



BEYOND ARCHITECTURE

NEW INTERSECTIONS  
& CONNECTIONS

International Conference on Architectural Research

PROCEEDINGS OF THE ARCC/EAAE 2014  
INTERNATIONAL CONFERENCE ON  
ARCHITECTURAL RESEARCH

**BEYOND ARCHITECTURE**

**NEW** | INTERSECTIONS  
& CONNECTIONS

Proceedings of the ARCC/EAAE 2014 International  
Conference on Architectural Research  
Beyond Architecture: New Intersections & Connections

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# **Beyond Architecture: New Intersections & Connections**

Proceedings of the ARCC/EAAE 2014 International  
Conference on Architectural Research  
February 12 – 15, 2014

Architectural Research Centers Consortium  
European Association for Architectural Education

Editors  
David Rockwood, Marja Sarvimäki



**Beyond Architecture:  
New Intersections & Connections**

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## INTRODUCTION

### **Spring ARCC/EAAE 2014 | International Conference - Beyond Architecture: New Intersections & Connections**

The ARCC/EAAE International Conference provides a critical forum for the dissemination and engagement of current ideas in the discipline of architecture from around the world. This international research conference is held every other year, and is the result of an important partnership between the Architectural Research Centers Consortium and the European Association for Architectural Education.

Research and scholarship are typically framed by conventions, forms, and methods, and often within disciplinary boundaries. However, our increased awareness of the multiplicity of the deep and broad connections between mental, physical and metaphysical constructs leads us to rethink the autonomy and insularity of disciplinary structure. Considering that the formation, naming, development, and institutionalization of disciplines have, and have had, pragmatic, political, and instrumental purposes, it now appears that such applications are also limiting in a world demanding more interconnectivities and transactions.

In the conference, we investigate: why is a new transformed structure of thinking and practice emerging now? What forms should a restructured knowledge and praxis take in the re-disciplining of architecture? What benefits might arise from such new constellations of thought and action? What might we lose, or forget? What is the impact for the future profession and body of architecture? The Proceedings of the ARCC/EAAE 2014 International Conference presents 58 papers that expound on and interrogate such issues. The original call for submissions was divided into five categories or themes. Each theme attempts to frame investigations of disciplinary limits and new connections in slightly different ways.

**RE-DISCIPLINING: The Rise, Fall and Reformation of the Disciplines. History, Theory, Historiography, and Future Studies.**

**STRUCTURES OF INTERSECTIONS: Reorientations of Identities and Alliances. Global, Local, Geographic, Ethnic, and Disciplinary.**

**METHODS: Agents of Change in Changing Paradigms. Scientific, Technological, Strategic, Intuitive, and Pragmatic.**

**ENDS: The Dystopia in Utopia and the Final Cause. Forces, Causality, Ideology, Values, Myth.**

**SCRAMBLE: Knowing, Structuring, Configuring, Processing, Assembling, Consuming.**

The wide range of issues, subjects, and perspectives taken up in the papers allow insight into new ways of structuring thought and knowledge. They also point to means of connecting the discipline of architecture to other important bodies of knowledge and to forge new important alliances. We are called to reflect and rethink, in light of contemporary forces and practices, better ways to understand, share, and act.

The ARCC/EAAE 2014 International Conference received strong interest, with 213 abstract proposals submitted. The double blind peer review process included the stages of abstract review followed by full paper review, and submission of the final paper. We are most grateful to our Paper Review Committee members who graciously offered considerable time and their expertise in this process. We especially thank all of the contributing authors whose interest, expertise, and ideas formed the intellectual core of the event.

We would first like to thank the respective boards of ARCC and EAAE for allowing us to host the conference. Former Dean Clark Llewellyn and current Interim Dean Thomas Bingham of the University of Hawai'i at Mānoa School of Architecture ("archawai'i ") have been extremely supportive throughout the process. We are most grateful to the early and continued guidance given by the previous ARCC Conference organizers, most notably Hazem Rashed-Ali, Philip Plowright, Christopher Jarrett, and Nicholas Senske. And we are thankful to the many archawai'i faculty and staff who helped to make the conference possible. June Lee provided support with overall logistics and production of the Proceedings. Lance Walters was instrumental in helping in the many stages of the blind peer review process. Tony Cao served as the IT manager, and set up and maintained the conference website, while Hongtao Zhou, Marcel Colon, and Christopher Lee provided graphic and web design services. Charlene Langondino helped with finance and budgeting, including sponsorship from Tongji University, College of Architecture and Urban Planning. In addition, without the support from and expertise of the whole archawai'i faculty, it would have been impossible to host such a significant venue on architectural research. Finally, our special thanks go to the University of Hawai'i Conference Center, particularly to Director Amy Nye who tirelessly worked with us from the early stages of the conference organization until its final completion.

It has been a great joy and privilege to host the ARCC/EAAE 2014 International Conference at the University of Hawai'i at Mānoa School of Architecture. We trust this event has helped to broaden, deepen, and provide new connections for the discipline and practice of architecture as well as for the many trans-disciplinary intersections beyond architecture.

Marja Sarvimäki, Co-Chair  
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## **Re-Disciplining**

The Rise, Fall and Reformation of the Disciplines.  
History, Theory, Historiography, and Future Studies



# Water, water everywhere: Charting new courses for architectural history

W. Mick Charney

Kansas State University, Manhattan, Kansas

**ABSTRACT:** Too often the basic framework upon which historians hang the facts of architecture's past is constructed from presumptions that the only historic events of any consequence are those based on *terra firma* because that is where foundations must necessarily come to rest. Occasionally, we need to upend the usual exposition of contextual historical circumstances in order to chart new courses for our explorations of architecture worldwide. Michael Shenefelt's seafaring proposition, proffered as a template by which to explore the ebb and flow of any number of historical forces, can challenge the tyranny of Western architectural canon as well as doctrines of Western cultural hegemony. Ultimately, it can undermine those obdurately insoluble formulations that have typically imparted historical narratives as separately cloven chapters of different global building traditions clumsily butted together in reputedly comprehensive texts.

The integration of non-Western traditions in traditionally Eurocentric courses has always been problematic; but, with Shenefelt's approach as a springboard, this paper models an alternative didactic strategy that leaves deeply-rooted principles of historical taxonomy behind, embarking instead on a more fluid exposition of how the legacies of several cultures are rendered more coherent if studied as a great confluence of cross-cultural currents that overlap each other in one boundless yet tentacled sea.

The particular case study outlined here demonstrates how the historical dominion given to Atlantic trade is subsumed within a universal global impulse to sail the "Seven Seas" – evidenced in particular by the far-flung voyages, from Africa to Indonesia, of Ming dynasty sailors. However, in a larger sense, tales of Chinese nautical enterprises grant students permission to fathom, to think critically about the interconnectedness of other-worldly cultures – yesterday and today. These new yarns reorient the magnifications of storied European adventures through different lenses thereby correcting (mis)perceptions of supposed Western-only "ages of discovery" or cultural superiority.

**KEYWORDS:** architectural history, multiculturalism, thematic pedagogies

*Water, water, everywhere,  
And all the boards did shrink;  
Water, water, everywhere,  
Nor any drop to drink.*

Samuel Taylor Coleridge  
*The Rime of the Ancient Mariner*<sup>1</sup>

## INTRODUCTION

I live at the bottom of an ocean – or, more accurately, what was once an ocean over 65 million years ago. Lying near the geodetic center of a great land mass, largely treeless, and semi-arid in the last weeks of summer, the Flint Hills of Kansas convey such an incontrovertible image of "earth" that it strains credibility to encounter indisputable evidence to the contrary. Yet, Kansas was once inundated by a great inland sea (Everhart 2005). To accede to the essential truth of that alternative proposition is to challenge one's own deeply embedded and presumptive perceptions of the world. Ultimately, the reconciliation of two equally valid viewpoints offers a more complete conceptualization of the world which, in this case, means that I can never again

roll through the undulating terrain of the Flint Hills without simultaneously envisioning the floor of that prehistoric ocean. Parenthetically, the emblematic city of the Flint Hills, Manhattan, Kansas, is situated precisely where it is because its first settlers, having run their paddle steamer aground on a sandbar in the Kansas river, had literally run out of navigable waterways (Parrish 2004).

### 1.0 DARING TO VENTURE TO TIMBUKTU AND BACK

Arab conquerors of the Maghreb – which includes present-day Algeria, Tunisia, Libya, and Morocco – came to regard the Sahara’s flowing sands as a turbulent river with treacherous currents that could sweep unwary travelers away to lands unknown. Abu al-Muhajir, by one account the last conquering commander of Islamic armies to have swept across the North African littoral in the seventh century, arrived at the shores of the Atlantic, dipped his toe into its vast stretches of water, and declared that there was nothing left to conquer. Moored securely to the land, he had reached the limits of what was conceivable to him. The unconquerable ocean was, from his vantage point, a barrier. It delimited his world and tethered his cosmopolitan reach. This single evocative passage, recounted twice by Marq de Villiers and Sheila Hirtle in their book *Timbuktu: The Sahara’s Fabled City of Gold*, employs water as an analog for obstructions to further conquest and expanded knowledge as it alerts us to those other vibrant worlds that co-existed alongside the admirable accomplishments of Western civilization (de Villiers 2007).<sup>2</sup> However, those other “exotic” worlds are now proving more and more to have equaled and even outshone what we have routinely extolled about the West.

Implicitly, de Villiers and Hirtle urge us not merely to dip a toe into that unfathomable ocean and then turn away. We should take the plunge, explore its vast reaches, and then bring back our discoveries and fresh insights to our students in order to expand and redirect their parochial vistas outward toward a worldwide culture replete with both divergent and parallel happenstances.<sup>3</sup>

### 2.0 THE BAY OF NAPLES

Now, imagine how much more enriched intellectual constructs could become were we to introduce our students to yet another maritime-themed narrative that sits in counterpoise to the historic journey’s ending of Abu al-Muhajir. The end of the road for Romulus Augustulus, the last emperor of the Western Roman Empire, was Campania. After having been deposed by a “barbarian” and exiled from Ravenna in 476 CE to live in a villa on the Bay of Naples, the teenage Romulus Augustulus passed his last days in relative royal comfort, always visually cognizant of the sea.

In his book *Are We Rome?*, Cullen Murphy muses:

But the breeze off the bay is fresh and constant. Even without vendors selling *granita al limone* it would have been a congenial spot in which to endure your exile, especially on 6,000 *soldi* a year and with Vesuvius quiet. For many Roman emperors, the end had been far less kind, and the breeze far more fleeting, and felt only on the back of the neck (Murphy 2007, 189).

Even if more apocryphal than accurate, these romanticized embellishments of ancient accounts suggest that Romulus Augustulus did spend many of his idle hours on that headland gazing at the waters of the Mediterranean. The boy emperor had never constructed a single piece of architecture; but did he sit in his seaside villa contemplating the course of the great empire he had lost? Did it dawn on him that the edifying strength of that empire had been founded on and around eminently navigable waterways? Rome was, after all, the only historic entity to control the entire Mediterranean coastline (Norwich 2006). From the perspective of Augustulus, water then would have been not an insurmountable barrier to conquest or to the acquisition of knowledge. Abu al-Muhajir’s tribes had navigated the Sahara’s ocean of sand, guided by stars like a ship’s pilot, from the backs of “ships of the desert” – camels. For the

Romans, deserts and mountains were the more formidable barriers; it was the mighty sea that fortified a united “Romanized” citizenry.

### 3.0 PLOTTING NEW COURSES

Together these two counterbalancing tales, both set against the backdrop of water, conspire to plot a new course for the purveyors of history courses. They speak tellingly, through the metaphor of water seen alternately as impossibility or potentiality, of the diverse cultural modalities that inherently govern our worldviews. Now, it has been the standard schema in history courses to relegate non-Western cultures and their architectural styles to secondary roles, if they are espied at all. As a corollary, the standard architectural history textbook has tended, until recently, to distort all the thousands of years of all non-Western architecture by fusing it into a single chapter, dropped somewhere between chapters on the Byzantine and Romanesque styles, instead of dispersing its contents throughout the sweep of the annals of history.

Too often the basic framework upon which we hang the facts of architectural history is constructed out of a kit of parts that presumes the only historic events of any real relevance are those based on *terra firma* because that is where the foundations of structures must necessarily come to rest – on solid ground. By contrast, the role of great Neptune’s multitudinous, briny seas is more often than not whole neglected, as if ingesting their reputedly noxious waters could ever satiate those who thirst for wisdom.<sup>4</sup>

What if, from time to time, we were to swamp and upend the usual exposition of contextual circumstances in our architectural history courses? Michael Shenefelt had done just that in 2003 when he published his essay “Why Study the Greeks? Check the Map.” Arguing that “in most historical periods, land transport was largely irrelevant” (Shenefelt 2003, B11), the NYU philosophy professor effectively wielded a seafaring proposition to explain why the ancient Greeks dominated their world and why they continue to deserve to predominate in college curricula. In brief, the Greeks were masters of their world not just because they had assembled a coherent superior philosophical or artistic culture but because their separate city-states and islands could exchange cultural breakthroughs by virtue of their mastery of transport across an exceptionally smooth sea.<sup>5</sup>

His emphasis upon the free exercise of seafaring skills was a new take on an old proposition – that transportation technologies were crucial mechanisms for cultural dissemination and exchange. While his tactic buttressed the “Great Books” and “Dead White Men” models of a general, or liberal, education, Shenefelt had demonstrated, first, the intellectual necessity for reversing the perspective of authoritative texts – in this case, vistas of buildings seen not from the obdurate land but from the tireless seas – and then, second, the didactic mechanisms by which to introduce those countertexts.

### 4.0 WHY NOT STUDY THE GREEKS?

Shenefelt’s work anticipated a uniquely maritime history of the Greeks authored by John R. Hale. In *Lords of the Sea*, Hale contended that it was Athenian commitment to naval power and their mastery of the sea that propelled free inquiry, forged a democratic spirit, and underwrote “arts and letters.” In Hale’s view, the Parthenon, although elevated on the Acropolis, stood in the shadows of the greater, but now little referenced naval arsenal of Philo. “Philo himself . . . felt so proud of his naval arsenal that he wrote a book about it. No such sign of respect or public interest had been accorded the more prestigious Parthenon on the Acropolis” (Hale 2009, xxx). The arsenal was designed in the Doric style, like the Parthenon, but it far surpassed it or any other temple in Greece in size. Ought not it then also be covered in a history course as a complement to – not necessarily a substitute for – the more aesthetically prestigious Parthenon? After all, the arsenal stood at the true epicenter of Athenian power – Athens’s port of Piraeus.

When Hale does first focus our attention on the Parthenon, it is from a vantage point that is, at first, disconcertingly detached from our usual perception of the temple’s importance:

The glories of the Acropolis dominate our modern view of Athens. Ancient Athenians saw their city differently. In terms of civic pride, the temples of the gods were eclipsed by the vast complex of installations for the navy. . . . Only one contemporary literary reference to the Parthenon has survived to our time, in fragments of an anonymous comedy. Even here the Parthenon takes second place to [the mention of] nautical monuments (Hale 2009, xxx).<sup>6</sup>

To paraphrase Hale further, were a history class to devote as much time to the lively, daily functioning of Philo's Arsenal as to the shell of the creature – the Parthenon – that it spawned (Hale 2009, xxxiii), would not our perception of ancient Greek culture and its touchstone of matchless poise and grandeur be more balanced, not to mention more complete? An expansive, comprehensive panoramic vista from Zea Harbor at Piraeus rather than the delimiting, calculated framed view through the portal of the Propylaea alerts us to the urgency to chart new courses of action that similarly seek the fluid incorporation (not interjection) and the comfortable amassing (not coagulation) of non-Western building traditions into our architectural history classes. That urgency is underscored not only by the contemporary academy's self-stated mission to instill multicultural competencies among all its students but also by the demands imposed by accreditation criteria that undergo continual adjustment.<sup>7</sup>

### **5.0 CLAIMING NEW CULTURAL COMPETENCIES**

The integration of non-Western traditions in traditionally Eurocentric architectural history courses has always been problematic; but, by employing Shenefelt's approach as a springboard, history instructors can model for their students alternative didactic strategies that channel non-Western traditions into the usual reservoir of Western historical examples. That is, by leaving behind from time to time those deeply-rooted principles of Western art historical taxonomy, the history class can embark instead upon those more fluid thematic expositions wholly demonstrative of suggestions that diverse cultural manifestations do not always run as crosscurrents to each other but are, in fact, the result of great confluences of cultural streams that overlap with each other, merge with each other, and then part from each other through the medium of – as in the case of this paper – one boundless yet tentacled sea. Certainly, the ultimate goal here is to imbue students with multicultural competencies; and, by regularly treating course content in just such thematic groupings, we stake out and claim new contextual territories on which to prepare the ground for improved critical thinking skills among our students.<sup>8</sup>

### **6.0 WHEN CHINA RULED THE SEAS**

For instance, a substantial amount of ground in non-Western building traditions can be covered – and covered coherently in ways that are meaningful to today's students so as to emphasize both parallel and divergent building canons within a global culture – by sailing the same far-flung sea trading routes that the legendary Ming Dynasty treasure ships had plied. From Africa to Indonesia and perhaps parts beyond, this long-presumed exclusively landed civilization in China actually exerted quite a formidable naval presence when, at the order of the Yongle Emperor (Zhu Di) in 1403, it began building a flotilla of 317 large ships to be commanded by Zheng He, a eunuch admiral believed to have been a Muslim. He sailed most of the known world between 1405 and 1433 in seven epic voyages (Levathes 1994).<sup>9</sup>

The odyssey of China's treasure ships is revelatory for at least three reasons. First, the stereotypically isolationist Chinese were, at least briefly, a sublime naval power that ruled the waves over nearly half the world. Second, not only did these inconceivably gigantic Oriental junks dwarf anything in Columbus's modest Western exploratory fleet but they antedated Columbus's mere four Atlantic crossings by nearly 100 years. Third, these early 15th-century titanic Chinese treasure ships were such marvels of wooden structural engineering that they more than equaled Brunelleschi's contemporaneous structural acumen in building the masonry dome of Florence's cathedral. Thus, greater clarity and more detail about Ming dynasty accomplishments – beyond the conventional exposition of Beijing's Temple of Heaven – challenge the canon of a hegemonic, Western-only "renaissance."

The treasure ships – so named because they were laden with porcelains, silks, and art objects to be traded for African and Middle Eastern products – ivory, rare woods, incense, tortoise shells, medicines, pearls, and precious stones – facilitated the establishment of a system of tribute to the Chinese emperor throughout the Indian Ocean and the southern Pacific Ocean. Ironically, the primary exports of Europe – wool and wine – held little appeal for the Chinese (Levathes 1994).

When, in 1497/98, the Portuguese sailed around the Cape of Good Hope to the east coast of Africa, they found natives there wearing fine embroidered Chinese silk. The natives scoffed at the trinkets that Vasco da Gama offered them – bells, beads, and coral – in trade. The natives told tales about large treasure ships that had visited them long, long ago (Levathes 1994).

## **7.0 DEEPEST, DARKEST LANDLOCKED AFRICA**

Our perceptions of maritime explorations are so skewed toward an emphasis on Europeans working their way down the west coast of Africa that we are all but blind to the exploration of that continent's east coast by not only the Chinese but Indians and Arabs as well. The two latter cultures found their way aboard dhows southward to the prosperous coastline towns sitting at the termini of trading routes that originated inland at Great Zimbabwe (Garlake 1973).<sup>10</sup>

Great Zimbabwe is sub-Saharan Africa's largest known stone structure, a wondrous formal countertext to hackneyed historical perceptions that suggest Africa's only monumental architecture of note arose in ancient Egypt. Archaeologist Peter S. Garlake has deduced that the landlocked and culturally isolated circumstances of Great Zimbabwe did not prevent it from benefiting "from the economic growth of its coastal partners and eventually of remote peoples in other continents" (Garlake 1973, 173). As not only a political and religious center but a great trading reservoir of gold, copper, ivory, and perhaps even slaves, Great Zimbabwe was the ultimate basis for all those legends that hinted at the existence of cities of great wealth deep in the heart of darkest Africa (Gates 1999). Great Zimbabwe reached its zenith just as Zheng He was commanding his fleet (Garlake 1973).

## **8.0 A DELUGE OF THE WORLD'S MOST COMMON HOUSE TYPE**

While the record is not clear regarding any direct Chinese contact with Great Zimbabwe's trading ambit, it is well documented that, by the end of the 1300s, Chinese merchants had already established vibrant trading colonies on Java (Levathes 1994).<sup>11</sup> The Javanese kingdom, then at the peak of its ascendancy, had come to dominate large portions of the other islands of the archipelago including Sumatra, Borneo, Sulawesi, Papua, and Bali – essentially the modern-day Indonesia – in what is called the Majapahit Empire.

Indigenous gold and silver Javanese coins were eventually replaced by a copper coinage system that was first introduced there by the Chinese; and the importation of Chinese money had become widespread by the 1400s when Zheng He sailed the seas (Miksic 1996).<sup>12</sup> As more and more foreign merchants were attracted to Java, making it a major Southeast Asian trading center, copper coinage became so plentiful that practical ways had to be found to store it in individual households. The solution was to craft terra cotta money boxes, many of which were fashioned to look like animals – especially pigs because they were associated with prosperity (Miksic 1996). Owned by individuals, "piggy banks" probably also held some sort of ritualistic significance within a household.

The ancestral home of the Toraja region of Sulawesi was the focus of that culture. Called a "tongkonan" (meaning "a place where one sits"), this type of stilt house was the place where family members sat down together to discuss important affairs or to partake in ceremonies. The tongkonan was the symbol of familial identity and traditions, encompassing all the descendants of the founding ancestor (Kis-Jovak 1988).<sup>13</sup> Now, given population densities in this part of the globe – India to Southeast Asia to China – and given the prevalence of the tongkonan, the stilt house (of which there are other Asian and Oceanic variations besides the tongkonan) may be the most common house type in the world and thus a particularly noteworthy specimen for any global survey of architectural history.



The most dominant feature of any tongkonan was decidedly its saddleback roof. Deliberately accentuated in varying sizes to convey the degree of family wealth, it also symbolized the arc of the cosmos as well as the boats upon which the first settlers were said in tribal stories to have arrived (Kis-Jovak 1988).<sup>14</sup> Under the floor of the more important tongkonan dwellings, positioned somewhat centrally, an *a'ri ri posi* rose to symbolize the genesis of the house as well as its connection to the earth. It was literally the “navel post,” and its vertical line continued as a *petuo* post inside the house’s living quarters thus creating a symbolic world axis. It also referenced the fabled destruction of an entire early Toraja village by a downpour of water blown in on winds and channeled down each house’s central post, so engulfing all its cursed, incestuous villagers that nothing remained after the deluge (Kis-Jovak 1988).

The thick stilts of a tongkonan were a response to climate, lifting the dwelling above tropical dampness, although not necessarily floodwaters, while also facilitating ventilation, protecting families and foodstuffs from pests, providing undercroft shelter for livestock, and defending inhabitants from intruders by affording them time enough to retaliate against those attackers as they labored to saw through the stout supports. The heavy-timber structural members and construction techniques, like those employed in the saddleback roofs, are evocative of shipbuilding methods (Kis-Jovak 1988).

## 9.0 A PREDOMINANTLY WATER-COVERED SPHERICITY

In *Critical Path*, R. Buckminster Fuller extolled the majesty of those “massively keeled and ribbed, deep-bellied ships” (Fuller 1981, xx) that had altered the course of human history. Their admirals had proven the essential “water-covered sphericity” (Fuller 1981, xxi) of planet earth. Noting how humanity the world over, before the advent of continental highways, had “always strung [itself] out along the brooks, rivers, ponds, lakes, seas, and oceanfronts” (Fuller 1981, 5), Fuller was prompted in the 1940s to re-envision the global map. The resultant “Airocean World Map” – also called the “Dymaxion map” or “Fuller map” – depicted the earth’s several continents as a single island comprised of very nearly contiguous land masses. He had cleverly managed to find a way to construct a globe of the earth that, when unfolded and laid flat, portrayed a “nonvisibly distorted, one-world-island-in-one-world-ocean” (Fuller 1981, xxxi). The effect was visually striking and intellectually transformative. Fuller’s version of Pangaea was eminently sensible as a graphic means by which to demonstrate just how responsive the entirety of a coast-hugging human species had been to the one element that irrefutably surrounds and yet isolates us all – together. Acknowledgment of humanity’s deep dependence on water naturally propels us toward the revision of the story of humankind’s cultural milestones not as neatly partitioned chapters of bounded content but as interwoven, oversailing episodes, thus jettisoning what Fuller had decried as “remotely-deployed-from-one-another, differently colored, differently credoed, differently cultured” and “multipeopled, bias-fostering” notions of “otherness” (Fuller 1981, xvii, xii, xi).

## 10.0 CHINA’S CURRENT GLOBAL REACH

The nautical enterprises of the Chinese of yesteryear grant our students today permission to fathom the interconnectedness of other world cultures as diverse as the Zimbabweans and the Javanese. Knowledge of the epic Chinese voyages reorients storied European explorations – like that of Columbus in 1492; and that very different lens corrects inordinately magnified (mis)representations of a Western-only “Age of Discovery.”

That same lens of critical reflection also helps us to make sense of current events. Six hundred years after Zheng He sailed the oceans, modern China is reaching out once again. It claims it merely wants to hug the world. However, it is clear that modern China is seeking something more than exploratory adventurism. It is exerting a growing presence in African countries such as Kenya where, by sponsoring the building of much needed infrastructure projects such as highways and ports, the Chinese hope to curry favor among the Kenyans in exchange for access to energy resources that can fuel Beijing’s economic program. That prospering economy allows the average Chinese worker to afford exotic products from overseas like his Ming era forebears. Naturally, Kenyan wildlife is at risk as the Chinese seek to quench their deeply inculcated cultural thirst for medicinal rhino horn and high grade, sculpture-worthy

elephant ivory. And, in Europe, China's most important infrastructure project is its investment in the Greek port of Piraeus, which the Chinese see as a crucial gateway to the European and Black Sea markets (National Public Radio 2011). We have come full circle.

## 11.0 HISTORY REFUSES TO BE CONTAINED

Every dedicated scholar, writes historian Robert Darnton, understands the frustration associated with the inability to convey to others the “fathomlessness” (Darnton 2009, 75) of the past. Historiography “refuses to be contained within the confines of a single discipline” (Darnton 2009, 206). In charting new routes for architectural history, the best of its critical thinkers will find “themselves crossing paths in a no-man’s land located at the intersection of [dozens of] fields of study” (Darnton 2009, 176). Multicultural countertexts – such as a basic familiarity with the ebb and flow of worldwide maritime explorations – can suddenly plop unfamiliar phenomena into familiar waters. The resultant, ever-outward expanding ripples eventually envelop the world. It becomes a phenomenon so sweeping in scope that, as Darnton contends, it defies “conclusive interpretations” (Darnton 2009, 86) and, therefore, scuttles the exclusionary “otherness” brought about by canonical interpretations.

## CONCLUSION

More than many others, architectural historians, especially those teaching in architecture programs, must take the mariner's helm of well-trimmed ships. Despite being moored securely to their individuated backgrounds and anchored to their professional specializations, safely covering familiar territory by teaching what they have come to know best in the same manner by which they themselves were once taught, historians must conceive alternative courses of global exploration. It is incumbent upon them, especially today, to embark upon sweeping odysseys that sail out courageously across the rolling seas of worldwide cultural literacy, tacking back and forth across that bar that has for too long separated their generally Westernized scholarly passions, methodological constructs, and didactic objectives too sharply from the rest of humanity — a humanity that, as in millennia past, still largely lies strung along the world's waterways. Water is everywhere.

*He went like one that hath been stunned,  
And is of sense forlorn;  
A sadder and a wiser man,  
He rose the morrow morn.*

Samuel Taylor Coleridge  
*The Rime of the Ancient Mariner*<sup>15</sup>

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## ENDNOTES

<sup>1</sup> Samuel Taylor Coleridge, "The Rime of the Ancient Mariner," *Adventures in English Literature*, eds. J. B. Priestley and Josephine Spear (New York: Harcourt, Brace & World, Inc., 1963) 401 [lines 119-122].

<sup>2</sup> On the other hand, the majority of scholars of Islamic conquests in the Maghreb agree that it was actually Uqba bin Nafi al-Fihri, Abu al-Muhajir's great rival, who rode his horse into the Atlantic until its waters lapped up onto the steed's belly whereupon Uqba, invoking the Lord's name, lamented his inability to extend the faith any further. In either case, "...the moment passed into legend..." and the image of the progress of a religious conqueror being "halted only by the ocean remains one of the most arresting and memorable in the history of conquests" (Kennedy 2007, 214). In 670, Uqba founded Kairouan in what is now Tunisia. Again, according to legend, it was one of Uqba's soldiers who there had unearthed a golden goblet from the Sahara's sands. A spring miraculously gushed forth with waters held to have originated from the same source as waters that fed a sacred well in Mecca. Kairouan became the "Mecca of the Maghreb."

<sup>3</sup> For instance, one such happenstance occurred in Western civilization's seminal year 1492. The Songhai Empire, centered at the bend of the Niger river in western Africa, was then ruled by Sonni Ali Ber, whose repressive policies were most directly felt by the scholars in Timbuktu. The tyrannical ruler boasted a fleet of 400 war barges. Yet, astonishingly, on 6 November 1492, he died accidentally by drowning in a flash flood while encamped in a desert wadi (de Villiers 2007). That very same day, the Italian sea captain Christopher Columbus was exploring the northeast coast of Cuba near the mouth of the Río de Mares (Dor-Ner 1991). Soon afterward, in 1493, the usurper Askia Mohamed I seized the Songhai throne and, to legitimize his power, allied himself with the scholars of Timbuktu, thus ushering in the second and greatest golden age in that city's history, a period of intellectual inquiry that coincided with and rivaled the High Renaissance in Italy (de Villiers 2007).

<sup>4</sup> Some phrasing here was inspired by William Shakespeare, "Macbeth," *Adventures in English Literature*, eds. J. B. Priestley and Josephine Spear (New York: Harcourt, Brace & World, Inc., 1963) 147 [Act II, Scene II, lines 61-64], specifically the lines: *Will all great Neptune's ocean wash this blood | Clean from my hand? No; this my hand will rather | The multitudinous seas incarnadine, | Making the green one red.*

<sup>5</sup> John Julius Norwich is one of several historians who has recently reaffirmed the essential benevolence of the Mediterranean, calling it "utterly unique, a body of water that might have been deliberately designed, like no other on the surface of the globe, as a cradle of cultures. Almost enclosed by its surrounding lands, it is saved from stagnation by the Straits of Gibraltar, those ancient Pillars of Hercules which protect it from the worst of the Atlantic storms and keep its waters fresh and . . .

unpolluted. It links three of the world's six continents; . . . it also provided the principal means of communication. Roads in ancient times were virtually nonexistent; the only effective method of transport was by water, which had the added advantage of being able to support immense weights immovable by any other means. The art of navigation may have been still in its infancy, but early sailors were greatly assisted by the fact that throughout much of the eastern Mediterranean it was possible to sail from port to port without ever losing sight of land" (Norwich 2006, 1).

<sup>6</sup> It is not only the Parthenon, of all things quintessentially Greek, that takes second place to the sea in Hale's nautical history; the legendary prowess of Greece's hoplite (citizen-soldier) land forces is also downplayed in contrast to Hale's emphasis on naval campaigns. For instance, when first beheld by Hale, the epic Battle of Thermopylae that pitted Spartans against Persians (480 BCE), so utterly synonymous with courage against overwhelming odds, is seen but distantly, as if from sea through a spyglass. His countertext concentrates, instead, on the sometimes neglected naval battle at Artemisium that raged on simultaneously with the defeat of the 300 Spartans at the "gate of hot [water] springs." Rather than recount the land battle from a vantage point *in situ*, Hale presents it as a second-hand narrative reported to a squadron of Greek ships, or triremes. In some ways, Hale's proposition is the rhetorical counterpart to that wonderful panoramic vista in Albrecht Altdorfer's 1529 painting *The Battle of Issus* in which the heady march of classical Western culture confronts the sobering enormity of countervailing Oriental forces marshaled from around the rest of the world. As we scrutinize the mass of humanity engaged in an intense battle between Alexander the Great and Darius III, the king of Persia, we realize that the Mediterranean basin and its European coastlines are barely identifiable, for Altdorfer has chosen to reverse the vantage point from which we might normally expect to witness the *melée*. We are coerced into looking across the Mediterranean *from* the North to the South because, in this instance, "North" uncustomarily coincides with the *bottom* edge of the canvas. If only architectural history courses had the same courage to swivel round, to "come about" — even upside down.

<sup>7</sup> Most notably, the National Architectural Accrediting Board [NAAB] validates the necessity for all architecture students to be broadly and liberally educated. It recently modified its conditions for accreditation so that the artificial fault line within the previous set of performance criteria dividing an understanding of "traditions" (not "histories") into separate Western versus non-Western categories was erased in favor of a rubric that now blends the perspectives of "parallel and divergent canons and traditions" all into a single great "historical traditions and global culture" criterion (National Architectural Accrediting Board 2009, 20).

<sup>8</sup> The viability of thematic approaches in art history survey courses has been recently reaffirmed by other art historians (Dell'Aria 2013). The important point here, however, is that instructors should take care to thread themes as signposts throughout the course and not merely interject them as singular and, therefore, disconnected interludes.

<sup>9</sup> Zheng He's flotilla of 317 ships, along with over 3,000 other Chinese vessels, comprised the largest navy in the world at that time and housed a virtual "floating city" populated by 27,000 to 28,000 crew members aboard the treasure ships and their support vessels — supply ships, water tankers, cavalry transports, warships, and patrol boats — the largest armada ever assembled until the Allied invasion fleets of World War I. Zheng He died during his last voyage in 1433 and was buried at sea. During the course of the next century, China began to retreat from the sea and turned inward, into a period of self-imposed isolation. Because of rival private Chinese sea merchants, the government restricted the size of sailing ships to just two masts. Then it forbade the going-to-sea entirely, making it a capital offense — punishable by death. Ship building became a lost art; and the treasure ships were left to rot away in their ports.

<sup>10</sup> The Great Zimbabwe site was first settled in the 200s AD; but the first major stone structures appeared there in the 1100s AD and were eventually expanded to their present size by the year AD 1450. Great Zimbabwe ("zimbabwe" means "stone house") consisted of two major parts: (1) a Hill-Fortress, or Acropolis, which served as a citadel and tribal chieftain's official and ceremonial residence; and (2) the Valley Ruins, of which the Great Enclosure, or Temple, was the most impressive structure. The Great Enclosure, or Temple, was comprised of an elliptical circuit of stone walls, laid without mortar, ranging 16 to 35 feet high. The lower wall on the north side permitted easy surveillance of any activity within the enclosure from atop the Hill-Fortress. Initial assumptions that the Great Enclosure functioned originally to protect a cluster of habitable huts have been superseded in recent decades by theories surmising that the Great Enclosure served as a transit camp for slaves awaiting shipment to the coast. These same slaves, traded to Indian and Arab explorers and merchants, may have also formed the caravans that transported other treasures and commodities down to the east coast of Africa (Mallows 1984).

<sup>11</sup> In fact, Chinese refugees, most likely seeking relief from the duress of persecution, famine or floods, had begun settling on Java as early as the tenth century.

<sup>12</sup> Gold and silver were not well suited to commonplace monetary transactions. By contrast, Chinese copper coins, available in much smaller denominations, proved more desirable as a medium of exchange in the everyday marketplace. In a prospering Javanese economy that was growing more

complex with increasing numbers of small, daily monetary transactions, a shift to copper coinage indicates that the Javanese work force was moving from agrarian jobs into a wide variety of wage-based occupational specialties; and they were, as a consequence, compelled to acquire most of their daily needs through purchase rather than self-sustenance.

<sup>13</sup> Ancestry was traced on both sides – father and mother – so that a house did not belong to any one individual but an individual belonged to many houses.

<sup>14</sup> Toraja origin stories speak of a small fleet of eight boats, or proas, sailing forth from the mythical island of Pongko' only to be driven off course by a storm and eventually landing on Sulawesi. These first settlers of the Toraja region followed the Sa'dan river upstream where they fashioned their houses to look like proas. Each end of the most daringly pronounced saddleback roofs was supported by a vertical wooden post, or *tulak somba*, that, in turn, was ornamented with buffalo horns or buffalo head sculptures. Buffalos were common symbols of prosperity and ritual sacrifice. Their horns were arrayed as talismans against evil.

<sup>15</sup> Coleridge, *Adventures* 414 [lines 622-625].

# Re-thinking Design Studio Pedagogy: Collaboration Between Architecture and the Allied Disciplines

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**ABSTRACT:** Building on research from the past two academic years and papers presented as a result of that research this paper is based on additional research and added variables to test the viability of collaborative studios between Architecture (ARC), Building Construction Science (BCS) and Interior Design (ID) students. The studios explored are based on three different collaborative methods. The first method is a three-week charette teaming students from ARC, BCS, and ID. The second method is a semester-long studio where collaboration was limited to ARC and BCS students who were physically separated and then came together for set assignments determined by the faculty. The third method pairs the first two methods to co-habitate the ARC and BCS students to encourage better collaboration in addition to modified assignments based on lessons learned from past collaborations.

The variables between each studio include number of studio iterations, collaboration time, co-habitation of each collaboration, varying faculty for each iteration, and year-level/experience level of the students. Consistencies on pedagogy from each studio were both preconceived and also developed over the length of the studio exploration and will be discussed in more depth and detail in the following paper.

The collaborations will be analyzed based on data collected from all prior collaborative studios. The three-week charette studio collected data via a variety of surveys conducted over the three weeks of the studio, which included both quantitative and qualitative data. The semester long studio will use data from two surveys conducted during the semester to gauge student perceptions and information learned. This data will then be consolidated to garner successes and failures to move forward into the third iteration of both studios to improve the collaboration for the upcoming studios, as well as future iterations.

**KEYWORDS:** building information modeling, collaboration, interdisciplinary, integrated project delivery, co-habitation

## INTRODUCTION

*“Students can no longer afford to work in sublime isolation from others, nor can faculty continue to ignore the essential interdisciplinary nature of architectural decision making.”* (Boyer and Mitgang, 1997, 85)

While this quote from Allan R. Cooper, director of California Polytechnic State University- San Luis Obispo in 1997, is over sixteen years old, architecture education continues to struggle to achieve collaboration with the allied disciplines to teach our students the true interdisciplinary nature of architecture. The 2010-2011 BIM/IPD SURVEY RESULTS-SUMMARY conducted by the Association of Collegiate Schools of Architecture (ACSA) shows that while architecture programs are teaming architecture students collaboratively in relatively large numbers, this is not happening with as much success with students in the allied disciplines. (2011)

Also noticeable in this data from the ACSA survey is that Building Construction Science and other construction related disciplines are not mentioned as one of the non-architecture students and/or faculty that are part of these collaborative design strategies. This is especially concerning considering building contractors have slowly taken over the process of building from architects. There are many opinions as to why this is happening, but a prominent one is

the insulated and isolated world of architects, as noted by an architecture student speaking to Boyer and Mitgang:

*“The field is turning too introspective and closing itself to clients and the other professions. That is why contractors are doing all of the building – no one wants to hear about the selfish interests of the architect. Schools should address this instead of perpetuating it.”* (Boyer and Mitgang, 1997, 111)

## **1.0. THE IMPORTANCE OF COLLABORATION**

### **1.1. Integrated Project Delivery, Integrated Practice and Building Information Modeling**

Collaboration with the allied disciplines is not just important to overcome the isolated nature and image of architecture, but also because of the evolution of the architecture profession and the development of ideas like Integrated Project Delivery (IPD), Integrated Practice, and the use of Building Information Modeling (BIM). Perhaps due to the recent dominance of building contractors in the built environment, architects are making the effort to take the lead on Integrated Project Delivery (IPD) and are the most experienced and informed of all AEC professionals in the definition and use of this important project delivery method (Kent and Berckerik-Gerber, 2010). However, the majority of architects who are using IPD, and are the most experienced with IPD, are AIA members that have been in practice for fifteen years or more. Principals are also the most frequently reported as having experience on an IPD project. Architecture education has a unique opportunity not only to teach our students how to collaborate with the allied professions, but also to increase the number of architects experienced in IPD by educating the younger generation of emerging architects.

### **1.2. Collaboration and IPD in Design Studios**

Integrated Project Delivery (IPD) may have become the fastest growing form of project delivery since the American Institute of Architects (AIA) issued the first contracts referring to BIM in 2008 (Sabongi, 2009). There is no mention of IPD in the NCARB 2007 Practice Analysis of Architecture, and “Collaboration/Cooperation” is the 7th most important change wanted in the field of architecture at only 4.97%. However, the recently released NCARB 2012 Practice Analysis of Architecture shows an agreement between educators and practitioners on knowledge and skill sets important to IPD and BIM (2012 NCARB Practice Analysis of Architecture, 2013). This increase in significance has already been shown in architecture education through the recent 2010-2011 BIM/IPD Survey Results conducted by the ACSA.

The NCARB 2012 Practice Analysis of Architecture released in June 2013 gives more in-depth information on the importance of collaboration, IPD, and BIM. Educators, interns, and licensed architects were surveyed to gauge the level of agreement on the knowledge and skills that students were achieving during their education. The research gauged a wide variety of knowledge and skills that are needed to succeed as an architect, but this paper is focusing on the knowledge and skills that relate to collaboration, IPD, and BIM. The data shown below, from the Education section of the report, notes that there is disagreement on whether this information is actually introduced during architecture education. However, it does not discuss the importance of introducing the information.

Another area of the Education section of the *2012 NCARB Practice Analysis of Architecture* delves into the knowledge and skills that educators and practitioners think architecture students should achieve. It is broken down into areas of understanding and application. Select data from this report shows that over 50% of architects and educators agree on the importance of the understanding of certain knowledge and skills such as different project delivery methods, the roles, responsibilities and authorities of project team members during construction, and building information modeling (BIM) and its impact on planning, financial management and construction documentation.

These results show the importance of knowledge and skills relating to collaboration, IPD, and BIM to both the practice and academe. Also noteworthy is that educators tend to rate these areas of knowledge and skills as more important than do the practitioners. This is an important

development showing how educators understand the need to prepare architecture students to collaborate in the profession.

Additional results of the 2012 NCARB Practice Analysis of Architecture are that more than 80% of practitioners that completed the survey feel that “collaboration with stakeholders is important, very important, or critically important.” Educators note that collaboration is included in their program, with a response of over 50%, and 70% of educator respondents noted that students worked collaboratively with either guidance or feedback from faculty, or collaborated independently (Fig. 1). Nonetheless, interns surveyed reported a lower level of collaboration at only 31.5% which shows a gap in how interns and educators perceive collaboration in education. (2012 NCARB Practice Analysis of Architecture, 2013)

EDU TASK #	TASK STATEMENT	EDUCATORS		INTERNS WHO COMPLETED IDP WITHIN THE PAST 2 YEARS	ALL LICENSED ARCHITECTS
		TASK IS COVERED IN PROGRAM	TASK IS PERFORMED BY STUDENTS	ARCHITECTS LICENSED IN THE PAST YEAR	
				TASK WAS PERFORMED BY COMPLETION OF DEGREE	IMPORTANCE RATING 0 1 2 3 4
64	Collaborate with stakeholders during design process to maintain design intent and comply with Owner requirements.	55.6%	70.8%	31.5%	2.46
0 = Of little or no Importance    1 = Somewhat Important    2 = Important    3 = Very Important    4 = Critically Important					

**Figure 1:** Collaboration Data Chart from 2012 NCARB Practice Analysis of Architecture Report. Source: (2012 NCARB Practice Analysis of Architecture, 2013, 48)

In addition to this quantitative data gathered by the survey, qualitative data was also gathered by asking three open-ended questions. The three questions were:

“ How do you expect your job in the field of architecture to change over the next few years?”

“ What tasks will be performed and what knowledge/skills will be needed to meet changing job demands?”

“ If you could change the field of architecture, what is the most important change you would make?”

The first two questions garnered 1,485 responses which among other things noted an increase in the use of BIM and IPD, as well as “the need for better interdisciplinary collaboration with clients and contractors...” (2012 NCARB Practice Analysis of Architecture, 2013, 65) The qualitative data also collected information on how architecture education could help educate students based on how the role of the architect is changing. Collaborative work in design projects and especially in the earlier parts of the various project phases was an important item noted, as well as the establishment of “a more collaborative relationship with other professionals earlier in the design and construction phases.” (2012 NCARB Practice Analysis of Architecture, 2013, 66) Additionally, skills noted by respondents as needed in the future included the formation of “clearly defined roles and responsibilities for members of a design and construction team.” Respondents felt that this could help control project outcomes better than current practices. Notably, these ideas are integral to IPD and its use of collaboration and BIM.

Building construction education programs have not been as successful as architecture programs in implementing IPD and BIM into that curriculum. A survey by Farid Sabongi found that 62% of respondents feel that BIM education in undergraduate construction curriculum is inadequate. This is despite the data that shows that 75% of respondents to the survey think that BIM will increase in the marketplace over the next five years. Additionally, only 10% of building construction programs are addressing BIM in any way (Sabongi, 2009). IPD,



Integrated Practice, and BIM can be used as tools to help architecture students learn how to collaborate with the allied disciplines, while also being prepared to enter the profession with important skills that will help the profession develop in the future.

## **2.0. THREE STUDIO STRUCTURES**

### **2.1. Three-Week Charette**

This project has been conducted in the Fall semester of the past three academic years. The first year teamed fourth year students from the ARC, BCS, and ID departments to create a new town hall, library, and fire station for the town of Smithville, MS that was devastated in the tornados that hit Alabama and Mississippi in April 2011. The second year of the charette again teamed fourth year BCS and ID students, but this time with third year ARC students. The project was the sustainable renovation and redesign of a graduate student multi-family housing community on campus built in the 1960s. The third year, completed this past Fall 2013, was a much smaller project for the design of an infill lobby in a practice facility for the tennis team on campus. However, it did go back to the structure of all fourth year students from the three allied disciplines.

The organization and duration of each year was slightly different in that the first and third years of the charette were only two weeks long, and the second year was three weeks in length. Also, the charette did not start with the first day of classes in the first year, but instead had ARC students create a design that then the BCS and ID students had to accept and adapt to. This was seen as a deterrent to collaboration and IPD so the next two years began the project on the first day of class and all students were involved in the development of the project solution from the beginning. The makeup of each collaborative group varied each year based on enrollment in each of the department studios. However, ARC students continue to dominate the groups due to larger enrollment than in the other two departments. BCS is second in enrollment dominance but teams are usually divided to have one or two BCS students depending on the enrollment difference with ID.

Due to the varied faculty, project organization, and project types over the past three iterations of the charette a core group of faculty has emerged and decided to set standards for the charette to maintain more continuity for the sake of the research on the collaborative value of the project. The standards developed include:

- Set square footage range to keep the project size consistent
- Project duration pending project size and academic schedule, but no shorter than two weeks and no longer than three weeks
- Final project reviewers to include the project client, and the charette sponsors Brasfield & Gorrie General Contractors, but no faculty
- Student year will stay fourth year for all involved departments
- Speakers and experts on collaboration, IDP, and BIM will come present to students as part of the charette
- Team selection will include student-on-student interviews, skills to contribute to the team, and personality tests to develop a better team dynamic and to overcome the social issues inherent in bringing together such diverse professions
- Final presentation will be organized into a “gallery-style” presentation where reviewers walk around and informally speak to each team, while the faculty will choose the three strongest teams and they will present formally, as was done in the second year of the charette. This allows all students to receive feedback but gives the students time to see the strongest projects and to hear feedback from reviewers on a project other than their own. Similar to traditional design studio reviews.
- All students will be encouraged participate in research surveys, unlike this past year where faculty not involved in the research discouraged students from participating
- All faculty involved in the charette will meet with each student group as a team to avoid being unfamiliar with the designs of their specific students and to avoid contradictory or incorrect information.

Since this project is the longest running of the three studio structures, most of the best practices have come from these experiences. Conversely, since the duration of the project is so short the structure of the project for each studio must vary accordingly.

## **2.2. Limited Collaboration**

This studio actually began in Fall 2011 when only second year ARC students participated in what was then called the “Tectonic I Studio.” This studio was to be the pilot for the ARC department to see if information taught in two lecture courses, Assemblages and Materials, could instead be taught in a studio course. The studio was also to be developed and piloted the next year to include BCS students to work collaboratively with the ARC students since the BCS students shared at least one of the lecture courses, Assemblages. The second semester of this studio was termed “Tectonic II Studio” and was also meant to supplement information from the two lecture courses of Assemblages and Materials, and prepare ARC students to work with BCS students in the next year. The difference between these two studios was that the second “Tectonic II Studio” was for third year ARC students and was comprised of a larger scale project that included masonry and steel. The “Tectonic I Studio” was to cover all materials since it replaced the above mentioned lecture courses, but it was determined that there was too much material to cover and that the lecture courses were still needed to give the students a basis in which to come to this studio to complete the collaborative work.

The second year of the “Tectonic Studios” became a pilot of how to have the ARC and BCS students work together collaboratively. While the tectonic aspect of the studios still remained, it was obvious to the faculty that the tectonic was no longer the focus, but instead the collaboration. Both studios included second year BCS students, but the Fall 2012 semester included second year ARC students and the Spring 2013 semester included third year ARC students. This created an additional set of issues in that the students were not only culturally incompatible due to different ideas on work ethic and studio culture, but also incompatible in knowledge, maturity, and studio experience. Therefore, the two studios for the Fall 2013 and Spring 2014 semesters are pairing ARC and BCS students up by year with second year ARC students working with second year BCS students and third year ARC students working with third year BCS students.

This second iteration in Fall 2012 and Spring 2013 also limited the students to separate studio spaces and only a handful of collaborative assignments. The faculty had not successfully collaborated themselves in creating the assignments and the studio structure to allow both sets of students to truly feel invested in the studio. This is an especially important problem, based on the issues seen in the charette project discussed above, but also due to lower enrollment of BCS students in relation to ARC students. The BCS students are always outnumbered. Therefore, the ARC and BCS faculty worked together this past summer to create assignments and studio structure to try to overcome the isolation of the BCS students and the domination of the ARC students. This was done through a variety of assignments where either BCS students or ARC students take the lead based on the skills and knowledge that are specific to their field. Since the students are working in teams the students in the opposing field still must participate in the assignment and they then learn more about the skills and knowledge of their peers and the allied profession.

## **2.3. Co-Habitation**

This academic year is the first year of fully integrating the collaborative studio with a tectonic focus. As mentioned above, the “Tectonic Studio” has been renamed the “Collaborative Studio” with a restructured focus on collaboration, while still allowing students to develop and understand the tectonics needed for their knowledge level. Currently, the second year ARC and BCS students are working on the design and construction of a bus shelter for the Mississippi Choctaw Band of Indians in Choctaw, Mississippi. The students all work together in one studio space and are divided into teams of four with three ARC students and one BCS student. But, again due to enrollment issues, there is one team of three BCS students and two ARC students. Assignments began as team designs for the bus shelter, which the faculty quickly learned alienated the BCS students since they had never designed something before. Yet, when the next assignment was introduced and should have been dominated by the BCS

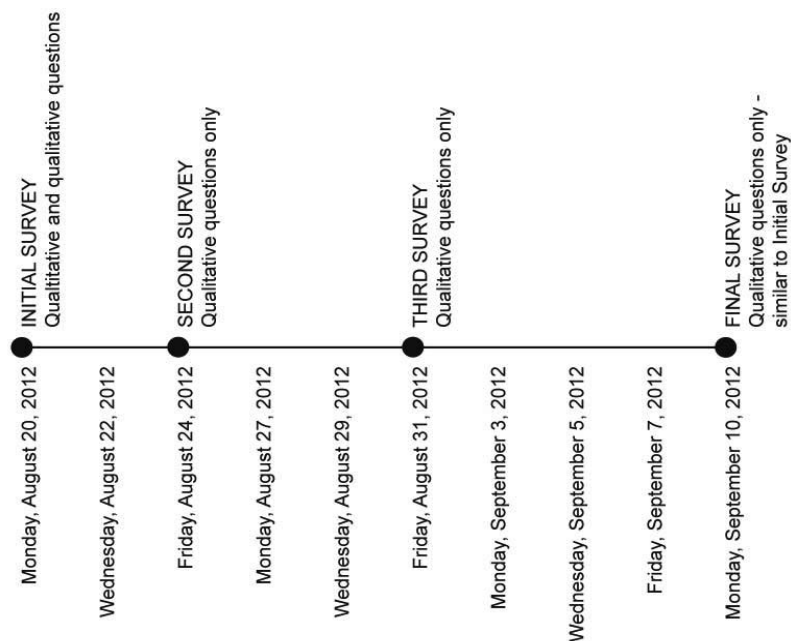
students due to the construction, budget, and scheduling aspects, the BCS students again lagged behind their architecture counterparts.

While the studio is ongoing, the faculty consistently meet and evaluate the studio assignments and structure and reassess and restructure as needed. More individual assignments were created based on the cultural conflicts that arose between the ARC and BCS students who have very different work ethics and ideas of what studio should be. Despite this teamwork is still necessary as only two bus shelters are ultimately being built and there are forty-nine students in the studio. More development is needed to continue to help the BCS students adapt to what is still a foreign concept to them, while the ARC students need to learn to let the BCS students take the lead on more assignments and tectonic issues. All of this is also being assessed for the upcoming collaborative studio between the third year ARC and third year BCS students in Spring 2014.

### 3.0. METHOD AND DATA RESULTS

#### 3.1. Three-Week Charette Method and Data Results

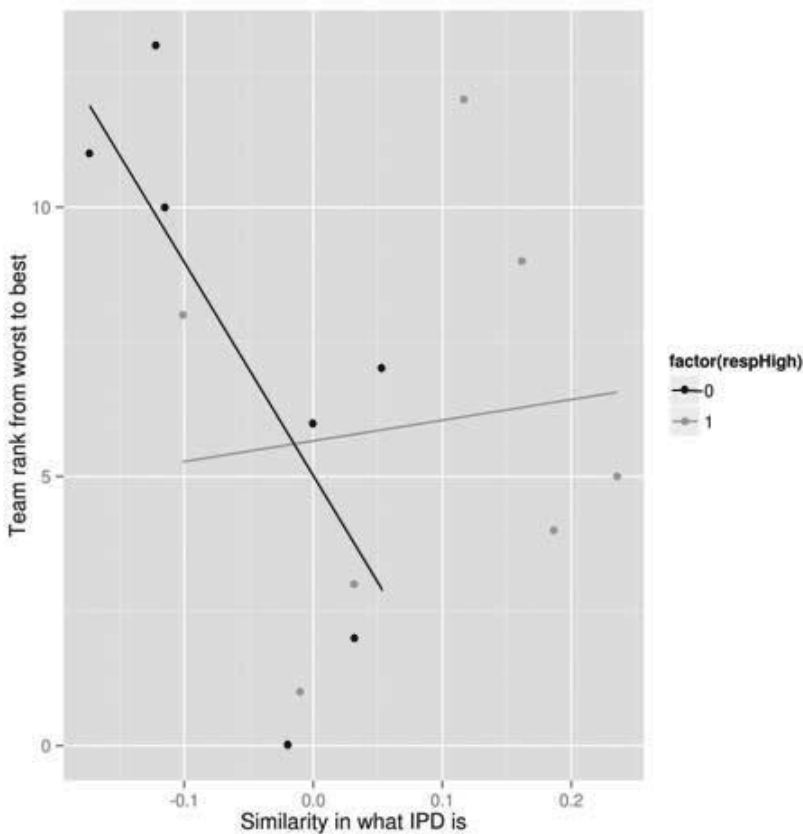
The data collection of this charette has not been very consistent, as noted with the development of the project itself. The first year consisted only of paper form surveys given at the beginning and end of the charette. The survey from the first year was developed more and digitized into an online survey what was conducted not only at the beginning and end of the charette, but also at two additional intermediate points during the charette. This was done with the collaboration of a Psychology professor who not only helped



**Figure 2:** Timeline of Survey Distribution Fall 2012. Source: (Author 2013)

refine the survey, but also helped with qualitative and quantitative data collection and analysis. The extended three-week period of this charette also allowed more data to be collected because there was more time for the total of four surveys. In spite of this, the new faculty conducting the charette this past Fall 2013 decided to limit the charette back to two weeks, which limited the data collection to three surveys instead of four. Those surveys consisted of the pre-survey, intermediate survey, and post-survey. The surveys were done typically at the end of each week, but sometimes varied due to national holidays that precluded the gathering of the studio. (Fig. 2)

The surveys were developed to collect demographic information from the students as well as their perceptions of IPD and collaboration before, during, and after the charrette. Qualitative data analysis based on the similarity of team members on responses to the question “What is your understanding of integrated practice?” showed that for teams where their initial responses were similar the final responses did not change much in relation to similarity. However, for the teams where their initial responses differed more their final responses had a much higher agreement in what integrated practice means. This shows that those teams who had different ideas of integrated practice possibly ended up having similar ideas on integrated practice as they learned more about it and their teammates in allied disciplines. Moreover, the teams that were more successful in the execution of their final project were no more similar in their agreement on integrated practice than those teams that were less successful. This shows that while the project development may not have been successful the students did learn more about working collaboratively and agreeing more on ideas like integrated practice by working with their teammates. (Fig. 3.)



**Figure 3:** Chart of Agreement Amongst Team Members from Initial to Final Survey. Source: (Jarrod Moss, 2013)

### 3.2. Limited Collaboration Method and Data Results

This studio had limited data collection partially because this was a pilot studio where true collaboration was not the goal, and partially because of lack of collaboration on the part of the faculty in ARC and BCS. Collaboration between the three ARC faculty was very good as the faculty were well organized and had a similar pedagogy and idea of what the studio should be. The BCS faculty member also had a similar pedagogy and ideas to the ARC faculty, but was placed into the studio at the last minute so had no history of developing the studio for collaboration. This created a lot of chaos and misunderstanding in the collaboration between

the two departments despite the collegial relationship between the various faculty. The two research instruments were a survey/analysis of the collaborative aspect taken by both BCS and ARC students at the end of the semester, as well as a self-evaluation/team evaluation taken by the ARC students only half way through the semester.

All data was qualitative with open-ended questions asking the students to provide comments about the teamwork. The self-evaluation/team evaluation was for the preliminary project research that the ARC and BCS students completed together during the first half of the studio. This work consisted of research into building code and zoning, ADA and egress, LEED, site influences, project precedents, demographics, program, and construction specific issues. It also included teamwork on the design and creation of a physical site model, Revit site model, and studio booklet documenting all of the information gathered as part of this research. The survey/analysis of the collaborative aspect at the end of the semester included questions asking what the specific student learned and/or taught their team member from the other department, as well as any issues with teamwork, decision-making, and dependability.

Comments from the first evaluation taken only by the ARC students showed an inconsistency in skills and knowledge of technology, such as Adobe Creative Suite, as well as an inconsistency in knowledge of building codes, zoning, ADA and egress. The faculty believe this was due to the different year levels of second year BCS students working with more experienced third year ARC students. This issue should be addressed by having all third year students working together in Spring 2014. Another issue that arose from the comments was the inconsistency in studio culture and work ethic of ARC students and BCS students. This was noted on the comments from the final surveys as well. The ARC students are used to working nights and weekends in pursuit of a more developed and perfected product, whereas the BCS students are not even very familiar with the studio concept and are catching up with their ARC colleagues in that respect. This will also be remedied by having the students from the same year working together, but cultural differences between the two fields still exist even in higher education.

### **2.3. Co-Habitation Method and Data Results**

No data has been collected from this studio yet since it has yet to be completed, but course evaluations at the end of the studio will be used to gauge the response of the students in the second year collaborative studio. The Spring 2014 studio will use the same midterm survey and final survey as last year to assess changes from the previous studio that had limited contact.

### **CONCLUSION**

The data from the various studios show similarities despite the many variations in the studios. First, that the students in all departments must have similar knowledge and skill sets to make communication and collaboration possible. Second, that co-habiting students improves collaboration because the students spend more time together and therefore learn from each other more. This leads to better collaboration. However, how do you define “better” collaboration? The data from the longest running studio, the two-to-three-week charette, shows that even with less successful design projects the students were more successful in converging their ideas and understanding of collaboration, and the skills and knowledge of their colleagues in other fields. Time will tell if this remains consistent throughout the other collaborative studios.

The largest obstacle seems to be the cultural differences between the allied disciplines. This is not limited to academia, but is also prevalent in the profession. The most important thing that the professional and educational aspects of IPD share and must address is the importance of relationships and the barriers created by the social constraints of the allied professions. Deutsch reminds us of that fact when he quotes the GSA’s Charles Hardy in his article “Notes on the Synthesis of BIM”. Hardy is famous for stating “BIM is about 10% technology and 90% sociology,” and Deutsch reiterates that we must focus on the social aspects of integrated design (Deutsch, 2010). Understanding the evolution of the world-views of the stakeholders in building design and construction is also important and Ryan Smith analyzes this in his article “Socio-Technical Practices.” Smith posits that the various parties involved in construction have

diverged since the Renaissance, with disastrous consequences. This is further exacerbated by traditional construction contracts, which focus on winning the project instead of creating the best product possible. Defining the knowledge and resultant boundaries for each profession is important to overcoming this long-established barrier to an efficient and well-constructed project (Smith, 2011). This is also important to a successful collaborative studio to help the students understand not only their abilities and limitations, but also those of their partners.

These studios attempt to emulate these issues to help our students not just learn to collaborate but also understand their colleagues in the allied professions. The development of studio culture in building construction science and other allied professions where this is absent is one step to help our students work together in an atmosphere of equity and understanding. While not every program is interested and open to this we are seeing more and more success in the BCS students who are being taught similarly to the ARC students so that they can overcome their cultural differences. Further research and development of these studios is needed to test these ideas and eventually include other allied professions such as landscape architecture and engineering.

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# Beyond buildings [but] inside architecture

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**ABSTRACT:** In recent years, mass customization and computer aided manufacturing (CAM) technologies have transformed off-site building component fabrication. At the same time, traditional repetitive manufacturing still dominates building component production. Bricks, bathroom fixtures, window mullions, and door hardware are all repetitively manufactured. Ironically, CAM's computer numerical controlled (CNC) machines have made the fabrication of custom molds for repetitive manufacturing easier. This allows architects to customize repetitively manufactured architecture components. I am using the term customized repetitive manufacturing (CRM) to refer to this type of work. Through my ongoing research, I have identified a wide range of historic and contemporary examples of CRM for architecture components.

Designs for repetitive manufacturing architecture components involve coordination between the architect and the manufacturer. Both must balance capital costs with production runs, mold complexity with manufacturing parameters, and size restrictions with manufacturer's abilities. How these issues are balanced depends on the application of the architectural component. I have identified three categories of custom designed architecture components based on application—custom components, architecture prototypes, and architecture products. This paper presents the three categories of application in reference to CRM. I define each category, provide multiple examples, and analyse particular case studies. Analysis of the case studies provides the architectural and manufacturing impacts on CRM within each category.

**KEYWORDS:** architecture, components, customization, manufacturing, and product design

## INTRODUCTION

In recent years, mass customization and computer aided manufacturing (CAM) technologies have transformed off-site building component fabrication. At the same time, traditional repetitive manufacturing still dominates of building component production. Bricks, bathroom fixtures, window mullions, and door hardware are all repetitively manufactured. Ironically, CAM's computer numerical controlled (CNC) machines have made the fabrication of custom tools for repetitive manufacturing easier and thus have reduced costs. CNC milling machines, electrical discharge machines (EDM), and hot-wire foam cutters are used to creating tools for repetitive manufacturing. Reduced tooling costs therefore require smaller production runs to offset those costs. Architecture benefits from smaller production runs, as architects can now consider customizing repetitively manufactured products for architecture components. I will use the term customized repetitive manufacturing (CRM) to refer to this type of work.

Through my ongoing research, I have identified a wide range of historic and contemporary examples of CRM in producing architecture components and have presented in-depth investigations into selected case studies. The case studies of CRM in architecture are located around the world and use a variety of manufacturing processes. Using those examples, I have identified three categories of customized architecture components. The categories are custom components, architecture prototypes, and architecture products and they are based on the architects' design, intention, and application of their components. Custom components are designed by the architect to be custom manufactured for a particular building. Examples include Renzo Piano's sand-casted, ductile iron truss members for the Menil Collection (1987) and Tom Phifer's contact-molded, fiberglass reinforced plastic (FRP) ceiling coffers for the North Carolina Museum of Art (2010). Architecture prototypes are full-scale, mock-ups used to test and architectural idea. Examples include R. Buckminster Fuller's Prefabricated Bathroom for the Dymaxion House (1940) and houminn practice's Drape Wall (2008). Finally, architecture products are architecture components available for mass consumption. Examples



include Zaha Hadid's ZH Duemilacinque doorknobs for Valli&Valli and Robert A.M. Stern's Rhythm light fixtures for Lightolier.

Although building component design is outside of standard architecture practice, architecture components are simultaneously part of architecture. Components are attached to the building and it is the aggregation of components that physically makes a building. In order to use CRM for architecture component design, the architect must decide that the available building components products do not meet the needs of the design. Additionally, because the CRM component is repetitively manufactured, the architect must believe that a new component's design is strong enough to warrant multiples. Designs for CRM components require coordination between the architect and the repetitive manufacturer. Both must balance capital costs with production runs, mold complexity with manufacturing parameters, and size restrictions with manufacturer's abilities. How the architect and the manufacturer balance these parameters depends on the component's application.

This paper highlights architects' design work beyond the profession's standard definition of architecture design. For this research, I use contemporary and historic case studies to define the three categories, study the lessons learned by the case studies, and draw conclusions. The three categories—custom components, architecture prototypes, and architecture products—provides particular constraints on CRM that the architect should consider. By grouping the examples together, I am able to draw out common themes, challenges, and constraints that should be considered in each category. For example, by examining the custom components together, I discovered the challenges for architects in educating themselves about potentially unknown manufacturing processes. This paper is part of my investigation to understand the overall conclusions that my collection of CRM case studies provides.

## **1.0 CRM AND ARCHITECTURE COMPONENTS**

Repetitive manufacturing reuses its tools (e.g. jigs, molds, and patterns) to produce runs of similar products. Production runs for repetitive manufacturing can be varied, ranging from small-batch productions to production runs over one million units. Product run lengths depend on the production media, the tooling media, and manufacturing processes. Typically, the product's production run length is directly dependent on the cost of the tools; high production runs are necessary for manufacturing processes that have high tooling costs. For example, if a mold costs \$50,000, but produces 100,000 units, the added cost of a custom mold would be just 50 cents per unit. CNC machines have made it more affordable to fabricate manufacturing tools and therefore have reduced production run lengths. This means that CNC technologies have allowed smaller production runs and therefore more customization in repetitive manufacturing.

CRM balances the value of repetitive manufacturing with the ability of the designer to customize a building component. There are forms, materials, and finishes available in CRM that are not available in CAM. Processes such as precision slumping glass and clay, blowing glass, and contact molded fiber-reinforced plastic (FRP) are available in CRM but not CAM. In comparison to subtractive CAM processes, repetitive manufacturing typically uses only as much materials as the mold, pattern, or jig needs<sup>1</sup>. By reusing tools and reducing raw material requirements, customized repetitive manufacturing can have little to no production waste. Manufacturing tolerances for most of these processes are high and have the potential to rival the tolerances of CNC equipment.

In comparison to CAM, architect need to consider more variables in CRM. In CRM, one must consider desired materials, shapes, allowable production runs, capital costs, and finishes in order to select a manufacturing process. For example, if a production run is small and costs are required to be low, then a designer may want to consider thermoforming for plastic rather than injection molding. Additionally, the mold media affects the manufacturing process. In thermoforming plastic, changing the mold from wood to aluminum (with imbedded cooling lines) increases the cycle time, tolerances, mold costs and production run lengths. Conversely, there are fewer variables in CAM than CRM. A CNC router is consistent in its operation regardless of the media, shapes, production runs, and finishes. Media and finishes may affect production speed, but the operation of the machine, tolerances, and production run lengths remain the same.

The three categories of architectural components—Custom Components, Architecture Prototypes, and Architecture Products—affect the variables of CRM production. Therefore, in order to design for manufacturability, the designer should consider the category in which their design is. For example, if an architect-designed component is a product to be made of metal and available for mass consumption, lost wax casting with injection-molded patterns could be considered. If a component is custom for a particular building application, then it may have a smaller production run and could be sand casted. The capital costs and finishes with the lost wax casting with injection-molded patterns are substantially higher than those of sand casting metal are.

### 1.1. Custom components

In many ways, custom components are the most interesting category of architectural components. Custom components are components that the architect has custom designed to be unique to a particular building design. (See Table 1.) Custom components are typically pursued by architects and building designers that are concerned with building details. Examples include Renzo Piano’s custom sand-casted ductile iron truss members for the Menil Collection (1987) in Houston, TX and Herzog and de Meuron’s slumped glass windows for the Prada Store (2003) in Tokyo, Japan. With those examples, the custom components complete the vision of the project. The truss members of the Menil Collection are part of the building’s high-tech structural expressionism. The curved windows of the Prada Store are an extension of the building’s consumer nature, as they create a convex lens in keeping with the store’s consumerist program. ([herzogdemeuron.com](http://herzogdemeuron.com))

**Table 1:** Table listing selective case studies of CRM custom components. The listed case studies have been limited to examples from the past 10 years.

Year	Repetitive Process, Component	Project Name	Location	Designer
2003	<i>Slumped Glass</i> , Windows	Prada Store	Tokyo, Japan	Herzog and de Meuron
2003	<i>Wood Molded, Blown Glass</i> , Screen	Hesiodo	Hierve Diseneria	Mexico City, Mexico
2003	<i>Cast Metal</i> , Skylights	Nasher Sculpture Museum	Dallas, Texas	Renzo Piano
2004	<i>Rubber Molds</i> , Concrete Panels	Utrecht University Library	Utrecht, Netherlands	Wiel Arets Architects
2005	<i>Explosive Forming</i> , Panels	Theater Castellum	Alphen, Holland	Kraaijvanger Urbis
2005	<i>Stamped Metal</i> , Panels	Walker Art Center Addition	Minneapolis, Minnesota	Herzog + deMeuron
2007	<i>Fiberglass-molded Precast Concrete</i> , Walls	Rice University Data Center	Houston, Texas	Carlos Jimenez Studio
2008	<i>Extruding Clay</i> , Column Cladding	Spanish Expo-Pavilion	Zaragoza, Spain	Francisco Mangado
2008	<i>Extruding Aluminum</i> , Screen	Dee and Charles Wylly Theater	Dallas, TX	REX
2010	<i>Slumped Glass</i> , Windows	VAKKO Fashion Center	Istanbul, Turkey	REX
2010	<i>Extruding Stiff Mud</i> , Bricks	Yale University Health Services Building	New Haven, Connecticut	Mack Scogin Merrill Elam Architects
2010	<i>Contact Molding FRP</i> , Exterior Louvers	Walbrook Office Building	London, England	Foster and Partners
2010	<i>Contact Molding FRP</i> , Ceiling Coffers	North Carolina Museum of Art	Raleigh, North Carolina	Thomas Phifer
2013	<i>Rubber Molded Precast Concrete</i> , Panels	Cleveland Medical Mart and Convention Center	Cleveland, Ohio	LMN & URS
2013	<i>Contact Molding GFRC</i> , Panels	Contemporary Art Center	Cordoba, Spain	Nieto Sobejano Arquitectos



**Figure 1:** Selected Images of custom components. From left to right: Prada Store by Herzog and de Meuron, flickr: (InfoMofo, 2006); 290 Mulberry St. by SHoP, flickr: (joevare, 2008); Walbrook Office Building by Foster and Partners, flickr: (Myxi, 2009).

Custom manufactured custom components allow for customization from the designer while balancing the need for repetition in order to remain cost effective. Since customization is done on a per-project basis, the architect has to pay particular attention to the production run length of the custom component. Required production runs for custom components can vary between designs, applications, and production methods. Prior to the use of CNC equipment to fabricate tooling, tools were fabricated by hand and were thus labor intensive and costly. Therefore, historically an architect would be required to consider tooling costs for the designs of their custom components.

Historic examples of custom components include Frank Lloyd Wright's cast textile blocks for his California concrete block houses (c. 1920) and the stamped aluminum panels for the Harrison & Abramovitz's Alcoa Building (1953) in Pittsburgh, PA. Both examples used different methods to offset the additional tooling costs. Wright's textile blocks were manufactured on site, by hand, in a multipart mold. The mold was similar to a springform pan—its sides unhinged so that they could be separated from the mold's face. Tooling costs were reduced by breaking the mold into parts. The mold's sides were used for every block and two different faces were used to create the flat and textile block faces. The mold was made from aluminum, and by reusing the sides for all block production, less fabrication work was required to make the tools. The Alcoa building used a different approach for offsetting tooling costs. A thirty-story, high-rise building, the Alcoa has a custom, stamped aluminum panel under each window. Because the Alcoa Building is a high-rise, additional costs for the custom component is offset by the number of panels required to clad the high-rise.<sup>2</sup>

Today, because of the availability of CNC equipment to make tools, custom components are easier to produce than they were historically. CNC equipment fabricated the tools for the Utrecht Library, Walbrook Office Building, NC Museum of Art, 290 Mulberry St. and Cleveland Medical Mart. The case studies listed in Table 1 demonstrate the advantages of CRM over CAM. Sometimes CRM is less costly than CAM. For example, Foster and Partners had investigated using CNC equipment to make the louvers on the Walbrook Building, but then learned that repetitively manufacturing them with a mold was more cost effective. Oftentimes CRM produces less waste than CAM; such was the case for the Cleveland Medical Mart. Here the design team used a CNC-milled pattern multiple times to produce rubber molds and then used the rubber molds multiple times to create the precast panels. If the tools, were not used repeatedly for production, more manufacturing waste would have been created to make the panels

Analyzing the custom component case studies offers lessons for designer considering CRM for production. First, in order to reduce production costs and waste, the designer should consider creative uses for the production tools. Similar to Wright's multipart, textile-block molds, some of the case studies have considered molds that can be broken down or subdivided. At 290 Mulberry St., SHoP designed the building's precast concrete and brick composite panels so that they could be manufactured using one large rubber mold that was sub-divided. At the Cleveland Medical Mart, the toolmaker used dams to make different rubber molds from a single CNC-milled pattern. Both examples allowed for multiple variations using a single tool, thus reducing cost and waste. Second, a designer must consider both the production run and the manufacturing processes. For some manufacturing processes, high tooling costs cannot be reduced and the only way of balancing those additional costs is through high production runs. These processes typically use steel tools and include extruding clays, metals, and plastics. There are over 27,000 extruded clay pieces on the Spanish Expo-Pavilion and over 300,000 custom bricks for the Yale Health Services Building. Alternatively, some manufacturing processes have low tooling costs and therefore can support small production runs. This includes the explosive formed panels for the Theater Castellum, the precision slumped glass for the VAKKO Center, and the contact molded FRP coffers for the NC Museum of Art. Finally, since custom components are done on a building-by-building basis, architects may not have prior experience with their selected repetitive manufacturing processes. This often requires architects to find manufactures who are willing to collaborate for a particular design. Such was the case with FiberTech who worked with Phifer's office for the NC Museum of Art, and Ceramica Cumella and Ceramica Decorative who worked with Mangado for the Spanish Expo-Pavilion.

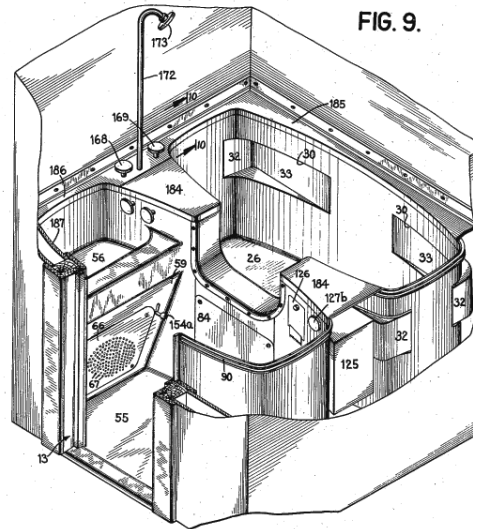
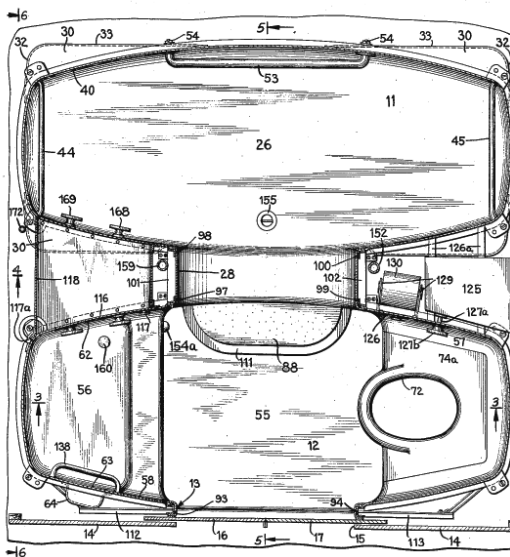
## 1.2. Architecture prototypes

I am defining architecture prototypes as explorations of architectural ideas, using full-scale, physical, mock-ups. Architecture prototypes are often not full buildings, but are pieces or ideas that can be applied to future buildings. Examples of prototypes include Dunescape by SHoP (2000) which explored CNC fabrication and unskilled assemblage and the Cellophane House by KieranTimberlake (2008), which was a vehicle for the firm to further develop applications for SmartWrap.<sup>3</sup> Architecture prototypes can include investigations into new materials, exterior enclosure systems, wall types, fabrication systems, or methods of construction. Architecture prototypes may be sited, but since they are built investigations of a larger architectural idea, they are often site-less. An historic example of an architecture prototype is R. Buckminster Fuller's prefabricated bathroom for the Dymaxion house (1940).

Innovative architectural practices, architecture researchers, and studio courses tend to explore design ideas through architectural prototypes. Today, CNC equipment and robots fabricate most prototypes. This may be because of the accessibility of CNC equipment in architecture academia, because CNC equipment can be programmed directly by the designer, or because CAM equipment has little-to-no capital costs. Despite those advantages, there are a handful of architecture prototypes that have made use of CRM for their component production. See Table 2. In these examples, CRM was selected because it offered something the CAM did not. For example, thermoforming metal was a cost-effective method to get 3-dimensionally formed tiles out of metal for the Busta Line project, and for the Dragon Pavilion CRM was more beneficial than CAM because the students could fabricate their own molds rather than gain access to CNC roller equipment.

**Table 2:** Table listing current, selective case studies of CRM in architecture prototypes

Year	Repetitive Process, Component	Project Name	Designer
c 2008	Ram Pressed Ceramic, Structural Tiles	EcoCeramic Envelope System	Jason Vollen, Center for Architecture Science and Ecology (CASE)
2008	Thermoformed Plastic, Bricks	Drape Wall	houminn practice
2010	Thermoformed Metal, Panels	Busta Line	Rentsch et al, University of California
2010	Thermoformed Plastic, Bricks	OS Wall 2.0	houminn practice
2012	Bending Plywood, Scales	Dragon Skin Pavilion	Keskisarja et al
2013	Electroforming, Copper	Electroform(alism)	Akoaki



**Figure 2:** Patent drawings of R. Buckminster Fuller's Prefabricated Bathroom. United States Patent Office. "Prefabricated Bathroom". No. 2,220,482.

For some architecture prototypes, the design team manufactures the CRM architecture components, directly. This was the case for Drape Wall, EcoCeramic Envelope System, and the Dragon Skin Pavilion. By working directly with the manufacturing process to build the architecture prototype, designers had freedom to experiment with the process. For example, the Drape Wall design and fabrication team purchased vacuum-forming equipment to make the prototype. According to an interview with Mark Swackhamer, the team researched the thermoforming industry's manufacturing parameters before experimenting with the process themselves to make the prototype. Although the manufacturing parameters were stated as a given, the team discovered that some parameters could be altered. Their investigations with Drape Wall have led the team in two directions. First, they continued to develop their architectural ideas into subsequent prototypes.<sup>4</sup> Second, lessons learned about vacuum forming plastic have led to research into manufacturing and they have been investigating the possibility of using a dynamic mold for thermoforming plastic.<sup>5</sup>

If architects intend to use CRM for their architecture prototypes, then there are specific issues that they should consider. First, in order to reduce costs, the architects themselves or other, less-skilled laborers often make the architecture prototype. For examples, Emmi Keskisarja et

al made the plywood scales of the Dragon-Skin Pavilion, houminn practice's team manufactured all Drape Wall's thermoformed plastic bricks, and Jason Vollen (with CASE) ram pressed the structural tiles for EcoCeramic. Second, CRM processes that use little or no complicated equipment are most often selected. For example, Drape Wall's plastic bricks and the scales of the Dragon-Skin Pavilion were both made in university fabrication shops. Third, to reduce capital costs, architects may fabricate the CRM tooling themselves. This happened in all of the case studies listed in Table 2. Finally, for prototypes, the architect will want to consider manufacturing processes with low capital costs, and thus will allow the small production runs associated with prototypes. All of the CRM processes listed with the case studies have low capital costs and thus small production runs.

### 1.3. Architecture products

Architecture products are the most difficult to define and yet are probably the most ubiquitous architect-designed components.<sup>6</sup> Architecture products are architecture components designed by architects and available for mass consumption. Architecture products demonstrate a push model in both design and manufacturing. This is to say that the architecture product is pushed from the manufacturer to the consumer. Before the building has been designed, the architecture product has been designed; before the building construction starts, the product is manufactured. Architecture products offer the greatest breadth of examples, both historical and contemporary and they are the most difficult to substantially catalog. Table 3 represents a selected list of architecture products that are currently available on the market.

**Table 3:** Table listing current, selective case studies of repetitively manufactured architecture products. For brevity, the table offers only one sample product for each component type.

Component	Project Name	Designer
Door Lever	Valli&Valli Fusital Series	various designers
Faucet	Axor Starck Organic	Phillipe Starck
Bathroom Sink	Agape Nivis washbasin	Shiro Studio
Bathroom Pedestal Vanity	Duravit Starck 1	Phillipe Starck
Lighting	Lightolier Rhythm Collection	Robert A.M. Stern Architects
Doors	Luadi L16	Lissoni Associati



**Figure 3:** Selected Images of Architecture Products. From left to right: Agape Nivis washbasin by Shiro Studio, Valli&Valli Fusital door levers by Zaha Hadid (top) and Jean Nouvel (bottom), Duravit Starck 1 Pedestal Ceramic by Phillippe Starck.

Unlike custom components or architecture prototypes, which are developed by the architect for a particular application, the architecture product's success depends on the consumer. Customers must desire the product, and therefore companies must promote the products. Companies promote products through advertising and are facilitated by the companies' brand, the quality of the design, or the designer's name recognition. Such is the case with the Valli&Valli Fusital Series door levers, which include designs by Zaha Hadid, Robert A.M. Stern, Frank Gehry, Jean Nouvel, and Richard Meier.

The value of architecture products to the architectural community is perhaps a difficult one to access. On one hand, it is beneficial to the architectural profession to specify building components designed by other architects. Since architects have not been involved with the design of the majority of our building products, architecture products allow architects to promote the value of our profession throughout all aspects of the building. This in turn offers architects more design opportunities beyond that of building designer. On the other hand, since architecture products are available to the public, products may be seen either as a commodification of design or as a perverse extension of a designer's fame (Deamer). For example, the Valli&Valli door levers demonstrate the importance of the designer's fame to the product—as each image of the door lever includes a head shot of the designer.<sup>7</sup>

Architectural products affect the parameters for repetitive manufacturing. First, depending on the anticipated popularity of an architecture product, architecture products could use manufacturing processes with high capital costs that support large production runs. With high production runs, an architecture product may support injection molding instead of thermoforming. This would in turn affect the component's finish, design, detailing, and materials used. Second, unless specifically marketed to have a handcrafted feel, consumers purchasing architect-designed products have high expectations of quality. This may require manufacturing processes that can produce items with high tolerances and quality finishes—such as the smooth, high-gloss finishes are available in lost-wax casting but not sand casting metals. Third, architecture products may be required to be certified by third party agencies, such as the Underwriter's Laboratory (UL) certification for light fixtures and American Society of Testing and Materials (ASTM) certification for hardware. The product's designs must be compliant with the certifying agency.

Finally, architecture products can be fabricated from a variety of single-process manufactured components. That is to say that the product's manufacturer may contract out the sub-components. For example, Phillippe Starck's pedestal vanity for Duravit fixtures are made with molded wood products and an injection-molded ceramic sink. Those subcomponents would be manufactured by different subcontractors and assembled by the final Original Equipment Manufacturer (OEM), Duravit. This means companies, such as Duravit, that contract with architects to design their products inherently separate the architect from the sub-component manufacturers. This means that Starck would have little to no contact with either the wood product molder or the ceramic injection molder. This in turn reduces the possible collaboration of the architect with the subcomponent manufacturer.<sup>8</sup>

## CONCLUSION

As the case studies demonstrate, CRM is rooted in both history and contemporary practice. There are many recent and global examples of architects using CRM for the design and production of architecture components. In comparison to CAM, CRM has more variables that an architect should consider for architecture component design and production. These variables include materials, shapes, required production runs, capital costs and finishes. From my collected case studies of CRM in architecture, I have identified three categories of architectural component applications. They are custom components, architecture prototypes, and architecture products.

This paper organizes these case studies into a larger discussion. My future goal for this research is to create a guide CRM for architects. The guide will include an introduction to different repetitive manufacturing processes, parameters for possible customization, and architectural case studies. By presenting this paper as an overview, my goal was to establish commonalities between the case studies within the category. Each of three categories provides particular constraints on the architect for the design and production of an architectural component using CRM. Custom components require the architect to consider production run lengths, creative use of molds to distribute costs, and collaborate with manufacturers. Architecture prototypes often use lower-skilled manufacturing processes, manufacturing processes that are accessible by designers, and allow for greater experimentation by the architect. Architecture products often use manufacturing processes with tight tolerances and high quality finishes, they are certified, and may allow for less collaboration between

manufacturer and designer. Understanding the constraints on the designer at the beginning of the design process is important, as they influence the component's design.

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## ENDNOTES

<sup>1</sup> Subtractive CNC machines are those machines that take material away in order to produce the unit. Subtractive equipment includes drills, lathes, millers, routers, surface grinders, EDM's, plasma cutters, water-jet cutters, laser cutters, knife cutters, hot-wire foam cutters, punch presses, and oxyfuel cutters.

<sup>2</sup> Additionally, the building was a showcase for architectural uses of aluminum and so the client had a financial interest to offset the added cost of a custom component.

<sup>3</sup> The Cellophane House was designed and fabricated for a Museum of Modern Art exhibit in New York.

<sup>4</sup> Subsequent prototype iterations by houminn practice include Cloak Wall and OSWall.

<sup>5</sup> In a 2010 interview with Mark Swackhamer, we discussed the practice's research into using dynamic molds for thermoforming. According to the practice's website, they recently presented their variable vacuum forming research at ACADIA 2013.

<sup>6</sup> For architecture products, I am including only 3-dimensional architecture products, but not 2-dimensional components such as carpets and fabrics. This keeps the types of components listed in architecture products similar to those listed in the categories of custom components and architecture prototypes.

<sup>7</sup> Headshots of each designer or architect are presented with all of the door levers. For an example of Zaha Hadid's door lever and head shot, visit <http://www.vallievalli.com/en/site/vallievallicom/ValliValli-USA/Products11/Fusital/Handles/H356/>



<sup>8</sup> The distancing of an architect from the manufacturer may be even worse than this example provides. Based on a recent story broadcasted on National Public Radio (NPR) a companies are now licensing their brands to products that they may not manufacturer. This means that Black & Decker may not have made the toaster oven that bears its name. Bobkoff, Dan. "How Much is NPR's Brand Worth? \$400 Million". Aired November 1, 2013. [www.npr.org/blogs/money/2013/11/01/240285576/how-much-is-nprs-brand-worth-400-million](http://www.npr.org/blogs/money/2013/11/01/240285576/how-much-is-nprs-brand-worth-400-million). Accessed November 2, 2013.

# Danish Vernacular – Nationalism and History Shaping Education

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**ABSTRACT:** Despite the number of internationally successful Danish architects like Jacobsen, Utzon and in recent years Ingels just to name a few, Danish architecture has always leaned greatly on international architectural history and theory. This is only natural for a small nation. However, since the beginning of Danish architecture as a professional discipline, there has also been a formation of a certain Danish vernacular.

This paper explores how the teaching of and interest in Danish historical buildings could have marked the education of Danish architecture students. Through analysis of the drawings of influential teachers in the Danish school, particularly Nyrop, this development is tracked. This descriptive and analytic work concludes in a perspective on the backdrop of Martin Heidegger's differentiation between *Historie* and *Geschichte* – how history was used in the curriculum and what sort of impact the teachers had on their students. Such a perspective does not just inform us of past practices but could inspire to new ones.

**KEYWORDS:** Danish architecture education, National Romanticism, Martin Nyrop, Kay Fisker



**Figur 1:** Watercolor by Arne Jacobsen, depicting the SAS hotel, Tivoli Gardens and City Hall in Copenhagen. Is there a link between functionalism and Danish vernacular?

## **INTRODUCTION: WHAT IS VERNACULAR?**

Despite a long and proud tradition of Danish design, there has been very little research into Danish architecture and design education and it was discovering this lack that sparked my research. Through an investigation of different educational practices in the 20<sup>th</sup> century I am concerned with answering how knowledge is produced and transferred through the act of drawing. In my work I focus on drawings because students very rarely actually build anything and for the sake of comparability and methodological coherence in this paper, when discussing

teachers' work I have also focused on drawings. In this paper I trace what I have called a *Danish vernacular* at the dawning of the 20<sup>th</sup> century and offer a view seldom available outside of Scandinavia into the school that was the cradle of Danish Design.

I should like to show how teaching of and interest in Danish historical buildings influenced drawing practices and marked the education of Danish architecture students. This descriptive and analytic work concludes in a perspective on the backdrop of Martin Heidegger's differentiation between *Historie* and *Geschichte* – how history was used in the curriculum and what sort of impact the teachers had on their students. Such a perspective does not just inform us of past practices but could inspire to new ones.

*Danish vernacular* grew out of the Nationalist Romantic Movement and the purpose of this paper is to demonstrate how National Romanticism through two influential teachers was rooted in the Danish Royal Academy, Architecture School (hereafter referred to as the Academy). I would, however, first like to outline what I mean by *Danish vernacular* and indicate its existence. A vernacular usually refers to “the native language of a place”. Vernacular architecture is based on local needs and availability of construction materials and is often not designed by professional architects but is rather simple and self-grown. With my term *Danish vernacular* I mean to point to something slightly different, namely the *Danish vernacular* as an *architectural dialect* that professional architects adopted and used in their work.

In the history of the Academy, published in 1954, Knud Millech, one of the most knowledgeable scholars of the period, comments on the impact the Danish architect Martin Nyrop had at the Academy. Millech states that Nyrop as a teacher in the Academy was far less influential than he had been as an architect, but then adds the curious point that “It later became apparent that there was a line to the so-called domestic functionalism from Nyrop's reflections on the artisan foundation of form and his care for materiality and sensuous qualities – in particular with regard to Danish building materials” (Millech 1954, 401). Millech does not comment further on the topic, but with this passage he indicates that the teachings of Nyrop influenced the later functionalist style. This is especially interesting as he gives Nyrop credit for influencing the areas that would become the hallmark of Danish Design.

The aim of this paper is not to herald that developments on the Danish architectural scene were unique, but rather to show how movements known also from Sweden, Norway, Finland and Germany developed in the specific Danish educational environment. *Danish vernacular* is thus not something radically different from other styles, but consists of traces, subtle features and choices of material that at least up until the 1950's marked the design tradition to a noticeable degree.

Understandably these subtle traces are also difficult to pinpoint, but characteristics include: The use of red brick, red tile hip, half hip or gable roofs as well as the use of wood, though seldom in complete wooden structures, but very often in interiors and for furniture. The interest in working on a domestic scale has also been mentioned as a characteristic feature (Lane 2000). The question we are concerned with here is, however, not a detailed view of such specific features, but rather how these features through schooling came into the architectural vocabulary of young Danish architects. The root of this was the National Romantic Movement in architecture and we shall therefore explore briefly what National Romanticism is in a Danish context.

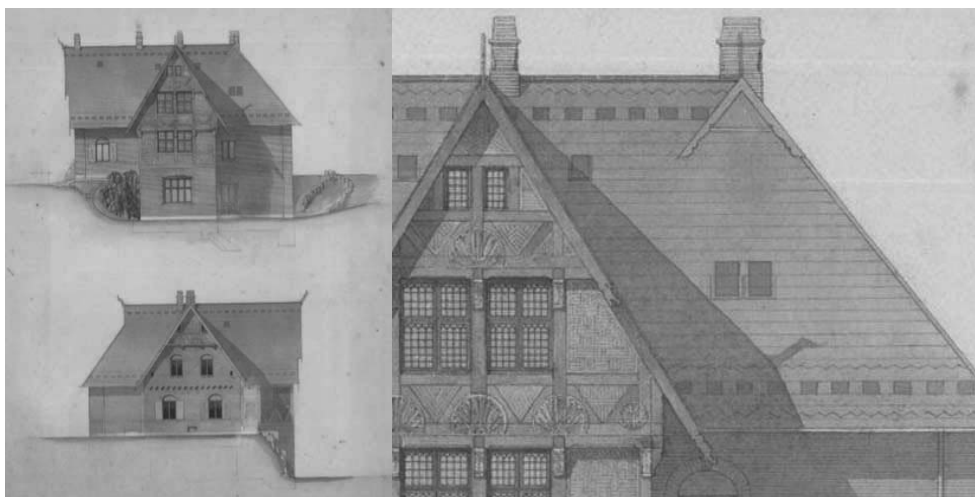
## **1.0 NATIONAL ROMANTICISM IN DANISH ARCHITECTURE**

It is not a new thesis that National Romanticism in the early 20<sup>th</sup> century was linked to the Functionalist Movement that grew out of, for instance, the Bauhaus school and that it also had an impact on Scandinavian Functionalism. It is the central argument in Barbara Miller Lane's book “National Romanticism and Modern Architecture in Germany and the Scandinavian Countries”. Here Lane argues that especially with the emphasis on home design and the home as a work of art, the individualism of National Romanticism fed into the social democratic ideals of the later Scandinavian functionalists (Lane 2000, 312).

For Lane National Romanticism in the north is defined by the search for an original national architecture. National in this respect is defined as “home” or “homeland” and the search perhaps symptomatically starts out “at home” in small scale structures and with an emphasis on the lives of the “worker-peasant”. Other scholars, such as Dragsbo, 1999 have asked how regionalism played into these national agendas, without doubt a valid point but beyond the scope of this paper. As an overall movement National Romanticism in Denmark like elsewhere took hold in the beginning of the 19<sup>th</sup> century in the form of widespread interest in Danish history, culture and mythology. In architecture, however, the influence is only seen later in a period roughly defined as 1880 to 1915 (Lane 2000).

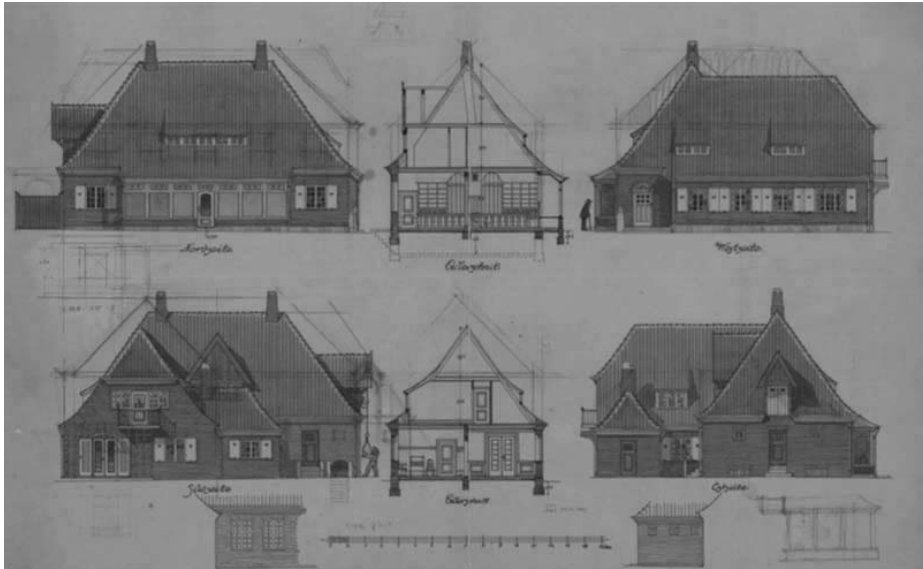
### 1.1. Hans J. Holm and the dawning interest in national building culture

The educational influence of National Romanticism can be said to have its beginning with the appointment of Hans J. Holm in 1883 as professor of Architecture at the Academy in Copenhagen. Holm had worked as an assistant at the Academy from 1866 to 1879 (Weilbach 1994), but as a professor he had the liberty to direct attention to one of his passions: architectural measurement and drawing of historical buildings. Holm was interested in European architecture, but was one of the first to take an interest in domestic architecture as his publications of “Drawings of older Nordic Architecture” (1872-1884) attest to. Holm’s own work cannot be uniformly classified as national romantic – although as the drawings demonstrate there are definitely parts of his oeuvre where nationalist motives were used.



**Figure 1:** Villa by Hans J. Holm for the painter Fr. Schwarz, 1884<sup>11</sup>

In figure 1 above, the timber frame with carved wooden decorations, the dragon heads on the gable top and even the choice of red brick are used to tie this villa to Danish traditions and make it a natural fit in the landscape. It should also be remarked that the “nationalist features” in fact aren’t very different from what one could expect to find in the northern part of Germany. This underlines that although Holm was instrumental in fostering an awareness of Danish building culture, it was not his actual building works but his methods that inspired students. Holm taught his students how to accurately measure and draw historic buildings and took the students on trips throughout the country to measure and draw Danish architecture. The measuring of old buildings caught the students’ interest to the degree that they in 1892 formed *Foreningen af 3. December*, an influential society dedicated to the measuring, drawing and publishing of drawings of old Danish buildings.

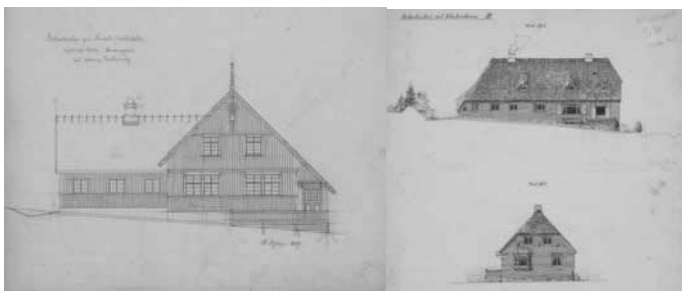


**Figure 2:** Student work by Kaj Gottlob, Kaufmanns Haus in Skærbæk, 1909

Through the exposure to old Danish architecture and the diligently detailed, if sometimes probably tedious, work of measuring, the students' knowledge and understanding of traditional buildings rose and with it rose a growing dissatisfaction with what were deemed the dead classical styles. At this time in the Academy the education was of a beaux-arts type, where younger students trained drawing skills by copying classical fragments and column orders and older students were obliged to draw three projects – one in each of the main styles. Students as well as practicing architects sought after expressions that seemed to fit more naturally into the Danish climate, materials, culture and mood. Research into Danish cultural heritage seemed to provide an inspirational source for such expressions.

## 2.0 MARTIN NYROP – ARCHITECT AND TEACHER

One young architect that was inspired by Holm's teachings - although he wasn't a student of his but an assistant working with Holm at the Academy from 1883 to 1893 – was Martin Nyrop (Weilbach 1994). Martin Nyrop, today renowned for his City Hall in Copenhagen, has been called the "father of Scandinavian National Romanticism" in architecture<sup>iii</sup>. A central agent in the Danish form of National Romanticism was the folk high school movement. As a young architect Nyrop was asked to put his ideas for a national architecture into the building of an exercise hall at Vallekilde, one of the prominent folk high schools. Nyrop, who had a background as a carpenter, designed a wooden structure, which would resonate through numerous subsequent works and in many ways pave the way for his influence. The exercise hall at Vallekilde with its characteristic decorated bargeboards on the front gable is very like the residential house Nyrop drew for Vallekilde later, but perhaps nothing epitomizes the Danish Vernacular quite like Nyrop's small residential house from 1895 (Figure 3, Right).



**Figure 3:** Left: Martin Nyrop, residential building Vallekilde, 1889. Right: Martin Nyrop, small residential building, 1895

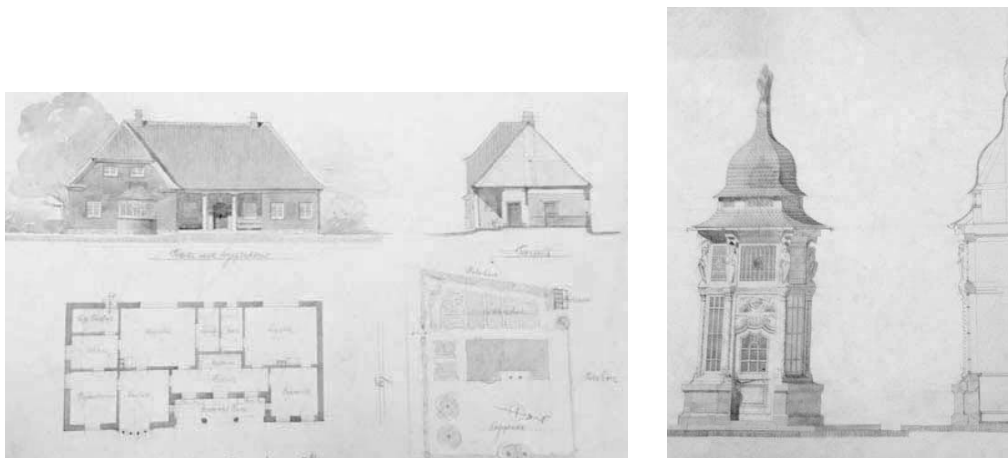
The structure is simple and rural in outlook. The walls are of plain red brick with a single decorative band across the gable. The thatched roof signals a cozy cottage like atmosphere and the building sits comfortably on a slightly sloped site – note here both the difference and similarity to the project by Holm, where the slope is much more dramatic. In both cases though it has been of vital importance for them to set the building into the context of the landscape. The roof is half hipped, with return cornices and predominately with small paned double windows. Remarkable also is the broken symmetry in the gable and the roofline drawn almost to the ground on the west side of the house. These are good examples of Nyrop’s way of working individual details into a project.

## 2.1. Struggle over style

At the turn of the 19<sup>th</sup> century Nyrop was one of the most influential people in the Danish architectural world and in December 1905 he was appointed to one of the two professorships in architecture at the Academy in Copenhagen. This can be seen as something of a final victory of the “national movement” over the “European movement” that had long since ruled at the Academy<sup>iv</sup>. This was the same year in which Nyrop finished the City Hall in Copenhagen, considered to be his definitive work. Despite many stylistic influences – amongst others a strong Italian influence – Nyrop’s individualistic composition remains very Danish (Lane 2000, Millech 1954).

With Nyrop’s professorship the ideas of National Romanticism were institutionalized at the Academy. This was done first and foremost through a more pronounced individualism and a softening of the stylistic demands for student projects (Millech 1954, Schmidt 2004). An example of this can be seen in the register of final assignments<sup>v</sup>. The prescribed style of the project was listed as a requirement, but Nyrop as a rule used phrases such as “based on” a certain style, and thus the stylistic requirement seems less rigid. An example from 1907 is an orphanage to be “carried out using renaissance motives suitably adapted to Danish conditions” (Protocol 1907)<sup>vi</sup>. From 1916 the stylistic requirement in the assignment is removed and it never returns.

A further interesting development that can be read out of the protocol of the final assignments is the turn towards the more modest “homely” projects that comes with Nyrop. The Danish beaux-arts tradition did not, as in the case of the French and American variants, have a *system of the esquisse*<sup>vii</sup>, but students still did sketch-assignments. To be permitted to sit their final exam they had to complete two sketch-problems, a practical and an artistic. With Nyrop and Holm in charge the practical assignment was sometimes downright mundane, as when in 1910 the students were asked to design a henhouse. More typical would be the 1907 assignments of an orphanage and a kiosk



**Figure 4:** Student work, Gerhardt Poulsen, Sketch assignment, 1907. Left: An Orphanage. Right: A kiosk

Typical for the assignment is a detailed description of what types of rooms and functions the building should contain. The similarities from the student Poulsen's design and Nyrop's cottage from 1895 should be noted.

It is said about Nyrop that he favored the students that struggled with their work and always was inherently suspicious of those whose excellent draughtsmanship he felt made things too easy for them (Millech 1954). The struggle with the material was valued because it was a sign that the student was using the drawing to think architecturally – to struggle with problems of the design, whereas the eloquence of the superb draughtsman could hide the problems under the shimmer of the aesthetically pleasing. This tendency shows, however, that Nyrop as a teacher was less interested in the technical prowess of the student and more interested in developing their thinking. This in turn gives a vital clue to what sort of influence Nyrop had on his students and in what way the features of National Romanticism were taken up by the students and marked the Danish strand of functionalism.

### 3.0. LESSONS LEARNED FROM NYROP

One of the most intriguing links between the Functionalist Movement and National Romanticism is in the establishment of the so-called "Danish Class". When Holm was followed by Hack Kampmann as a professor in 1908, Kampmann split up the two-year long course in monumental architecture nicknamed "The Temple Class" into two sections and added the Danish Class (only officially from 1910) (Schmidt 2004, Millech 1954). The Danish Class was significant because it was the first time the students were taught to design "ordinary" buildings such as a worker's home, a small farm house in the country or even multistory housing units (something earlier considered too mundane for architectural consideration). Everyday life entered architecture school. These relatively simple curricular changes symbolize a watershed in architectural thinking. Stylistically the projects drawn in the Danish Class were far from functionalist, but as the Danish modernist Kay Fisker writes in a retrospective article, very little of the functionalist program was something new (Fisker 1964). Lane also has said that the roots of functionalism were closely connected to the home (Lane 2000).

The belief that architectural excellence needed not necessarily great scale or refined and expensive materials, but could be built by local craftsmen, in simple shapes suited to the landscape as modest homes to serve a democratic purpose became the focal point not just for the nationalists but also the functionalists. Fisker, who himself became an influential teacher at the Academy, was a student of Nyrop's (1909-1920) (Weilbach 1994). Fisker in his student years was in open opposition against Nyrop's nationalism (Weilbach 1994), and in his early practice he was purely neoclassicist. Later, however, many of Nyrop's ideals can be found in Fisker's projects, not just in the form of red brick, tiled roofs and wood, but also in his interest in residential buildings. If we compare for instance the 1942 project in the Copenhagen suburb of Vangede, it is easy to recognize the proportions used by Nyrop for gables in the cross-section of the house.

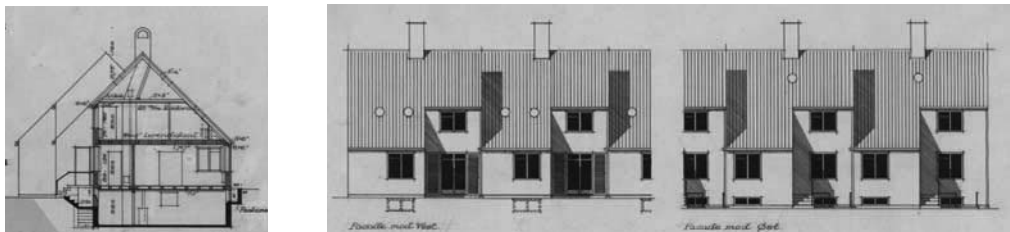
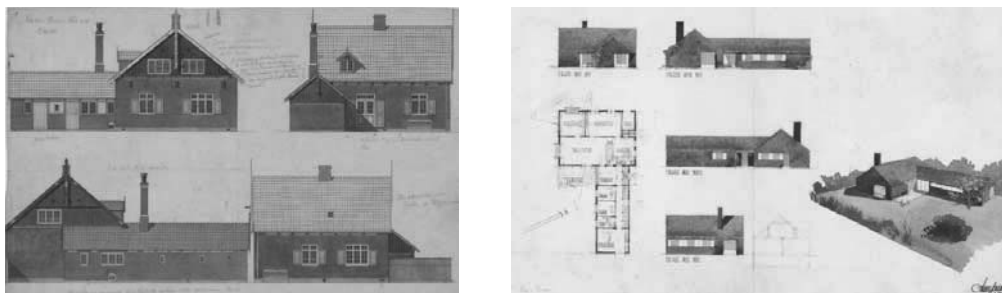


Figure 5: Kay Fisker, Row houses Vangede, 1942

Even pure modernists such as Arne Jacobsen sometimes returned to compositions and shapes that echo those of Nyrop. Compare for instance the two projects in figure 6. The project below is far from typical for Jacobsen, but it isn't the only one among his works either. Nyrop was no longer a professor when Jacobsen studied, but the tradition of measuring historic buildings was kept up until at least the 1980's and the example demonstrates how this

knowledge of architectural heritage - a construct of National Romanticism - still prevailed in the Copenhagen school even though other stylistic paradigms such as the revival of neoclassicism in the 1920's arose.



**Figure 6:** Left: Martin Nyrop, House for Captain Brix, 1899. Right: Arne Jacobsen House for Solicitor Holm-Nielsen, 1942

#### **4.0 HISTORIE AND GESCHICHTE: What This Story can teach us about History in the Architecture Curriculum**

In a 2011 article in JAE, Randall Teal describes his experiences practicing an integrated approach to history and theory in design teaching. Teal argues the importance that design education be shifted “from the creation of particular objects toward cultivating practices that open up territories (...) where all the relevant elements and information can react with one another.” (Teal 2011, 38) He analyzes his approach through the distinction between *Historie* (history) and *Geschichte* (story) in Heidegger's philosophy. *Historie* for Heidegger points to the descriptive linear and scientific recording of the past, whereas *Geschichte* mixes and consists of overlaps of historic time, bound together by a sense of meaning. *Geschichte* is linked to the present by having an affective presence and therefore an inherent nonlinearity.

What clearly happened for the students studying under Nyrop, Holm and Kampmann was that the historic became meaningful in a new way. It became part of a narrative of Danish culture and society and a social agenda aimed at creating better environments for the common man. What Nyrop, Holm and Kampmann did in their teachings was not concerned primarily with *Historie*. There were lectures in architectural history like there had always been, but the new approach was the way that students were trained in embodying the historic work through their drawings that put it into a then modern context.

The tool to achieve the affective presence of the old building culture was the faithful drawing of old structures, which gave the students not just knowledge of the history and an attention to detail, but literally a bodily memory of, for instance, proportions. To return to the topic of the *Danish vernacular*, one can hypothesize that the sensation of the drawing of old buildings was lodged in the students so thoroughly that it stayed with them even as they blossomed as architects and got new stylistic ideals. Fisker in 1964 assessed Danish architecture and concluded that in Denmark there might not be as many geniuses as in neighboring Sweden but that the average level of architectural skill was much higher (Fisker 1964). Fisker saw this as a desirable state because he perceived more value in designing the framework of “the good life” than in individual and exceptional masterpieces. The trained sensibility achieved through the measuring exercises more than just being one of the pillars in Danish architectural education was likely the foundation (if we take Fisker's word for it) of the high average quality.

#### **5.0 CONCLUSION**

For most of us, characters like Nyrop and Fisker are but glimmers from a long past architectural reality, so what can we take from these musings to modern day architectural education? Firstly I think the notion of vernacular is beneficial to illustrate the kind of influence teachers have on students: a sort of dialect in their work, a subtle pattern that doesn't interfere with personal style or limit new waves of influence. Like we saw in the case of Nyrop, he had little direct stylistic influence but was very influential in the way individualism and interest for tradition and materials played into the Danish Functionalist Movement.



The case also demonstrates how history was used in the teaching of architecture, not in a descriptive dead way but more akin to Heidegger's notion of *Geschichte*. The use of historic national motives was based on thorough and extensive research, but it came alive and was given an affective presence in the students' work. This happened through the measuring and drawing of old national architecture, which suggests that it was an underlying belief that students could learn something about historic building culture, not by reading about it, but by embodying it through their drawings. It demonstrates the strong link that still exists between the practice of drawing and the cognitive process of understanding and creating architecture.

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## ENDNOTES

<sup>i</sup> English translation of Millech 1954 from Danish is my own.

<sup>ii</sup> All images are from the Danish Art Library Online collection: [www.kunstabib.dk](http://www.kunstabib.dk)

<sup>iii</sup> See for instance *The Oxford Companion to Architecture*, 2009

<sup>iv</sup> The "Europeans" had had the architect Ferdinand Meldahl as a leading figure since the mid 19th century and Meldahl ran the Academy with an iron fist until his retirement in 1905. There has been criticism from some scholars of the terms nationalist and Europeans (Schmidt 2004). Indeed the names may oversimplify the difference between the two factions, but the fact remains that there were two factions at the Academy and in the architectural community and calling them Europeans and nationalists here is purely to mark a distinction between them.

<sup>v</sup> The final assignment was fixed and given by the professors - until 1906 only Meldahl wrote the final assignments.

<sup>vi</sup> Records of the Royal Academy. Protocol for Hovedopgaver (Final Assignments) 22<sup>nd</sup> of January 1907 in The Danish National Archive.

<sup>vii</sup> The system of the esquisse as described by, for instance, Harbeson 2008 meant that students independently drew a sketch at the beginning of an assignment that they then had to adhere to throughout the project. In the Danish system this was not the case. The sketch assignments weren't linked to the main assignment, but were simply just drawings made without guidance in a short space of time – usually 9 hours – and where the students were allowed to hand in drawings in pencil.

# Verbal literacy in the design process: Enthusiasm and reservation

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**Abstract:** This paper inquires into the role of verbal literacy in design processes and the teaching of design.

During the Renaissance, Alberti identified literacy as the point of distinction separating an architect from a builder or craftsman. From the Renaissance through the nineteenth century, the idea of the architect as a liberally educated professional prevailed until Modernism in the twentieth century developed as an avant-garde movement, consciously seeking to negate the past. Experimental methods of teaching at the Bauhaus school in Germany emphasized visual thinking and encouraged disdain for traditional academic practices and values. Instructors from the Bauhaus eventually brought these ideas to the United States where they became firmly rooted during the post-World War II era.

Gradually from the 1950s onward, Bauhaus methods were in turn perceived as stagnant, precipitating a search for new theories. Heuristic methodologies became a popular focus in the effort to re-establish design as a rigorous academic discipline. Around the same time or shortly afterward, an interest developed in the relevance of phenomenology to design, along with associated hermeneutic approaches.

Heuristic and hermeneutic methods depend on verbal literacy, a shared requirement that should unite rather than divide them, but whether the two processes are complementary or opposed is far from clear. Critics of heuristic strategy disparage its techniques as reductive problem-solving, whereas hermeneutics is impugned for being arcane and cultish. Proponents of both sides can be found on most faculties of architecture, but may not be willing to speak to one another.

The arguments of this paper rely on analysis to bring criticism into the open rather than assert a conclusion. My intention is to establish a common ground for discussion based on a better understanding of how design pedagogy relates to verbal literacy.

## 1. The Discovery and Loss of Literacy: From Alberti to the Bauhaus

Writing around 1450, the Renaissance architect Leon Battista Alberti was anxious to distance his profession from the social ranks of builders and crafts-people. In order to achieve this goal, he invoked the criterion of literacy:

The architect should follow the example of those who study letters. For in this field no one will think he has done enough until he has read and studied all the authors; and not just the best ones, but all those who have written anything on the subject (Borsi 1986, 10).<sup>i</sup>

Beyond ambition, Alberti's emphasis on the ability to read was motivated by his recognition of the need to infuse a practical art with formal knowledge. Over the course of the next 500 years, the conviction that literacy would ensure an architect's professional expertise did not survive unaltered, or unchallenged.

The growth of the Industrial Revolution from 1750 onward precipitated the demand for a new kind of professional, educated primarily in mathematics and the physical sciences. This was a development that threatened the architect's authority. Engineers and architects now stood together on contested territory. As the nineteenth century progressed, the architectural profession, seeking to maintain superiority, hardened around the fine arts and accepted a French institution, the *École des Beaux Arts*, as the custodian of architectural education. The continuing encroachments of science exacerbated an intrinsically unstable position prior to the

eruption of modern movements at the turn of the twentieth century. While a seemingly ubiquitous – although not necessarily unified – avant-garde gathered momentum, opposition to traditional education represented by the *École* coalesced around the *Bauhaus*, a German school that had evolved through efforts to unite industrial design and fine art. Walter Gropius, who had been chosen as the founder and director of the new school at the end of World War I, publicly stated his belief that “There is no essential difference between the artist and the craftsman” (Whitman 1993, 38).<sup>ii</sup> Gropius thus distinguished the Bauhaus from the *École des Beaux Arts* while retaining the Bauhaus’ identity as a school of art and, not incidentally, rejecting Alberti’s notion of the architect’s superiority over the artisan-laborer based on a traditional understanding of literacy and education.

Gropius served as director of the Bauhaus until 1928. He left Germany in 1934, a year after Hitler’s National Socialist (Nazi) Party forced the school’s closing. Traveling to the United States in 1937, Gropius was invited to teach at Harvard University, where he eventually became the head of architecture and succeeded in installing an American version of Bauhaus methods and philosophy.

Gropius’ new agenda challenged the established hegemony of architecture schools in the United States. Most had been founded during the late nineteenth and early twentieth centuries and were modeled on the *École des Beaux Arts*. The leadership from Harvard was considered innovative and advanced despite emerging defects. Success in Germany had hinged on energy materializing across a coalition of activities focused on industrial design, but these conditions were not replicated at Harvard. Bauhaus methodologies in isolation could not generate scholarship, inquiry, or development. In essence an art school without an academic connection to the fine arts, the Bauhaus had always been intrinsically anti-intellectual.

## 2. Recovering Literacy: Three Models

### 2.1 Slutsky, Rowe, Hoesli, Hejduk – Developing an Argument

By the time Gropius’ tenure at Harvard ended in 1952, architectural education throughout the United States had evolved into an amalgamation of “modern” Bauhaus teachings, traditional Beaux-Arts beliefs, and regional loyalties.<sup>iii</sup> The Bauhaus’ suspicion of the past led to a relentless demand for innovation, rendering novelty an end in itself. Absent a theoretical foundation, the emphasis on creativity could not be sustained, and the focus shifted to appearance (Herdeg 1983). Ideas about substituting visual thinking for language spoken in words supported this trend, and the Bauhaus-inspired curriculum became correspondingly word-free. Dissatisfaction with this state of affairs surfaced unexpectedly within a group of newly hired faculty members who arrived at the University of Texas in Austin during the mid-1950s. The main participants – Bernhard Hoesli, Colin Rowe, John Hedjuk, and Robert Slutsky – targeted the *École* and the Bauhaus simultaneously with a plan for resistance and change, but contracts were terminated, and their plan failed.<sup>iv</sup>

During 1955-56, the year before they left Texas, Robert Slutsky and Colin Rowe had worked together on an argument about the relationship between painting and architecture. John Hedjuk and Bernhard Hoesli were also involved on a more casual, collegial basis. Slutsky and Rowe transcribed a summary of their conversations but did not publish a written account until several years later, when the essay appeared under the title “Transparency: Literal and Phenomenal” (Rowe-Slutsky 1963). A number of factors relative to this endeavor are worth noting – among them, the diversity of the participants. Slutsky was a painter, hired to teach representational techniques at UT Austin. His interest in the theory underlying transformations in painting during the early twentieth century led him to engage Rowe. An art historian, Rowe was skillful in developing arguments and relating words to visual references. Hoesli and Hejduk, as architects and design teachers, were knowledgeable interlocutors. The use of words and theoretical analysis that drew the participants together was alien to the Bauhaus approach. In the process of attacking Gropius and the Bauhaus, Slutsky and Rowe discovered a European architect whose work demonstrated theoretical principles that could serve as a foil to Gropius’ shortcomings, and they proceeded to recommend Le Corbusier to American educators and students as an alternative model, worthy of study.

All four men eventually found academic work in other, dispersed venues where they remained dedicated to the idea of transforming architectural education – Slutsky and Hedjuk at Cooper

Union, Rowe at Cornell, Hoesli at ETH Zurich (Carragone 1995). In addition to its intrinsic value, the “Transparency” essay served to document the original work and identity of the group. The essay modeled a methodology for architectural study that was simultaneously traditional and new. The underlying structure of the argument revealed that artistic theory in painting was compatible with an avant-garde position and suggested that the same might be possible for architecture. Principally analytical, the entire operation foregrounded the advantages of re-investing in scholarship and re-established the potential relevance of literacy in architectural education.

## 2.2 Heuristic Reasoning

In retrospect, the publication date of the Rowe-Slutsky essay in Yale University’s student-edited journal *Perspecta* appears to mark a turning point: written works tapping into the notion of architectural theory in relationship to historical analysis began to proliferate from the mid-1960s onward. Christian Norberg-Schulz completed his first book in English, *Intentions in Architecture*, in 1965. The following year, Aldo Rossi published *L’architettura della città* in Italy, and Robert Venturi produced *Complexity and Contradiction in Architecture* in the United States. Edmund Bacon’s *Design of Cities* first appeared in 1967. These authors had all been educated as architects and were practicing designers or design teachers.

Although awareness of architectural theory increased during the late 1960s throughout the 1970s, and the teaching of design shifted along with it, academic culture was slow to reflect on this transformation. Analytic studies could yield a certain kind of knowledge, which was deemed valuable, but design is a creative process, and theoretical study related to creative aspects of design proved more challenging. An effort to explain the process of design and its methodology materialized in 1982 with an article by Peter G. Rowe in the *Journal of Architectural Education*, “A Priori Knowledge and Heuristic Reasoning in Architectural Design” (Peter Rowe 1982). At the time, Rowe was Director of the School of Architecture at Rice University in Houston. He subsequently transitioned from Rice to Harvard where his initial formulations expanded into a book, *Design Thinking* (Peter Rowe 1987). Rowe became Dean of Harvard’s Faculty of Design in 1992.

The term heuristic refers to a concept or rule that can be adopted and used to direct experimental behavior. Contemporary understanding of the phrase “heuristic reasoning” derives from the work of George Polya, a Hungarian mathematician who began teaching at Stanford University in 1940. His study of problem solving was first presented as a mathematical method in *How to Solve It*. Originally published in 1945, the book went into several printings; it has become broadly known and proven influential across a number of disciplines (Polya [1945 and 1957] 1973 and 1985).

Through historical references and by observing students in the design studio, Peter Rowe was able to identify and categorize design strategies and persuasively argue that the logical processes they contain fit Polya’s model. The book *Design Thinking* was reviewed by the architect Michael Rubin for the *Journal of Architectural Education* in Spring 1990. Rubin did not stint on enthusiasm or praise for Rowe’s study:

Rowe has presented the architectural community, and hopefully a wider audience, with...a radically alternative way of understanding the activity of design as a mode of inquiry and a re-appreciation of architectural production as a way of human knowing. (Rubin 1990, 45)

In reality, Rowe’s argument was largely based on observation and description – and, in that sense, not new. The methodology that Rowe outlined was further contingent on the validity of transposing a method intended to solve mathematical problems into the realm of design.

A heuristic investigation requires a concept or rule to launch the process. Selection depends on the ability to retrieve and analyze prior knowledge (hence, Rowe’s use of the term *a priori*) and is axiomatic. Architectural concepts and rules tend to be acquired in one of two ways – through study and analysis of precedent or by applying technical knowledge to the problem. Forming a heuristic proposition necessarily entails a verbal expression, even when visual imagery serves as a vehicle for description and analysis. Examples range broadly but are

familiar to most designers: preserving or enhancing an environmental feature such as a lake or river, projecting the ease or intensity of social interaction, referencing a “pattern language”, experimentation with proportions based on the golden mean, bio-mimicry that translates the shell of a crab into the structure of a roof, and so on (Peter Rowe 1982 and 1987).

After a concept or rule has been selected, it must be tested. For architectural designers, this is the point where verbal expression yields to traditional strategies of visualization and representation. When the testing phase reaches closure, evaluation follows, and words resume their relevance. Evaluation may lead to a reformulation of the original concept or rule. Its abandonment and replacement with an entirely different rule or concept is also possible. In either case, a new cycle begins, further shaping the problem’s solution. The ending point for these iterations is not specified in Rowe’s scheme, but the assumption is that a solution to the problem continues to form up to the point that its evaluation is deemed satisfactory.

Designers who are engaged in a heuristic process must submit the result of their experimentation to evaluation – both intermediate and final. This is often the point at which the validity of the underlying strategy fails: the method is prone to exalt the value of reasoning and logic in a way that leads designers to lose sight of the vulnerability of assumptions embedded in the process. To the extent that logic dominates this model, it can become overbearingly verbal. A persistent criticism is that heuristic techniques detract from the primacy of representational processes – drawing, model-making, and other forms of visual thinking.

The authority of Rowe’s approach to heuristics stems from his own experience as a designer and design teacher. Heuristic routines are common in design teaching, and the techniques he describes are correspondingly familiar to those who share Rowe’s background. The prevalence of heuristic approaches to design suggest the importance of understanding them, along with their deficiencies. Rowe’s particular contribution resides in the way in which he codified these operations, opening them to scrutiny and discussion.

Heuristic methodology emulates the history-theory model that precedes it to the extent that both rely on analytic reasoning. The main distinction derives from a concern that retrospective aspects of historical analysis must project forward to accommodate the creative process. Ironically, what makes this possible – the introduction of a framework for problem solving – presents a new set of complications. The mathematical problems that Polya conceptualized were intended to yield a solution that could be identified as correct, but a single correct solution is not possible in design. When applied to creative processes, heuristic techniques are liable to produce results that correspond to a reasoned explanation even though they may be faulty or inadequate, giving rise to the complaint that heuristic strategies are deterministic and potentially reductive. Rowe recognized this difficulty and referred to Horst Rittel’s concept of “ill-defined” problems to adjust his position (Peter Rowe 1987, 40-41). Although interest in developing the concept of “wicked problems” continues to evolve, the topic remains open to debate (Buchanan 1992).

### **2.3 Reflective Conversation and Interpretation through Hermeneutics**

Shortly after Peter Rowe’s original paper on heuristic reasoning appeared in the *Journal of Architectural Education*, Donald Schön published *The Reflective Practitioner: How Professionals Think in Action*. In a pivotal chapter, “Design as a Reflective Conversation with the Situation”, Schön reviews data he has collected in the process of observing an architectural design studio over an extended period of time. Although the locations differ – Rowe was at Rice in Houston and Schön at MIT in Cambridge – similarities between Rowe’s and Schön’s case studies are striking. Schön’s description reveals a relationship between instructor and student in which the instructor directs the student toward preferred rules – and even outcomes – that suggest the two are working within a heuristic universe. But Schön shifts away from the idea of deploying *a priori* knowledge and focuses instead on the behavior of the designer. He is struck by the realization that the designer enters into “a conversation with the materials of a situation”, observing that “the situation ‘talks back’ “ (Schön 1983, 78). Schön concludes, “In a good process of design, this conversation with the situation is reflective” (Schön 1983, 79). Summarizing the case study leads Schön to another insight: “Drawing and talking are parallel ways of designing, and together make up...the *language of designing*” (Schön 1983, 80).

By the time Rowe succeeded in expanding his seminal ideas in *Design Thinking* (Rowe 1987), Schön's publication of *The Reflective Practitioner* had already reached a wide audience. Although both men had based their investigations on a study of design education in an architectural setting, Schön was the first to draw attention to design as an inclusive discipline, a manner of thought and action, extending beyond the boundaries of architecture. Schön's relative disinterest in design as systemic logic compared to his fascination with the designer as a actor and participant proved timely in another way. Compared to Rowe, Schön was better able to connect to a broader sequence of events unfolding within the reaches of design theory – in particular, an appreciation for the role of hermeneutic methodology in design practice.

Although the origin of hermeneutics dates to Ancient Greek philosophy, our current grasp of the theory and its methods derives from the efforts of German scholars, Friedrich Schleiermacher and Wilhelm Dilthey, working within the climate of Romanticism and Idealism that succeeded the Enlightenment. During the early years of the nineteenth century, hermeneutics focused on the interpretation of difficult or obscure texts, both religious and secular. As the century progressed, the scope expanded to include history and related social sciences. Traditional hermeneutic methodology required the perception or initial projection of a whole, however incomplete, followed by identification of its contributing parts. The parts and the whole were then placed into a reciprocating dialogue with each other, creating a "hermeneutic circle". As the dialogue developed in complexity and depth, a corresponding knowledge of the whole and its parts would simultaneously take shape.

With the arrival of the twentieth century hermeneutics became associated with phenomenology and broadened to encompass works of art, but developments in hermeneutics were slow to reach American audiences due, in part, to the difficulty of obtaining English translations of scholarship formed in other languages. Of particular importance was Hans-George Gadamer's essential text, *Truth and Method*. Although the book was published in Germany in 1960, errors in the first English translation (1989) were not corrected until a new, authoritative English edition was issued in 1994 (Gadamer [1960] 1994).

During the 1990s, architectural scholars and educators were drawn to Gadamer in part because his philosophical arguments provided a context and an explanation for what they were already doing. Gadamer expanded the nineteenth century concept of dialogue, which had always been central to the hermeneutic process, transforming a common understanding of conversation into a theoretical construct that emphasizes elements such as engagement, alternating roles of listening and speaking, flexibility, and openness to change. His pursuit of theoretical studies pertaining to structured play led to the recognition that the dialogic model could extend to include multiple players, not all of whom needed to speak a verbal language (Gadamer 1986 and 1994). This position is strikingly consistent with Schön's conclusion that that drawing and talking in tandem constitute the "language of designing" (Schön 1983, 80).

Writing in 1992, John Hejduk described the manner in which Robert Slutsky and Colin Rowe worked out the complex arguments of "Transparency, Literal and Phenomenal" with assistance from himself and Bernhard Hoesli. Hejduk's account documents the actuality of a hermeneutic dialogue as the source of the essay and supplies persuasive evidence for the effectiveness of hermeneutic methodology:

...Bob was the main source and inspiration for the deep understanding of Cubism and its relation to the architectural vision. I sat in many an evening and night in Austin's heat and listened to Colin's and Bob's seminal dialogue. Colin learned more about Cubism through Bob's visions of its profound order and space. Slutsky was the prime mover and generator of thought in that realm. Also it was he who engaged Bernhard on the *Gestalt* ramifications. (Caragonne 1995: 164, n18)<sup>y</sup>

Transitioning from a philosophy of interpretation to the physical production of something designed requires more than trust in the dialogic capacity of words or a conversation between words and images. To the extent that interpretive methods, like analytic strategies, are retrospective, they appear incompatible with the activity of design, which by definition must look forward. Relative to hermeneutics, response to this concern resides within the discipline of

phenomenology. A phenomenological position might, for example, argue that meaningful design reveals the true nature of a situation, which may be uncovered through discourse that is formed by a hermeneutic process. Adrian Snodgrass and Richard Coyne have addressed the issue in *Interpretation in Architecture, Design as a Way of Thinking* (Snodgrass and Coyne 2006). Marcus Jahnke has more recently suggested that the work of Paul Ricoeur sheds light on this topic (Ricoeur 1991; Jahnke 2012).

For Gadamer, a conversation cannot reach closure as understanding unless the voices of the participants are articulated and heard as equals (Gadamer 1994). Schön appears to agree with Gadamer when he identifies design as a “reflective conversation” with a “situation” that is capable of “talking back” (Schön 1983, 78). Both Gadamer and Schön ascribe independence to the thing being designed. The designer, although he or she is the maker, is not in complete control, but must enter into a relationship with the design that allows for autonomy on both sides. This equality may be perceived as inherently faulty, particularly when it translates to educational settings and the relationship between a student and instructor.

### 3. Verbal Literacy in Relationship to Architectural Processes

Amalgamations can be treacherous and should be approached with care. Each of the models presented in this paper requires further, independent study. A commonality that does emerge is the dependence of the design process on language that is spoken. Literacy, by contrast, is normally defined as the ability to read and write. The consequences of foregrounding language in its spoken, as opposed to written, form are not necessarily obvious and need to be more openly discussed. Emphasis on spoken communication – whether as conversation or presentation – does not release architectural designers from an obligation to read or write, but may affect the way in which those abilities are learned and practiced.

All the models presented in this paper rely on verbal literacy, but they do so in different ways. Even when the final goal may be a written document – as is often the case in the realm of history or theory – arguments develop through the ability to “hear” more than one side of an issue. Heuristic strategies may be prone to soliloquy, but the dominant modality for hermeneutics is conversation. The methodology implicit in conversation serves to reconcile visualization with language and promotes complex understanding. Verbal literacy itself is not a theory, or an encompassing solution, but it is integral to the act of designing.

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## ENDNOTES

<sup>i</sup> *De re aedificatoria* was published posthumously (after 1472) although it was most likely completed prior to 1452; Borsi (1986) is quoting from the 1966 Milan edition which combined the Latin text with a new Italian translation, *L'Architettura*, Book IX, chap. X, 854-56.

<sup>ii</sup> Whitman, 38-41, reproduces the *Manifesto and Programme of the Bauhaus*, written by Walter Gropius at Weimar in April 1919, in its entirety.

<sup>iii</sup> Caragonne (1995) makes this claim for the University of Texas at Austin, but a similar situation prevailed in most, if not all, American schools.

<sup>iv</sup> Slutsky, Rowe, and Hejduk left at the end of the 1956 academic year. Hoesli's contract was renewed, and he remained until 1958.

<sup>v</sup> Caragonne (1995) is quoting a letter he received from John Hejduk in May 1992. The quotation appears in a sidenote to the text.



# GIS for Architects: Exploring the Potentials of Incorporating GIS in Architecture Curriculum

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**ABSTRACT:** Geographic Information System (GIS) has significant potentials to contribute in contemporary architecture education. GIS techniques are increasingly used in both realms of research and practice; especially in the fields which deal with spatial concerns, like geography, earth and mineral sciences, landscape architecture, etc. Unfortunately, GIS is yet to be conceived as an important content in the global trends of architecture education. Very few schools have incorporated GIS in their curriculums and the conceptual connection between architecture and GIS is yet to be explored.

In light of their experiences of developing a graduate GIS course for an architecture school, authors of this paper discuss a feasible way of incorporating GIS contents in the architecture education system. The course is intended to provide students with a foundation for reading, understanding and using basic GIS techniques which are relevant to architectural research and/or practice. Main objective of the paper, however, is to establish a bridge between the two conceptual realms - architecture education and GIS. It is understandable that without defining the conceptual connections between GIS and Architecture, the intended course cannot fully achieve its goals. This paper tries to deal with this challenge by defining the course objectives that address the needs of GIS for an architect.

The field of architecture, both in terms of practice and research, may be benefited by GIS. In the changed context of emerging practice and thinking in architecture, GIS has the potential to contribute in the restructured knowledge and praxis taken in the re-disciplining of architecture education. A fully dedicated GIS course for architects can be an important step towards this re-disciplining process.

**KEYWORDS:** GIS, architecture education, curriculum development, course objectives

## 1.0 INTRODUCTION

Is GIS relevant for architects? Why do architects need to learn GIS? While briefing the history of *Geodesign*, author William R. Miller retold the famous story of Frank Lloyd Wright's designing of the Fallingwater (Miller 2012). Wright completed the entire design concept, including floors plans, elevations, sections, and a quick perspective within just three hours; the time Edgar Kaufmann Sr. (the client) was on his way to Wright's studio near Spring Green, Wisconsin (Toker 2005). Wright had the site's geography and its rich layers fully in mind while he was doing the design, giving consideration to topography, the location of the stream and waterfall, the placement of boulders that provided the foundation for the house, views to and from the house, and site-related environmental conditions such as the use of solar access for heating the house in the winter and cold air flow along the stream for cooling the house in the summer (Miller 2012). As the masterful architect dealt with so many layers of geographic information simultaneously, Miller (2012) finds it to be similar to the processes of GIS based design or *Geodesign*. Transparency is an inevitable part of architects' drawing sheets which enables them to envision the complex layers of existing site features while laying out the new designs. This phenomenon is almost similar to the principal concept of GIS known as graphical overlay technique. It is not surprising that many of the pioneers behind the conceptual development of GIS are either architects or landscape architects.

Today, GIS is not just about the topography or land-use patterns. It offers a dynamic way of representing unseen patterns of socio-cultural, socio-economic, behavioral or demographic data and their contextual relationships across a regional area. As mentioned by Nicholas de Monchaux, an architect, urbanist, and professor at the University of California, Berkeley, the modern world is moving from a place where it was hard to find information to where we are flooded with place based data (Zeiger 2010). Spatial data are increasingly being available over internet and they are often free or very low in cost. In this present context of data availability, GIS offers architect so much more than just base maps or site diagrams. It allows architects to make informed decisions based on real world data. GIS enables architects to answer complicated questions like 'How can we use our buildings more effectively?' or 'Does a building need to be built at all?' It is now inevitable that GIS technology, long relied on by planners, is making its inroads into architecture.

### **1.1. Why GIS for Architects?**

It is a matter of great significance how architects respond to this changed context of data availability and increasing popularity of GIS based analyses and techniques. GIS has many potential uses in architectural research and practice, especially in the areas of urban design, community planning, and the site selection processes. At the high end, GIS techniques are used in cutting edge designs by architects in visionary projects like the planned city of Masdar in Abu Dhabi which is driven by solar and renewable energy and is totally sustainable—zero carbon, zero waste (Zeiger 2010). GIS can also be used in conjunction with other visualization tools, such as AutoCAD, Google Earth, Adobe Illustrator, and Google Sketchup, to create dynamic and complex models. The benefit of GIS lies in its analytical capabilities, wherein multiple phenomena can be linked by location and viewed through a spatial lense. Information on an area's geology, soil type, infrastructure, and demographic information, for example, can all be taken into consideration when planning a structure or selecting a site (Moore 2013). However, in both realms of practice and research, architects adopting GIS techniques are still a rarity.

Architecture curricula need to respond to this growing need of GIS education for architects. Developing new GIS courses in architecture is a need of the time.

### **1.2. Present Trend of GIS Education in Architecture: Understanding the Challenges**

GIS is conceived to be an important content, but it is still not treated as an integral part of the Architecture curriculum. There is little or no GIS content in most of the architecture programs all around the world. Even programs which incorporated GIS in their curriculum often show lack of enthusiasm to establish the conceptual connection between GIS and architecture.

The following four challenges are identified as reasons of the present trends of reluctances and lack of enthusiasms to incorporate more GIS contents in architecture education.

- a. Architects intuitive nature: Architects are often intuitive but their decision making processes are not always based on data. One of the biggest challenges of adopting GIS into architecture is getting architects to think about data as part of a creative decision-making process and to translate geospatial analysis into built form (Zeiger 2010).
- b. Lack of interdisciplinary research in architecture: The prime characteristic of GIS enquiries is their interdisciplinary nature. GIS has the capacity to reveal spatial patterns of not only geographic data, but also demographic, socio-cultural, socio-economic, criminological or even behavioral data. This interdisciplinary notion in research is often absent in architecture research. Instead of collaborating only with technical schools of engineering and construction, Architecture Education should also look forward to interdisciplinary research with relevant other disciplines like sociology, psychology, behavioral studies etc.
- c. Dominance of technical research in GIS: Architecture alone should not be held responsible for the lack of GIS based contents in its curriculum. GIS is dominated by technical research and by uncritical accounts of application. The available literature is

not only limited in extend, but also biased towards the implementation of GIS, rather than the effects of its use on the host organization (Craglia 1992).

- d. Failure to understand the conceptual connections between GIS and Architecture: GIS contents should not be just dumped into the intense curriculum of architecture. Like any other interdisciplinary course, the needs of GIS for an architect must be realized and this realization should be reflected in the course design. Course objectives and assignments should be formulated accordingly to articulate architectural design or research problems through GIS. GIS course contents should be grounded in the needs of an architect. Otherwise, the course would never acquire its mission of producing data awareness among students of architecture.

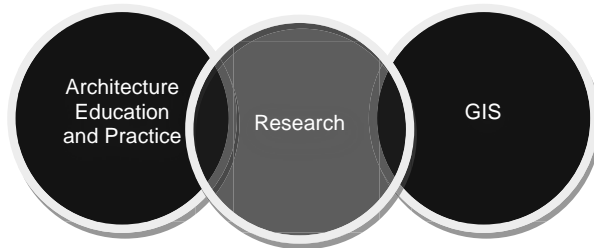
**2.0 CONCEPTUAL FRAMEWORK**

It is essential to establish conceptual connections between GIS and Architecture Education. This process can simply start by looking into the broad definitions of the two domains. Table 1 contains the broad definitions of Architecture (Merriam-Webster 2013) and GIS (ESRI 2013). The primary difference stated is that, architecture is a design process while GIS is a way of analyses.

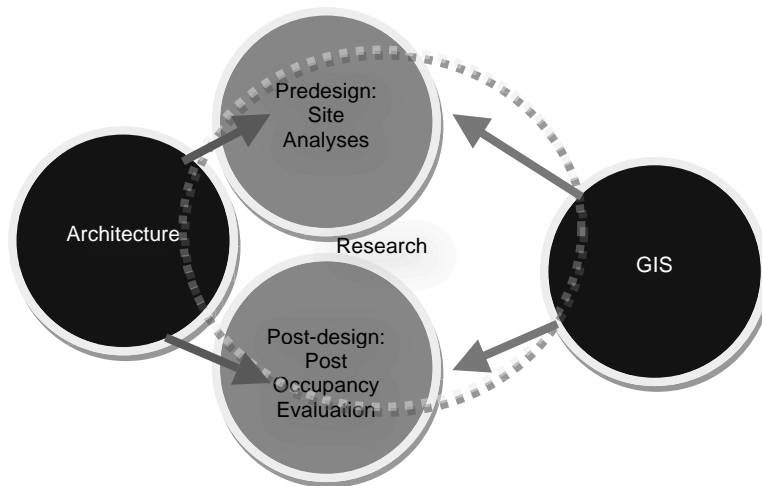
**Table 1:** Definition of Architecture and GIS

Architecture	GIS
1. The art and science of building, <i>specifically</i> : the art or practice of designing and building structures and especially habitable ones	A geographic information system (GIS) integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information.

**Conceptual Level**



**Operational Level**



**Figure 1:** Research is a critical domain to connect GIS and Architecture Education

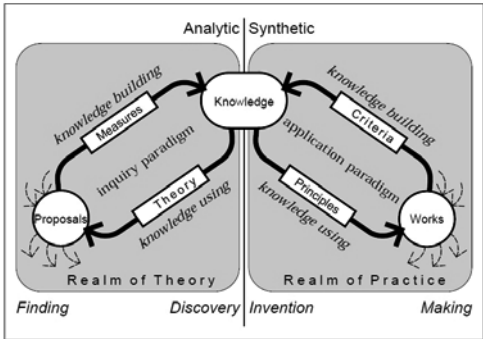
In the conceptual level, a third domain *Research* is introduced to integrate GIS in the process of Architecture. The scope of research in the pre-design phase and post-design phase can be benefited by adopting GIS techniques. For example, GIS can provide rich and holistic analyses of a site or can be used to identify the most efficient site location/s of a proposed building in an urban landscape. Similarly, GIS techniques can also be used in the post occupancy evaluation/research of a building or a city. For example, GIS based behavioral mapping of a designed environment can predict users' preferences and guide/evaluate design decisions. It should be kept in mind that GIS is not a tool for designing, rather a collective way of analyzing and recording spatial data. Research is the holistic framework to integrate GIS in the process of architecture education and practices.

**3.0 THEORETICAL PERSPECTIVES**

Three different theoretical perspectives are revisited which are closely related to architecture/design. It is assumed that these theoretical perspectives have potential contents to merge GIS and Architecture studies and will exemplify the process of conceptualization. It should be kept in mind that there may be many more different theoretical perspectives in architecture and other disciplines, which can be successfully used to constitute the relationships between these two spheres of knowledge.

**3.1. Owen's Design-Research Paradigm**

Since architecture is a process of design, and research in architecture is considered as the key of incorporating GIS contents in Architecture education, Owen's diagram (Figure 1) on design research (Owen 1998) can be revisited to understand the reciprocity of the two realm of research and practice in the fields of design. In a series of flow diagrams, Owen showed how *Design Research* and *Design Practice* interplay in one continuous process of knowledge making.



**Figure 2:** The continuous process research and practice in design (Owen 1998)

This theoretical perspective with illustrated design-research continuum can be a useful starting point for designing a GIS course for architects. This diagram can be modified or even extended to provide a broad theoretical perspective for the proposed course of GIS for architects.

**3.2. Roger Barker's Theory of Behavioral Settings and Behavioral Mapping**

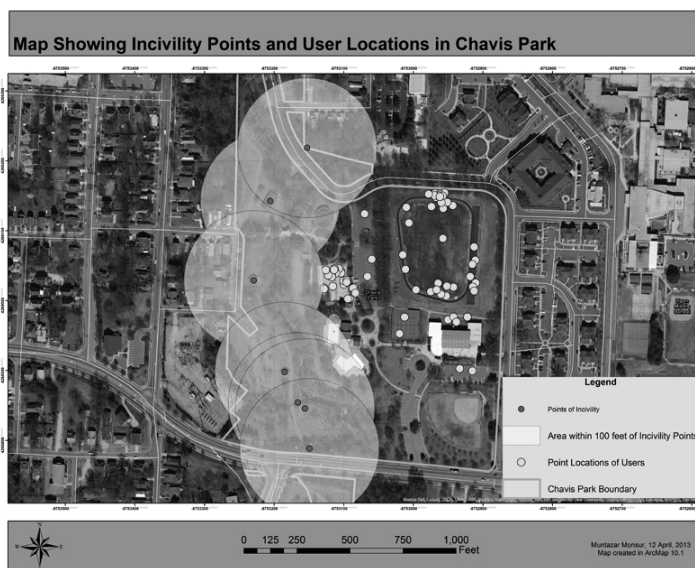
Behavior setting has been applied for decades as a useful construct in environment-behavior research. Behavior settings are ecological units where the physical environment and the behavior are indissolubly connected. These eco-behavioral units were first described by Barker (1976). Behavior settings have a clear structure: they are located in time and space, they are composed of entities and events (people, objects, and behavior) and other processes (sound, shade, etc.), their spatial and temporal boundaries are identifiable. The most significant characteristic feature of this concept is that, it offers researchers to study the reciprocal relationship between environment and behavior.

The method that is most comprehensively aligned with the concept of behavioral setting is known to be Behavioral Mapping. It allows a researcher to measure or evaluate a physical environment in terms of activities and behavior. This concept can be very useful for formulating course contents and assignments for the proposed GIS course for architects. GIS based behavioral mapping has the capacity of evaluating a designed environment in terms of contextual behavior. This method can be used for post occupancy evaluation/research in architecture by using GIS based strategies.

### 3.3. Defensible Space

The central tenet of Newman's defensible space is that the physical design and layout of urban living environments are a principal factor that determines why some places are more vulnerable to crime than others (Newman 1972). With this principle, the crime–design thesis offered an exclusive selling-point, because it emphasized the fact that the built environment is more easily manipulable than the sociological context, making it a potentially more fruitful angle from which to tackle crime prevention at place (Reynald and Elffers 2009). Newman's defensible space concept refers to the systematic way in which the physical design of urban residential environments can be manipulated in order to create spaces or places that are less vulnerable to crime by providing residents with more opportunities to control their space and defend it if necessary. To the authors' understanding, this concept has a lot to offer for the proposed course design because it explores the relationship between designed environment and human behavior.

In spite of its durable contribution and continuing influence in the field of criminology, Newman's theory has been criticized as extensively as it has been influential (Reynald and Elffers 2009). Newman's defensible space is often criticized to be merely a 'fashionable consensus' rather than a set of empirically robust concepts that effectively prevent crime. GIS based research in architecture can counter these criticisms by providing empirical evidences of relationship between designed environment and real crime data. Figure 3 illustrates a similar research conducted by one of the author where signs of incivility were plotted to understand their relationships with the usage pattern of visitors in a recreational park in Raleigh, North Carolina.



**Figure 3:** Author's study of mapping incivility points in a recreational park to understand how signs of incivility are related to the usage pattern of the park area

#### **4.0 THE COURSE IN A NUTSHELL: GIS FOR ARCHITECTS**

The conceptual framework of the study and the different theoretical perspectives discussed above provides the ground work for constituting a GIS course for architects which will attempt to connect the two different conceptual spheres of architecture education and GIS.

##### **4.1. Course Description**

The course introduces the basic concepts and techniques of GIS (Geographic Information System) to architecture students. It is intended to provide students with a foundation for reading, understanding and using basic GIS techniques which are relevant to architectural research. The course will be conducted in two basic segments. In the *Theoretical* segment, students will explore the principles of GIS - what it means, how it is linked to design research and its potential usage in the contemporary world to conduct spatial investigations. In the *Application* segment, students will be assigned with small GIS based research tasks which would require them to use single or multiple strategies based on the complexity of the given problems. Learning from both the theoretical and application segments will be incorporated in a final project where students will be asked to generate their own architectural research questions and demonstrate GIS skills for collecting and analyzing data to answer their questions. Course readings cover major GIS concepts and techniques and present samples of recent articles from major journals and dissertation theses which used GIS techniques to answer architectural research questions.

##### **4.2. Course Objectives**

By the end of the course students will

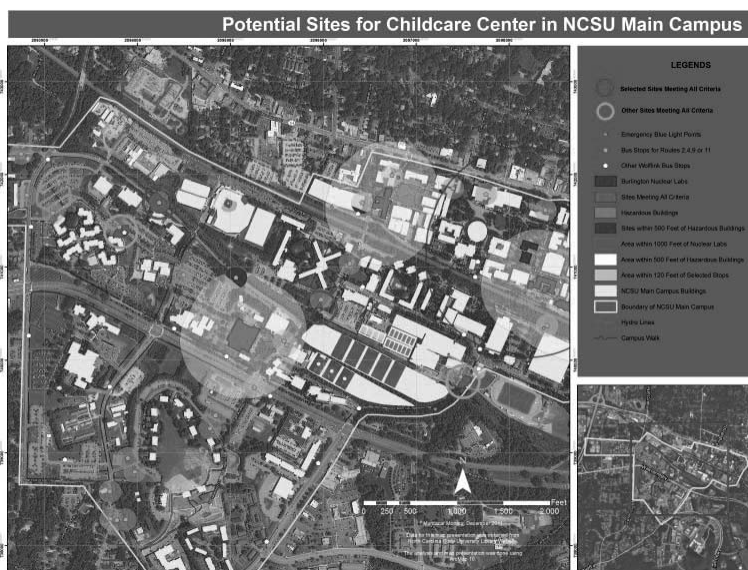
1. Be acquired with a knowledge base on the broad range of GIS principles and applications in the domain of architectural research.
2. Obtain an ability to choose the appropriate strategy/strategies from the wide range of GIS techniques and apply them to answer specific architectural research question/s.
3. Demonstrate their understanding on how GIS can be effectively used to answer research questions in architecture.
4. Acquire an ability to transform a spatial research investigation into an effective research design, ranging from data collection to data analyses by using appropriate GIS techniques.
5. Be able to use common terminology in discussions of various GIS based strategies relevant to architectural research and practice.

##### **4.4. Three Conceptual Assignments for the Course**

Once the course objectives are defined, the next step is to formulate thematic research problems (in architecture) which can be answered by GIS techniques. Three conceptual problems are described below which can be refined and adopted as assignments for the proposed course. These problems represent only a few examples of GIS based tasks which may relate to architectural problems. It should be kept in mind that there can be a thousand different assignments similar to these. The most important thing to keep in mind for designing assignments for the proposed course is to ground GIS based techniques to architecture oriented problems or questions.

#### 4.4.1 Site Analysis

Instead of a mere thematic site analysis, students may be asked to perform a comprehensive site selection process which involves critical geographic and other conditions.

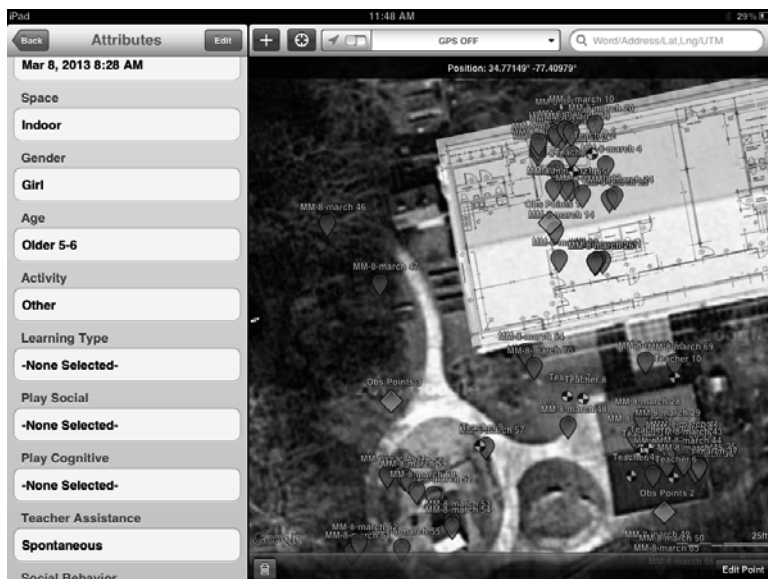


**Figure 4:** A critical site selection process with multiple complex conditions (Author)

For example, in Figure 4, the map shows a complex site selection process for a childcare center in the main campus area of North Carolina State University (author). Teachers may provide students with imaginary or real life conditions for the selection of the most suitable site/s, for example – the sites cannot be within 500 feet of any hazardous building, or they should be in proximity (walking distances) of any campus bus stop. When teachers introduce multiple and complex conditions like these, it will require the students to explore the potentials of data interpretation to answer geographic questions. Instead of merely drawing a base map, students will get an essence of real world complexities of site selection and site analyses.

#### 4.4.2 Behavioral Mapping for Post Occupancy Evaluation

Behavior mapping is an objective method of observing behavior and associated built environment components and attributes. It provides researchers with an innovative method of assessing behavior linked to detailed physical characteristics of indoor and outdoor areas (Cosco, Moore, and Islam 2010).



**Figure 5:** Behavioral Mapping can predict behavioral variation linked to designed environment (Author)

Traditionally, behavioral mapping has two distinct parts – *mapping* allows a researcher to map the point location of the subject on a base map and *coding* records all the attributes of the subject. The *coding* part is flexible and designed as per the direction of the research question. However, with latest advent technologies, mapping and coding can be done simultaneously in touch sensitive electronic devices (Figure 5). Teachers may formulate an assignment in which students will gather behavioral mapping data in a designed environment and present their predictions about the design in GIS maps based on usage patterns.

#### 4.4.3 Testing Defensible Space Theory by Crime Data

As discussed in 3.3, assignments can be formulated in which students will select a manageable land parcel in an urban environment and evaluate the physical design in terms of Newman’s three characteristics of *defensible space* – territoriality, natural surveillance and image/milieu. Later students will plot real crime data to test defensible space theory with empirical evidences.

## 5.0 CONCLUSION

This paper merely attempts to identify the vast possibilities of intelligent course design which would emphasize GIS contents in architectural education. It tries to draw attention to the fact that innovative approaches can be applied to establish conceptual connections between GIS and architecture which would result in meaningful course content that would establish strong ground for GIS based education and research in the domain of architecture.

The field of architecture, both in terms of practice and research, may be heavily benefited by GIS. This paper tries to introduce the construction of a knowledge base on the broad range of GIS principles and applications in the domain of architectural research. It may contribute as an eye opener towards a discussion which is crucial in the reform and restructuring of architectural education in the changed context of thinking and practice. Architecture education has long been criticized for not having enough research contents in its curriculum. New courses should be developed to address this lacking. Incorporating GIS courses may contribute towards the structuring of a new genre in architectural research.



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# Including Film Analysis to Investigate History of Architecture

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**ABSTRACT:** This paper describes a historical research on architecture and city design based on film analysis, and suggests that cinema, as the most influential form of popular culture during the first-half of the twentieth century, provides a critical insight into the cultural impact of both modernism and industrialization in America and Britain. This research also illuminates how dominant discourses of spaces, rooted in old cultural traditions that condemn the metropolis and celebrate the countryside, were systematically distributed through American and British films produced in the 1930s-60s. This study also suggests that commercial films use modernist spaces to portray places of work and productivity, and modernist buildings to represent the twentieth century's image of the poor, but rarely as houses of "healthy" families. For the contrary, American and British films represent domestic spaces as cozy houses, recalling a traditional architectural style of small villages inherited from past centuries. This apparent discrepancy between the discourse of design disseminated by design intellectuals, and the discourse promoted by films, illuminates on the one hand how popular culture contributed to the misconception of the Modern movement in architecture; and on the other hand how the notion of community was systematically associated with low-dense neighborhoods and suburbs close to the countryside, and never with metropolitan spaces, dense public spaces and multistoried buildings.

**KEYWORDS:** Historical research, industrial city, cinematic spaces, popular culture, dominant discourses.

## 1.0 THE GREEN IDEAL: A DOMINANT DISCOURSE FOR URBAN SOLUTIONS

In the context of industrial cities at the beginning of the twentieth century, the "green" assumptions and the idea of open space, sun light, fresh air and parks for the urban masses, seemed to be the best response to crowding into slums of working classes. Put in a very simplistic way, the green argument was used to promote the two main urban solutions developed in the first-half of the twentieth century: the Garden City, and the suburban developments inspired in this model; and the Radiant City, and the urban developments based on high-dense buildings inspired by the Modern Movement.

In America and Britain, the green ideal was not a new concept. It had been supported by European Enlightenment's intellectuals, such as Voltaire and Adam Smith, romantic poets, a large list of nineteenth century artists, and diverse writers and reformers, who pushed the view of the city as full of vice, risk, and crime, and a disappointment of hopes raised by the Enlightenment project (Schorske 1998, 43-9). The Victorian industrial elite adopted a rural nostalgia particularly reflected in literature, with Thomas Hardy's country books as leading examples (Williams, 1973). The celebration of the rural was also evident in the United States: the flight from the city, the role of the highway as a refuge, the claim of man in nature and the emphasis on rural spaces, had constituted a constant theme from Thomas Jefferson to Frank Lloyd Wright (White and White 1982, 333-43). The metropolis seemed to embody all the miseries of modern life, whereas the countryside became an idyllic hope. From the bucolic *Idylls* of Theocritus written in the first half of the third century BC, or Virgil's *Eclogues*, written between 42 and 39 BC, pastoral has been always depicted as an idealized lush, tranquil and cultivated landscape (Gold and Revill 2004, 90).

The green ideal was also a dominant discourse of space promoted by diverse film genres of American and British cinema. From documentaries produced in the 1930s-40s, family dramas of the 1940s, urban dramas of the 1930s and 50s, crime films of the 1950s, to romantic comedies, American and British films seem to communicate a very clear message: first, the

city is necessary for the economic progress, but it is not an appropriate place to raise a family; second, in the city we can not build a real community; and third, true love, family values, and decent life only can be developed in low-dense neighborhoods close to the countryside. These discourses of the city are the main conclusions of a three-year research, which aimed to identify the most predominant urban models and housing models that appear in American and British films produced in the 1930s-60s.

In terms of methodology, the selection of films included only movies in which urban spaces and domestic spaces play a relevant role within the story. An extensive search of films was required, included reviewing more than 300 films and a final selection of 87 films. The selected films were those (1) that set the action in a city, (2) describe how social life of the characters is influenced by the city space, (3) and films that describe a community, which is organized in urban spaces that influence their communitarian life. The film analysis focused on (A) formal aspects, or what kind of urban models and housing models were placed in front of the camera; (B) film techniques, or what kind of dramatic values expressed by camera angles, editing, illumination, etc., were used to tell the story of the film; and (3) rhetorical practices, meaning how the characters of the story described and experienced the spaces that appear in the film. Based on the analysis of these three aspects, the research suggest that the condemnation of the metropolis and the celebration of low-dense communities close to the countryside were dominant discourses, systematically distributed by most of the studied films.

### 1.1 Community is always close to nature

In 1919, the Garden City and Town Planning Association defined a garden City as a “planned town for industry and healthy living,” surrounded by a belt of rural land, which like the whole land was in “public ownership or held in trust for the community” (Purdom 1921, 34). The Association also pointed out that the limited size “makes possible a full measure of social life” (Ibid). The next year the American architects Clarence Stein and Henry Wright, inspired by Howard’s ideas and the success of Letchworth and Welwyn, created the city of Radburn in New Jersey, promoted by slogans, such as ‘a town planned for the motor age’ and ‘a town for children’ (Girling and Helphand 1994, 59-60). The design included the separation of pedestrian and vehicle traffic, superblocs, each one of 23 acres of commonly held parkland, a hierarchical road system with curved streets and cul-de-sac, and common open spaces.

The image of a small town surrounded by rural land, where boundaries between urban space and countryside are blended in a harmonious communion, is the image used by American and British family dramas in the 1940s. American films, such as *It’s a Wonderful Life*, *Magic Town*, *Our Town* and many others, illustrate how the commercial industry of cinema reiterate the connection between honesty, decency, and especially family, with low-dense neighborhoods, single-family homes, traditional architectonic styles, walkable spaces, Main Street, the church, the school, and the drugstore. All these spaces provide a safe environment to cultivate enduring relationships. In American films, family-centered values are also represented through the emphasis on specific styles of domestic architecture.



Our Town, 1940



kings Row, 1942



It's a Wonderful Life, 1946



The Magic Town, 1947



All That Heaven Allows, 1955

In Hollywood films, the rooms of single-family houses are cozy rather than luxurious spaces. Cedric Gibbons headed the Metro-Goldwyn-Mayer's art department and gained unparalleled recognition as one of the most influential designers during the Golden Age (Wilson 2000, 101). Gibbons was particularly renowned for introducing modern design to Hollywood films, however his use of the term 'modern' does not mean the Modern Movement, but a style inspired on the Art Deco. The domestic interiors created by Gibbons became models that female moviegoers could attempt to reproduce in their own homes (ibid, 110). The country house of the film *The Women* was described in 1942 by the magazine *House Beautiful* as "Hollywood Provincial," and recommended because it "makes such a friendly home" and represented the "American ideal of good living" (ibid, 111). As Wilson notes, Hollywood films have both reflected and shaped American views about modern domestic design, and most of Americans did not want to "start from zero," at least not in terms of architecture (ibid, 159-60).



Dark Victory, 1939



Our Town, 1940



Kings Row, 1942



Meet Me in St. Louis, 1944



Hail the Conquering Hero, 1944



It's a Wonderful Life, 1946



The Magic Town, 1947



The Bachelor and the Bobby Soxer, 1947



Mr. Blandings Builds his Dream House, 1948



Father's Little Dividend, 1951



All that Heaven Allows, 1955



Imitation of Life, 1959

In the post-war Britain, and particularly in London, there was a simultaneous desire for radical changes, and at the same time, the aspiration of tangible continuity (Shonfield 2000, 4). The functionalist principles of the Modern Movement established the rules for the new buildings developed between the the 1930s-40s, with extensive examples of social housing. While the Modern Movement aspired to achieve a real social change and a complete transformation of the urban space, the response to the anxieties of people after their cities were heavily destroyed was mirrored with a need to recover old cultural traditions. In terms of architecture,

this attitude was reflected by a revival approach to traditional images of English houses, closer to the ideals of the Arts and Crafts Movement. This trend was also expressed through commercial films.

In the 1940s, British films represented common middle-class families in suburban neighborhoods with townhouses and cared gardens. Examples, such as *Million Like Us*, *This Happy Breed*, and *London Belongs to Me* represent this trend. Gardens are an important part of British tastes, but also the way that middle-class families can differentiate from the overcrowded slums, characterized by lack of greenery, communitarian facilities and modernist aesthetics. As James Maude Richards argues, the Englishman's passion for gardening may be seen in other places than suburbia, but only suburbia, is where an Englishman can exercise his passion (Richards, 1973).

### **1.2 The city: a place to work but not to raise a family**

American and British films produced in the 1930s-60s tend to represent big cities as places to work and run important business, necessary for the productive growing of the country, but completely inappropriate to raise a normal family. Diverse film genres, such as urban dramas, crime films, family dramas, and romantic comedies, systematically associate dense urban spaces with suffering working-class, selfish interests, hedonistic attitudes, poverty, delinquency, dysfunctional families, or at least, sexual temptations. In these films, communitarian and moral values cannot be supported by the metropolitan life.

Many commentators find clear associations between films that use the city as a main backdrop and certain recurrent themes, characters, and pro-filmic features. Vivian Sobchack, for example, argues that there is a type of Hollywood film obsessed with the dark city, which represents a crowded and impersonal modernity with spaces that invite casual and impermanent relationships. These spaces refuse to support traditional moral values, any establishment of family life, and by opposition, emphasize types of spaces such as the nightclub, the bar, the hotel room, the roadside cafe, the bus and train station, and the wayside motel (Sobchack 1998, 130). In relation with the themes, Larry Ford argues that films that portray the metropolis have recurrent crime plots, and usually feature a psychological drama in which normal people are drowning ever deeper into a very personal, isolating nightmare (Ford 1994, 123). In the cities of crime films, there is a moral and ethical ambiguity in the sense that everyday people may gradually become criminals (ibid).

American and British crime films of 1940s-50s are clear examples of how the dense and impersonal city seems to be the only scenario in where the racketeering and the crime in general can be developed. American films such as *The Asphalt Jungle*, *The Naked Street*, *The Street with No Name*, *Dark City*, *Panic in the Streets*, and many others, clearly portray the city and the streets as dangerous places. In these films city spaces are the background of criminal acts, an uncertain environment in where true love, family values, community values, and optimism are absent. Romantic encounters are ephemeral and with tragic ends. The night prevails over sunlight, sadness over happiness, and evil over good.



Scarlet Street, 1945



The Street with No Name, 1948



Panic in the Street, 1950



Dark City, 1950



The Asphalt Jungle, 1950



Where the Sidewalk Ends, 1950



On the Waterfront, 1954



Down Three Dark Streets, 1954



Naked Streets, 1955

The American urban dramas about troubled kids of the 1930s are a distinctive genre that portrays the urban poverty of slums located in inner zones of the city, especially after the Great Depression. Examples, such as *Wild Boys of the Road*, *Boy of the Streets*, *Angels with Dirty Faces*, and *Boys Town* present the city streets as schools of delinquency, in where vulnerable kids have no choice but to become future criminals. In these films families are dysfunctional, parents seem to be absent, so kids are always in the streets, learning from negative role models and cultivating dangerous associations. Interior domestic spaces are practically invisible, and street spaces are dense, dirty and dangerous. Kids are always in troubles, they are fighting and policemen watching and controlling the street form part of the townscape, creating a sort of unsafe atmosphere in any corner of the street.

British films also portray troubled youth. In the second-half of the 1940s, the film *Odd Man Out* is about a gang who belongs to the IRA and become idols and models for the kids of the streets. British films, such as *Violent Playground* and *The Loneliness of the Long Distance Runner* represent an excluded working-class youth, who grew up in the industrial city and their dissatisfaction with the urban environment is translated into a rebellious and defiant attitude, which leads them to commit criminal acts.



Wild Boys of the Road, 1933



Boy of the Streets, 1937



Dead End, 1937



Boys Town, 1938



Angels with Dirty Faces, 1938



Odd Man Out, 1947



Boy of the Streets, 1937



Dead End, 1937



Angels with Dirty Faces, 1938



One Third of the Nation, 1939

The common characteristics of both American and British films, is that the metropolis together with poverty, seem to be the reason why young people become engage in criminality. All these films present on the one hand, the criminalization of the metropolis, and on the other, the pastoral power as a way to salve individuals and transform them into good citizens. In *Boys Town*, a dedicated priest builds a community for city kids in the middle of the countryside. The rural life, the gardens, the nature and the discipline are the key elements to rehabilitate hundred of trouble kids.



Boys Town, 1938

In *The Loneliness of the Long Distance Runner*, the city is linked with criminality, materialism, and consumerism, while nature is systematically associated with liberation and love. In this film nature functions as a trigger of conscience, as the instance of reflection and deep though. While Colin runs through the open fields analyzing his criminal past and taking decisions for the future, the only moments of happiness that Colin remembers are portrayed by natural landscapes.



The Lonliness of the Long Distance Runner, 1962



The Lonliness of the Long Distance Runner, 1962

Other British films, such as *Love in a Dole*, the Hardcastles, a struggling working-class family that live in an industrial slum of Salford is portrayed as suffering people that survive within an extremely adverse environment. Sally, the daughter, falls in love with the socialist agitator Larry, and their romantic encounters are framed in bucolic landscapes, far away from the city. When Sally goes for the countryside for first time, she comments, "Here is so lovely, make me see things different; I never want to come back." In *A Taste of Honey*, the only time that Geoffrey kisses Jo and asks to marry is when they leave the city, the cement environment and goes to the countryside. In *It Always Rains on Sunday*, the only time that the urban townscape shifts to a natural and bucolic landscape is when Rose's daughter, Vi, goes with her boyfriend to the countryside to spend a quiet day together. In American films, such as *Our Town*, *Kings Row*, *The Magic Town*, and *All That Heaven Allows*, only to mention few examples, romantic scenes are always framed in natural landscapes.

The apartment, as the most distinctive housing model of inner zones of big cities, is never associated with positive or happy characters. Especially in American films, with the exception of luxury apartments inhabited by billionaires, apartments are spaces that serve to portray stories of poverty, crime, violence, adultery, and drug abuse. Examples such as *Scarlet Street*, *The Apartment*, and *Any Wednesday*, tell stories about extramarital encounters and easy women that occur in metropolitan apartments.



Pillow Talk, 1959



Come Blow your Horn, 1963



The Apartment 1960



Sex and the Single Girl, 1964



Who is Sleeping in My Bed, 1963

In *The Lost Weekend*, an alcoholic writer experiences his worst crisis in the claustrophobic space of a New York apartment. The apartment is also the refuge of excluded people; besides the poor, apartments are homes for minorities, immigrants, and anyone who do not fit entirely into the productive society, such as artists, divorced, and playboys. In *Two for the Seesaw*, a divorced man and a little known artist, share their sorrows in decadent apartments that evidence deteriorated walls, and provisory decoration. From *Dark Victory* to *Come Blow your Horn*, when frivolous characters that refuse any commitment decide to put their life on order and get married, they always leave their apartments and the mundane city life to start a family in the countryside or the suburbs. From comedies to crime films, apartments seem to be useful as transitory solutions, but never as proper places to raise a family. Films, such as *Mr. Blandings Builds his Dream House* and *Don't Eat the Daisies* are examples of families with children that live in apartments but their main objective is move to the countryside.

Sharon Marcus argues that the apartment functions as a micro-cosmos of the city. Its capacity to make urban and domestic spaces continuous, because its impossibility to fully separate the city from the home, allows the apartment as vantage points for visual observation and exhibition, nodes of commercial and sexual exchange, and settings for the sensory overload and chance encounters associated with crowds (Marcus1999, 12). The apartment living that possesses blurred frontiers between the public and the private space appears as a foreign



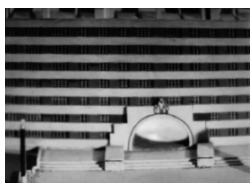
lifestyle for common middle-class families, especially for Americans, who celebrate the self-contained communities as the most appropriate context to raise a family. As Pamela Robertson notes, the apartment offers a vision of home centered on values, such as visibility, contact, density, friendship, mobility, impermanence, and porousness, which sharply contrast to more traditional views of home as private, stable, and family-based (Robertson 2010, 5).

### 1.3 Modernist buildings are for the poor

During the 1930s-40s, American and British authorities took advantage of the popularity of cinema, using documentaries to promote radical changes in towns and housing models. In these films, urban planners presented governmental initiatives, such as the slum clearance program and the construction of new neighborhoods to relocate slum dwellers. Unlike commercial films, Documentaries of the 1930s-40s helped to introduce the new aesthetic of the Modern Movement in architecture, providing rationalistic explanations about the convenience of new materials, new techniques of construction, and reinforcing the idea that the new architecture was conceived for the health improvement of the population.

However, the distinctive modernist image of social housing projects, with their multistory buildings and open collective spaces, which strongly contrasted with the single-family homes and low-dense neighborhoods of the middle-class, also served to position the modernist aesthetics as the new image of urban poverty.

The Modern Movement in architecture, commonly recognized for its 'urban imagination' and principles, such as rational zoning land-use, separation between home and workspace, and emphasis on transport systems, saw the models of massive housing as a way to achieve a social transformation, however in America and Britain, modernist high-dense solutions were mostly used to implement social housing for the poorest sectors of the population, rather than a solution for the middle-class. In economical terms, high-dense apartments built with prefabricated techniques were a cheaper solution than extended suburbs that implied more portions of land, more investment in roads, power and sanitary lines. In this way, the green ideal embodied by suburban solutions close to the countryside, low-dense neighborhoods, cared garden and single-family homes were the choices of the American and British middle-class, leaving modernist buildings for social housing and former slum dwellers.



Housing Problems, 1935



Home for Workers, 1939



Development of the English Town, 1942



Violent Playground, 1958

### Conclusion

While architectural historians, such as Henry Russell Hitchcock, Nicolai Pevsner, and Siegfried Giedion, wrote the first "official" history of the Modern Movement in architecture, celebrating modernist projects and influencing many generations of architects and scholars, modernist-housing solutions were barely promoted by the commercial cinema in the first-half of the twentieth century. During several decades, American and British films used modernist spaces to portray places of work and productivity, but rarely as places in where normal families live. This apparent discrepancy between the discourse of design disseminated by intellectuals of the design field, and the discourse promoted by cinema, suggests that the analysis of

architecture and city design in films is a valuable way to investigate how popular culture have discussed city spaces and domestic spaces.

This study also demonstrates that big cities are systematically represented as spaces of risk and vice, and the notion of community, presented as the most fundamental value of a healthy society, is never linked to metropolitan spaces, but systematically associated with small towns, low-dense solutions, suburban developments and rural communities. This dichotomy suggests that American and British cultural identities, in which urbanization and industrialization were crystallized in modernity, differ from other cultures, such as South European cities and Mediterranean cities, based on old urban identities and the understanding that cities are spaces of culture, memory and virtue. These differences of cultural backgrounds are also illustrated by zoning land use. While European cities combine residence with economic and leisure activities at walking distance, American cities separate residential neighborhoods from central business districts and recreational spaces.

Cinema has served to create meanings and values associated with spaces, affecting the way designers and everyday people perceive spaces and define preferences. The historical analysis based on dominant discourses distributed by popular culture suggests a reflection on our understanding as designers of city spaces. Are we really designing our cities, and thinking about the best solutions, or are we operators immersed in a dominant discourse and our designs respond to that? Are high-dense solutions and apartment living places full of negative values, and the politics of dispersion the only way to create communities? The analysis of films serves to be aware about how dominant discourses of space create cultural frameworks that influence the preferences of both designers and users.

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# What would Vitruvius Do? Re-Thinking Architecture Education for the 21<sup>st</sup> Century University

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**ABSTRACT:** In the 1996 AIA Convention in Minneapolis, the governing bodies in the education and professionalization of architects; namely, the AIA, AIAS, NCARB, NAAB and the ACSI released the Boyer Report, subsequently published as *Building Community: A New Future for Architecture Education and Practice*. The report was named in honor of Ernest Boyer, an educational theorist who also participated in writing the text. Less comprehensive than the canonical texts by Vitruvius and his interlocutors, it is nonetheless a mirror of our current assumptions about the education of the architect. This paper looks at the epistemology inherited from Vitruvius as it shapes pedagogy up and through the Boyer Report and into the twenty-first century. The basis of our argument is that historical divisions between professional or applied knowledge and liberal, or theoretical knowledge inherited from the past limit our capacity within architecture education to integrate new strategies for knowledge creation and dissemination. We conclude that considering architecture education also means reconsidering the basis of architecture knowledge. What of the (persistent) Vitruvian model is relevant in our post-modern condition? What do we learn from the image of our profession projected through the lens of the Boyer Report and it's like? In other words, what would Vitruvius do?

**KEYWORDS:** Architecture epistemology, pedagogy, education, design thinking

## INTRODUCTION

Our purpose in this study is to look at issues in the epistemology and pedagogy of architectural education in the twenty-first century. Our starting point is a broad analysis of the canonical texts in architecture education originating with the Roman military engineer and architect Marcus Vitruvius Pollio's first century text, *De Architectura* or *The Ten Book on Architecture*, that arguably still informs the underlying intellectual structure of the education of the architect. The educational context of Vitruvius' text was a post-Eleatic, pre-Scholastic discourse without institutional bearings. Universities as such didn't exist in Augustinian Rome. In contrast, recent texts such as the 1996 Boyer Report are a product of the modern research university whose origin in Germany in the early 1800s is indebted to the *liberal artes* or 'free arts' model divided between 1) knowledge for knowledge sake and 2) knowledge about how things are made. The clarity of the modern academic structure where liberal arts are separate from technical schools was contaminated in the mid-1900s with the advent of interdisciplinary and hybrid degrees like bioengineering, but architecture schools and the profession still labor under an older epistemological paradigm. It is not clear if the Boyer Report helps or hinders us in the search for a new paradigm, but search we should as the contours of our disciplinary landscape are shifting. What of the (persistent) Vitruvian model is relevant in our post-modern condition? What do we learn from the image of our profession projected through the lens of the Boyer Report and it's like? In other words, what would Vitruvius do?

The basis of our argument is that historical divisions between professional or applied knowledge and liberal, or theoretical knowledge, limit our capacity within architecture education to integrate new strategies for knowledge creation and dissemination. Another way of framing this is to say that the current pedagogical structure is awry to an epistemology of architecture.

### 1.0. Pedagogy

From its rediscovery, translation by Daniele Barbaro, and publication at the start of the Italian Renaissance in the fifteenth century Vitruvius' Ten Books stakes its claim as the foundational

text in the education of the architect. Daniele Barbaro's 1556 commentary on Vitruvius (second edition 1567), written and illustrated in part by Andrea Palladio secured its place in history some 1200 years after the original publication. Palladio writes his own *Quattro Libri dell' Architettura* (1570), clearly echoing and expanding the Vitruvian model.

Arguably, every movement in architecture since the Beaux-Arts has to discredit, support or supplant the Vitruvian model. One explanation for its endurance is its simplicity. Ten Books is first and foremost an argument for architecture knowledge as practice with some theory. Architects who rely solely on theory and scholarship without manual skill are 'hunting the shadow, not the substance.' Second, it outlines an ecumenical approach to the kind of knowledge architect's need – astronomy, medicine, economics, and so forth. Although this argument is often decontextualized and used as a basis for the interdisciplinary of architecture knowledge, it's a bit of a red herring as in Vitruvius's time these are not institutional nor discrete areas of study, but part and parcel of the generalized topics any well-educated Roman would understand. It helps to remember that Vitruvius himself was not an aristocrat and could not even afford to visit the Greek architecture that is his touchstone (Dripps, 1987). Finally, the Ten Books outlines a social and ethical role for architecture as a civic project and the architect as the arbitrator of the good in what is built. Architects are more skilled in theory than craftsmen, as they must negotiate custom, use, and the nature of the setting, the appropriate expression of the social status of the occupants through correct use of the orders, and the eurythmic adjustments to the canonic *symmetriae* in order to evoke a greater appearance of beauty—in short, the suitability of the form to the purpose (Vitruvius and Morgan, 1960; Semes, 2004). The argument was critical in an Aristotelian intellectual context where only general principles not knowledge about making things registered as wisdom or understanding. Vitruvius' argument is a general call to acknowledge the role of the architect in a social and intellectual hierarchy that would otherwise reduce it to carpentry or poetry, not science. The point here is that outside of its intellectual context, the Ten Books are only minimally useful even as they have been so difficult to shake loose.

Broadly defined, the difference between early Vitruvius—that is the Renaissance re-reading of him—and his resuscitation in the French Beaux-Arts tradition through Claude Perrault is an emphasis on art and the role of human culture in the first, and geometry and the role of Cartesian abstraction in the second. Vitruvius didn't change, but his interlocutors did. In either case, what is really at issue is whether or not architecture in an Aristotelian sense is more than merely practical art in which case it would not be located in the university system, but taught by craftsmen in the guilds. We find echoes of this argument in Christian Norberg-Schultz 1966 book, *Intentions in Architecture*, the Boyer Report, Richard Sennett's *The Craftsman*, and others. The twin arguments about what constitutes knowledge of general principles or theory, and the value of the hand, artisanal, or the practical arts bogs us down in an intellectual mud from which it has proven impossible to extricate ourselves. For the classically defined disciplines that fall clearly into a liberal arts education in the humanities, this is problematic, but not impossible. They can justify their existence in a modern university as necessary foundational education. Architecture knowledge does not immediately pertain as 'foundational' and even if the classical model is potentially flawed, architecture is a professional school education, not really a part of the humanities.

### 1.1. History of the School

The modern architecture school begins with the Académie Royal d'Architecture (1671–1793). It is the precursor to the Académie des Beaux-Arts, later École des Beaux Arts in Paris, and based on the structure of apprenticeship. Learning models in France and Britain vary in the details, but share a similar overall attitude that architecture is an artisanal practice learned through the practice of making drawings of buildings. The French system is a state-certification structure with a strong built-in hierarchy where the eight directors of the Académie determined everything from the winner of the Rome Prize, the awarding of commissions, who received government employment. Similarly, the British system was built around articulated pupillage where students apprenticed to master architects but in addition students were expected to participate in professional associations. Students in professional training in Britain did not attend university but were educated by practitioners outside of academic institutions. The Architectural Association is representative. Founded in 1847 by architectural assistants it

remains to this day unattached to a university. As late as the 1958 Oxford conference, 63% of architecture students in the United Kingdom were trained in art schools or polytechnics, not at university. In both cases, the alignment between what architects did— even if based on conflicting notions of whether it's formal order was derived from natural law or abstract geometry—the pedagogy outlines a program of making artifacts that were pleasing, durable, based on basic laws of statics, and socially responsive.

Research is introduced into the university in the 1800s in Prussia starting with the University of Berlin. Based on the educational theories of Christian Wolff that linked the university teacher with scholarly research to be disseminated to various audiences. Interestingly, these new research professors were equally divided between the general faculties providing the German tradition of *bildung* or a civilizing education and those directed to the few occupations requiring university-level training: law, theology, medicine, and secondary school education. German universities were communities of scholars organized around as colleges of professors who determined the direction of research, funding for assistants and generally participated in faculty governed campus life. The modern research university's roots vary to the degree that they adhere to the Germanic tradition whereby most professors saw themselves as academics first and only secondarily connected to their professional discipline. Most other professions (engineering, architecture, accounting) were trained as in the British system through associations of practitioners organized in private institutions or polytechnics and arts and crafts schools. These were not research driven and did not bear the burden of being knowledge producing.

The condition of architecture education in the United States was a hybrid from the beginning. Universities in the US synthesized the French state-dominated system and professional practitioner dominated English system in an uneasy mix that has proven especially unstable for architecture education. Compounding this are recent developments toward research-based universities that demand more applied science and less architecture-as-art from faculty little prepared for scholarly production based on a professional school education. The American condition did not have the historically entrenched professional associations of the English – compared to their British counterpart the AIA is a significantly weaker political body than the RIBA. Well over half of all registered architects in England (66%) are member of the RIBA, whereas 53% of their American counterparts belong to the AIA. The RIBA exerted direct control over university education from its inception in 1834 and continues to do so today. The US National Architecture Accrediting Board (NAAB) that oversees professional programs in architecture only began its work after 1945. William Robert Ware, founder of MIT's (1865) and Columbia University's (1871) architecture programs instrumentalize and adapted the French system into American schools that had largely been directed toward the education of gentleman architects who most often studied abroad in the Beaux-Arts system before returning home to spend a few years at university. Given the weakness of the professional organizations it is not surprising that universities saw an opportunity after the Civil War to provide a standardized education for a growing middle class. The first architecture schools in the US are founded after the war in such schools as MIT, Cornell and Illinois. Professional education in the US is university-based rather than professional-based. It is also not research- oriented, as the advent of the research university is not until the late-1800s with the creation the Johns Hopkins (1876), University of Chicago (1892) and others.

The American research university model differs in several important ways from its German predecessor. These differences are especially trenchant for architecture curricula. First, the department structure is organized around a chair with semi-independent faculty pursuing autonomous research projects unlike the more autocratic German structure where a single scholar leads a department and determines the coherence of the research agenda. Secondly, the American universities include applied research in addition to theoretical research whereas applied research is left to the technical schools in Germany. Lastly, teachers in American professional schools tend to see themselves as practitioners first and academics second. When combined with their historic affiliation to the Beaux-Arts apprenticeship model, American architecture schools put greater emphasis on the studio-as-learning environment where a practicing architect conveys practical knowledge about buildings based on their individual temperament and intellectual orientation. William Ware's mid-nineteenth century precepts for

the modern architecture school reflect the Beaux-Arts model and reverberate with tensions that we hear in today's university environment: details of a practical nature are best postponed until after formal education, architectural design should be conducted by a competitive method with judgments by jury, the study of design should be continuous through school and design problems should not be overly practical, the study of construction should be stressed, and the architecture curriculum should include as broad a cultural background as time permits. One can hear strains of the applied research demands of the American university (the study of construction, structures) and the overarching tones of the artistry of the Beaux-Arts model.

## 1.2. Epistemology

This brings us to the current milieu: the twentieth century and its conflicting pedagogical structures that foster additional confusion about the kind of knowledge, if any, that architecture schools produce. This is not to be glib—it is not clear in the current professional architecture school whether it should be an art academy, or a research unit. Schools of architecture are caught between the scholarly demands of the research university and a crisis of confidence in professional knowledge and education grounded in our own hybridity (Schön, 1988). As Donald Schön reminds us, architecture as an occupation is concerned with the "design of usable structures and an art based on the forms of buildings and the experience of passage through their spaces" (Schön, 1988), however; the structure of architecture knowledge may be otherwise.

As early as 1932 the ACSA *Study of Architectural Schools* noted the 'scarcity of real research in architecture schools' and the difficulty of architecture programs fitting into the university model. The problem is little diminished by 1954 when the AIA *Architect at Mid-Century* reports that there 'needs to be more support for research in architecture schools,' "study institutes" for faculty, and schools need to maintain a closer relationship with practice. Repeatedly from the 1930s onward, reports by the AIA, ACSA and independent studies sponsored by universities underscore 1) the importance of applied research, 2) the need for basic competencies in technical issues, 3) increased relevance between practice and formal education, and 4) a need to connect architecture programs and departments to other academic units through faculty and student engagement (AIA, 1967, 2009; Arch Education Study, 1981; Moore, 1965; Gutman, 1988; Cuff, 1991; Boyer, 1997; Schön, 1988, NAAB, 2008-12; McGrath and Navin, 1992; Jann, 2010). While the reports are good at outlining the problems, they are often confused—in the same way the American university system tends to mix the apples of applied research with the oranges of practice, so too recommendations about how to 'fix' the problems outlined above in architecture schools mix pedagogy with epistemology, how to teach with what is being taught. To give the Boyer Report, *Building Community, A New Future for Architecture Education and Practice* (1997) its due the recommendations reach back to the Vitruvian model of theory and practice to resuscitate and revive the architecture educational system. Interestingly, it is Robert Gutman's *Architectural Practice: A Critical View* (1988) that highlights a general misconception: if schools are having difficulties, then so must the profession. While architecture schools may not be doing well in their academic setting, the demands for professional architects only continues to increase. There are more architects working on more diverse projects today than at mid-century (Gutman, 1988).

## 1.2. Doing and/or Thinking

The Boyer Report, named in honor of the sociologist Ernest Boyer, an educational theorist who also participated in writing the text, outlines seven 'essential' goals: 1) training practitioners dedicated to promoting beauty in our society, the rebirth and preservation of our cities, including building for human needs and happiness, and the creation of a healthier, more environmentally sustainable architecture, 2) diversity with dignity where we would continue to promote variety amongst schools and program diversity in the curriculum, 3) standards without standardization to establish a coherent set of expectations for all schools without diminishing individual schools capacity to tailor curricula, 4) better integration between schools and practice, and architecture department and other units in the university, 5) schools would create a 'climate for learning' between faculty and students, 6) support of productive partnerships between school and the profession such as internship programs that build ties with practitioners but also include extended learning throughout professional life, and 7) encourage architects to participate in civic engagement through service to the nation and their

communities adhering to the highest and best practices and ethical standards.

While this all seems reasonable, the Boyer Report confuses theory and practice much the same way the introduction of Vitruvius did in the foreign intellectual soil of the Renaissance. The problem with architecture knowledge is systemic and emerges from the particular soils of the modern condition. This argument should be especially apparent after reviewing the historically determined categories of pedagogy outlined above. It will be improbable, if not impossible for a new approach in architecture education to flower from the ground laid by Vitruvius or his interlocutors, even their most recent incarnations in the twentieth century, regardless of how well meaning and sincere the humanist tendencies are. The classical education divided knowledge into theoretical and applied science, which architecture, in Vitruvian terms, aspired to emulate. Our failure to thrive is one of kind, not degree: architecture knowledge may not be about types of knowledge, but a way of thinking. As Linda Groat suggests:

“In academic circles, the gradual emergence over the last twenty years of architectural research as a recognized avenue for generating new knowledge seems to affirm the stature of architecture as a discipline. However, the tendency of architectural research to be defined (and to define itself) in terms of the traditions of apparently discreet, and allied disciplines suggests instead that the focus of the architectural discipline remains elusive.” (Groat, 1992)

Groat goes on to explain that although many contemporary theorists “have attempted to post various philosophical positions (i.e., structuralism, phenomenology, or deconstruction) as viable alternatives to the now discredited positivist assumptions of modern thought, these apparent alternatives do not in fact extricate us from the theoretical cul-de-sac in which we now find ourselves.” In her example, the intellectual conditions in both practice and research involve the “philosophical and ideological failure of modern thought to sustain a sufficiently robust conceptualization of cultural phenomena in general and architecture in particular.” In other words, as much as we want Vitruvius to help, discussions resonant with classical definitions promoting beauty and sensitization to cultural relevancy (like sustainability) are doomed to fail if we use this to define an architecture epistemology.

One alternative is to reconsider how we constitute architecture knowledge. If architecture is established as an either/or proposition where artistry and applied science, Vitruvian beauty and firmness respectively, are instantiated as separate categories much as the original dictum in classical philosophy that separated the applied arts or poetics from the natural or philosophical sciences, we stand to repeat the failures of our predecessors, while hoping for different outcomes. However, reconsidering architecture as a *set of cognitive practices that enable artifact making* may offer new possibilities, will certainly require restricting the curricula and, after reflection, are not especially new.

Donald Schön argued in the mid-80s at MIT for the introduction of a cognitive orientation to design reasoning as a foundation of design learning (Schön, 1992). He observed that regardless of how current pedagogy was modeled, the education focus was on the representation of the design artifact, rather than an explicit articulation of knowledge. Schön calls this latent knowledge “design reasoning.” His prescription is a workable marriage of artistry and applied science, reflective practicum and classroom teaching centered around the idea of ‘design reasoning’ where design-as-cognition relies heavily on visual reasoning. Architects use representations to think through the problems of design and this kind of cognitive structure is the real focus of the knowledge environment of studio, not the artifact produced at the end.

Beyond the utility of representation in design thinking, Schön argued firstly that studio-based projects should mirror the complexities of real-life problems from the professional world, and secondly; learning would proceed through reflection-in-action and reflection-on-action such that the design student’s thinking would eventually mirror the ‘expert’ thinking of their tutors. Schön substitutes ‘reflective practice’ for design artistry, but retains the emphasis on the idea that a student is to be coached by a knowing tutor, ideally a trained practitioner with expert



knowledge of the field who would model, correct, and guide the habits of reflective practice.

The success of Schön's learning program should not be underestimated or ignored – it has proven a trenchant theory of cognitive or 'reflective learning' in professional education (Brockbank and McGill, 2007). However, critiques of Schön identify several key factors, one of which is of particular interest, namely that he demonstrates a limited understanding of the domain of cognitive learning (Webster, 2004b). Additionally, Schön's model ignores many devices formal education uses to direct student learning, presents a narrow notion of how learning takes place (master to student only), under conceptualizes the notion of 'reflection,' uses research methods of dubious validity, and does not recognize the structure/agency dialectic widely recognized in learning theory as an important component of the relationships of power inherent in the master-student model (Webster, 2008; Webster, 2004b; Foucault, 1990; Giddens, 1984; Dutton, 1991; Stevens, 2002). In the final analysis, Schön is a reflective-turn on the traditional Beaux-Arts apprenticeship model where a master teacher/practitioner inculcates an unknowing student into the cognitive habits of the professional. Schön's epistemology is based on the critical reflection of expert others as the primary means of transformative reflection in the student. Reflection is undeniably important, however; it is only one part of the design process. As Helena Webster notes, architectural educators may be better served to consult theories of innovation and creativity if this is the primary issue as there provide better and more nuanced models of the design process (Webster, 2008).

More recently Rivka Oxman and others propose that a more reasonable cognitively formulated approach is through the phenomena of visual reasoning in design as opposed to the product-making orientation of professional traditions (Oxman, 1999, 1992; Finke, Ward, and Smith, 1992; Papert, 1991). In *Educating the Designerly Thinker*, Oxman proposes that the goal of design education should be defined as the acquisition of the cognitive ability to manipulate the representations of design knowledge and to acquire basic schema in design thinking. Making the design process visible – where it is coded and cataloged – is the first step in training students in 'designerly thinking,' that, while not an ability to design *per se*, is part of design awareness. The Issue-Concept-Form strategy used by Oxman is presented to students through a computer-based program that offers a series of interconnected choices such as Issue=phenomenological content, concept=use of traditional elements, form=inner court. Students navigate an increasingly more abstract set of relations as they work out the knowledge structure of elements in an architectural schema. This kind of think-map makes possible a visualization of the process, albeit a process wholly pre-determined by knowledge schema from within a codified architectural cannon. What is not previously known cannot be encountered from within the program.

What is most promising with the Oxman approach is that results are measured and learning outcomes evaluated. The most significant qualitative results were in the area of the development of concepts and knowledge structures measured by evaluating the student's ability to model, and the coherence and complexity of student models. Students worked individually and in teams in the computer environment to generate their schema. Even though the models students generated primarily represent their ability to navigate a series of choices based on pre-determined options, the value of the method is that it shifts the focus away from the apprenticeship model toward a new learning environment: a computational environment where students worked together using a shared set of learning tools. While this is not intended to replace studio-based learning, it may be a potential test-bed for understanding the cognitive structures of design thinking not only in architecture, but in other disciplines as well.

## CONCLUSION

Much as hybrid disciplines in the sciences that challenge traditionally constructed divisions between theory and practice, natural and artificial, architecture education needs to be reconsidered at the epistemological level in order for us to re-think our pedagogical strategies. Bioengineering, human-computer interaction science, biophysics and so forth are not the sum of separate disciplinary parts. These are new disciplines not because Frankenstein-like they are built from familiar parts; their newness is in the very fabric from which they are cut, requiring new language, new tools, new learning environments and new cognitive structures to contain the particular kind of knowledge they produce. It may not matter which comes first,

chicken or egg-like – if we develop new learning environments, new epistemologies may emerge. Conversely, new ways of describing what an architect needs to know may engender new learning environments. As with most paradigms, it is our perception of the learning schema that constitute architecture education that determine not only how, but what an architect thinks.

One alternative offered in this paper outlines how we might re-think the structure of knowledge in architecture by focusing on the cognitive phenomena of design thinking. This would entail being attentive to the cognitive schema we use in our visual representations in architecture, developing more complex visual schema that encode and fuse complex information sets, and formalizing through research and dissemination the processes of design. That means taking design out of the 'black-box' and exploring its' cognitive contours – not an easy task, but one that could re-draw the learning landscape of architecture in preparation for the challenges of the twenty-first century city, just as Vitruvius attempted so many years ago for his Roman inheritors.

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# Urban Planning, Neurosciences and Contemplation for improving well-being in our cities

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**ABSTRACT:** This paper presents the results of a pilot experiment which is a part of research attempting to prove that specific space-design strategies can induce contemplative states, as indexed by neurophysiologic measures of mindfulness. This study establishes an important dialogue between artistic and scientific disciplines: landscape architecture, urban studies, neurosciences and traditions of meditation, for finding methods that will enable improvement of well-being in cities by urban green open space design. The innovative part of the investigation is usage of EEG (electroencephalography) laboratory methods for evaluation of impacts of designed urban landscape settings on brain and mental states. This interdisciplinary approach is to create a tool for contemplative space design. It shows how to implement these findings in a design practice by highlighting the importance of particular, so called "contemplative design", and for creating restorative landscapes in our cities. Finding the right design techniques can provide a significant contribution to green space design with inclusion of stress reduction and mental health improvement strategies. The pilot experiment is a proof of concept and showed that the applied framework can serve well for further experiments. It also managed to establish a new reliable method of contemplative landscapes evaluation.

**KEYWORDS:** urban planning, landscape architecture, neurosciences, EEG (electroencephalography), contemplation, mindfulness

## 1.0 INTRODUCTION

Architecture, as well as landscape architecture, is a design discipline that even though borrowing from various scientific areas, still bases itself on artistic expression with its incomprehensible, immeasurable, metaphysical aspects. This brings forth many questions and doubts such as: What is the link between the human and his environment? How does one perceive the designed space? What is the impact of that space on one's mental health and well-being?

One scientific discipline that seems to be able to provide the answers for those questions is neuropsychophysiology with its methods of brain scanning. In the end, it is the brain that processes all the sensory stimuli as well as interpretation of them and emotional response. We believe that establishing the link between the visual *outer* space with the *inner-self* (inner space), that can be represented by the specific brainwave pattern, can provide interesting answers to previously mentioned questions.

There is no doubt that architects and landscape architects should design with people in mind; and that being the case, their designs should prioritize people's health and well-being.

The percentage of the population of the More Developed World living in urbanized areas is now 78,7% and still growing (Champion, 2001). Since one of the biggest challenges facing contemporary metropolises is mental health, and one of the biggest problems of developed societies is psychological imbalance and distress leading to various mental disorders (W.H.O. 2005), this would be a target problem to resolve using joined forces of scientific and artistic disciplines.

Researchers from such areas as landscape architecture, environmental psychology, and medicine have agreed that contact with natural settings and greenery has a positive influence on our health and well-being (Kaplan and Kaplan, 1989).

The aim of this study is to go one step further by explaining which kinds of greenery and landscape types have those therapeutic powers; because not every attribute of space design will have the same impact on the observer just as not every piece of art brings up the same types of emotions in each individual.

Based on the existing concepts, scales and measures for different mental states and healing processes we have designed a relatively simple experiment that aims to prove that some specific design strategies in urban parks and gardens can induce the brain activity patterns associated with restorative states of mind, such as mindfulness.

## 1.2 Central concepts:

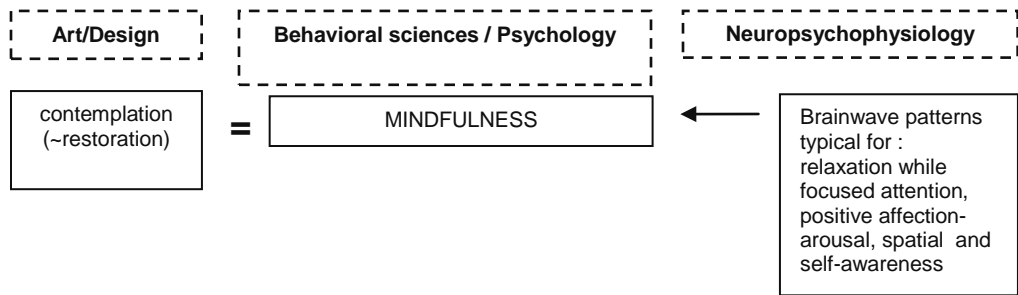
**Contemplative landscapes/spaces** – this concept is used in various artistic disciplines; contemplative values of the nature, space or art has been described by poets writers. Nevertheless there isn't any set of rules for creating landscapes of contemplation. What we know about those kinds of spaces is that they stimulate contemplation.

**Contemplation-** The word contemplation is commonly used as an attentive watching and/or perceiving of some phenomena. It can be induced by some landscape setting, leading to stress reduction and relaxation, which is connected with the concept of the healing power of nature. It focuses on the elimination of thought, benefiting body and mind, giving a sense of wellbeing, contributing to psychological, intellectual and spiritual development, and stimulating creativity and stress reduction mechanisms (Kaplan, Kaplan, 1989).

Contemplation can sometimes be misunderstood as an activity; however it is rather a state of *being not doing*. This state could be compared with a trance, but not every type of trance provides contemplation. *“Television, modern culture’s peculiar contemplative shrine, supplies a contemplative trance to millions of people, for hours on end day after day year in and year out.”* But this kind of trance very often is a cause of reinforcement of sensory dissatisfaction, imprinting anger and violence, confusion, construction and maintenance of the delusion of materialism (Thurman, 1994). In general, we are all involved in contemplation on a daily basis and we assume that contemplative states are associated with specific therapeutic benefits (mental restoration), and expressed by particular brainwave patterns.

The term contemplation has often been used across the artistic disciplines because it involves some kind of object, phenomena, piece of art or landscape: we contemplate something – the painting, the sculpture or the beautiful landscape. The concept of contemplation doesn't have a rigorous scientific character.

**Mindfulness** - What artists want to understand as contemplation is well described and scientifically measured as mindfulness under the umbrella of psychology. And then, neuroscience developed specific tools and scales to measure what is called mindfulness. Therefore, it makes the concept of mindfulness an important inter-disciplinary bridge. The relation between disciplines is shown by the graph below (Fig.1).



**Figure 1. Inter-disciplinary relations between central concepts of the research**

Unlike transcendental meditation (mantra), mindfulness meditation focuses on the present moment and surrounding realm. Mindfulness refers to the process of bringing one's attention, in a nonjudgmental manner, to the internal and external experiences that exist in the present moment. Those external experiences can be, for example, the visual stimuli received from the landscape setting. Typically, mindfulness includes awareness of: sensations, thoughts, bodily states, consciousness, and the environment, while simultaneously encouraging openness, curiosity, and acceptance towards them (Bishop, 2004).

Mindfulness is increasingly being employed in Western psychology to mitigate a variety of mental and physical conditions for it is believed that it improves well-being. The popularization of mindfulness studies is visible by the number of scientific publications that is growing almost geometrically (1 publication in 1989; 477 in 2012, (Black , 2013)).

The mechanisms of mindfulness include changes in neural networks underlying emotion regulation (Holzel et al., 2008); changes in self-processing (Vago and Silbersweig, 2012) which effects in strong relation between mindfulness and mental health improvement, stress defense, anxiety, depressive states reduction (Kabat-Zinn, 1982; Shapiro, et al. 1998) learning and memory processes, emotion regulation, self-referential processing, and perspective taking (Baer, 2003).

Despite the fact that mindfulness is generally reachable through education and training (typically retreat-oriented), we believe the brainwave patterns associated with the state of mindfulness can be induced or stimulated by outer stimuli such as specific landscape setting; also without the subject even realizing.

### 1.2 Hypothesis and aim of the Pilot Experiment

The presented pilot experiment is a part of initial stage of the project entitled '*Contemplative values of urban parks and gardens*' that aims to prove that there are certain characteristics of urban parks and gardens that can induce in the visitor the pattern of brain activity that is associated with contemplative or meditative states (mindfulness).

The goal of the pilot experiment was to revise the methods, evaluate feasibility, time, cost, adverse events, effect size and getting familiar with methods and equipment that allows predicting an appropriate sample size and improving the experiment design before a full-scale one.

All the steps taken across the framework process have been evaluated and tested. However the interpretation of results and explanatory effort has not been undertaken regarding to the EEG-Lab method, because the aim of this pilot is not proof of the hypothesis but the proof of concept and preparation for a full scale experiment.

The output of the Pilot was to observe the typical brainwave power spectra for the landscape settings that are considered to be contemplative, and attempt to track the tendency, if existent before the further experiments. There was no control groups included in the pilot, as its goal is purely methodical, and the EEG data obtained shall mean nothing regarding the proof of our hypothesis.

Nevertheless the questionnaire-based part of the framework is supposed to provide rigorous results that can be interpreted and used in forthcoming experiments.

## 2.0 METHODOLOGY

The applied method consisted of two major parts: (1) questionnaire-based and (2) laboratory-based.

In the first part we developed a questionnaire of contemplative attributes and attempted to evaluate a set of selected design landscapes in terms of those attributes. - The second part was intended to study brainwave patterns induced by the landscapes with higher contemplative attributes. The questionnaire-based part helped to select the proper material for the laboratory experiment, and the laboratory data delivered the empirical evidences concerning the effects of the selected landscapes on the brain. Both parts together contribute to the final explanatory effort.

### 2.1 Questionnaire / Checklist

After a deep study of the respected contemporary literature of architecture, landscape architecture and design in its broad meaning, all possible contemplative attributes of the landscapes were listed. As a 'respected contemporary literature' we consider books and papers that have been published during the last 20 years, in peer-reviewed journals and also books by recognized scientists (Smardon, F. Palmer, Felleman ;1986; Hermann, 2005; Krinke R. 2005 ; William J. 1992; Zelanski&Fisher,1996 Treib M, 2005;). These publications deal with the contemplative aspect in space design, and are usually the only source of knowledge about those aspects in the design of spaces. We understand the term 'contemplative attributes of the landscapes' as those characteristics of space that are intended to inducing contemplative states of mind in the visitors.

All of the listed contemplative attributes of the space were studied and divided into groups. We have distinguished 5 groups of attributes:

- 1) *physical attributes*, that are connected to the spatial composition and visual values (i.e. long distance views or geometrization of natural elements);
- 2) *psychological attributes* – how the space potentially makes us feel (i.e. 'sense of reorientation from', 'sense of solitude');
- 3) *archetypal elements* existing in the setting – those based on the findings of Carl Gustav Jung and his study on collective subconsciousness (Jung, 1991), such as *path, clearing or single old tree*;
- 4) *art&bio* characteristics that can be more or less intense such as *character of peace and silence* or level of *biodiversity*, and
- 5) the last group of attributes consists of classical division of the landscape's composition into six main types: *canopied, enclosed, feature, focal, ephemeral and panoramic* (Smardon, 1986).

A 52-item checklist based on that list was created and organized in five parts including all of the contemplative characteristics found in the literature (Table 1).

**Table 1 Checklist specification including division into parts, response scheme; number of items and the reliability expressed by the percent of overall agreement for each part (21%-40% - fair agreement, 41%-60% - moderate agreement, 61%-80% - substantial agreement, 81%-100%-almost perfect agreement (Fleiss,1981))**

	<i>Group</i>	<i>Response scheme</i>	<i>Nr of items</i>	<i>Percent of overall agreement</i>
<i>Part A</i>	Physical attributes	Nominal (Y/N)	23	70%
<i>Part B</i>	Archetypal elements	Nominal (Y/N)	12	90%
<i>Part C</i>	Art & Bio attributes	Likert scale (1-5)	4	40%
<i>Part D</i>	Psychological attributes	Likert scale (1-5)	12	30%
<i>Part E</i>	Landscape type	Nominal (a-f)	1	60%
	<b>Total</b>		<b>52</b>	<b>60%</b>

We have selected three urban parks that have been built during past 50 years and provide biggest possible number of various settings. (Parque de Cidade, Serralves (Porto/Portugal) Parc Andre Citroen (Paris/France). However the selection of parks isn't most relevant as we evaluate settings, not parks. During several site visits we established a big photographs collection of random photos taken during a regular walk in the park. We tried to take a photo everywhere accessible for the visitors, and all the settings and views were included. We made sure the light conditions are equalized on each photo, therefore, we took photographs with a white-sky weather conditions. After removing photographs with a repeated content we had the collection of 50 photographs, that were then forwarded for further evaluation of the Jury panel.

Selected landscape settings were evaluated by four independent experts, representing the space design profession. They were instructed to give the most objective answers to 50 selected photographs, according to their professional experience and knowledge. Photographs were displayed to them on the PC screen, there was no time limit for the procedure.

## 2.2 EEG-Laboratory

The second part of the study consisted of a laboratory-based EEG passive task, one condition data collection. Nine healthy subjects, 4 females, age ranging from 25 to 35 years old, were tested with an Emotiv EPOC, 14-channel headset (researcher version). All participants provided informed consent.

The experiment took place in a closed dark room<sup>1</sup>. The 15 photos of landscape settings rated highest by the panel of experts in terms of contemplative attributes were displayed to the subjects, for 8 seconds each; in a 21 inch computer screen, placed 70 cm in front of the place where they were sitting. Subjects were instructed to relax, focus on the setting and imagine that they were there.

The EEG recordings were performed in a laptop computer running MAT-lab EEG acquisition software in Windows 7; Raw EEG data was processed and analyzed with the *EEG-lab* toolbox, then the signal was de-trended and offline-filtered. Average scalp maps for different power bands across all subjects were obtained and, because of a small number of subjects, scalp maps of different power bands for each subject were also analyzed. Finally, EEG asymmetry was explored through the average powers across all subjects for frontal electrodes (electrodes F3, F7 for left and electrodes F4nF8 for right hemisphere), and subtracting left from right alpha-power.

<sup>1</sup> Indoor environment of the experiment helped avoiding serious noise-contamination of the eeg signal.

Theoretically, the used equipment allows taking it outdoors, due to its wireless function, so it may seem a better solution because of the "full perception" of the landscape. Nevertheless, the noise ratio recorded by Emotiv outdoors is very high and seriously contaminates the record. Secondly, the number and intensity of the stimuli occurring outdoors would not be controllable during the experiment. The study is dealing with the design strategies and only visual attributes of the space, therefore the indoors character should not be considered as a limitation.



### 3.0 RESULTS

The results are separate for each part of the study, and only after compared in the stage of conclusions and explanation.

#### 3.1 Questionnaire results

As a result we obtained the ranking list of 50 evaluated landscape setting according to their contemplative values. The highest score was 55% , and the lowest was 27,5%. We also obtained 50 files of datasets, one for each photo, with a detailed description of its contemplative values, and attributes. Examples of those datasets are presented by Figure 2.

We were then able to select 15 most contemplative and 15 least contemplative settings out of the ranking, for further study with the EEG methods (identifying the brainwave response between the block of most contemplative compared with the block of least contemplative settings).

The checklist showed a substantial inter-examiner reliability rate measured with the percent of overall agreement of the jury panel ( $P = 0.61$ ) (Fleiss 1981) (Table 1). The reliability was also measured for each of the five parts of the checklist (Table 2). Selected 15 settings from the top and from the bottom of the ranking, showed a statistical difference  $t(28) = 22.9, p < 0.00001$ . It means that photos evaluated as most contemplative are statistically proved to be different from ones evaluated as least contemplative.

#### Example 1



##### Part A (physical attributes)

long distance view, universalism in design, large empty space, smooth land form, natural asymmetry, contrast with surrounding urban landscape, openings and closings of the views, explicit spatial order, physical and visual relations are worked out, warm color tonation, stimulation to look up towards the sky, simplification of form, visibility of shade movements along the daily cycle, seasonally changing vegetation

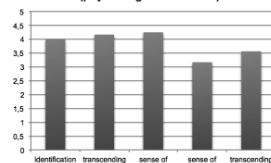
##### Part B (archetypes)

clearing, forest

##### Part C (art&bio attributes)



##### Part D (psychological attributes)



##### Part E (landscape type)

Panoramic

#### Example 2



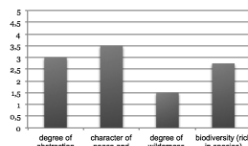
##### Part A (physical attributes)

Long distance view, universalism in design, signage elements in the hierarchical relation to each other, geometrical use of some natural elements, contrast with surrounding urban landscape, opening and closings of views, explicit spatial order, physical and spatial relations are worked out, warm color tonation, simplification of forms, repetition, seasonally changing vegetation, space enclosed

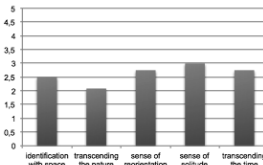
##### Part B (archetypes)

path

##### Part C (art&bio attributes)



##### Part D (psychological attributes)



##### Part E (landscape type)

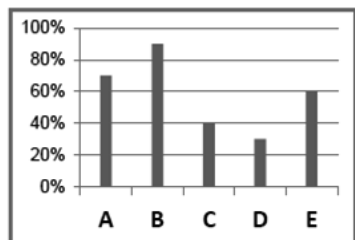
Focal

**Figure 2. Evaluation of landscape settings based on the results of the checklist (2 examples out of 50; contemplative attributes-oriented datasets)**

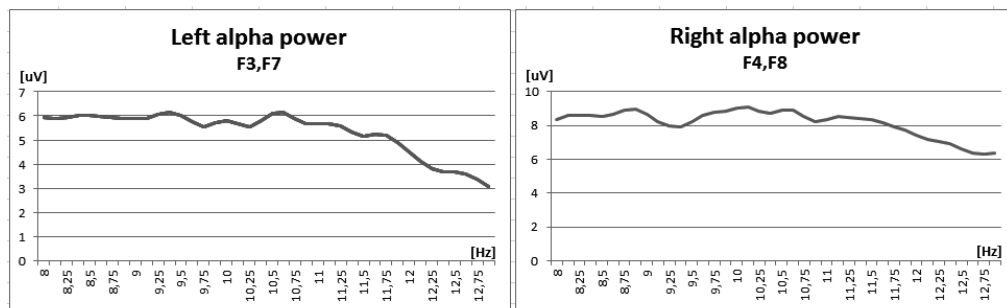
#### 3.2 EEG-lab results

In figure 3, we show the average (across all 9 subjects) scalp maps for all power bands (delta, theta, alpha and beta). These maps clearly show hemispheric asymmetry, with higher power in the right frontal lobes. Also, we can notice that the average maximal power of alpha brainwaves (10,8  $\mu\text{V}$ ) is higher than beta brainwaves (6,5  $\mu\text{V}$ ) (see figure 2).

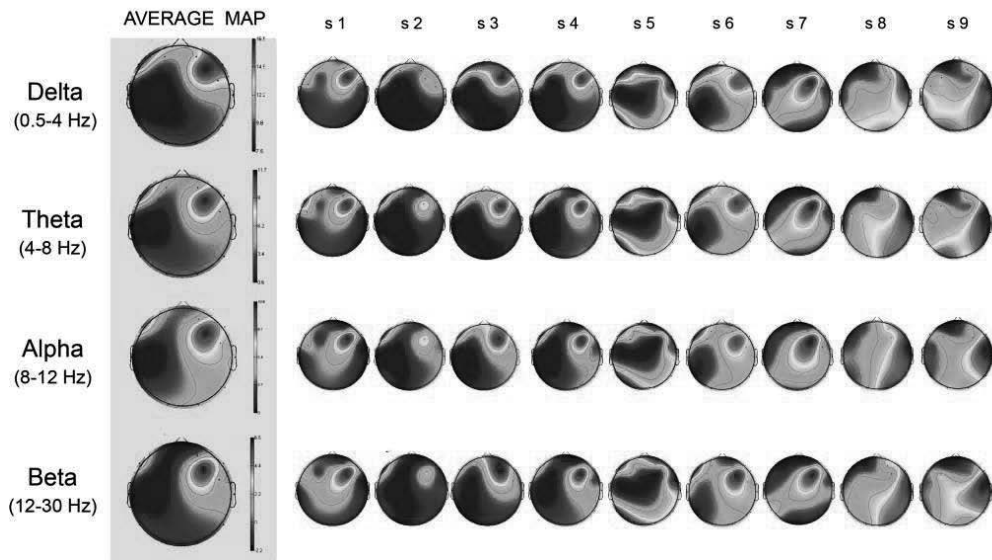
The alpha power spectra for left and right frontal lobe electrodes across all subjects, while observing the landscapes show lower alpha power in the left hemisphere (approx. range 3  $\mu\text{V}$  - 6  $\mu\text{V}$ ) than in right hemisphere (approx. range 6  $\mu\text{V}$ -9  $\mu\text{V}$ ) (see figure 3).



**Table 2.** Percent of overall agreement [%] for each part of the checklist (A,B,C,D,E)



**Figure 3.** Alpha power spectra for left (F3 and F7) and right (F4 and F8) frontal



**electrodes**

**Figure 4. Scalp maps for different power bands (alpha, beta, delta and theta) , average maps across all nine subjects and specific maps for each subjects, contributing to the average. Each scalp map is an average across all displayed photos.**

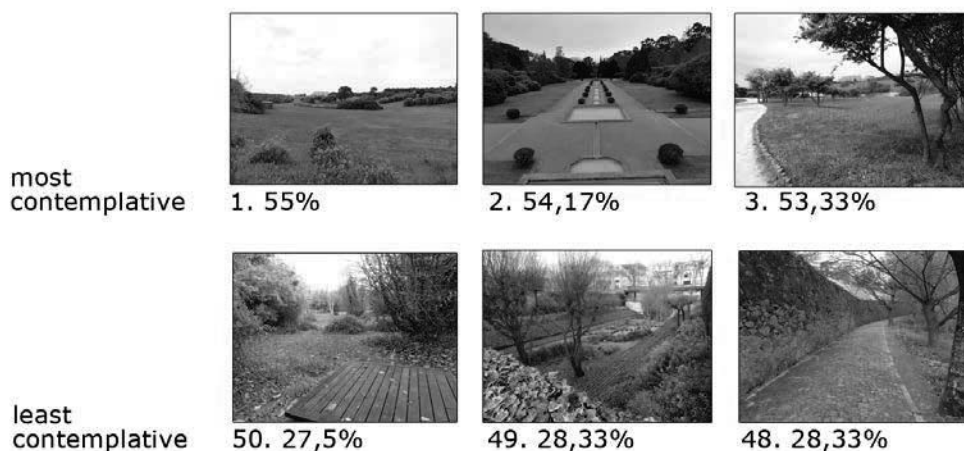
**4.0 DISCUSSION:**

The first part of the study (questionnaire based) provided us with the data describing 50 selected photographs of urban parks and gardens in terms of contemplative attributes of spatial design. Thanks to the applied scoring system we were able to rank them in terms of contemplative values. The primary gain of the first part of the study was the ranking of landscape settings and the checklist-framework that showed substantial reliability and therefore can be used in further experiments.

Showing 15 top-ranked photographs to the subjects, recording their EEG signal, analyzing it and comparing to the existing scales and measures of mindfulness led us to the finding that there is a similar response to all of the photos across the subjects.

The ranking of landscape settings shows, that the common attributes for 10 settings evaluated as mostly contemplative are those characterized by: long distance view (more than 400m), large empty space, smooth landform, natural asymmetry, contrasting with an urban type of landscape, openings and closings of views were worked out, stimulation to look up to the sky, simplification of forms, and seasonally changing vegetation. Their main archetypal element is clearing. They are all characterized by a high character of peace and silence and biodiversity, and low degree of abstraction and wilderness. They represent panoramic or focal type of landscape.

On the other hand the least contemplative settings are usually lacking most of the physical attributes of the contemplative space, the main present archetypal element is a path. The character of peace and silence as well as biodiversity is lower, but degree of abstraction is higher. They usually represent an enclosed type of landscape composition. Three most contemplative settings and three least contemplative settings are presented below, Figure 5.



**Figure 5.** Most and least contemplative settings, with a number in the ranking and scoring based on the contemplative attributes.

Once again we want to underline, that the experimental part results will not be interpreted and explained on this stage of research, because of the pilot character of the experiment, and too many limitations, the explanatory effort would not be accurate. Nevertheless, the experiment carried out proved the concept, and can be repeated with bigger sample size and number of conditions. The success of the pilot is to find out that we are actually able to produce a measurable and explicable data through applied framework. Further research on the mindfulness will bring answers on how to interpret the data, and what to look for in the EEG brainwave recordings.

#### 4.1 Main limitations

Most of the limitations are mainly due to the initial stage of the study which involved only 9 subjects (while a regular experiment should involve around 30 subjects). Also, the performed experiment had only one condition (‘most-contemplative landscapes’ condition), while it should be compared with ‘least-contemplative landscapes’ condition). The limitations of the undertaken method are also increased by the used equipment which is a 14-channel headset excluding midline electrodes and reported by some experts as registering high noise frequencies leading to low clinical reliability (Duvina et al., 2013).

The one limitation of the questionnaire-based part lays on the *psychological attributes* part of the checklist, which performed the fair reliability rate (30%), and in the further experiments should have the form of an on-site questionnaire with at least 40 respondents.

#### 4.2 Main contributions

The presented experiment is an innovative initiative joining together the insights of landscape architecture and design disciplines with neurosciences and the traditions of mindfulness meditation. The development of the performed experiments can prove that there truly exist design strategies that can help induce the brainwave patterns typical for mindfulness in the visitors (city inhabitants), which, in further perspective, can influence the improvement of their mental health and well-being. The results of the research can contribute to better understanding of spatial perception and its influence on people, promoting mindfulness, as well as re-defining the term *genius-loci* and demystification of design practice.

#### 4.3 Conclusions:

Even though our study is on initial point (pilot experiment stage), our findings differ from what we know as a “landscape preference” (Kaplan&Kaplan, 1998).

Nevertheless, our aim is to remain independent from already known methods of landscape evaluation by “do you like this landscape?”-surveys. Restorative or mindfulness mechanisms in

our brains are unconscious (unless we are meditation practitioners); this is why the subjective response might be misleading for the landscape evaluation. Also, number of respondents do not really know what they feel about some certain landscape; their more or less extended knowledge about photography or composition can be misleading too. Finally, we do not procure the landscape settings that are likeable, but ones that can have a particular influence on our brainwave patterns, and therefore provide a design tool contributing to improvement of quality of living in the cities, and improvement of health and well being.

Further experiments following the checklist-based part, should be conducted with extended number of independent experts, and in a laboratory environment. Finding out the brainwave patterns associated with mindfulness present during observing the contemplative settings, and finding how it differs from response to non-contemplative landscapes, can significantly contribute to this research as well as scientific evolution of design disciplines.

Effects of our study can be part of the innovative space design policy, having in mind the mental health improvement in the city environments, and designing spaces in order to reduce stress and mental fatigue of people. Confirmation of our hypothesis will also give artists and designers an important tool – scientific confirmation of beneficial influence of art on our lives.

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# Reinterpreting Architectural Education: Exploring Methods for Incorporating Sustainability Themes

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**ABSTRACT:** This paper explores prospective means of incorporating sustainability and green building themes into formal architectural education. By unpacking and understanding the most common and perceived successful methods of including these themes in curriculum, suggestions can be made to steer and capitalize on the effective integration of sustainability and green building topics within the framework of architectural education.

Grounded theory methodology focuses on the generation or discovery of a theory to develop a framework for further research in a field where no strong, generally accepted theories exist (Strauss and Corbin 1998; Creswell 2007). The topic of integrating sustainability into formal architectural education is a prime candidate for this type of exploration, as it is a field of great interest, but without a substantial theory. Referencing constructivist grounded theory, this study was framed in how individual faculty members and their groups of peers interact to create their perceived social constructs, thereby establishing a reality of their own processes and the familiarity of colleagues' processes. Through purposeful sampling, a list of potential participants included eighteen faculty members from different architecture programs around North America. Twelve were interviewed before theoretical saturation was reached. The data sets were analyzed through an iterative coding process, and resulted in themed categories and clustered data addressing the primary topic of interest and other sub-research questions. Core categories of *Student Engagement* and *Repositioning the Worldview* emerge from exploring relationships within the gathered data. It is perceived by study participants that the most promising opportunities for leverage in this arena include establishing frameworks for student reference, defining levels of context for projects, addressing differences in sustainability terms, engaging studio courses, and integrating themes across support courses.

**KEYWORDS:** Design Education, Sustainability, Pedagogy, Student Engagement

## INTRODUCTION

As emphasis increases on sustainable and high-performance building strategies across realms, formal architectural education is striving to incorporate new ways of embracing green design into an already overflowing curriculum. Currently, the methods for incorporating these themes vary, ranging from vernacular design to ecological thinking to building science and more. By understanding and disassembling some of the most common and seemingly successful methods of this integration, such as teaching style, internal and external conversations, or material covered, guidelines can be framed to steer the effective integration of sustainability and green building topics within the architectural education framework. Establishing this knowledge base will better enable educators to prepare future generations of architects, who can make successful contributions to the world they inhabit as professionals. This paper reviews the results of a grounded theory study addressing this complex issue.

The term "sustainability" is used broadly and in a wide variety of contexts, and is frequently seen as synonymous with green building, while at the same time viewed as a blanket term without meaning. This paper takes the position that green building is only one component of true sustainability, which by definition requires no resulting negative impacts on the environment. While the terms sustainability and green design may seem to be used interchangeably throughout this paper, please note the slight nuances of each application, and that both scopes are actually different.

A few select accredited architecture programs around the country have established themselves as leaders of the sustainability and green building movement by incorporating environmental education within their design programs; sustainability and green building issues are arguably viewed as integral to every course and not as a separate concentration for study. Other programs have begun to offer select courses as electives, but have not reached a level of full integration. The methods of incorporation vary, and have corresponding results. This exploration provides insight into how sustainability and green building themes can be productively and strategically integrated into formal architectural curricula by individual faculty members and peer groups, and suggests avenues for further exploration.

## 1.0 LITERATURE REVIEW

Given that the audience of this work is familiar with the development of architectural education standards and methods, this topic will not be reviewed in depth here. Nor will the associated topics of ecological literacy, architectural education assessment, environmental education, or environmental rhetoric, though they were all reviewed as a part of the original scope of this study. Instead, the focus of this paper will be on applicable literature in the field of Curriculum Design. One of the main topics addressed within education literature concerning curriculum evaluation is the question of what particular qualities are being evaluated during curricular reviews. In the humanities, it has been proposed that the importance is placed on the content of courses, rather than on the application of skills when the program is complete (Helm 2000). Literature also notes that is important to look at the true goals of the curriculum, rather than the particular content and topics covered in courses (Ibid). This curricular approach favors the creation of core values and foundational training instead of catering to upper level applied skills on a weaker foundation, and does not place value on the regurgitation of facts and skills in the absence of critical thinking.

The issue of quality management is also important in the evaluation of curricula and is well covered in education journals, outside of design and architecture. Some education experts separate curriculum issues into three specific aspects including *quality of design* (QD), *quality of conformance* (QC) and *quality of performance* (QP) (Mergen, Grant et al. 2000; Widrick, Mergen et al. 2002). The *quality of design* category relates to how well the curriculum addresses the consumer's requirements, which, for design, would be the professional field and potential employers. The *quality of conformance* addresses how curriculum satisfies design requirements and conventional touchstones, such as the employment rate and pay achieved upon graduation. And the *quality of performance* addresses the satisfaction of the end user, in this case the student's satisfaction with their education experience.

Similarly, Gilbert (2004) identifies three levels through which some research programs, such as doctorate programs, can be evaluated: quality of individual projects, as viewed by both the professors and the students; the quality of the field of study itself and contributions to that field; and the completion of particular indicated goals, as well as the intrinsic worth of those goals as a foundation. Both frameworks identify three major – and similar - criteria applicable to all educational fields: contributions to the profession, contributions and service to the field, and student satisfaction. Architecture and design are often viewed as non-traditional in higher education circles due to the role of studio in instruction, and the alternative culture that results. However, despite this uniqueness, architectural education can still be viewed through this established three-part framework of product, process, and experience.

In addition, three primary perspectives must be reflected when looking at curriculum: the final product, such as the final project in a studio course; the process of getting to that final product and the issue being explored; and the individual's experience through the journey. These three perspectives can also each be viewed through an *intrinsic* or *extrinsic* lens (Ibid). *Extrinsic* matters address the final “pay-off” of a program, such as achieving stated objectives and goals; *intrinsic* matters speak to “questions about the worth or value of the stated objectives themselves” and question other outcomes that may not be addressed in published objectives (Gilbert 2004).

Another framework helpful to establish a foundation for course development is Backward Design, described by Wiggins and McTighe (2005). This method identifies the goal of the



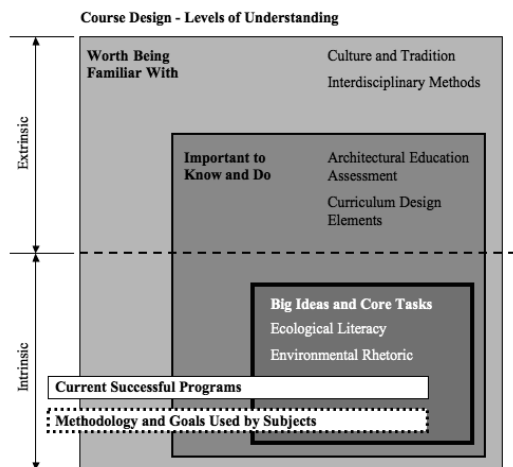
course first, and then ascertains what elements of the class can support the students reaching that goal, thereby boosting the students' level of true understanding of a core issue (Ibid). The concept of understanding content is central to the course development process and highlights 'big ideas' to prioritize learning, similar to the intrinsic issues noted earlier (Gilbert 2004). This also mirrors the *Quality of Design* categories reviewed by Mergen et.al (2000). Wiggins and McTighe's framework (2005) is similar in its emphasis on the importance of core values, as mentioned repeatedly in the literature (Helm 2000; Mergen, Grant et al. 2000; Widrick, Mergen et al. 2002; Gilbert 2004). The reviewed literature highlights the significance of the development of core values within curriculum, tiered information, and establishing larger goals within programs.

## 2.0 CONCEPTUAL FRAMEWORK & RESEARCH QUESTIONS

The conceptual framework for the original exploration scope can be seen in Figure 1. This illustration references the framework reviewed previously and outlined by Wiggins and McTighe (2005) in their Understanding By Design methodology in the three large boxes. Within that framework, relevant topics to the larger research scope are included: *Sustainability Themes in Design Education, Environmental Education, Current Program Review, Curriculum Design and Assessment, Architectural Education Assessment, Cultures of Architectural Education, and Environmental Rhetoric and Architectural Education*. It is proposed that programs successful at green building integration span effectively across these different zones of understanding, therefore integrating with the different topics. Particularly, the research explored where certain teaching practices fall within this continuum and how faculty engage this framework, illustrated by the lower dotted bar.

The primary research question of the larger study was: *What methods are being used to successfully incorporate sustainability and green building into architectural curricula?* This question was meant to explore how such themes are currently used in architectural education, and which approaches are perceived to be most successful by the participants (instructors). Because of the stringently prescribed course load for accredited architecture programs, a particular area of interest becomes how non-traditional threads such as sustainability and green building themes can be included.

A number of subquestions were included in the original study as well, but this paper will concentrate only on the first series of sub-questions: *What elements are necessary for a successful course? What type of instruction is most conducive to sustainability integration?* In other words, what are the "big ideas" identified by successful faculty members? What are their goals? Are participants working toward a true understanding of the information as defined by Wiggins and McTighe (2005) by uncovering big, transferable ideas with enduring value? Such questions look toward the core intent of the course, and the guiding principles by which it is designed.



**Figure 1:** Conceptual Framework

### **3.0 METHODOLOGY**

Qualitative research studies objects in their natural settings accounting for context and everyday life (Groat and Wang 2002), making this approach fitting for this exploration. In qualitative exploration, researchers concentrate on attempting to understand how the participants are making sense of their own experiences (Ibid). The value in this thread of research is in the capacity to establish a deep understanding of real-life situations and settings through “thick descriptions.” (Ibid) This also requires the flexibility to alter the focus or collection methods, as new elements are uncovered throughout data gathering and analysis. However, because of this flexibility and responsiveness to unique circumstances, there are no firmly established procedures and protocols, requiring considerable adaptability from the researcher (Ibid).

#### **3.1. Research Strategy: Grounded Theory**

This exploration aimed to identify emergent theories pertaining to the integration of sustainability and green building themes within architectural curricula. The grounded theory methodology focuses on the generation or discovery of a theory to develop a framework for further research in a field where no strong, generally accepted theories exist (Strauss and Corbin 1998; Creswell 2007). The central phenomena of interest in this exploration are the experiences and perceptions of individual architectural faculty members as they strive to integrate sustainability and green building themes into their courses and curriculum. Research and literature addressing this type of integration are under-represented. Therefore, the topic of integrating sustainability into formal architectural education is a prime candidate for a grounded theory study.

The goal of this exploration was to extract each participant’s individual perspectives about integration methods through in-depth interviews and personal narratives. By establishing a detailed understanding of participants’ educational methods, patterns of experience may be unearthed to provide further understanding. Researchers undertaking grounded theory studies are frequently told to enter the field free of preconceived notions and motives (Groat and Wang 2002), though Charmaz (2006) encourages a social constructivist perspective, accepting the constructed realities of a particular group through common views and values. It is necessary to appreciate both the direct experiences of the participants (instructors), but also to comprehend hidden networks, situations, and relationships as understood from their perspectives, in addition to realizing hierarchies, opportunities, and communication (Creswell 2007). Because some of the lesser-discussed qualities of architectural education such as biases, leadership, and tradition are being addressed, it is appropriate that it be based on a social constructivist theory.

Grounded theory is iterative, permitting the initial open-ended data collection to guide the processes following; the data collection, data analysis, and theory building happen in unison (Groat and Wang 2002). By superimposing rigor and established processes onto a qualitative approach, Glaser and Strauss established a research methodology in grounded theory that closely fit with gathered data, was useful, had conceptual density, showed durability over time, was modifiable, and was explainable (Glaser and Strauss 1967; Glaser 1978; Glaser 1992; Charmaz 2006).

#### **3.2. Participant Selection**

For grounded theory studies, literature suggests that the participant sample is rooted on the participant’s individual contribution to the development of a theory (Creswell 2007), or theoretical and purposive selection (Schwandt 2007). This bases the participant selection on relevance to the research question instead of population representation (Ibid). Given this, a purposeful sample was used to establish an initial pool, which included a number of faculty members within accredited architecture programs from around the United States popularly thought to be incorporating sustainability themes within their courses, and was not interested in representing specific populations such as race, gender, age, etc.

Because not many organizations are concentrating solely on the incorporation of sustainability and green building themes into architectural education, and the overall pool of engaged faculty members is comparatively shallow, two particular organizations were used establish an initial

participant pool that capitalized on both engagement and expertise. The populations of these leading organizations overlapped, and thereby established the foundation for approaching participants, and provided five names for initial contact. To increase the number of the initial pool, additional contacts were identified through participation in email listserves with postings specifically referencing the integration of sustainability within formal architectural education. Eighteen potential participants from different schools around North America were included on the final list. Suggestions for additional participants were requested at the end of their interview. This allowed for supplementary snowball sampling, and these suggestions were used as needed.

A total of 49 potential subjects were identified; a total of 12 were interviewed. Though ten participants is typically on the lower end of acceptable sample numbers, the data gathering process indicated that ten participants achieved theoretical saturation. The final two participants provided no new information, so interviews stopped with ten individuals. The final sample was comprised of ten faculty interviews with an additional and unexpected two interviews: one of a professional in sustainable design, and one studio faculty member holding alternative design philosophies. These individual interviews were supplemented by assorted document reviews (journal articles, project outlines, curriculum structures, and syllabi). Participants were approached through email, and asked about their interest in participating anonymously. A pilot interview was also held so help streamline the interview process.

### **3.3. Data Analysis Procedures**

Through the purposeful sampling and the interview process, descriptive data sets were collected to provide insight on the complex subject of incorporating of sustainability into architectural education. In grounded theory, the analysis of the collected data results in themed categories pertinent to both the central research question and the sub-research questions.

The data gathering process in grounded theory studies employs a constant comparative analysis. The initial stage is referred to as initial coding, or open coding, as outlined by Strauss and Corbin (1998). This step focuses on identifying emergent themes, categories, and concepts. After establishing primary categories, axial coding allows subcategories, properties, and dimensions of data to begin to link interactions to the primary categories and themes, establishing clusters of supporting evidence. Selective coding, the final phase, uses additional data to further detail the categories and relationships, creating an explanatory concept addressing the full range of perceptions and experiences surrounding the issue (Ibid).

The interviews were completed over a ten-week period, with the data gathered predominantly in the form of narratives. Interviews were digitally recorded and transcribed by a third-party service before the participants asked to review the content in an effort to maintain accuracy and the intention of quotes, words, context and thought processes. As the early discussions were examined and coded for initial themes, considerable unity emerged concerning the basic criteria and methods that participants used in integrating sustainable and green building themes in their courses. However, there was variability in personal experiences, factors, and feelings that were voiced in tandem with the approaches. This variability helped to form the interview prompts for subsequent interviews.

#### **3.3.1. Open Coding: Understanding Context**

Following the initial analysis process outlined by Strauss and Corbin (1998), the data that surfaced from the first interviews was gathered and then separated into detailed groups to better understand the complexities of the comments. The data were then compiled into associated groupings to establish a series of larger categories. The initial open coding process explores these emergent categories, as well as the properties and dimensions within each of these new categories. Tables were created to summarize the data, supporting the narratives and creating the thick description of the developing themes. Quotations were provided in support of these categories and themes as applicable. Throughout the analysis, and even in the first four interviews, the primary themes that emerged include *Cross-Campus Integration*, *Culture and Tradition*, *Framework Development*, *Student Activities*, *Faculty Involvement*, and *Integrated Curriculum*. Given this emergence of initial themes found early during open coding, detailed axial coding was conducted in light of the six initial categories. This paper will focus

solely on *Framework Development*, though even by only addressing this one theme, it is impossible to cover all the sub-content in-depth in this paper.

Table 1 illustrates the properties and dimensions found within the emergent category of **Framework Development**. One popular point of discussion was how specific terms are used to discuss sustainability or green building methods. All participants were hesitant to use or discuss **specific terms** such as sustainability, green building, carbon neutral, or regenerative. When asked specifically about terminology, many participants said that they either do not think about terms or specifically try not to use any of the terms at all. One participant shares, “I don’t teach about it, I teach the principles of it.” The participant’s point being that the larger movement is not defined by one term or another. Instead, there are underlying principles and values that define the subject better than any single term possibly could. Another participant supports this saying, “Basically, what we do in school is teach students the vocabulary of architecture.” In other words, principles and strategies are emphasized over the delineation of terms. A different participant, however, is happy to use and embrace whatever terminology comes up.

I love them all. It makes it interesting to talk about it because each one puts a little bit different filter on what you’re trying to do, and I think all the terms are descriptive of good paths. Architecture is such that there’s no right answer. I love the ambiguity of that.

Framework Development	
<b>Property</b>	<b>Dimensional Range</b>
<i>Rhetoric</i>	Specific terms, relationship of terms and knowledge
<i>History</i>	Not a new subject, static
<i>Understanding context</i>	History, priorities, financial
<i>Complexity</i>	Process, frameworks, creating priorities, research

**Table 1:** Category: Framework Development

Another distinct subject emerging throughout the interviews illustrates the conviction that sustainability themes are not new to architecture. These strategies have been included in designs throughout **history**. All participants felt strongly that sustainability is integral to design, and cannot be separated from what others may consider the subject of ‘design.’ To illustrate this, one participant relayed through a narrative timeline how sustainability concepts have been included in seminal pieces of design, often covered in history courses but without the mention of the sustainability elements, and how designers could in fact incorporate sustainable themes without compromising their elevated design intentions.

Participants supported an emphasis on interdisciplinary design by speaking about an increasing spectrum of considerations, and how they establish an understanding and **appreciation of context** in their students. One participant notes, “...they have to understand, ‘Okay, this is where we’re going. This is our goal.’” This illustrates the belief in presenting students with a possible path that addresses not only the decision making process and the considerations required, but also the end performance criteria of the building. In other words, there are opportunities, limits, and important context that must be considered in partnership with potential strategies.

Participants voiced varying opinions about the levels of **complexity** necessary to include in courses, as well as how to help students understand that complexity. One participant shares their take on how the educator and designer can manage layers of complexity and sustainability:

You are involved in a management process of getting control over complexity. You have to be very thorough in laying out the framework issues that you’re going to engage, and you have to be very articulate in presenting how you’re thinking about those issues as you develop your strategies and your transformations, so it’s a different approach.

This participant also addresses the issue of awareness:

We create our own problems the minute we make a gesture, make a choice, the minute we choose a material, a placement on the site, an attitude about the sun. Whatever attitudes we bring to the design, we are constraining, and influencing what next comes as design decision opportunities. So we create problems in the process as much as we're solving any problems.

Organizing complex problems is a strong theme articulated by each participant, often addressed by creating frameworks for establishing design priorities. Some participants establish the importance of energy from the beginning. As one participant states:

I would guess 95% percent of studio faculty do not understand solar geometry or solar responsive design. By sustainable, we mean buildings that don't use much energy. Everything else is immaterial. If we don't solve that, nothing else is going to count.

Similarly, another participant tells students that the focus is on carbon neutrality. "I'd say it's the most important issue we're facing right now." Establishing this prioritization initially helps students understand appropriate and meaningful implementations. Similar narratives from other participants show that, as a group, participants believe that the current design process, and the education of that process, does not address the current complex problems found in the profession.

### **3.3.2. Axial Coding: Categorizing**

The open coding process examined and reorganized the data, and established six related themed categories. The axial coding stage more deeply explores the nuances and detail of the emergent data. As the axial coding phase advances, the individual data pieces are re-contextualized through a continuous process of constant comparison, synthesis, and re-categorization. The relationships between the emergent categories that develop through the open coding process are analyzed during axial coding by exploring *Causal Condition, Phenomenon, Context, Intervening Condition, Action/Interaction, and Consequence* as described by Strauss and Corbin (1998). The Intervening Conditions of each category answer the questions of *why, where, how come, and when*. Actions/interactions of categories look at *by whom* and *how*. Consequences then look at 'what happens' in light of these actions/interactions (Strauss and Corbin 1998). Charmaz (2006) notes that the point of axial coding is for researchers to develop a framework to apply to their data gathering.

The axial coding process for the phenomena *Framework Development* is illustrated in Table 2. Each of these phenomena is explored individually by looking at a number of developing themes (contexts), outlined in an initial table. Following each table, the contexts are investigated individually by looking at the intervening conditions, actions, and consequences. We will look in depth only at Context 3.1 and 3.2.

Phenomenon	Contexts
3 <i>Framework Development</i>	3.1 <b>Simplified view</b> of elements and considerations are involved in current studio design projects.
	3.2 Issues for consideration (climate, structure, materials, teammates, goals, resources, etc) are given to the students <b>void of context</b> .
	3.3 The <b>building is an object</b> unto itself that can pull from and contribute to its surroundings as needed.
	3.4 The <b>creative process is unable to be defined</b> or guided; it is without structure and 'magical.'
	3.5 The <b>design process is typically linear</b> progressing from programming, to adjacencies, through extrusion from the plan, manipulation of form, to the engineer, and into final documents.
	3.6 Subjective assessment of products and <b>unclear learning objective</b> are primarily implemented in courses.
	3.7 <b>Extensive terms</b> and methods for addressing sustainability are being used in both academia and the profession, and few of them have a concrete definition.
	3.8 <b>Legislation</b> regarding any energy efficiency measures or green building implements is not regularly included in courses.

**Table 1:** Category: Framework Development

**Context 3.1:** Simplified view of elements and considerations are involved in current studio design projects.

- Intervening Condition: Experienced the actual building process, overlaid with holistic concerns of sustainability
- Intervening Action/Interaction:
  - As their interest in sustainability themes grew, faculty each actively sought to better understand an acceptable process and factors necessary for sustainable design.
  - Participants felt that by eliminating and simplifying so many issues into glossed-over issues in the studio, students would perpetuate these methods in practice and create additional environmental problems from built form.
  - As various and seemingly endless considerations were perceived to be needed for inclusion into the design process, the complexity of the problems became apparent.
- Consequence:
  - Broadening the scope of information provided to enable students to understand the enlarged scope of influences and impacts of their decisions.
  - Provide an understanding of the major systems at a global scale.

**Context 3.2:** Issues for consideration (climate, structure, materials, teammates, goals, resources, etc) are given to the students void of context.

- Intervening Condition: Experienced the actual building process, overlaid with holistic concerns of sustainability
- Action/Interaction:
  - Participants began to understand the complexity of the problem and sought to expose students to various established models and frameworks to help organize the issues in a coherent manner.
  - Through various categorization methods, participants felt students needed to better understand which methods and goals might be easiest to achieve.
  - Students needed additional organization and information.
- Consequence:
  - Faculty developed frameworks and reference points for students to use in their current design process and modify as they moved forward.

- Students were provided with various frameworks and alternatives for personal assessment and greater control of their design.
- Faculty began to prioritize and focus on selected strategies within courses.

### 3.3.3. Selective Coding: A Holistic View

Selective coding, the third and final coding phase, re-examines emergent categories from the first two phases, resulting in a core category explaining relationships between the established sub-categories. In narrative form, this progression explores the complexities of internal relationships between the categories and concepts. Explained by Strauss and Corbin (1998) as a final process to outline the “variation as well as the main point made by the data,” this final step creates a viewpoint from which to comprehensively view the data. During this process, the established narrative is repeatedly reviewed for logic and internal consistency. Linkages in the narrative address all outliers and variability within category dimensions, establishing logical connections between the dimensions and the developing explanatory narrative (Ibid). This reasoning and connectivity establishes credibility, as outlined by Eisner (1991), who posits that creating clear theoretical connections with strong coherence is important to grounded theory studies. The following narrative links together the themes relating to this paper’s question about implementation.

To begin to incorporate the **added complexity** inherent in sustainability, participants create **different frameworks** to provide necessary context in their courses. These frameworks are structured at different levels, from **overarching paradigms and philosophical stances to strategy matrices** for understanding design implements and their impacts. Participants believe that **various levels of context** are missing in existing educational methods, and as a result important topics are omitted. Understanding sustainability at a philosophical level allows students to **frame decisions** in all stages of their processes. Establishing an environmental context requires **connections, references and linkages** that are not obvious when the project is otherwise **viewed as an object** placed within a landscape.

**Studio is the most important venue** for sustainability themes, but the perceived divide between ‘champion’ faculty members and customarily **uninterested design studio faculty** is a massive hurdle. Traditional design faculty often do not address green building themes, **viewing the issues as additive and separate**; green-friendly faculty members are often approached to give a “sustainability spiel” instead of presenting the themes as **integral to the design process**. Programs in which multiple **building science faculty also teach studio** are often seen as being very strong in integration. **Support courses**, or other courses intended to complement studio through specific topics, are not the focal point of integration but are also important. Every course taught can have **sustainability feathered into its content**. While studio provides the most opportunity to holistically address sustainability themes, the support courses are equally as important in establishing the **foundational knowledge** to be used in studio. Architecture is a field of **ambiguous terms and subjectivity**, and the realm of sustainability follows suit. Participants do not readily use terms such as *sustainability*, *green architecture*, *carbon neutral*, and *regenerative design*, or others. Instead, the **principles of these themes** are the focus of instruction.

### 3.3.4. Emergent Core Categories

The analysis of the associations between categories and subcategories resulted in the recognition of two primary themes. Though Grounded Theory customarily tries to establish one core category, the larger exploration revealed two consistent themes as core categories, at two different levels: *Student Engagement* as a teaching method used by participants; and *Repositioning the Worldview* in relation to the culture, tradition, approach, and community. This paper predominantly addresses the second, *Repositioning the Worldview*, which works in concert with individual faculty methods for integrating sustainability themes into courses. Participants believe that crafting a holistic curricular response to the environmental demand for a new worldview in architecture is important. Recurring themes within the data relate to issues including a division of faculty, modified approaches to traditional subjects, changing demands of the profession, and the place of studio in the educational process. The *Repositioning the Worldview* core category mediates other emergent categories by identifying areas for possible

action regarding curricular and philosophical development. While many participants do not reside in programs exemplifying this holistic shift, their perceptions regarding such a transition are consistent. Participants believe that an architecture program would excel at sustainability integration by including elements such as: a level of respect and acceptance of sustainability themes by the faculty; increased communication about environmental issues; established standards by which to assess sustainability efforts; and increased engagement with other discipline. In this context, participants believe that programs have a better chance of becoming successful by critically assessing the position of their programs in light of these larger issues.

#### **4.0 FINDINGS**

Studio courses invite the most attention as the staple of architectural curriculum, and also provide the academic and creative space where students are engaged with the breadth of design concerns. Ideally, the knowledge that is established in other lecture and seminar courses is assimilated into a coherent design process within the studio setting. In agreement with the historical importance of studio instruction, participant narratives reiterate the significance, applicability, and effectiveness of the studio as a teaching space.

Beyond studio, no other course structures are favored regarding sustainability themes. While many of the participants were involved with environmental control (ECS) courses, they feel that these courses are often seen as token courses for sustainability. Though participants agree that sustainability should be addressed in ECS courses, they also feel that more is needed to address these topics. Ninety percent (90%) of study participants have been involved with ECS courses in their programs. Similarly, all noted that the faculty members typically most interested in sustainability are those most interested in building science. Participants feel that most faculty members actively interested in sustainability do not serve as studio faculty. In this exploration, despite 80% of the participants regularly teaching studios, they view their sustainability interests to be in the minority of studio instructors, and feel strongly that there is a perceived divide between studio and non-studio faculty, or – in schools where all faculty teach studio – design and non-design faculty. Faculty members interviewed believe design instructors share this view of a segmented faculty, distinguishing between “us” (designers) and “them” (others). This perception of faculty division is supported by the negative case interview, which regularly insinuated the existence of distinct “sides” or conflicting philosophies within architecture programs.

Relating successful studio experiences, participants frequently establish conceptual frameworks in studio courses to create context for students. Participants will relay an ordering methodology to students by identifying and prioritizing issues. These constructs serve multiple purposes: (1) to provide context in which students can work; (2) to help students manage the complexity of various issues; and (3) to establish a process for students to reference throughout their education and into practice. Some frameworks are abstract, created by the participants themselves, while others are tools established by others that participants feel are valuable. Many frameworks are geared at instilling foundational knowledge in the students; they are also predominantly process-oriented. Prioritizing real-world considerations, in partnership with formal design elements, guide the faculty in formulating instructional methods. There is a perceived dichotomy between the traditional product-oriented studio courses and the development of a design process. The former have traditionally resulted in problem-solving techniques related to adjacencies, site constrictions and constructability, while the latter critically reflects on the decision making process.

#### **CONCLUSION**

This exploration supports the view that including sustainability themes within architectural education is complex and multi-faceted. Interested faculty members are exploring ways to provide substantial, holistic information to students, while still working within the constructed boundaries of the architecture and design culture. The identified issues vary for each program, and are highly modifiable depending on context, faculty, university setting, initiatives, and student body. However, when looking at the incorporation of sustainability themes, integration should be explored at two levels: individual methods used in courses and the philosophical approach of the program and profession. In partnership, these two perspectives provide the most promising opportunity for the integration of sustainability themes within architectural



education. Specifically, interested faculty should explore opportunities in studio courses, establishing reference frameworks, defining context, and addressing differences in terms. Through the exploration of leading architectural educators in the field, this research has identified a number of areas as fundamental to a curricular shift. Areas of further research include: understanding negative cases and opposing viewpoints within architectural education; investigating the myriad of terms in the field, connotations and popular uses, including how they are shaped and perceived; exploring potential boundaries and considerations for developing a faculty identity within the context of architectural education; and communication patterns within architectural education and the profession, and how they differ depending on various participants.

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# Reorienting historic house museums: An anarchists guide

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**ABSTRACT:** Although other types of cultural sites are experiencing growth, Historic House Museums (HHMs) are seeing declining visitation, financial instability, and misguided Board stewardship. (Rocco 2013) All too often, HHMs are places where a well-intended docent points at obscure portraits, and gestures into barren rooms while sharing a seemingly fact-based, exclusive narrative about the great deeds of the great, white man who once lived in the home. There are few actual signs of habitation or the complexity of family life, and any opportunity for a shared, meaningful, and human connection across generations disappears in the stark museum atmosphere. Frozen in a pre-determined period of historic interpretation, HHMs fall harshly out of sync with the larger community as demographics change around them. They have become autonomous, self-referential and insular in an era defined by social media, mass communication and the collaborative process.

The well-meaning Board and staff leadership of HHMs, with expertise primarily in museum studies, history and collections management, is ill equipped to deal with either the contemporary understanding of context, or the civic engagement expertise of urban designers and architects. *The Anarchist Guide for Historic House Museums (AGHHM)* attempts to bridge some of those disciplinary boundaries and offers a comprehensive strategy for reorienting HHMs from a curated museum setting to a new paradigm of real-life habitation. This more inclusive *re-orientation* is organized under four guiding themes of *Community, Experience, Habitation and Shelter*, and is illustrated as *The Anarchist Guide for Historic House Museums Graphic Manifesto*

The Historic House Trust of New York City has tested the *AGHHM* concepts at several of its historic house sites. *AGHHM* inspired events have been undertaken at NYC's Morris-Jumel Mansion and have led to substantial increases in the number of first-time visitors, press, and funding/earned revenue. A follow-up study funded by a \$100,000 grant from the New York Community Trust is now underway to design, launch and evaluate an *Anarchist Plan* for the Latimer House Museum in Queens. The former home of African-American inventor and electrical pioneer Lewis Howard Latimer, the house is located in what has become a Chinese/Korean community, and offers a compelling narrative that has the potential ability to bridge the past and the present, and act as a center of social history, explorative experience and common identity.

**KEYWORDS:** historic, house, museum, community engagement

## INTRODUCTION

House museum professionals are struggling to find answers - ways to make house museums meaningful and relevant to diverse 21<sup>st</sup>-century audiences. The fallacy of this exercise is that perhaps house museum professionals shouldn't try to do it alone. - Rachel Abbot

There are over 15,000 Historic House Museums (HHMs) in the United States. The organizational health of most of them is in decline. Frozen in a pre-determined "period of interpretation", many are viewed as irrelevant and unresponsive having fallen out of sync with the changing communities that surround them. HHMs have become out-dated, autonomous, and insular, a detrimental condition in a modern era characterized by easy communication and collaboration. (Vaghn 2008)

All too often, HHMs are places where a well-intended docent points at portraits, and gestures into barren rooms while sharing a seemingly fact-based, exclusive narrative about the great deeds of the great, white men who once lived in the home. There are few signs of habitation or the complexity of family life, and any opportunity for a shared, meaningful, and human connection across generations disappears.

The critique of HHMs is not new. In 1998, the Philadelphia Athenaeum's symposium focused on the challenges then being faced in HHMs, as did Moe's influential 2002 article: "Are there too many house museums?" (American 1998 and Moe 2002) Their shared ideas came together in 2007 when national leaders of historic sites gathered at the Kykuit National Historic Site to discuss these and other challenges being experienced by their institutions. In response, the attendees stated that innovation, experimentation, and collaboration would be essential to HHM sustainability, acknowledging that success would be dependent on the local leadership's willingness to change its structure, programs, and services, and generate more varied ways to utilize their resources to enrich people's lives.

Towards that goal, the Historic House Trust of New York City (HHT) is working to address the disconnect between time, place and shared experience, and is experimenting with new ways of operating house museums. The organization is a nonprofit that operates in tandem with the New York City Department of Parks and Recreation to aid in the preservation of 23 city-owned historic properties located in public parks in all five boroughs. This out-of-the-box thinking is expressed in the organization's Mission Statement:

Historic sites are not static antiquities – they are living institutions uniquely poised to address current issues while retaining their connections to the past. HHT is therefore dedicated to preserving its member sites, protecting their collections, engaging diverse audiences, educating visitors and sustaining the nonprofit organizations that operate the houses. (Historic, 2013)

## **1.0 THE ANARCHIST GUIDE TO HISTORIC HOUSE MUSEUMS**

The *Anarchist Guide for Historic House Museums (AGHHM)* was developed out of frustration with the traditional, existing museum perspective on the operations of HHMs. These best practices seemed to hinder innovation and experimentation as they were developed from the perspective of artifact and collection management rather than visitor experience. Consequently, the *AGHHM* advocates for the holistic re-examination of the current HHM model of seemingly pristine preservation to one that inverts traditional museum operations and encourages a shared experience through the expression of human habitation. We use of the term "Anarchist" not to be merely sensational, but rather to reflect the systemic and fundamental changes needed to address the dire extent of problems most Historic Homes now face. We seek to politely rebel against the well-meaning but increasingly irrelevant rules that typically define the Historic House Museum experience.

We advocate for a comprehensive strategy from a shared authority that reorients HHMs towards a more diverse audience borrowing state-of-the-art community engagement, experience and habitation tactics from urban design, public art, film and experiential theater. (Ryan and Vagnone, 2013) This more inclusive *re-orientation* of HHMs is demarcated through an evolving list of 24 concepts and 30 tactics organized under





Anarchist Guide to Historic House Museums: Finding the Poetic in Other People's Homes		
Engage mind/body/neighborhood/city/world Don't talk about your stuff - ask about theirs Avoid the bait-n-switch and "one-offs" Don't be afraid to fail		
AGHHM Category	Concepts	Tactics
<b>SHELTER (architectural)</b> <i>the building of the home</i> 	wealth location politics age authentic operations	Be honest about the illusion of authenticity Embrace contemporary vistas and neighborhoods as a form of condition preservation Stop treating everything like a Rembrandt - because everything is not (unless you actually have one) Use multiple theories of preservation in the same historic house museum (not purist) Remove all "black holes" in the physicality of preservation of the building and grounds. Recognize the ebb and flow of the physicality of a structure (use as well as maintenance) Trace building materials from origin through use (labor/social/cultural) Consider "universal access" as a part of preservation
<b>HABITATION (physical)</b> <i>the furnishing of the home</i> 	EATING (taste) COOKING (smell) SPEECH & HEARING (sound) HANDS & FEET (touch) SEEING (visual) life cycle health garments daily cycle gender social	Create environments that are natural and about habitation appropriate to the narrative Create environments that reflect all day cycles (sleep/wake/ day/night/light/dark) Utilize complex and non-pure collection relationships (multiple eras represented) If appropriate, embrace clutter objects as part of the curated interior (clean/mess) Strive for a "N.U.D.E." expression of habitation (Non-linear, unorthodox, dactylic and experimental) Believe in the intelligence of the guest Create habitation from several viewpoints at once (adult/child/servant/slave/dog/visitor) Create habitation through "movements" not stage-sets Pay particular attention to "USE" as a determining factor in curated interiors
<b>COMMUNITY</b> <i>the home within its context</i> 	representative persons and lives historic and current events historic and current economies gender	Be welcoming (signage, languages, social & cultural interests) Investigate the neighborhood "six football fields" around the HHM (languages/ethnicities/culture) Locate "Reverse Affinity Groups" - find out what is wanted and provide it Undertake a strategy of "Seven Touches" and send visitors away with a parting gift Capitalize on all forms of personal "fingerprinting" - use social media as a form of conversation/dialogue Set up a citizens advisory group - listen - substantially modify historic house uses as needed Set up one day a month as a "community day" and spend it outside of the HHM
<b>EXPERIENCE (behavioral)</b> <i>the home-life</i> 	social and personal seasonal social order and activity	End the passive tour - choreograph the experience to represent real life De-centralize the experience to allow visitors to feel a sense of ownership Kill the silence - engage all of the senses in creating an holistic experience Eliminate all denied spaces by making the movement through the house as real as possible Fully consider tactility of the building and the collections Fully embrace the concept of simultaneity, conjecture, rumor and gossip to expand the experience

Figure 1. The *Anarchist Guide to Historic House Museums*. Source: Vagnone and Ryan, 2013.

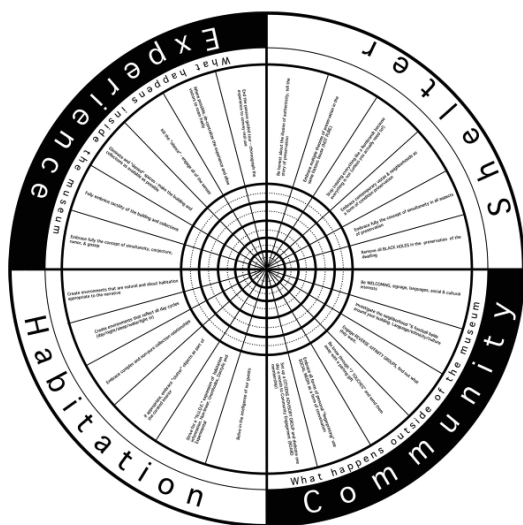
four themes of *Community*, *Experience*, *Habitation* and *Shelter* (Figure 1). When addressed simultaneously, these themes can produce a new genre of historic house museums that is an expression of the community and embraces the visitor experience through tactile engagement than more traditional, best museum practices.

*Shelter* tactics question expensive, pure notions of preservation. Instead of restoring every house according to the highest standard, HHMs would adopt a spectrum of condition and be honest about the illusion of authenticity. Multiple theories of preservation and conservation would be employed and preservation work would be seen by visitors while underway. Unpreserved parts of a building would become areas of teaching and inspiration, rather than remain hidden and off-limits. HHMs would embrace the fabric and energy of the current context instead of operating in an imagined, pastoral past.

*Habitation* tactics in the *AGHHM* introduce radical changes to historic house interiors by encouraging a experience that relays the anachronistic realities of historic interiors shunned by frozen-in-place furnishing plans. With the *Anarchist* model, the specific items that populate the house would often change, like they do in any house, to suggest the rhythm of household life - seasons, celebrations, room function, births, and deaths. Objects placed in the HHM would contribute to both the historic context and the current vitality of the space through actual use, rather than deaden it by their untouched permanence.

The seven tactics under the *Community* theme of the *AGHHM* prioritize relationship building, and the development of relevant narratives with local communities. Collections and research would no longer solely dictate docent-led tours and programming. Instead, HHM staff would identify and approach "reverse-affinity" neighborhood groups that heretofore have had little connection to the historic site, identify shared interests, with their members, and build new narratives that make the sites more relevant to local communities. By building on the interests of reverse affinity groups, HHMs can increase their visitation by expanding their mission to house soup kitchens, provide community meeting rooms, space for learning new skills/languages/trades, and exhibition/gallery spaces. These new functions can then be melded with the collections and historic narratives to create an entirely new model for connecting communities to their local historic sites.

*Experience* based tactics in the *AGHHM* promote the loosening of the boundaries that separate visitors from the HHM, and the increase of sensory engagement. Just as the earlier inhabitants of the HHM had free movement throughout their home, so too should today's visitors. Narratives about members of the family and household would be shared, not just the head of the household. Rumor, gossip and conjecture within the narratives would be embraced, acknowledging the holes in primary, historic source material. Very little of the HHMs' collections would remain in locked, glass cases, or behind velvet ropes; almost everything would be accessible. Engaging visitors' senses through light, scent and sound installations would bring the house to life and encourage visceral, immediate connections. Simply put, HHMs would feel like homes, not museums. Visitors would feel more like welcome and invited guests, rather than intruders onto a frozen stage set.



The *Anarchist* tactics are depicted in a *Graphic Manifesto* circular plan intended for use as a self-assessment tool. (Figure 2) The concentric rings allow for a recording of up to five HHM initiatives for each of the tactics by coloring in the applicable components of the graphic. A successful and balanced *Anarchist* approach with multiple initiatives underway would result in marks growing concentrically from the center. An evaluation of an HHM adhering to a more traditional model of docent-led tours through pristinely restored interiors would result in very few marks.

Through these four guiding principles, the *AGHHM* inverts the typical house museum approach with a reiterative process intended to build relationships,

inclusiveness, access and interest. In doing so, the *AGHHM* is potentially a groundbreaking effort to promote and measure innovation in historic house museums across the United States.

**Figure 2.** The *Anarchist Graphic Manifesto*. Source: Vagnone and Ryan, 2013.

## 2.0 TESTING AND DEVELOPMENT

The *AGHHM* has been developed through and tested in architectural studios, museum studies programs, and preservation classes at the Cooperstown Graduate Program, the University of North Carolina at Charlotte, NYU, and Columbia University. The methodology of these initial studies was comparative and focused on the analytical, emotive, and behavioral mapping of habitation in HHMs and personal contemporary dwellings. (Ryan and Vagnone).

In follow-up classes, students further explored the four *AGHHM* themes from a personal perspective through the production of one-minute smartphone videos and created *Anarchist Plans* for three HHT properties: Van Cortlandt House Museum, Edgar Allan Poe Cottage and Morris-Jumel Mansion Museum. The findings and recommendations from those studies were presented at the 2013 ARCC Conference in Charlotte, the American Association of State and Local History, Cooperstown Graduate Program, Cosmopolitan Club of New York City, Great Camp Sagamore, Greater Hudson Heritage Network, The Metropolitan Museum of Art, Museumwise, New York State Historic Preservation Organization, Parsons the New School for Design, and NYU.

Concurrent to these efforts, a social media campaign was initiated to gauge public response and solicit peer review. The *Anarchist Guide to Historic Houses* Facebook page and Twitter account provide a forum to exchange progressive ideas on historic houses. The *Anarchist Guide* LinkedIn group now has over 687 international members, most of whom are museum

professionals who review *Anarchist* tactics and ideas, and share on-the-ground practices that reflect their intent.

### 3.0 CASE STUDY AND PILOT PROJECT

#### 3.1. The Morris-Jumel House

You've got to know the rules to break them. That's what I'm here for, to demolish the rules but to keep the tradition - Alexander McQueen (British Fashion Designer and Couturier 1969 - 2010)

The Morris Jumel Mansion (MJM) is Manhattan's oldest private residence. British Colonel Roger Morris and his American wife Mary Philipse built it as the family's summer home in 1765. During the Revolutionary War, they returned to England and the house was used by General George Washington as his headquarters during the Battle of Harlem Heights in the fall of 1776. After the war, the mansion exchanged hands many times until French emigrant and wine merchant Stephen Jumel and his wife Eliza purchased it in 1810. Twenty years later, Mr Jumel passed away, and his wife Eliza, who had become one the wealthiest women in New York, married U.S. Vice President, Aaron Burr. It was a marriage of convenience. He was attracted to her money, she to his position. Their union lasted less than a year. Once divorced, Eliza lived in the mansion until her death at the age of 90. Sold in 1903 to NYC, MJM became a house museum in 1904.

Eliza had the longest tenure in MJM, and yet, her story has been largely untold. Women's narratives often remain overshadowed by the men who lived along side them, due in large part to HJM's historical role and political purpose, especially when overseen by patriotic societies like the Daughters of the American Revolution (DAR), or the Colonial Dames. Both organizations were founded in the 1890s with a mission, "to teach patriotism by erecting monuments and protecting historical spots, by observing historical anniversaries, by promoting the cause of education, especially the study of history, the enlightenment of the foreign population, and all that makes for good citizenship". (Butcher-Youngmans 1993) MJM fills a similar role as a notable site in American history. And yet, it is Eliza's story that now attracts the most interest.

Born in Providence, Rhode Island to a prostitute and raised in a brothel, Eliza was a kept woman from the age of 16. After a pregnancy, she was moved by her protector to NYC and became an actress. There she met a French sea captain, and traveled with him to Paris where she learned about French Fashion. When she returned to NYC, she started a millinery business with her newfound knowledge. But when her shop was unsuccessful, she turned her shop girls into prostitutes and became their madam. Eliza rented her shop from Stephen Jumel, who became her patron, and eventually, her husband. (Braver, 2009)

In April 2013, MJM embraced the rumor and gossip that had long surrounded Eliza, through an exhibition that featured 18th and 19th Century-style corsets that were created by designer and couturier Camilla Huey. Entitled *The Loves of Aaron Burr: Portraits of Corsetry & Binding*, the show focused on the lives of Eliza, an earlier wife of Burr's, his mother, and four of his purported 12 mistresses. Most of the women were authors, diarists or letter writers, and the exhibition attempts to present their creative pursuits as if emerging from their intimate attire. (Feiden, 2013)

As if acknowledging the *Anarchist Guide*, Chloe Wyma wrote in the *BlouinArtinfo* that, "Camilla Huey's feminist retelling of history is well-intentioned; and her beautiful, exquisitely executed couture pieces are a breath of contemporaneity in the Morris-Jumel Mansion's hallowed halls. As art objects, however, they aren't as titillating as the bodice-ripping gossip they resurrect. (Wyma, 2013)

Washington and Burr's narratives, and the house's role in the country's political history have overshadowed the stories of these women's lives. *The Loves of Aaron Burr* brings them to the forefront. According to Carol Ward, MJM's Executive Director, the exhibition, "was part of its

new campaign to lure non-traditional museum-goers, like art lovers and fashion aficionados. The old model of historical houses is dying off. They can be very static and passive, so the idea is to reactivate the space and make it less of a museum and more like an active house.” (Feiden, 2013)



**Figure 2.** Corsets from *The Loves of Aaron Burr: Portraits of Corsetry & Binding*. Source: Camilla Huey

The intent of the exhibition was not simply to boost attendance by flirting with racy sensationalism, but rather pay homage to Alexander McQueen's 2011 exhibition *Savage Beauty* at the Metropolitan Museum of Art in which fashion was presented to convey turbulent, historic narratives. Often inspired by 19<sup>th</sup> Century Victorian Gothic, McQueen embraced “dialectical oppositions” with themes of horror and romance, life and death, lightness and darkness, and the interplay between victim and aggressor. Huey’s work makes manifest similar political themes within a domestic context, where sex and power were intertwined. (Campbell, 2012)

*The Loves of Aaron Burr* was both praised by art critics and broke attendance records. The show broadened the typical audience found visiting historic house museums. Compared to the same period of the previous year, there was a 560% increase to an opening event, a 30% increase in house visitation, and a 60% increase in revenue from the gift shop.

Carol Ward credits *The Anarchist's Guide to Historic House Museums* for providing the safe space and impetus for these ongoing initiatives. Through her direction, the House has embraced three of the four guiding themes and 9 of the 30 tactics. MJM staff have improved the *Experience* of the house by (1) ending the passive guide tour, (2) allowing visitors to roam freely, (3) killing the silence, and (4) embracing conjecture, rumor and gossip. In terms of the *Habitation* of the house, the programs (5) allowed participation in the changing cycle of day and night, (6) embraced NUDE (Non-linear, Unorthodox, Dactylic and Experimental) expression, (7) and illustrated belief in the intelligence of the guests. *Community* was built by (8) engaging reverse affinity groups (people’s whose primary interest in visiting was about something other than the historic house), and (9) using social media as a form of conversation.

The *Anarchist Guide* broadened interest in the MJM, but anecdotal evidence would suggest systemic and fundamental changes to the operations are needed to truly embrace the AGHHM concepts. Successive rounds of all four *Anarchist* themes will be needed to judge the validity of the *Manifesto*. As thought leaders in museum studies, curators and museum directors like Rhianedd Smith, Robert Boast, Viv Golding and Thomas Campbell have suggested, longevity of cultural and historic sites may ultimately rest not just in building community, but becoming relevant enough to remain at its center.

### 3.2. Latimer House Pilot Project

To further develop, implement and evaluate the effectiveness of all 24 tactics of the *Anarchist Guide*, the Historic House Trust submitted a grant application to use the Lewis H. Latimer House as a pilot site for the *AGHHM* concepts. The New York Community Trust funded a \$100,000, 2-year pilot study in 2013 to conceptualize, develop and launch a complete *Anarchist Plan* at the Lewis H. Latimer House in Flushing, Queens. This project aims to re-imagine the Latimer House Museum as a community place that bridges the past and the present, and unites diverse communities by acting as a center of social history, explorative experience, and common identity.

The Latimer House (LH) was the home of African-American inventor and electrical pioneer Lewis Howard Latimer from 1903 until his death in 1928. The House became a member of the Historic House Trust in July 2008, making it one of the most recent additions to HHT. Currently, Latimer House has no Executive Director or staff. The Board consists of approximately ten passionate volunteers invested in seeing the house flourish but as yet unable to create sustained initiatives. The caretaker, an art handler and museum professional, operates as *de facto* staff member, opening the house on weekends and giving tours to visitors. The house has few collections; its main interpretive element is a bland, text-based panel exhibition in one room. In 2012, monthly attendance at the site ranged from 16 to 125 visitors. The house's location in the center of a diverse residential community, the willingness of its Board and caretaker to test new ideas, the lack of collections and regular programming, the current low visitation and a compelling narrative that includes social and cultural diversity, African-American history, science and technology among other topics render Lewis H. Latimer House a prime host for its pilot *Anarchist* initiative.

Piloting the *AGHHM* philosophy at the LH is the most focused effort to date to better understand and attract new audiences. This objective is particularly appropriate for Latimer House, as the house does not possess a visitation base that it could risk alienating with the major changes that may come about with this project. The main objective is making the local community aware of the Latimer House and foster shared ownership of the site. Due to barriers both real (limited open hours, language) and abstract (lack of accessible or interesting content, perceived elitist attitude of the museum), LH has struggled to attract its most immediate local community. The project's framework will allow HHT staff and a consulting team to draw from their own successes with community involvement while helping to conceptualize ways for LH to engage its neighborhood and use local interests to update narratives.

To begin the project, an analysis of Latimer House was undertaken per the *Anarchist Guide Graphic Manifesto*. For each criterion, the house was rated on a scale of 1 to 5 for each tactic. An average score of less than one point for each of the four guiding themes was recorded. To address these challenges, a project team was formed of 12 Edward I. Koch Fellows who are working in concert with project consultants and HHT staff to design and implement an *Anarchist Plan* for the house. The Fellows' skill sets are purposefully broad including theater, arts, civic engagement, finance, museum studies, communications, preservation, and collection management. Collectively, the fellows speak seven languages.

An initial survey of the neighborhood has revealed the importance of their broad expertise. Latimer House is surrounded by diverse but segregated neighborhoods. The single-family house is located just a half mile from Flushing's main intersection at Main Street and Roosevelt Avenue, the third busiest in NYC, and home to one of the largest Chinese communities outside of China.

More than half of Flushing's population was born outside of the United States, and do not speak fluent English. Immigrants come from all parts of China, although over 80% speak Mandarin. Many own small businesses, a large part of Flushing's economy. According to the New York State Comptroller's 2011 report, almost 90 percent of Flushing's businesses had fewer than 10 employees, making the city one of the largest hubs for small business in the nation. Changing census numbers between 2000 and 2010 suggest that the Chinese



immigrant community is contributing to the aging of Flushing's population, where family units live together with cousins, siblings, aunts and uncles, and grandparents. (Dickerson, 2013)

Between Main/Roosevelt and the Latimer House are other concentrations of Latino, Taiwanese and Korean immigrants. The four groups generally do not mix.

The *Anarchist Plan* must address the unique demographics of Flushing especially since the racial make-up is so drastically different than when Lewis Latimer lived in the neighborhood and it was primarily African American. To do so, the project team will undertake extensive community outreach efforts including meetings with elected officials, liaising with local businesses, hosting "town halls", surveying visitors, tracking social media activity, and identifying reverse-affinity groups.

To begin building relationships across such diverse constituencies, community engagement will focus on the shared narrative of *Aspiration*. Lewis Latimer's life story was one of achievement. The child of escaped slaves, he was a civil war veteran and self taught draftsman. He rose through the ranks of an attorney's office from a delivery boy to a patent consultant, becoming a sort of renaissance man working on inventions by day while also playing flute, writing plays and poetry, and being actively engaged in the Unitarian Church. His largely fulfilled hopes and dreams were probably not unlike those of the many immigrants who arrive in Flushing each day, although few know of their commonality.

Whether through a town hall gathering, or over lunch at one of Flushing's many restaurants, the civic engagement campaign will have three primary components. The first phase of the project will focus on gathering the hopes and dreams of local residents, as well as the challenges that stand in the way of their being achieved. LandDesign's "Meeting-in-a-Box", Ryan-Harris's "Food for Thought" methodology using disposable paper placemats as survey instruments, and Candy Chang's "Before I Die" and "Career Path" community walls, where participants individually share their life choices within a larger artistic frame, will serve as precedents for the outreach. (Chang, 2013)

In the second phase, neighbors will be invited to the Latimer House to participate in events that acknowledge their shared aspirations. Invitations will be extended by way of person-powered, mobile engagement carts that will be moved throughout the surrounding neighborhoods. The carts may be modeled after Michael Graves and Ralph Appelbaum's New Jersey Hall of Fame Mobile Museum albeit at a more modest scale, or inspired by the emerging field of Tactical Urbanism as a sort of pop-up sidewalk experience. The carts may evoke Wunderkammers or cabinets of curiosities, like Museum, NYC's one room exhibition space tucked away on Cortlandt Alley behind the street level doors fronting an abandoned freight elevator.

The third phase of engagement will occur on the grounds and inside the Latimer House. Yet even then, the conversation will be focused on the guest rather than the host, with an attempt to serve the needs and interests of the visitors. In celebration of Mr. Latimer's many interests and his work as a part-time tutor teaching English as a second language, the LH could be resurrected as a place of life-long learning, providing space for afterschool lessons in math, science, music and history. It could be a place where new ideas about energy and resource conservation are discussed, or simply where free light bulbs are distributed, building on the annual "Lamp Trade" program that already occurs during the Historic House Trust celebration.

#### **4.0 ASSESSMENT AND EXPECTED OUTCOMES**

The final phase of the Latimer *Anarchist* project will focus on assessment. Many of the ideas suggested in the *Anarchist Guide to Historic House Museums* and the actions proposed in the *Anarchist Plan* will be new and provocative. They might not be measurable. They might fail. The project team will remain flexible and anticipates needing to change and adapt some of its plans according to feedback from the Latimer House Board and community members. If some initiatives are not resonating with the community, the Task Force will evaluate results and create new recommendations.

HHT expects to see measurable outcomes from the *Anarchist* pilot at the Latimer House, including:

- Increased site accessibility and community presence, greater visitation and use of the site, and more representation of the community in Latimer House's narrative and programming
- Increased interactivity at Latimer House, such as less restricted visitor movement through the house, handling of objects by visitors and the introduction of light and sound installations
- Noticeable changes to interiors at Latimer House, such as the introduction of reproduction items and the presence of the detritus of habitation
- Increased emphasis on community engagement at Latimer House, such as the establishment of social media pages and the presence of community-driven themes within narratives
- Noticeable changes to preservation at Latimer House, such as embedding information on the house's preservation within the narrative and the presence of multiple theories of preservation,

Ultimately, the goal of the Latimer House Pilot Project is to fully test and consequently refine the *Anarchist Guide* concepts. To that end, the Task Force will conduct a final evaluation of the *Anarchist* initiatives using the *Anarchist Graphic Manifesto*. The process will track improvements in each of the four guiding themes and suggest actions that will further advance Latimer House towards this new paradigm through an *Anarchist* Sustainability Report.

By successfully piloting this approach, the Historic House Trust aims to emerge as a leader in progressive historic house museum management and operation. In turn, the Lewis H. Latimer House will be able to implement exciting historic house management principles in a supportive environment, thus beginning to attract the attention of new audiences. Other HHT houses will also benefit by participating intimately in the development of this project. By piloting these *Anarchist* ideas, HHT and its member houses can collaboratively begin to chart a new course for the future of historic house museums.

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# Memories and Performance

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**ABSTRACT:** This study intends to explore one aspect of contemporary architecture, that is, the tension between the universal and the particular. It is the tension between the emphasis on modernist abstractionism and technology and the concerns about nature, history, and human experiences, both individual and collective. Basically, it is the notions of identity and place. In this line of thought, the discussions on place usually are anchored on the formal and spatial level, which carries symbolic significance. However, architecture has a greater impact on human life in subtle ways, that is, through the ways in which a design operates in relationship to the social and physical environment. It is what I would call the performative aspect of architecture. How can we establish a mode of reading of the notion of place by focusing on the performative aspect of architecture? This paper examines examples of works related to the notion of place, both design work and architectural texts from the heroic period of Modernism to the contemporary period, including those of Le Corbusier, Alvar Aalto, Maxwell Fry and Jane Drew, Paul Rudolph, to those of critical regionalists. This juxtaposition between textual and formal analysis aims to arrive at a critical understanding of how the cases perform and, in turn, engage the place. Overall, this study hopes to contribute to the intersection between history and theory of architecture and design, as well as to the notion of place and identity in architecture.

**KEYWORDS:** identity, building performance

## INTRODUCTION

This study begins with rumination on the relationship between history and theory of architecture and design practice. Architectural theory used to be seen as providing answers to the design process, for example through the use of historical precedence, which gave formal solutions to design problems. For a long time, history is thought to have provided stable, synchronic answers to design. The search for this way has informed architecture since the Renaissance. Among architectural historians in the twentieth century, Manfredo Tafuri criticizes this view and labels that as “operative history,” in which he detected an attitude to project the pasts into the future as a way to legitimize design. Instead, he has shown us that architectural works are deeply embedded in the socio-political milieu. In the context of modern architecture, as it incorporated the logic of production and organization, architecture, in turn, has become a means to plan the future. In this line of thought, architecture eventually lost its ability to be critical of its socio-cultural context, as architecture is simply absorbed into the system. As a part of the system, architecture also lost its ability to be meaningful, as meanings eventually resided in the larger system itself. This criticism eventually leads to the belief that architecture should take a critical distance from the socio-cultural milieu and turn to its own internal logic. Often labeled as critical architecture, this position aims to exhaust the formal logic of architecture in its investigations as a form of resistance. Hence, it argues for autonomous architecture. However, in his incisive criticism of modern architecture, Tafuri does not only argue for critical architecture. Indeed, he also suggests the need for architecture to engage with reality, although without the illusion of the totality of architecture, as reflected in his discussions of cities in Germany and the history of Italian architecture.

Reflecting on the contemporary world that is characterized by globalization, it seems that modern architecture has acted as one of its agents. Designs based on elementarism and affinities with contemporary techniques and materials have become prevalent in every part of the world. This phenomenon poses the question of the place and role of architecture in the junctures between the local, particular and the global, universal. Elaborating the notion of engagement with the reality seems to provide a way to investigate this issue. In this line of thought, the issue is the way a building relates to its program and its surrounding, both in socio-cultural and natural, physical terms. In other words, the key theme for this research is

how a building performs with regards to the internalities and externalities. How can we establish a mode of reading of the notion of place by focusing on the performative aspect of architecture? The framework for this research includes reviews of architectural texts that explore the relationship between architecture and specific environment, as well as the notion of place. It also incorporates examinations of some examples of projects that engage the notion of place. The findings inform a discussion of a design research that problematizes the notion of a contemporary building type in a particular location.

## 1.0 OVERVIEW

### 1.1. Buildings and environment

Reyner Banham, in his book *Architecture of Well-tempered Environment*, argues that the trajectory of modern architecture in the twentieth century still relied on generative principles based on formal principles; an argument that he put forward in his previous work, *Theory and Design of the First Machine Age*. Basically, he laments the missed opportunity of continuing the program of the Futurists of exploring contemporary technology as the prime generator of architecture. Along this line, Banham argues that technology in environmental system still does not inform architecture. He points to the fact that contemporary buildings are in fact a shell whose life depends on these systems. Indeed, Banham argues that the act of designing architecture might be considered as an act of controlling the environment.

In fact, looking at writings on architecture in the mid of the twentieth century, Banham's concern was also shared by other writers. If Banham was more interested in the relationship between technology and the development of modern architecture, Sibyl Moholy-Nagy puts forward a history of architecture based on the performance of vernacular buildings. Moholy-Nagy argues that the history of architecture is basically a history of the relationship between humans and the environment (Moholy-Nagy, 1954 [2004]). These efforts to cultivate living environments lead to varieties of vernacular architecture. In essence, she argues that vernacular architecture is a manifestation of successful relationship between culture and architecture. Moholy-Nagy develops her thesis further in a book, *Native Genius in Anonymous Architecture*, in which she argues that buildings are a form of expression of site and climate, form and function, and materials and skills. She elaborates that buildings from a particular place reflect local building materials and skills, specific conditions of the locale, as well as specific functions. The underlying argument in this book was her efforts to search for the generative principles of architecture in the condition of the site and the efforts of humans to manage the living environment.

In this line of thought, Victor and Aladar Olgyay explore the relationship between local climate, the human body and the design of the built-environment, both at the scale of a building and of a settlement (Olgyay, 1963). Based on Jean Dolfus's argument that building styles are defined more by site condition rather than cultural organization, the Olgyays develop a methodology of design based on the analysis of the climatic conditions. Based on the data on site, the sun orientation, shading, and air movement, they suggested a series of formal and spatial responses in designing buildings and the environment, along with the considerations of the materials. The book even comes with a matrix of design suggestions. Clearly, in their argument, the Olgyays consider the notion of region in terms of geographic delineations.

A rather similar way of thinking appears in the work of Maxwell Fry and Jane Drew. After their work in Asia and Africa, Fry and Drew produced a theoretical work that highlighted their design methods (Drew; Fry, 1964). Their argument also tries to link up architectural design with the environmental conditions. They postulate that architecture emerges on the basis of humans need, the location, in particular the climatic conditions, and the materials and techniques of construction. Climatic conditions, in their argument, affect human bodies which, in turn, necessitates proper responses in the design of the built-environment. In this line of thought, they propose a series of formal strategies, which include the design of the roofs, walls and openings, ventilation, ground treatment, and spatial arrangement of the rooms. In a way, Fry and Drew abstract the locale into a matrix of environmental conditions and possible formal responses.

## 1.2. Theories of Place

One of the major approaches in considering the notion of place in architecture is the notion of regionalism. In the introduction to his compendium on the issues of place and identity in architecture, Vincent Canizaro points out that the notion of regionalism is simply about the connection to a particular place (Canizaro, 2007). He traces this concern all the way back to Vitruvius, who went at length to discuss the relationship between the conditions of a place with the way people constructing building. Indeed, the very word region has its roots in Latin. However, Canizaro stresses the strong presence of intentionality in regional architecture, as the main factor that distinguishes it from vernacular architecture.

The concept of regionalism regains its currency since the 1980s through the emergence of the notion of critical regionalism. Originally coined by Liane Lefaivre and Alexander Tzonis, the notion of critical regional was then taken up by Kenneth Frampton. In one of their writings on that subject, Lefaivre and Tzonis emphasize regionalism as efforts to counter globalization, which brings universal standards and methods (Lefaivre; Tzonis, 2001). In the place of universalization, regionalism emphasizes features that are specific to region. The couple refers to Lewis Mumford talks in the 1930s and 1940s as the source of their theory, in which Mumford aimed at establishing a dialogue between local and global culture, instead of exaggerating the contradictions between the two poles. In their view, Mumford's aim was to humanize modernity by paying attentions to the local and the specific. At the same time, locality could also benefit from the interaction with the global. However, Lefaivre and Tzonis differentiate critical regionalism from other regionalism by borrowing the technique of defamiliarization from the Russian formalists. This technique aims at using local and specific features in a completely different way in order to heighten the awareness of such locality. In a way, Lefaivre and Tzonis think about regionalism through the working method of the modernists.

Kenneth Frampton took up the notion of critical regionalism in a series of writing that he produced since the 1980s. In his view, critical regionalism is a critical stance toward both the local conditions and the global influences (Frampton, 1983 [1986]). The keyword for critical regionalism in his view is inflection, in which global and universal architecture is inflected to reflect the local condition. In design terms, Frampton puts emphasis on the tectonic aspects of the buildings, that is, the construction techniques and materials. In fact, Frampton frames his argument on critical regionalism along the line of his approach to architecture, which place the primacy of the tectonic aspect as the generative principles of architecture, as exemplified in his book *Studies on Tectonic Culture*. It is through the careful attention to the tectonic aspect that architecture generates meanings. Following the thinking of Heidegger and Hannah Arendt, Frampton aims to relate architecture to the human existential search, in which the acts of making building serve as the way to manifest humanity. In this line of thought, explorations in tectonic aim to reveal the texture and properties of materials, along with possible techniques of construction that are conditioned by such materials. Thus, by linking the knowledge in tectonic with building practices from a specific location, Frampton attempts to reconcile his humanistic thought in architecture with the notion of place.

In relation to Frampton's thought, it is worth to review the notion of memory and architecture that is argued by Stanford Anderson. Anderson asserts that architecture is essentially an embodiment of knowledge of a society (Anderson, 1995, 1999). In the form of vernacular and traditional architecture, manmade structures serve as a device that carries knowledge, practices and traditions in formal, spatial, and tectonic manners. In a way, the built environment guarantees the transfer of knowledge from generation to generation. In many parts of the world, this knowledge is preserved without the presence of written archives. Anderson calls this mode of transfer and preservation of knowledge as societal memory. He then argues that modern world, which relies of writing and specialization of knowledge, produces a different form of architectural knowledge. In the modern world, this form of knowledge was codified and institutionalized within the discipline. Since the Renaissance, architecture emerged as one of the disciplines in the modern world, complete with educational institutions that guaranteed the transfer of knowledge through pedagogy and the professional institution that safeguarded building practices. He calls this form of knowledge as institutional

knowledge. Obviously, the notion of place in architecture relates to the form of knowledge as societal one.

### 1.3. Places and Buildings

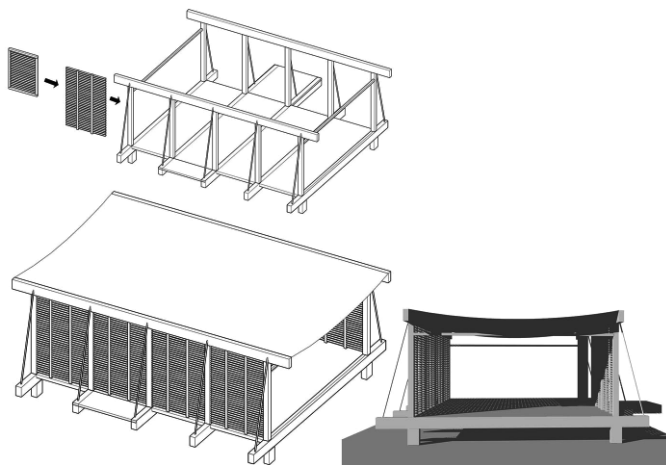
Concern with the notion of place is also apparent in design practice in the twentieth century. Although this section is not intended to give a comprehensive picture of the way in which major architects have engaged this issue, nevertheless it aims to sketch out some of these strategies. In the early stage of his careers, Le Corbusier produced architecture based on pure geometric form, concrete frames, and standardized, industrial elements. Based on his *Maison Dom-ino* and *Maison Citrohan* models, this design led to some of his famous houses of the heroic period of modern architecture in the beginning of the twentieth century; aptly expressed through his five points of architecture. However, starting in the 1930s, Le Corbusier also explored a different avenue in his oeuvre. An early example of these directions is *Maison Errazuris*, a house for a client in Chile in 1930s. The house is located on the coastal area, with one side facing a mountain. The design of the house exemplified geometrical clarity that was apparent in his designs. The plan of the house demonstrates the openness of Corbusian plans, with regularity of the grid serves as the datum of the plan. The house has large openings on one side, while on the opposite façade, the elevation is characterized by Corbusian long, strip windows. However, instead of standing on pilotis as in his European house of that time, *Maison Errazuris* sits on the ground on top of a stone base. Further, instead of employing flat roof in accordance to the five points of architecture, Corbusier design the roof as sloped-roof in the form of V-shaped roof. The house indicates clues of Corbusier's engagement with local vernacular building through the use of walls, sloped roof, and the grounding of the building. It also shows the consideration of the use of local materials. However, the intentionality of the design seems to rest primarily on the regularization through the use of geometry. Further, the plan and the section suggest that the intention was to deal with the provisions of natural light and the circulation of air. Thus, the site is abstracted for the light, view, and air factors, while local references are regulated within the field of geometric grid. Similar themes can be detected in subsequent project of Le Corbusier. In this type of Corbusian architecture, started with *Maison Weekend*, the designs are based on the abstraction of rudimentary building techniques, either based on brick vaulting systems, such as the types of *Maison Jaoul*, or based on V-shaped roof, exemplified by houses such as a house type for a foreman. The later exemplifies the use of long, thin geometry for the plan, still with the regularity of spatial cells. The roof is split to allow for air to circulate and to bring on natural light to the house. However, in contrast to *Maison Errazuris*, in his work as an architectural consultant for the Ministry of National Education and Public Health in Rio de Janeiro, Corbusier return to the purity of a geometric prism for the building. The response to the environmental condition is the introduction of the second skin to act as sun-screen, the *brise-soleil*. In this design, the locale is reduced to a series of environmental factors, light and air.

The second generation of modern architects started to problematize the premise of a universal architecture, by engaging history and traditions, exemplified by the works of architects, such as Alvar Aalto, Kunio Maekawa, Berthold Lubetkin, and many others. An example of the engagement with the problem of place appears in the work of Aalto in Finland. Aalto absorbed influences of the International Style in his oeuvre. However, he also developed a distinctive architectural expression of his own that has its root in the nature and culture of Finland. Instead of articulating the white, geometric architecture of the International Style, Aalto employed materials derived from local building traditions. Furthermore, he expanded his repertoire by using multiple geometries. In one of his later work, Aalto designed a holiday house for himself in the island of Muratsaalo, which he called the experimental house. This house is based on the courtyard type, with spaces arranged on two sides of the courtyard. The building sits on a mooring that floats above the glacier, a response to the local environment. Furthermore, the house is constructed out of bricks. The experiential qualities of the house articulate the framing of the views toward the forests and the lake. Thus, in relating to the place, Aalto foreground the experiential qualities through the framing of the vista and the palette of materials, while the formal and spatial configurations are still based on abstraction.

The subsequent generations of architects of the Modern movement in architecture demonstrate varying degrees of engagement to the place. The early work of Paul Rudolph in

Florida, for example, demonstrates the intentionality of problematizing local influences, both natural and architectural. In his houses of this period, Rudolph developed formal repertoire that exemplified his attempts at problematizing the local and the global. In the Cocoon house, the design articulates a parti based on a simple geometric prism, which also reveals the notion of a primitive hut. It clearly owes its debt to Mies van der Rohe's Farnsworth house in Illinois, including the siting of the house on a low-rise platform. Raising the house above the ground, however, seems to work more than for the visual reasons. It reacts well with its site in the marshy land in Florida. It also allows for air to circulate underneath the house. Nevertheless, the highlight of the house is the use of louver that covers the entire vertical surfaces of the house, from floor to ceiling. This feature comes from the use of louver for windows in vernacular houses in Florida. It acts as a filter for air and light as they penetrate the house. In a way, it seems that Rudolph abstracted the local climatic conditions through elevating the house and the providing ventilation device. At the same time, he also attempted to create a link to a

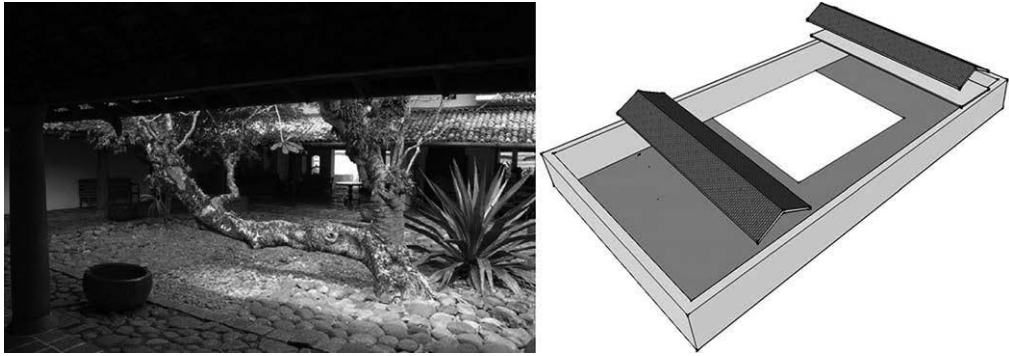
specific formal element of local building traditions. In essence, Rudolph abstracted a common feature in Florida vernacular, that is, louver windows then turned that into the main formal feature of the building.



**Figure 1:** Diagrams of Paul Rudolph's *Cocoon House*. Source: (Author, 2012)

The spread of modern architecture outside Europe and America also prompted the search for the juncture between the local and the global aspects of architecture. One prominent architects from Asia, Geoffrey Bawa, exemplified the way he engaged the notion of place and identity. In the Ena de Silva house in Colombo, Sri Lanka (1960-62), Bawa's architecture exemplifies the efforts to articulate the notion of identity in architecture. The parti of the house is based on a courtyard house, a basic spatial organization of both local and colonial architecture in the island. Within this parti, Bawa produces a plan that is very fluid and open, using a series of thick walls as partitions of spaces and structural support. Other than these supporting partitions, the architect turns the walls into screens of wooden lattice that allows air to circulate and filters light. The walls are painted white to reflect the tropical sun and minimize heat. The roofs of the house are layers of sloped roof that allow hot air to escape the house. The house is essentially a large courtyard garden lined up with verandah. In fact, Bawa essentially puts forward a design based on the abstraction of local architecture into two basic components: the wall-enclosure and the roof-umbrella. The result is a design that relates the local context on formal, spatial, tectonic, performative level.





**Figure 2:** Ena de Silva house, the view of the courtyard and the wall-enclosure and the roof-umbrella. Source: (Author, 2009)

The engagement with the issue of local and global not only happened in practice, but also explored in education. Maxwell Fry and Jane Drew continued their agenda in architecture by setting up a series of design studios at the Architectural Association School of Architecture in London. This program ran for a couple of years in the 1960s and drew students from all over the world. In response to climatic conditions, in the US the solar house movement emerged in the mid of the twentieth century. One prominent example is the Zome house by Steve Baer in New Mexico, 1972. The design of the house is based on a courtyard house. However, Baer develops the house based on what he called the Zome geometry, which basically a series of connected cells around a courtyard. Another distinct characteristic of the house is the use of drumwall as a means to collect energy. The response to the place is through the solar geometry and planar surface to collect energy. The parti may relate to houses in the southwest and the properties of the wall also somehow relate to the adobe wall.

With the emergence of Postmodernism in architecture in the late 1970s and 1980s, the debates in architectural shift to the semiotic reading of a design. In terms of the issue of locality in architecture, the rise of this approach to design led to the emphasis on the use of figurative elements and the rejections of abstraction. Architectural features of local buildings, such as sloped roofs or particular forms of columns, heavily informed the appearance of design. The intention of expressing identity through direct visual appearance led to the popularity of approaches such as Neo-traditionalism. In this line of design, the re-appropriation of vernacular and traditional buildings implies the hope that the designs would somehow perform similarly to their references.

## 2.0. ON PLACES AND PERFORMANCES

Anderson's discussion essentially argues that architecture is a mnemonic device that stores memories, including the knowledge of and about a place. These memories are stored as spatial and formal logics and the materials and tectonic aspects of buildings. At a deeper level, these aspects relate to the symbolic aspects that refer to a place, not only in physical terms, but also in socio-cultural terms. Approaches such as critical regionalism explore these carriers of memories, while problematizing the encounters between memories of a particular place with the universal influences. In a way, these attempts historicize memories by considering them in dialogues with the historical contexts. On the other hand, the engagements to a place as represented by the writings of the Olgays and Drew and Fry extract and isolate formal, spatial, and tectonic logics that allowed them to develop an abstraction of a place, which then can be applied to other places. While the Olgays tend to consider the location in engineering terms, Drew and Fry attempt to provide a series of formal and spatial strategies. In a way, these memories are cut off from its own contexts and abstracted into a matrix of universal solutions to environmental challenges that a locale poses. In practice, the history of modern architecture in the twentieth century suggests that the engagement with the notion of place also reflects the same tendency. The first and second generation of architects tend to abstract locale, whether the abstraction of the site or abstraction of the local building traditions. Work such as those of Le Corbusier put the emphasis on the performance of the buildings over the

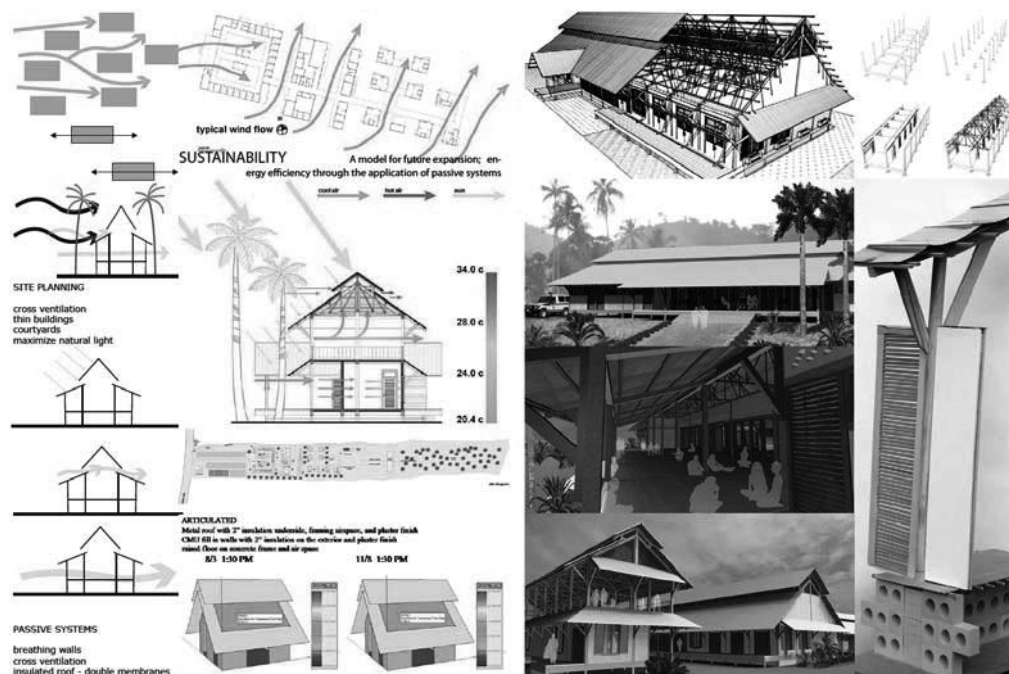
iconographic aspect. In true modernist fashion, his buildings are more of montage and collage of local and universal architecture. The later development tends to put the emphasis on the iconographic side of designs. In short, the approaches to the issue of place are either abstraction of the site or abstraction of the formal, spatial, and tectonic knowledge of local building tradition.

In this line of thought, the work of Moholy-Nagy offers an interesting view. Her works aims to articulate architecture as a carrier of memories as embedded in ways buildings related to environmental conditions and their impacts on human activities. In other words, the knowledge of localities is stored in the performative aspects of buildings. One only needs to recall the way Walter Benjamin characterizes architecture as a form of art that is appreciated in the state of distraction. It is precisely because architecture does not require sustained concentration that it able to affect human life. Architecture provides us with a backdrop for our daily life, thus entering our sub-consciousness and forming our daily habits. Further, Benjamin argues that the appreciation of architecture is not simply visual, thus formal, but more importantly tactile reception. It shapes and informs our life through the way it regulate our life through its spatial organizations and the physicality of the enclosure. This physicality of the enclosure precisely relates to the management of the micro-environment in which life takes place. Thus, our experiences are always the result of the formal, spatial, and tectonic arrangement. More specifically, the experiences relate to the experience of a place, that is, the memories of particularities. In this vein, the performative aspects of a building also relates to the symbolic role of architecture.

The challenges of investigating the relationship between the performative aspects of a building and its symbolic structure inform the design research project for designing an environmentally and locally appropriate hospital in West Borneo, Indonesia, conducted at Georgia Institute of Technology from 2008 to 2010. The project calls for a design that is appropriate to its functions and its contexts, both physically and culturally. Thus, the intentions of the research is to inquire possible ways for the design to perform, not only as a medical facility, but also as a structure in relationships to its particular environmental conditions, available materials and techniques, and specific socio-cultural practices. In terms of healthcare, the challenge was to deliver quality healthcare that is adjusted to local practice. Architecturally, it means that the design intends to engage the ways the local culture deal with care of the sick in spatial and programmatic terms. In terms of specific local conditions, the project requires ways to provide the facility with power and water, both of which are very limited. Along this line, another challenge relates to the efforts to minimize materials derived from the tropical forests. These set of challenges point to the vernacular building practice in the area. The project also aims to relate to the local building traditions, as buildings in contemporary styles tend to alienate the local population.

The agenda for this project then is to engage building traditions and practices in the area as a way to uncover local knowledge. Further, the idea of using building performances as the base on relating the design to the place informs the project, in a belief that the performative aspect is the storage of the memories of the local community. In this line of thought, the project examines examples from the area in terms of formal, spatial, programmatic, and tectonic aspects and then tests the way these findings behave. In formal terms, the project investigates the typology at various scales and how they relate to the environment as well the visual structure relate to the relationship between the community and buildings. Spatially and programmatically, the project studies the various organizations of space from the region in relationship to the environmental condition and to the healthcare program. In effect, the programmatic, spatial, formal, and tectonic approaches to the design are based on close readings of architecture in West Borneo, including traditional, vernacular, colonial, and modern architecture. However, the research did not only rely on the pasts. Instead, it takes into considerations the way contemporary factors, such as new materials, impacted local practices. These findings feed into the design process. A series of charette with the locals measure the degree of the acceptance of the designs. Meanwhile, possible tectonic solutions are studied though physical models. Further, the project tests design proposals generated from these steps through models and simulations. The formal solutions and choice of materiality are tested though computer models to simulate the performance of the design. The research also experiments possible ways to bring findings from local practices into contemporary conditions.

For example, it studies possible ways to use contemporary materials available in the areas in new ways. The design research deliberately avoids basing the process on a choice of a theoretical approach. Instead, it relies on data of architecture of the locale.



**Figure 3:** The Borneo Hospital Project. Source: (Borneo Hospital Workshop led by the author, 2009-2010)

### Conclusions:

Architectural design is about enacting memories, including memories of a place. These memories are stored in the formal, spatial, tectonic, and programmatic organization embedded in buildings. Thus, buildings are archival storage of knowledge about the built-environment. The specificity of architecture lies on the very notion of enactment, which covers not only the visual aspect, but also the haptic effects. The visual and the haptic elements work together to inform the experiences of locality. In this line of thought, theories in architecture stand as a way of interpreting architectural work, including the interpretation of the notion of locality carried in a design. They engage these interpretive tasks in three different ways. Theories can be descriptive, in that they describe existing buildings and decipher its iconological structure and its symbolic connotation. They can also be prescriptive, providing principles of design that inform design practice. Theories can also take a distance from practice and deliver critiques. However, theories can take a different stance, that is, through a reflexive practice. Instead of being instrumental or simply critical, theories respond to design outcomes and provide feedback to practice. In the long run, this feedback loop will contribute in producing new theories as well as exploring the intersection between theories and practice. The challenge is to develop rigorous methods of inquiry in doing so, one that was attempted in the design research for the Borneo project. This methodology takes into account varying degrees of the interactions between the local and global, as well as of building knowledge embedded in practices and traditions.

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# Disciplining fiction: Projecting Robin Evans through history and geography

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**ABSTRACT:** In 1978, Robin Evans published “Figures, Doors and Passages,” charting an explicit strategy for the coupling of architecture and fiction. In it, he argued that pairing architectural plans and their contemporary literature would elucidate the connection between spatial configurations and social life. By doing so, he conferred provisional legitimacy to literature, suggesting that there might be disciplinary avenues to conscript fiction in architectural research. For Evans, affording credibility to fictional representations required a specific bracketing, a bracketing leveraged against forms of representation particular to the discipline of architecture.

Although some may discount the use of fiction as source material as simply an eccentricity of a design profession, it is seen as a potentially significant resource in disciplines whose credibility is tied directly to their sources’ veracity: historians and geographers have argued for the inclusion of fiction within their canon, though not without significant discussions of its boundaries and potentials. These discussions, recorded in their trade publications, argue for the capacity of fictions and set boundaries relative to the rigors of their respective scholarship. These arguments in History and Geography, rather than finding their limits at fiction, have led to new inroads within their own scholarship through a continued, refined discourse that identifies fiction’s provisional legitimacy and latent capacity.

Architecture’s appropriation of fiction has been more idiosyncratic, and no systematic survey of method exists. This paper compares the agendas, boundaries, and potentials of historians’, geographers’, and architects’ employment of fiction. The contemporary resurgence of literature, fiction, and writing as appropriate domains of architectural research evidences a need to frame their inclusion within architectural scholarship. Using Robin Evans’ explicit methodology as a point of entry, this paper compares his architectural representations and social fictions to those of History and Geography, in an attempt to identify a line of inquiry appropriate to contemporary architectural research.

**KEYWORDS:** Robin Evans, Fiction, History, Geography

## INTRODUCTION

Robin Evans’ employment of literature is a concerted effort to implicate architecture in the realm of human affairs. In “Figures, Doors and Passages,” his introduction makes this explicit.

Take the portrayal of human figures and take house plans for a given time and place: look at them together as evidence of a way of life, and the coupling between everyday conduct and architectural organization may become more lucid. (Evans 2011, 56-57)

However, while his intention may be clearly disciplinary, his conscription of literature to supplement, inflect, and extend the discipline’s purview is not exclusive to Architecture. His contemporaries in the fields of History and Geography also solicit literature as a source and device to interrogate their own disciplinary boundaries. In analyzing Evans’ architectural appropriation, this paper qualifies the credibility he gives to literature in reference to other disciplines whose scholarship is bound fundamentally to their descriptive fidelity to an actual time or place.

## 1.0 Robin Evans: Architecture and Literature

The inclusion of literature in Robin Evans' scholarship was a calculated gambit, one of which he was unequivocally conscious. Given his contemporaries' excursions into literature, either Hedjuk's poetics or Eisenman's semiotics, his use of fiction found clear disciplinary demarcations. In turning to literature, he hoped to furnish architecture with evidence of its formative contribution to social worlds. However, in doing so, he conspicuously avoided equating architectural forms of representation with fictional forms of representation. In order to frame his intention in enlisting literature to provide proof of architecture's social agency, it is useful to anachronistically acknowledge his conclusion:

In reaching these conclusions architectural plans have been compared with paintings and various sorts of literature. There is a lot to be said for making architecture once more into art; rescuing it from the semiology and methodology under which it has largely disappeared. But too often this restitution has been attempted by taking it out from under one stone and putting it back under another. This is sometimes done in a rather guileless way, by equating architecture with literature or painting so that it becomes an echo of words and shapes; sometimes in a more sophisticated way, by adopting the vocabulary and procedures of the literary critic or art historian and applying them to architecture. The result is the same: like novels, like portraiture, architecture is made into a vehicle for reflection. Overloaded with meaning and symbolism, its direct intervention in human affairs is spuriously reduced to a question of practicality. (Evans 2011, 88-89)

To avoid equating literature and architecture, Evans purposefully defined both forms of representation and afforded them provisional legitimacy. In order to qualify these differences, it is helpful to examine Evans' writings and analyse their disciplinary discrimination.

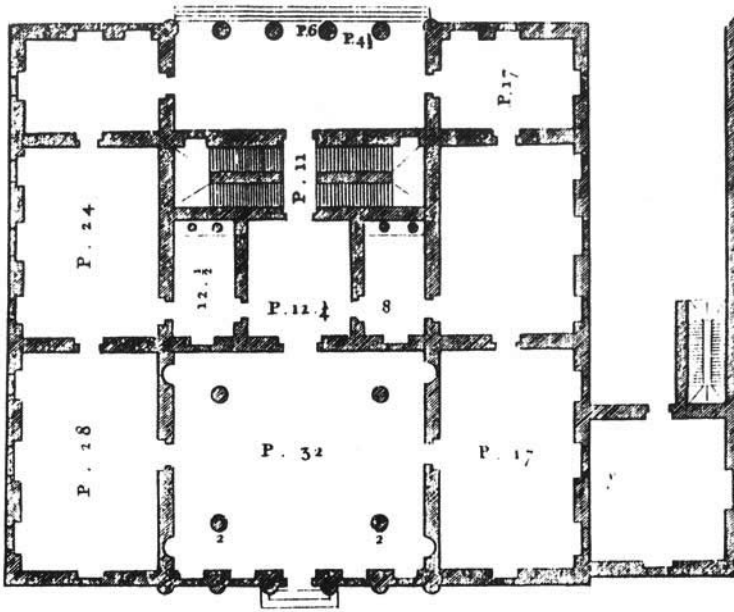
### 1.1. Spaces and Bodies: Plans and Literature

In "Figures, Doors and Passages," Evans turns to literature and paintings to evidence social patterns absent in architectural forms of representation. Evans qualifies what plans (a disciplinary form of representation) are meant to signify and what literature is meant to augment. He argues the plan is a useful representation of typical architectural spaces for this study, in that

If anything is described by an architectural plan, it is the nature of human relationships, since the elements whose trace it records – walls, doors, windows and stairs – are employed first to divide and then selectively to re-unite space. But what is generally absent in even the most elaborately illustrated building is the way human figures will occupy it. (Evans 2011, 56-57)

Evans prefaces his employment of the plan as the disciplinary form of representation that inscribes social patterns. However, despite this preference, he notes that such patterns are explicitly absent and only potentially inferred. In order to qualify architecture's influence on social patterns he couples the plans from two times and places with their contemporaneous literature to substantiate the relationship between architectural organization and cultural norms. Identifying three criteria that modern planners assume to be universal conditions of home (privacy, comfort, and convenience), Evans compares the architectural plans and literary situations of the 16<sup>th</sup> century Italian villa and the 18<sup>th</sup> century English country home.

In order to correlate the architectural organization and social patterns of the Renaissance villa, Evans presents the plan of Palladio's Pallazzo Antonini (1556) and cites two pieces of literature, Baldassare Castiglione's courtesy book *The Courtier* (1528) and Benvenuto Cellini's autobiography (1563).



**Figure 1:** Palazzo Antonini (Palladio 1556).

Palladio's plan is presented as a typically organized villa configured as a matrix of interconnected rooms. Given the disciplinary audience's ability to read the plan, we are able to project the manner in which bodies would be capable of seeing and circulating through space. Evans extends this to qualify a particular notion of convenience, one confirmed by Alberti's proposition that, "It is also convenient to place the doors in such a Manner that they may lead to as many parts of the edifice as possible." (Evans 2011, 63)

However, to qualify the conditions of comfort and privacy, Evans turns to literary sources to furnish the portrayals of bodies. Referencing the courtesy book, *The Courtier*, Evans brackets the book's credibility by noting that the description is undoubtedly "a purified, elaborated and sentimentalized account of actual events, but the portrayal of the group as a natural recourse for passing the time is in perfect accord with other sources." Those other sources include the autobiography of Renaissance artist Cellini. To qualify cultural norms of privacy and comfort, Evans quotes two short passages from Cellini

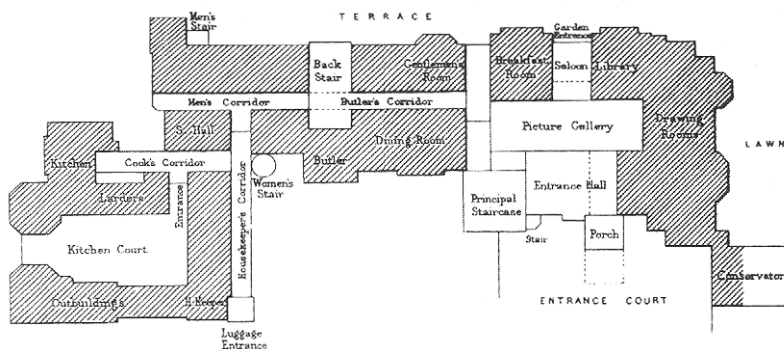
...as was only fitting at the age of twenty-nine, I had taken a charming and very beautiful young girl as my maidservant... Because of this I had my room at quite a distance from where the workmen slept, and also some way from the shop. I kept the young girl in a tiny ramshackle bedroom adjoining mine...

I had myself carried to the Medici Palace, up to where the little terrace is: they left me resting there, waiting for the Duke to come past. A good few friends of mine from the court came up and chatted with me. (Evans 2011, 66)

Privacy, in the first citation, is afforded through a calculated visual and physical distancing from the activity of others. Comfort, in the second citation, is meant to frame the normalcy of intrusion conditioned by the circulatory patterns of the matrix of interconnected rooms. As it was considered normal to happen upon someone in course of moving from one space to another, the protagonist opportunistically positioned himself and was camouflaged by a group of friends who also happened to find him in the normal course of their movements.

Evans concludes from these representations of space and portrayals of bodies a culture comfortable with the company of others, comfortable with being intruded upon given the convenience of movement, and able to construct privacy given the configuration of the homes they inhabited.

To implicate architecture in the “direct intervention in human affairs,” Evans identifies the emergence of the corridor. The transition from the previously described meanings of privacy, comfort, and convenience are contingent upon this new spatial device. To describe this transition, Evans provides plans of Robert Kerr’s Bearwood and Alexander Klein’s “The Functional House for Frictionless Living,” and references *The Way of All Flesh* by Samuel Butler.



**Figure 2:** Bearwood (Kerr 1864).

In the Bearwood house, the circulation afforded by interconnected matrix of rooms is replaced by the corridor, a space initially confined for servants, but elaborated into a planning schema appropriate to the division of domestic spaces for all inhabitants. Here, convenience is qualified not with the inclusion of company but by the exclusion of company. The seclusion of a space of movement brings “distant rooms closer by, but only by disengaging those near at hand. And in this there is another glaring paradox, in facilitating communication, the corridor reduced contact.” (Evans 2011, 79) This division between communication and contact is illustrated by the story of Cotton Mather, for whom any unintentional contact was a potential source of irritation. To prevent these intrusions, as the story goes, he engraved on his door in large letters “BE SHORT.”

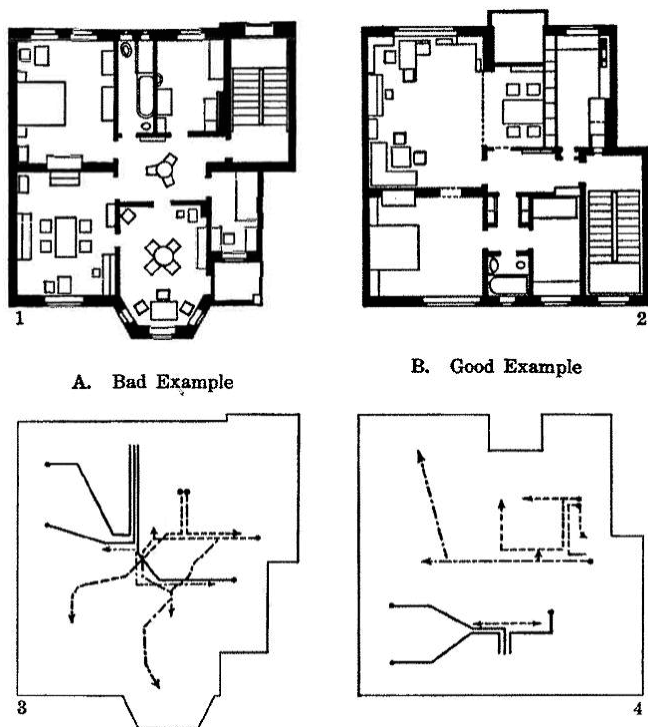
Attenuating this trajectory, Evans quotes the critique of Victorian domesticity *The Way of All Flesh*, the semi-autobiographical novel written by Samuel Butler that he only allowed to be published after his death. Citing a conversation between the protagonist and his mother, Evans portrays a culture discomforted by the proximity of others.

‘My dearest boy’, began his mother, taking hold of his hand and placing it within her own, ‘promise me never to be afraid either of your dear papa or me; promise me this, my dear, as you love me, promise it to me’, and she kissed him again and again and stroked his hair. But with her other hand she still kept hold of his; she had got him and she meant to keep him... The boy winced at this. It made him feel hot and uncomfortable all over... His mother saw that he winced and enjoyed the scratch she had given him. (Butler 1950, 235-6)

Evans follows, “The thing to notice is that when flesh touched flesh a subtle style of torture was taking place.” (Evans 2011, 84) Here, the acceptance of the intrusion of strangers identified in the Italian villa serves a foil for the assault of having one’s hand held by one’s mother.



Careful not to let the anecdotal nature of literature serve as the only evidence of cultural norms, Evans is quick to confirm the novel's veracity by extra-disciplinary qualifications by noting the book's appropriation by Dr. R.D. Liang's term "bondage" and Edward Hall's psychological citation for "proxemics." Bookending his description of Kerr's plan for Bearwood and the excerpt from *The Way of All Flesh*, is Alexander Klein's diagram of "The Functional House for Frictionless Living."



**Figure 3:** Functional House for Frictionless Living (Klein 1935).

Here, the critique of contact in Butler's description becomes a virtue in Klein's plan. Friction, or contact with others within the home, is an example of bad planning. It is not coincidence that this management of bodies occurs in plan. In conclusion Evans explains

....plans have been scrutinized for the characteristics that could provide the preconditions for the way people occupy space, on the assumption that buildings accommodate what pictures illustrate and what words describe in the field of human relationships... This may not be the only way of reading plans but, even so, such an approach may offer something more than commentary and symbolism by clarifying architecture's instrumental role in the formation of everyday events. It hardly needs to be said that giving architecture this kind of consequentiality would not entail the reinstating of functionalism or behavioral determinism. (Evans 2011, 89)

This passage is telling as it defines the role of the architectural plan, confronts a causal relationship between space and human affairs, and pushes historical understanding beyond simple commentary. The first two intentions have clear conditions for identifying disciplinary roles of representation and speculating about their significance through extra-disciplinary forms of representation. To understand the third condition, however, it is useful to compare the instances of evidence Evans provides to other disciplinary appropriations of literature.

## 2.0 History

Poets themselves, tho' liars by profession, always endeavour to give an air of truth to their fictions... (Hume 1878, 419)

Historian David Hume's suggestion that literature feigns truth serves as an effective frame for History's appropriation of fiction. Such reprimands fostered a rigorous, guarded, and contentious arbitration for their inclusion within historical writing. However, these injunctions may be foreign to architectural research and deserve their own examination in light of Evans.

### 2.1 Louis Mink: Historical Understanding

In 1970, Historian Louis Mink published "History and Fiction as Modes of Comprehension," countering the strain of logical positivism rooted in Hume and extended under Carl Hempel's "covering law." Conceding that such modes of comprehension were capable of furnishing "historical knowledge," Mink suggested they were insufficient in producing "historical understanding." In order to avoid the causal and predictive mechanisms that attempted to model History as Science, Mink proposed adopting the literary mechanism of the narrative.

Surprises and contingencies are the stuff of stories, as of games, yet by virtue of the promised yet open outcome we are enabled to follow a series of events across their contingent relations and to understand them as leading to an as yet unrevealed conclusion without however necessitating that conclusion. We may follow understandingly what we could not predict or infer. (Mink 1987, 46)

Under such a model, the historian would be obligated to describe the relevant conditions surrounding historical events, but such relevancies would be adjudicated by the reader's ability to follow and understand the narrative, not that such relevancies had causal or predictive relationships to their outcomes. This desire to qualify complicity without causality resonates with Evans' descriptions of social life and their architectural pre-conditions.

In Mink's model, the historian was responsible for constructing the understanding of history, not simply a chronicle or commentary of the past. Rather than model the historian on the scientist who seeks to uncover a pre-existing truth, the historian is obligated to construct such truths.

The sense that such truths were "pre-existing" would appear to be specifically sympathetic to the discipline of History as a study of the past. However, Mink is quick to identify the pitfalls of such presuppositions.

... so another presupposition has been that historical actuality itself has a narrative form, which the historian does not invent but discovers, or attempts to discover. History-as-it-was-lived, that is, is an untold story... The novelist can make up his story any way he wishes, subject only to the requirements of art. The historian, on the other hand, finds the story already hidden in what his data are evidence for; he is creative in the invention of research techniques to expose it, not in the art of narrative construction. Properly understood, the story of the past needs only to be communicated, not constructed. (Mink 1987, 188)

For Mink then, history is an active re-construction by the historian to provide an understanding of past events, rather than a passive commentary. **Here it is helpful to recall Evans' injunction that architecture should not reconstitute itself as literature, but employ literature and literary devices to illustrate architecture's potentials.** Similarly, for Mink the literary device of narrative is not a model of the past, but a heuristic device to produce understanding. However, history should not be imagined as literature, nor, in Mink's mind, could they be confused with each other.

Fiction may indeed be accurate in reporting some events, actions, and the details of life in a certain period, but we know this (and know that we know it), only because we can compare fiction with history, without doubting in principle which is which. (Mink 1987, 183)

While literature may provide useful devices for understanding Mink's own discipline, the possibility of conflating the two is, in principle, impossible. However, for Literature Professor Barbara Foley such conflation is not only ubiquitous, but opportunistic.

## 2.2 Barbara Foley: Literary Veracity

In "History, Fiction, and the Ground Between: The Uses of the Documentary Mode in Black Literature," Foley explores literary devices which connote historical actuality within novels. Employing history for its rhetorical power, Foley qualifies the necessity of authors to frame their work as historically verifiable.

The presumed historical truth of such documents also was--and is--central to their aesthetic effect: the explicit and concrete detail that produces powerful denunciation in autobiographical discourse would easily seem crude sensationalism in the realm of fiction. Linda Brent's account of her master's many attempts at seduction, for example, would be a kind of brashly salacious Pamela if viewed from the set of expectations routinely governing the reading of fiction; when viewed as factual statement, however, the narrative serves to heighten the reader's awareness of a particular oppression experienced by the female victims of "the peculiar institution." (Foley 1980, 392)

In order to assure the reader of a literary account, authors went to great length to substantiate their narratives. As Foley argues, Richard Wright found it necessary to append second additions of *Uncle Tom's Children* and *Native Son* with prefaces that evidence their historical veracity. While some literature may satirically adopt forms of literature assumed to be true, as in the case of Jonathan Swift's adoption of the travel memoir trope in *Gulliver's Travels*, others may subvert a documentary rhetoric.

[A] simulated slave autobiography written by the white abolitionist James Hildreth may have done more to hinder than to aid abolition, despite its forceful rhetoric, since it permitted Southern apologists for slavery to seize on the text's factual inaccuracies and charge antislavery advocates with deception and distortion of the truth. The guarantee of veracity was thus central to the political effectiveness of the fugitive-slave narrative as a genre. (Foley 1980, 392)

Such accusations are guarded against in Evans work as he explicitly paired his excerpts from novels with autobiographical accounts and noted extra-disciplinary citations. However, for Evans, the consequences of his conscription of literature extend beyond its rhetorical effects or its ability to understand, rather than comment on, history. In order to qualify Evans literary appropriations to implicate architecture in "direct intervention in human affairs," it is useful to examine his work in reference to Geography's appropriation of literature.

## 3.0 Geography

While literary devices are explored specifically for their epistemological and rhetorical consequences in reference to History, the physical consequences of literature are foregrounded in its appropriation within Geography.

### 3.1 Kenneth Olwig: Literature as Catalyst

In Kenneth Olwig's study of the Jutland Heath in "Literature and 'Reality'," he argues that literary (fictional, poetic, and mythological) depictions of geography can serve to activate actual shifts in the physical landscape. Skeptical of the use of literature to prioritize the experience of landscapes, Olwig argues the geography's appropriation of literature

... is concerned not so much with the individual's apprehension of geographic reality as it is, but literature's social function in envisioning reality as it is not but ought to be, and with its potential, thereby for stimulating change. (Olwig 1981, 47)

This potential for literature to stimulate change is illustrated in the transformation of the Jutland Heath. Quoting a survey from Harry Thorpe, Olwig notes that the heath was a characteristic landscape of 3,000,000 acres in Jutland in 1800 that had been reduced to 640,000 acres in 1950. This survey is accompanied by a quotation from a Fullerton and Williams account of the transformation which describes the transformation as a "waged war on the heather." However, apart from a general industrial narrative characteristic of modernization, no motive can be found for such an assault. Olwig points toward the poetry of Hans Christian Andersen and Steen Steensen Blicher to find such an impetus. (Olwig 1981, 54)

Conscripted in a military defeat that lost territorial claims to Slesvig and Holstein, Blicher and Anderson's prose serve as a call to reclaim a wasteland in service of Denmark's burgeoning national identity. Engineer Enrico Dalgas saw the effective, if disconnected, localized cultivation and afforestation of the heath. To galvanize public interest and solicit state and private investment to transform these minor/local interventions into a systemic and connected system, Dalgas founded the Heath Society and published *Geographical Pictures from the Heath*. To preface this agenda, Dalgas begins with Blicher's description of the heath which, counter to Mink's claim, he proclaims is "not poetry." As a paradoxical testament to the effects of Blicher's poetry, a stone with his name engraved upon it marks a hollow of preserved heath which his writing served to transform.

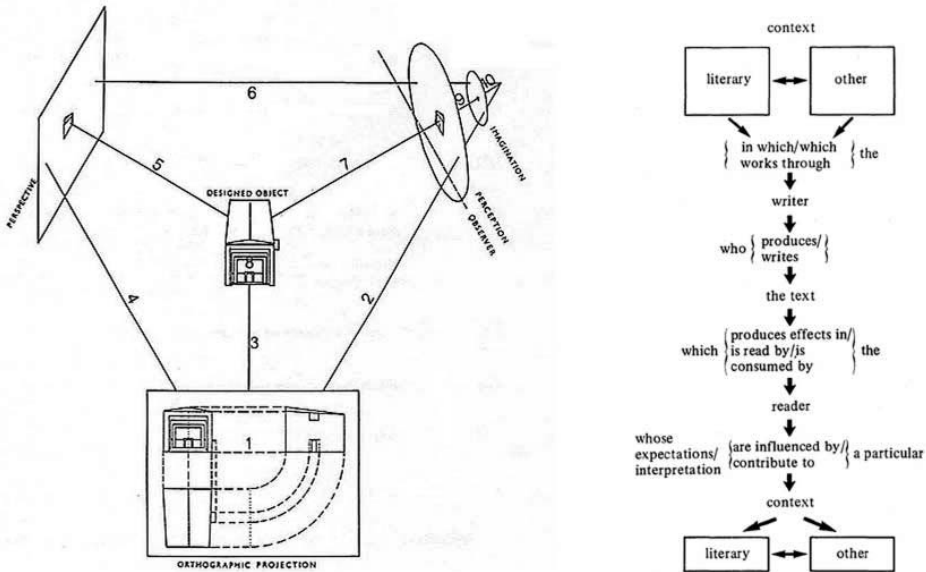
Despite the conviction and clarity of Olwig's conscription of literature, his appropriation is specific and calculated. His descriptions of the economic and political conditions are largely anecdotal, leaving any structural examination absent. Some geographers critical of this approach suggest such methods may amount to nothing more than

the casual ransacking of fictional writing as a ready means of recovering the most obvious images of intentionality, prised away from the material structures which help give them their effectivity... (Gregory 1981, 2)

Such material structures serve as the specific expansion of Geographer John Silk's appropriation of literature.

### 3.2 John Silk: Effect and Structure

Silk's "Beyond Geography and Literature" attempts to reconcile the context (social, economic, political) of the writer and reader with their potential effects. He frames the problematic relationship between reader, writer, and written text. This structure intends to explore the relationship between the context in which the text was produced and the production of a new context. To illustrate this relationship, he diagrams the process of the text in relation to these contexts. The diagram is strikingly similar, both in organization and intention, to a diagram produced later by Robin Evans for his book *The Projective Cast: Architecture and Its Three Geometries*. In both diagrams the object of cultural production serves as a fulcrum around experience and wider contextual effects.



**Figure 4:** Left, Projective Cast (Evans 1995), Right (Silk 1984).

Here the disciplinary differences are also significant. For the Geographer Silk, the text acts indirectly through the conscious readings and interpretations of the reader that contribute to the production of a new context. For the Evans, architecture, as understood from the previously quoted conclusion, operates as a “direct intervention in human affairs.” However, the intention to use literature as a probe into obscure and contingent social worlds is also evident. For Silk, the “taken-for-granted world” (Silk 1984, 169) vivified in literary works can be paired with ideological structures to guard against Gregory’s accusation of “casual ransacking”. For Evans, the assumed rationality of the ordinary configuration of domestic space, constructed in plan,

...is a delusion, and a delusion with consequences too, as it hides the power that the customary arrangement of domestic space exerts over our lives, and at the same time conceals the fact that this organization has an origin and a purpose. (Evans 2011, 56)

For both, literature provides a unique, if necessarily bracketed, resource and device for probing a disciplinary relation to social worlds.

**CONCLUSION**

This attempt to compare disciplinary appropriations of literature is meant to ground Evans’ architectural inquiries. This brief survey should not be considered encyclopedic, as it focuses on questions raised by Evans and analyzes them through his contemporaries in other disciplines. As such, it has intended to highlight sympathetic tendencies and agendas across disciplines. In all three disciplines, literature has been conscripted to describe consequence without causality. While the specifics of that appropriation differ, each strategy couples disciplinary forms of knowledge with literature conferring a provisional legitimacy to concededly fictive scenarios. In this way they attempt to appropriate literature without becoming literature. This last point for Evans is significant, both in his desire to distance his work from Eisenman and Hedjuk, but also for contemporary architectural research.

The contemporary resurgence of literature in architectural scholarship, for example Jill Stoner's *Toward a Minor Architecture* or Jimenez Lai's *Bureau Spectacular*, offer quite different positions on the relationship of design, history, literature, fiction, and research. Evan's work, then, is not meant to appear representative of an entire discipline's position, but form a well-grounded, situated, and explicit historical launching point to enter into contemporary architectural research.

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## **Structures of Intersections**

Reorientations of Identities and Alliances.  
Global, Local, Geographic, Ethnic, and Disciplinary





# Intercessions among American architecture students and a Puerto Rican informal settlement

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**ABSTRACT:** This paper presents the research and design experiences of American students of architecture working on a research project in the Puerto Rican informal settlement of La Perla. This neighborhood is located adjacent to the historic city of San Juan, Puerto Rico, (a UNESCO World Heritage Site) and has been segregated from the rest of the city since the first settlers invaded a plot of land about 100 years ago. This paper presents part of the experience of faculty members and more than 180 architecture students from the continental United States, who have visited Puerto Rico in the last 6 years, as an attempt to incorporate studies of informal settlements in their academic curriculum (through 14 field trips overall). A large research project has been developed to individually study approximately 400 dwellings in this sector. This experience has allowed students to understand the reality of urban slums in a developing country not as spectators, but through designing real architectural and urban projects with the potential to benefit the community, as well as conduct research on disciplines which are relevant to their future profession. As a result, several architectural proposals have been designed by the students, and presented to the local authorities for consideration and further joint development under social programs that will complement the proposed design interventions.

This study is part of a collaborative effort between Florida Atlantic University, the community of La Perla, and the local government of San Juan and has been partially financed through an ARCC grant. The work aims to integrate La Perla with the rest of San Juan and improve the quality of life through research and design.

**KEYWORDS:** Informal settlements, community design, tourism potential, old San Juan.

## INTRODUCTION

From the discovery of the New World until the independence of Latin America from Spain in the 17<sup>th</sup> century, the founding of Spanish cities in America has been among the most extensive urbanization efforts in world history. Apart from the evangelization of the aboriginal population, the main objectives of the establishment of such urban settlements on the American continent have been the conquest and domination of new territories towards the exploitation of mineral and agricultural resources. Shortly after Columbus discovered Puerto Rico (1493), in the year of 1508, the Spanish Crown started a settlement where today's capital, San Juan, still lies. The urban planning of the Spanish colonial cities was designed according to the principles of the "Laws of the Indies", which mandate everything from treatment of the local population to planning guidelines (i.e. width of streets) (Nuttall, 1573, Stanilawsky, 1947). Although San Juan was founded after the proclamation of the Laws of the Indies, the influence of this legislation still applies today.

The Spanish settlement of "Old San Juan" is strategically located in the small islet of San Juan. The islet topography emerges vertically from the ocean as a natural fortress. The Atlantic Ocean lies towards the north, and San Juan Bay, one of the best natural ports of the Caribbean, lies to the South and West. It is an ideal location for a fortified city, which allows protection from pirates and other invaders.

San Juan has historically been an important exchange center for the Spanish crown. Gold and other resources from South America were transported through Panama and the Caribbean to

San Juan and from there, shipped to Spain. Cargo going to the island is subject to taxation; as a result, San Juan, together with La Habana and Santo Domingo, became one of the richest and most important Caribbean ports during the colonial era. Monuments and buildings were erected using the typical Spanish Colonial architectural style.

Today, unlike the rest of the Spanish territories, Puerto Rico is not a country, but a "Commonwealth" of the United States and is considered the oldest colony in the world (Monge, 1997). Thanks to its ties to the American economy, it features the highest GDP per capita of Latin America (World Bank, 2012). San Juan is a sprawling city with more than 500,000 inhabitants. It has grown consistently, subsequently surrounding neighboring urban centers. It is a city where the old colonial architecture and Spanish culture mix together with American culture. The historic center of San Juan (Old San Juan) has been designated an UNESCO patrimony area since 1983. The area has hundreds of beautifully restored buildings and tourist attractions, including one of the busiest cruise ports in the Caribbean.

One of the most intriguing facts about Old San Juan is at the same time the most paradoxical; what is probably the most valuable piece of land on the whole island, located on a steep rocky slope bordered by the city wall and the ocean, is occupied by a shantytown named 'La Perla'. This area was deemed unsuitable for residential purposes in the past, because it incorporated the old city slaughterhouse and cemetery; it was therefore considered dangerous due to possible health risks associated with the land use.

By the middle of the 19<sup>th</sup> century, poor families started moving into this area. With the decrease of agricultural activity in the countryside, several families without alternative resources illegally invaded the whole area; the invasion took place as a spontaneous process without any urban planning or official regulations. Since then, two neighborhoods have co-existed on the same land separated by a colonial rampart and economical and cultural circumstances. La Perla, like other informal neighborhoods, represents the marginalization of the low-income social class in cities of the developing world. Informal neighborhoods, also known as 'shantytowns', are a typical phenomenon in developing countries, where urban poor invade the land and build groups of improvised shelters or shacks to form a neighborhood; as these settlements lack a design master plan, they are usually considered 'informal'.

In comparison to other informal neighborhoods around the world, la Perla has higher standards and several inhabitants live a relatively comfortable life. This, nevertheless, does not eliminate social problems such as the marginalization of the residents. The settlement's idiosyncrasies make it an attractive case-study for various fields of inquiry; among the studies available, some present a medical focus, while others concentrate on literature related to popular musical expressions because La Perla is home to some famous musicians. From an architectural and urban point of view, however, the only published studies are related to housing satisfaction (Caldieron, 2011), and self-improvement (Caldieron, 2013).

One of the main problems of la Perla is the advanced deterioration of residential structures as well as the lack of adequate infrastructure and public space. There are many abandoned shelters and unused plots; on the other hand, the neighborhood is economically segregated from San Juan and the millions of tourists who visit the city every year. Due to its vernacular architecture and the use of colors and murals throughout the neighborhood, La Perla has the potential of becoming a tourist attraction. In many developed countries, especially in Europe, slums have occasionally been transformed into tourist destinations. The Olympic Games in Athens, for example, helped transform certain areas in the city (Maloutas, 2009). Motivated by the growth of tourism, the restoration of particular cities in Cyprus has received mixed reviews (Akis, Peristianis, & Warner, 1996; Vehbi & Doratli, 2010), (Caldieron 2013). In Argentina, the neighborhood of Caminito, an area with a mythic past (Lacarrieu, M. 2002), was transformed because of its interesting architecture and musical legacy. La Perla may be similarly inserted in the tourist map of Old San Juan without losing its idiosyncrasy. It needs to grow as a permanent community that nurtures on the artistic disposition of its inhabitants.

## 1. OBJECTIVE

This project's objective is studying the necessary transformation required to integrate la Perla with the rest of San Juan. We will herewith discuss several challenges posed by this informal settlement and propose a series of possible architectural and urban interventions to improve life quality for the inhabitants of La Perla. This study is part of a larger body of research, and only specific factors are herewith addressed: The marginalization of La Perla from the rest of the city, Urban and architectural decay of the shantytown and, the possibility to convert La Perla to a tourist destination. The aforementioned arguments will be further supported by design proposals provided by architecture students.

## 2. METHODOLOGY

This article is part of a larger study that was conducted employing a combination of methods. Observational surveys and informal conversations were realized by a group of architecture students, researchers and a group of volunteers from the community. Several visits were made to the shantytown between 2008 and 2013. Once the neighbors became aware of this study, several participated in voluntary confidential surveys; they received questionnaires about their housing conditions, social factors and neighborhood characteristics. Responses of those inhabitants who agreed to participate were treated anonymously, by returning an unidentified envelope to a specific address. Observations, local maps and photos of the dwellings' exterior areas were taken to support the questionnaire data.

La Perla is divided in 4 different areas, all of which were included in the study. The research team spoke with community leaders from the neighborhood about the possibility of proposing several architectural projects designed by the students in order to improve the neighborhood. The community expressed some of their necessities and announced the availability of some vacant land plots for such future design interventions (some of which are presented herewith). Two of the projects are under consideration by the city authorities.

## 3. RESULTS

### 3.1 Urban Structure in la Perla:

There are big differences between the urban morphology of La Perla and the rest of San Juan. There is a strong difference in the street patterns: streets in Spanish colonial cities are usually laid out on a strict grid. In San Juan the grid was not completely enforced, yet a certain order is visible, and the succession of plazas and streets allow a very attractive urban pattern. La Perla, on the other hand, is a typical self-built neighborhood where dwellings were erected before the planning of streets and integration of services, resulting in constructions that are scattered around any available space. Two main parallel streets run along the large, stretched shape of the neighborhood. The topography between the colonial wall that separates the city and the ocean is very steep, as can be observed in Figure 1. As a result, there are no transverse streets but rather, narrow and long inclined stairs, depriving several residences from any vehicular access. Nevertheless, La Perla features some very interesting spaces; public spaces, for example, intersect with semi-private areas, permitting an easier integration among the community members. The informality of the shantytown design creates interesting spaces for circulation. The building masses and use of bright colors also prove beneficial, giving a vernacular and artistic sense to the overall area. If La Perla is strategically improved, it can be transformed into a model informal settlement able to attract tourists.



**Fig 1.** *The city ramparts and the change of topography separate the colonial city (on the left) from the informal area of “La Perla” (shown on the right).*

Two vehicular access points and two pedestrian stairs provide physical communication between La Perla and San Juan. However, the inclined topography that creates an abrupt change of level between old San Juan and La Perla, as well as the thick colonial city ramparts generate a strong physical separation between the two sectors. Notwithstanding the physical separation, La Perla and San Juan are worlds apart in other ways; the colonial city is a well-maintained urban jewel designed using a modified grid of cobblestone streets and Spanish Colonial buildings that attract millions of tourists annually. La Perla, by contrast, is a low-income neighborhood with social and infrastructural problems. The need to incorporate La Perla with the city’s tourist market is unquestionably fundamental.

### **3.2 Tourism Potential of La Perla**

Although this neighborhood is located on one of the most valuable pieces of the island’s real-estate, (Fig. 2) La Perla displays many signs of urban decay and poverty like many other shantytowns. Land speculators and developers have not been able to bulldoze the dwellings and re-develop the area due to the settlers’ strong positive feelings towards their neighborhood, which unite them in defending their right to remain in the illegally occupied land since the last four generations.

The inhabitants of Puerto Rico consider La Perla a dangerous area, a perception which has been reinforced in the past by the reluctance of police forces to enter the shantytown. Tourist guides and books caution visitors of the danger and strongly recommend avoiding these neighborhoods. During the past year, La Perla has taken steps towards becoming a much safer neighborhood and tourists have increasingly responded positively to its intriguing appearance. Considering the local culture’s strong artistic and musical references present in La Perla, one could discern the potential in transforming this area into a sustainable neighborhood that is attractive to prospective visitors. Unfortunately, members of the younger generations and students in developed countries are apathetic to the realities of the impoverished populations, as some ignore the aesthetic significance of informal architecture and the positive values of their hard-working settlers.



**Fig. 2.** *Partial View of La Perla from the beach area looking East (Photo: Sanders)*

#### **4. PROJECTS**

The main task of the projects discussed is the integration of the neighborhood with the city, a challenging mission from both a psychological and physical perspective. A hurried integration of the city and La Perla is not possible due to the neighborhood's negative reputation. Many inhabitants from San Juan are afraid to visit the shantytown; conversely, some of La Perla's settlers are not interested in having other people walking around their neighborhood for the purpose of entertainment. It is clear that an integration strategy needs to take this reciprocal difficulty into account and allow for a gradual assimilation of the two realities.

The colonial wall that separates the neighborhood from the city constitutes a major physical challenge, as explained earlier. The wall's status as a protected UNESCO monument prevents the execution of any modifications. According to the legislation, no structure to the north of the wall may be higher than the wall itself, making the construction of an elevated pedestrian access unfeasible.



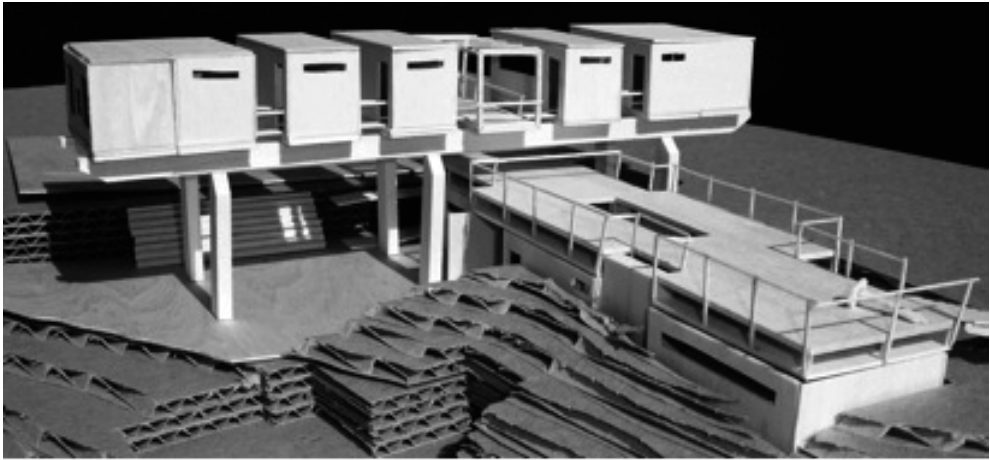
**Fig. 3.** Aerial view of la Perla in the superior area and its contrast between the formal city in the inferior area. Location of proposed projects is indicated as P-1 and P-2 (photo Google maps)

Based on this restriction, a physical connection can only occur through the existing access points or from the ocean side of La Perla. A possibility under consideration is creating a trail next to the ocean, passing through La Perla and connecting the two main fortresses of San Juan: San Cristobal and El Morro. This project is in progress under the supervision of the Agency of the National Park Services.

After studying the neighborhood and analyzing the results of surveys and observations, several improvement plans were proposed by the students. Among the proposals designed during several semesters, we will herewith discuss two solutions that best reflect a prospective integration. Figure 3 shows the location of the two projects. The site for Project 1 is next to the basketball court of the neighborhood while Project 2 negotiates a piece of land located next to the colonial cemetery, and can allow a connection between the city's visitors and the inhabitants of La Perla.

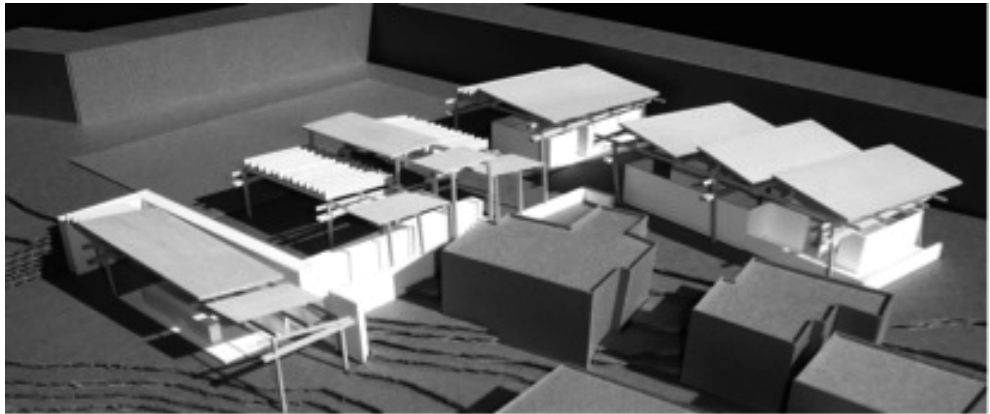
#### **4.1 Project 1. Wellness Center for La Perla**

Although La Perla includes three community centers, mostly dedicated to health services and education of infants, none is dedicated to young adults' activities. One of the most challenging problems of the settlement has been the increased use of recreational drugs, something especially worrisome among the younger generations. Many studies indicate a low level of recreational drugs use among athletes (Naylor 2001) and therefore suggest that sports can diminish the rate of drug abuse in the general population. In conversation with neighbors of La Perla, we have deemed a sports wellness center as a necessary addition for the neighborhood, accepting the prospect of sports related activities as an improvement factor in the well-being of the young generations.



**Fig. 4.** Model of a proposal for La Perla Wellness Center. (Design by M. Gonzalez-Maya)

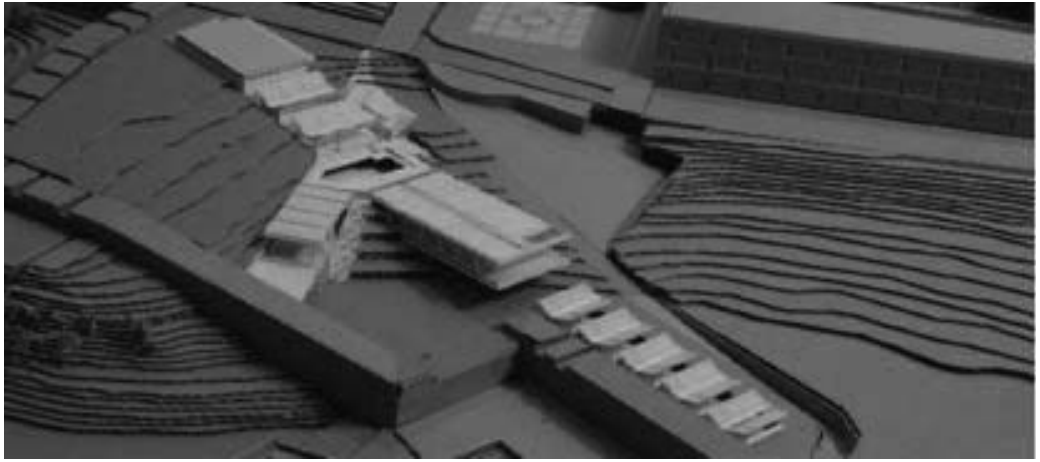
The only sport installation in La Perla is a basketball court. Because this is located next to the formal city, but on a lower level area, people from San Juan are able to look at the games played in the court. This is an element that can be positive for the necessary interaction between the city and the shantytown. The situation of a wellness center next to the basketball court seems very appropriate: Locals could use the actual stairs as a direct pedestrian access between the formal city and the basketball court and wellness center without passing between the shelters.



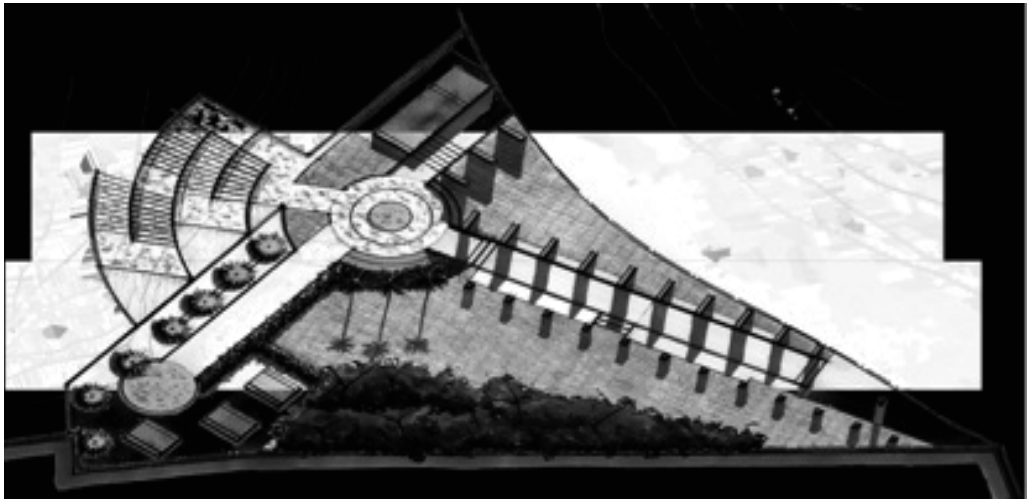
**Fig. 5.** Model of a proposal for La Perla Wellness Center (Design by M. Goodwin)

The authors, who are professors of architecture, developed the program and the students designed the projects with the professors' assistance. The program comprises multi-proposal activity rooms, a gymnasium, administrative office, and a cafeteria. The ideas were proposed for a lot that is currently occupied by two vacant shelters and an old community center. The student projects (Figures 4 and 5) were very successful from an educational point of view, and there is a strong possibility for their implementation.





*Fig. 6. Proposal for La Perla Market (Design by M. Goodwin)*



*Fig. 7. First proposal for La Perla Open Market (Design by T. Chui, M. Goodwin and P. Kondziola)*

#### **4.2 Project 2. Open Market Project. A Place for integration of la Perla and the city**

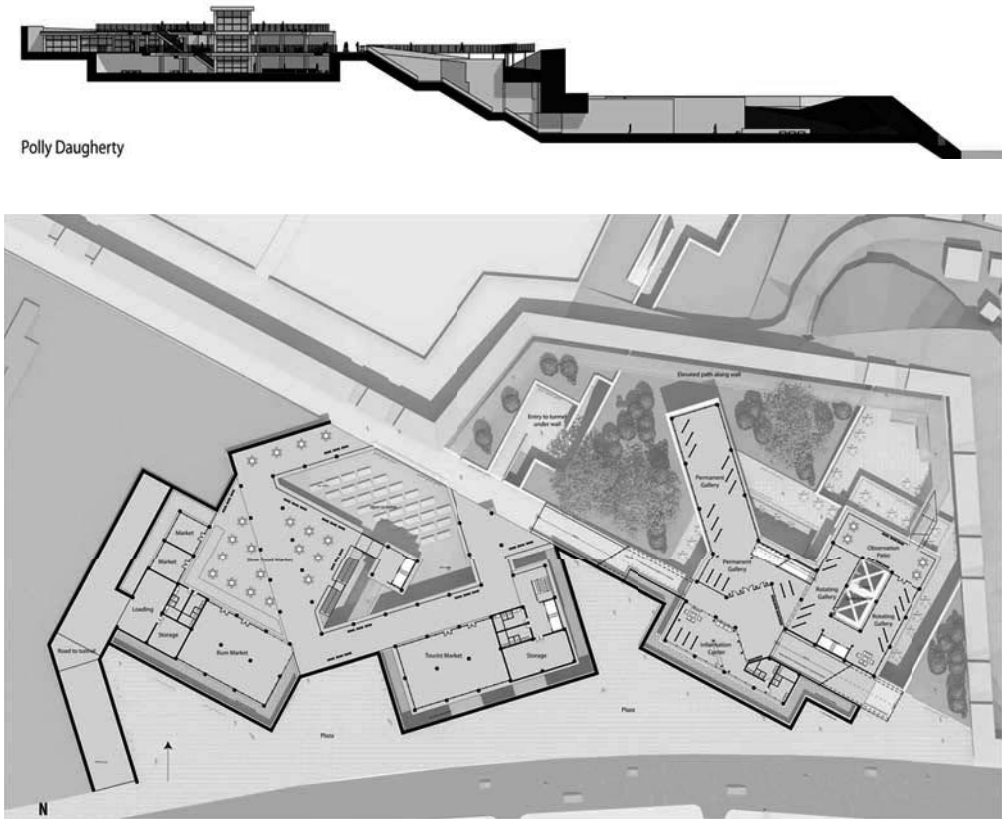
A second proposal was produced by third year architecture students who worked in groups over the course of several weeks to develop their ideas. Some of the projects were repeated with new groups of students during subsequent semesters. The land where the projects are located has a surface area of 1500 sq.m. and is about 18 meters above sea level. Pedestrian and vehicular access is provided via a steep ramp that penetrates the city wall. This is the same access that goes to the colonial cemetery.

As explained, the integration of La Perla to the Fortress area and the rest of the city must take place through one of the two vehicular accesses or two pedestrian accesses, which are already in use. The fortress and the old colonial cemetery form a walking axis that many tourists enjoy and the view of the esplanade surrounding the fortress is very attractive.

The proposal suggests the use of a vacant piece of land next to La Perla to create a space that can attract tourists and benefit all the city's inhabitants. Community leaders have agreed that a small food and handicraft open-air market may be a suitable solution because it will provide

some of La Perla's residents with an additional income. The selected plot for this project is right in front of the ocean, close to the only beach in the old San Juan area. Figure 6 represents a plan of one of the projects. The design consists of two main circulation paths: one from the shantytown on the left and the other from the cemetery to the right. Both circulation axes converge at a stair that allows the people to descend to the beach. The Plaza can also function as an open-air market. Figure 7 represents a Market located on a piece of Land North of La Perla that aims to integrate the neighborhood with the city. Figure 8 is a project that negotiates the combination of the formal city and La Perla through a connector that reaches the beach of La Perla.

Some of the proposals that adopted this idea during different semesters have kept a very simple program, proposing a square with some structures which function as an open market. Stairs allow the community and the rest of the city's inhabitants to access the beach, therefore allowing the intervention to integrate the beach and the city. Other proposals, on the other hand, proposed more complex solutions that involve the erection of buildings on both sides of the city walls; their main objective is creating physical links between the two communities. Although it is not entirely realistic to expect that tourists will visit the shantytown in the short-term, building something on the off-limits side of the colonial wall and next to the entry of the shantytown can be a definitive first step in creating a neutral area where inhabitants of both communities may co-exist.



**Fig. 8.** Plan and section of a proposed idea for La Perla Market. (Design by P. Daugherty)

## CONCLUSIONS

In several metropolitan areas, various reasons have imposed the segregation of informal settlements from the formal city. One such reason is that government bodies find ignoring shantytowns easier than improving them. For the formal inhabitants of the city, it is better to live separated from the “criminality” of the poor neighborhoods. Unfortunately informal settlements are synonymous with poverty, social problems and criminality. However, in most informal settlements inhabitants are honest people, which work hard to survive. Naturally, informal settlements demonstrate a large degree of diversity, which attests to the potential of several communities’ and warrants our identification and consideration of positive factors present therein, from an urban development perspective.

As previously described in the presented case-study, the separation between La Perla and San Juan is not only physical; both communities have been sharing the area but are separated socially. Some residents from San Juan may discriminate against La Perla inhabitants because of the shantytown’s bad reputation. The authors’ experience has indicated that La Perla is no more dangerous than any other low-income neighborhood of San Juan and its inhabitants are mostly good people. The decline of the neighborhood’s bad reputation and its integration with the rest of the city has proved a difficult task. La Perla is situated next to some of the most important tourist attractions of San Juan. As Puerto Rico is the most visited island of the Caribbean, the authors believe tourism can be an important element in the synergetic relationship between La Perla and San Juan. This integration is bound to be a slow process because it is not likely that tourists will start going to La Perla unless the neighborhood image is transformed for the better.

In order to start the integration of this neighborhood with the city of San Juan, the proposed ideas for a wellness center and an open market in the community may constitute a significant first step. Even though some inhabitants of la Perla may not welcome the idea of having visitors in the area, the fact that both projects are kept on one side of la Perla, and not in the middle of the settlement, may help neutralize this feeling. In addition, the market will allow some of the neighbors to have a supplementary income that can be a strong incentive for the community. Furthermore, the wellness center, with the introduction of sport activities, can help diminish the use of recreational drugs in La Perla. The active participation and collaboration of the community, not only in the proposals presented in this article but also in other projects, and in the general research developed by Florida Atlantic University School of Architecture, indicates the locals’ acknowledgment of a mutually beneficial relationship with the rest of the city.

The projects discussed have been already presented to the authorities of the island, including the mayor of San Juan. The authorities are interested in the construction of the proposed open market and the inhabitants of La Perla are excited with this possibility. From a pedagogical perspective, these projects and visits to La Perla have been positive experiences for all parties involved, especially the students. More than 180 architecture students from Florida Atlantic University visited Puerto Rico in the last few years, incorporating the study of La Perla community into their academic curriculum. These field trips have allowed the students to understand the reality of urban slums in a developing country, not as spectators, but through designing real architectural and urban projects benefiting the community, as well as researching disciplines associated with their future profession.

## ACKNOWLEDGEMENTS

This research has been partially funded with the help of the ARCC Architectural Research Consortium Centers and Florida Atlantic University. It is collaboration between Florida Atlantic University students of architecture and faculty members, the people of “La Perla”, the government of the city of San Juan, Puerto Rico and photographer Bill Sanders of Fort Lauderdale.

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# Havana's Urban Agriculture: productive land-scapes within a city's crumbling infrastructure

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**ABSTRACT:** When Cuba found itself abruptly cutoff from trade with Soviet bloc in 1989, the country spun into an economic crisis of unprecedented severity. Suddenly lacking the oil, pesticides, and machinery with which to grow crops, and without access to the imported food that had previously sustained it, Cuba's foodshed suddenly caved. Nearly twenty-five years later, this food crisis has vanished almost as swiftly as it arrived, in no small part due to the country's innovative and widespread urban food production efforts. This research addresses the urban design framework that Cuba created in order to support urban agriculture initiatives, and suggests ideas, opportunities and innovation that could inform the development of productive landscapes in other parts of the world.

Almost a dozen distinct types of urban farming approaches are visible in Havana, Cuba; these forms are a direct response to the 1989 food crisis and reflect the flexible modes of self-provisioning that followed. These farm types also expose the context, constraints, and cultural norms unique to Havana's urban environment, revealing changing attitudes towards urbanism in Havana's capital city. At the same time, this urban agriculture system can be distilled into a readable organizational taxonomy; a kit of parts approach to food production that could well translate to other parts of the world.

With natural and man-made disasters increasing in both frequency and severity, architects, landscape architects and planners can help cities plan for resilience by identifying replicable methods for self-sufficiency. This body of research focuses on the model urban farming programs underway in Cuba, which demonstrate self-sufficiency and food security in an oil-scarce environment. The goal of this paper is to share Havana's innovative urban agricultural interventions: food provisioning solutions that have been tested over the last twenty-five years and could be reproduced in other political and climatic zones.

**KEYWORDS:** Havana, Cuba, Urban Agriculture, Post-oil, Food Security

## INTRODUCTION

Global climate change and a dwindling world supply of oil threaten to erode the habits and systems that require consumption of and dependence on fossil fuels. Meanwhile, agriculture has, over time, become increasingly reliant upon these oil reserves, from crop harvesting and irrigation to the transportation and refrigeration of foods, and even pesticide and fertilizer production. As cities and towns prepare for a post-oil future, they necessarily must decouple food production from oil reliance, and through this process, redesign their regional foodsheds.

While food security hasn't traditionally been considered the domain of architects and planners, practitioners are quickly recognizing the value of engaging across disciplines with these infrastructures and systems. Designers bring an important lens to urban agriculture, where food production must be applied onto extant urban fabric. Landscape Urbanist Charles Waldheim reminds us that this work presents both social and physical opportunities, and suggests that "...architects and urbanists grapple with the implications for urban form attendant to their renewed interest in the agricultural." (Waldheim 2010, 18)

As architects, landscape architects, planners and educators look for tested models addressing the sister issues of scarcity and food security, the progressive urban farming work stemming from Cuba's Special Period stands out as a rare and important precedent. Widely understood

to be “one of the most successful examples of urban agriculture in the world,” Cuban urban farming incorporates grassroots organizing, the appropriation of public space for growing, and shared technical and educational support. (Koont 2009, 1) This surprisingly effective movement stands in stark contrast to other wartime or post-disaster environments, with outcomes ranging from widespread self-sufficiency and profound community engagement to environmental remediation and improved stewardship. Moreover, this Cuban model highlights a number of infrastructural, social and political features that could be applied to other areas.

## RESEARCH METHODS AND APPROACH

### 1.1. Field Documentation and Interviews

Cuba is undergoing rapid change under the leadership of Raúl Castro, and because of government control, information about many of these programs is nearly impossible to secure without fieldwork. This research relies on site visits to gardens and farms in Havana, including photographs, mapping, and interviews at those locations. A variety of different Cuban leaders contributed to this research, including professors from the architecture school in Havana, city planners, permaculture leaders, government agronomists, and journalists. Interviews with farmers and urban growers have provided worker's viewpoints. Finally, several state-sponsored organizations, including the National Urban Planning Office, the Provincial Urban Agriculture Department, the National Group of Urban Agriculture, the Association for Organic Agriculture, *Fundacion de la Naturaleza y el Hombre*, and the *Patio* and *Parcela* Movement facilitated the gathering of data.

### 1.2. Literature Review

Although Cuba's food landscapes have not been studied in depth by architects, landscape architects or planners, many other disciplines have published significant scholarly work on this topic. The literature reviewed for this paper was purposefully broad and interdisciplinary, in order to promote a more holistic understanding of the issues, factors and approaches to urban farming in Havana. These texts include blogs, papers, books and articles written by Cubans as well as foreigners, and farmers as well as academics, with a focus on the last thirty years.

### 1.3. Inventory of Farm Types

This paper identifies the physical structure of urban agriculture in Cuba, including growing areas and support services. Using the official state language for farm types, and on-site analysis of different farming components, a taxonomy of urban farms was developed. With an emphasis on Havana and the last twenty-five years of urban farming in Cuba, this paper categorizes nearly a dozen different approaches to urban farming and simultaneously explains the myriad factors (social, cultural, environmental, and political) that have shaped such a robust country-wide initiative.

## BACKGROUND

### 1.1 History

In 1989, the Cuban government abruptly lost an important trade ally with the dissolution of the Soviet bloc. Already isolated from world trade due to the U.S. sponsored trade embargos, Cuba became, almost overnight, cut off from the rest of the world. In the years that followed, the country was both incapable of effectively exporting sugar and citrus crops, and unable to import critical staples. This period became known as Cuba's food crisis, in which most Cubans lost access to roughly one third of their daily calories, there was widespread hunger, and the government instituted a peacetime austerity program for food rationing.

Beyond the overwhelming reduction of food-related imports, Cuba suffered from pervasive oil scarcity. One of the major motivations for turning to urban farming was that transportation in Cuba became very limited, as well as time-intensive and expensive. Growers had difficulty moving vegetables, meat and fruit to the tables around the region. In this sense, Cuba's food crisis was both political (in the case of trade embargos) and locational (people were stranded in a food desert). Although Cuba had become reliant on other countries for food provisioning,

its geography, history and political values actually pointed to a latent local foodshed. The island benefits from an ideal tropical coastal climate zone for growing, year-round crops, sizeable tracts of arable land, a strong post-1959 government, and a socialist appreciation for agriculture and self-sufficiency.

Presented with a near collapse of its food provisioning system, the Cuban government responded with an overhaul of agricultural systems on the island, preferencing organic farming, useful edible crops, and peasant labor. In urban areas, guerrilla gardening initiatives blossomed into new state-supported urban farming programs, with widespread voluntary participation. Grass-roots farming efforts, combined with the enthusiastic support of the state, has led to a robust urban farming program across the island. (Altieri and Funes-Monzote 2012)

## 1.2 Today

Havana is an exemplary model for this type of self-provisioning, and a useful precedent for individuals seeking to understand the opportunities and obstacles for transference. The city has more than two million people, many universal or ubiquitous infrastructural elements, and an urban form more like New Orleans than other cities in the Caribbean. In an effort to bring food production into the city, agricultural initiatives were necessarily layered over, and knitted into, existing urban fabric. From a design perspective, Havana's urban agriculture can read as an afterthought or a stop-gap measure, rather than a considered and intentional design process. This practice of urban acupuncture, however, is perhaps its most salient design feature, demonstrating that productivity can be introduced and infused into hardened urban wastescapes.

In the context of this paper, Havana provides an example of a systematic approach to rethinking urban landscapes for more productive means. Today, Havana has a unique food production infrastructure woven into its contemporary city form, including 475 large state farms, 318 livestock farms, 179 *organopónicos*, 418 high production orchards, 28 seedling production centers, 324 greenhouses; 162 *Autoconsumos*, 7,848 *parcelas*, 34,970 *patios*; 126 forest farms, 67 cattle farms; 52 different agricultural stores, 3 compost production sites; 7 centers for the production of entomophagous and entomopathogenic (CREE) and 40 urban veterinary clinics. (González 2008, 24) Professor Sinan Koont estimates that "more than 35,000 hectares (over 87,000 acres) of land are being used in urban agriculture in Havana!" (Koont 2009, 1)

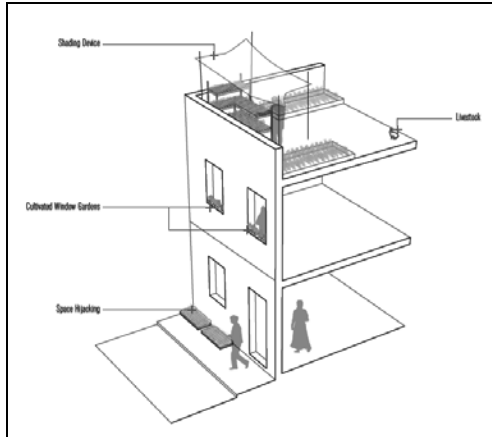
## THE FORM OF URBAN AGRICULTURE

Urban agriculture in Havana occurs at a host of different scales, from the balcony garden to the multi-acre fields that comprise Havana's greenbelt. These gardens also have a range in terms of production, from highly-productive enterprises to pleasure gardens, and varying degrees of state support and recognition. Havana's urban gardens typically produce food for human and animal consumption, although the same formal structure of gardens also supports the production of compost, biofuels and animal husbandry.

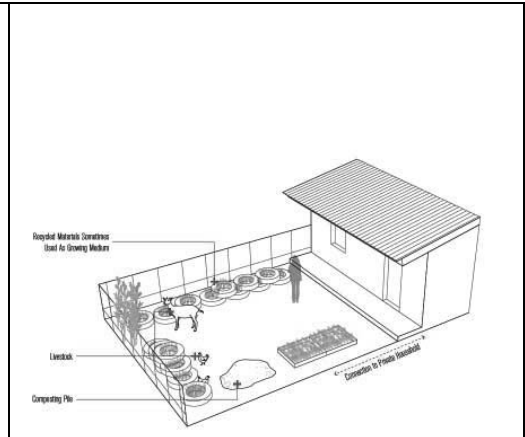
Many of these gardens have emerged somewhat opportunistically from vacant and blighted properties within the city, exploiting usufruct rights (free land provided by the government, indefinitely) to seize available space. Professor Sinan Koont notes that in Havana, "Plots that had become eyesores and informal garbage dumps have been transformed into productive land." (Koont 2009, 3) According to scholar Orlando Acosta Mirrelles, this unproductive urban land is rapidly running out. In Havana, of the 35,890 hectares of unutilized, cultivable land "all but 2,970 hectares were already in use as pastures, forests, and croplands as of November 15, 2006." (Mirrelles 2006, 14) Regardless, the state continues to identify underused landscapes, including polluted wastelands and informal dumps, as sites for productive urban agriculture.

The organization of Cuban agriculture can be understood in terms of state-sector farms and non-state sector farms. (Martín, 2002) State-sector farms include New Type State Farms (GENT), Revolutionary Armed Forces (FAR) farms, including farms of the Young Workers' Army (EJT) and the Ministry of Interior (MININT), Self-provisioning farms at workplaces and

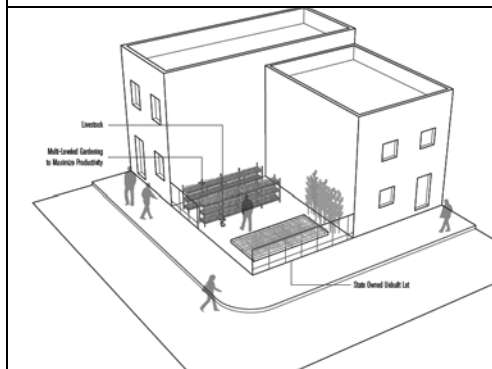
public institutions, Basic Units of Cooperative Production (UBPC) and Agricultural Production Cooperatives (CPA). Non-state sector farms include Individual Production Credit and Service Cooperatives (CCS), individual farmers, using both usufruct and private property, and mixed sector joint ventures between the state and foreign capital.



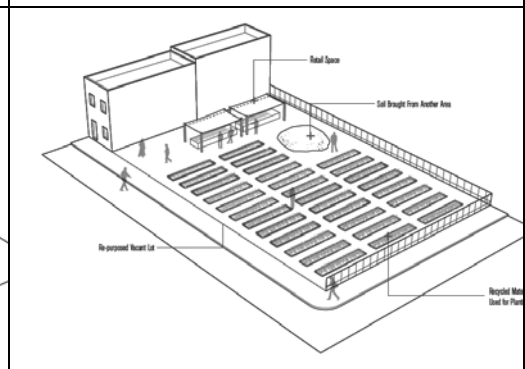
**Figure 1:** Micro-garden. Source: Jade Jiambutr



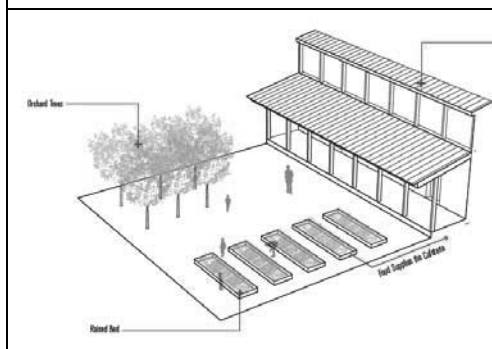
**Figure 2:** Patio. Source: Jade Jiambutr



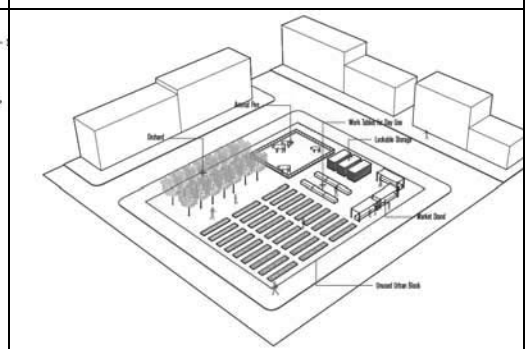
**Figure 3:** Parcela. Source: Jade Jiambutr



**Figure 4:** Huerto Intensivos. Source: Jade Jiambutr

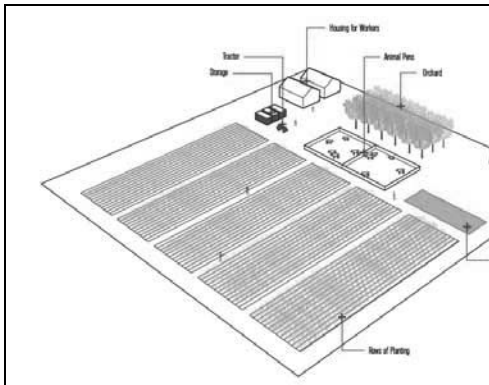


**Figure 5:** Autoconsumo. Source: Jade Jiambutr

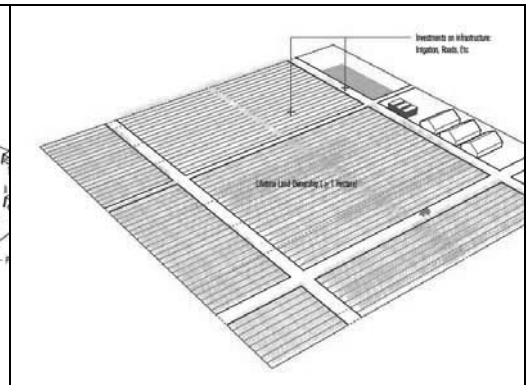


**Figure 6:** OAR. Source: Jade Jiambutr





**Figure 7:** Campesino Particulares. Source: Jade Jiambutr



**Figure 8:** Empresa Estatales. Source: Jade Jiambutr

## FARM TYPES

While the heterogeneity of each plot ultimately stems from site constraints and a grower's needs, most urban farms fall into one of the following four groups: *huertos populares* (popular gardens), *autoconsumos* (institutional gardens), *organopónicos* (cooperative gardens), and *empresas estatales* (state enterprises). The following farm types comprise the taxonomy of urban agriculture in Havana today: (Clouse: 2014)

*Micro-jardines*, or Micro-gardens, are typically less than 100 m<sup>2</sup> in size, and produce spatially efficient crops, such as herbs and container tomatoes, or small livestock, such as rabbits, guinea pigs, and poultry. Micro-jardines include planter boxes and potted gardens—the smallest-size garden types in Havana—which are found predominately in the dense central core, where outdoor space is limited. This type of garden is typically privately owned and worked by one person, for his or her own immediate consumption. Plastic or metal bins hold the growing medium and gardens are often made up of repurposed containers placed on racks, rooftops, or concrete surfaces. Some public space appropriation occurs at this scale—most often between the sidewalk and the street, where fruit and nut trees or tiny crops, such as herbs, are grown. (Figure 1)

*Patios* are Yards, typically less than 1,000 m<sup>2</sup> in size, which produce tubers and *viandas*, vegetables, grain, fruits, small livestock, such as rabbits, sheep, goats, and poultry. Often of a small scale, these gardens fit into underused or leftover spaces and can be easily managed by an individual. The proprietor grows items that are particularly suited to existing site conditions, such as soil type or the amount of available sun or shade. The proximity of patios to those who tend them shortens the distance between farm and table and also eliminates the need for commuting laborers. (Figure 2)

*Parcelas* are lots, typically less than 1,000 m<sup>2</sup> in size, which produce tubers and *viandas*, vegetables, grain, fruits, small livestock, such as rabbits, sheep, goats, and poultry. Parcelas are formed with usufruct land from the government. They could include playing fields, portions of public parks, and abandoned lots, but are generally small- to medium-scale gardens carved out of underused urban lots. They are usually worked by an individual or small group of growers, who produce for their own immediate consumption. The shape varies from the very private adjacent lot—indistinguishable from the yard—to a much more public garden. (Figure 3)

*Huertos Intensivos*, or Intensive Cultivation Gardens, range in size from 1,000–5,000 m<sup>2</sup>, and produce fresh vegetables for public and private use. Larger than parcelas but often still operated as independent businesses, huertos intensivos are single lots under cultivation by private collectives of growers. These medium-sized farms are located throughout the city, often employing state-owned land that was once vacant, a field behind a public building, or a piece of a public park. These farms typically are large enough to require multiple employees and can

sustain those employees and their families. Many of these farms specialize in a few different vegetables or products. After donating a portion of the yields to the state as a tax, the farmers then can legally sell their produce at markets for profit. (Figure 4)

*Autoconsumos*, or Self-provisioning gardens, produce food, usually vegetables and fruits, for self-provisioning institutions. *Autoconsumos* are gardens physically connected to a school or a workplace and are farmed by their employees to support the needs of the cafeteria at the institution. These gardens augment the cafeteria food that the government must provide for each institution, while ensuring that fresh produce will be incorporated into these meals. These gardens represent the efforts of each institution to support socialist ideals by being productive at multiple scales. Because *autoconsumos* are hosted by state-run organizations, these growing areas represent solidarity with the country's dispersed and prolific food security scheme. (Figure 5)

*Organopónico de Alto Rendimiento* (OARs), or high-yield urban gardens, range in size from 2,500 m<sup>2</sup>–20,000 m<sup>2</sup>, and produce vegetables, such as lettuce, spinach and radishes, cooking herbs and spices, eggs, and fruits, for public and private use. OARs characterize the most common large-scale farming efforts within the city's limits. These farms are usually found on infill sites near housing developments and stretch across entire city blocks. (Figure 6)

*Campesinos Particulares*, or Private Peasant Gardens, range in size from 5000 m<sup>2</sup>–80,000 m<sup>2</sup> per farm, and produce soil, nursery, tree farms, flower farms, multi-crop farms, some animals, *viandas*, vegetables, grain, spices, flowers, soil, tree saplings, honey, and fruits for sale. Located primarily in the green belt or peri-urban areas, these farms have the physical structure of rural counterparts. (Figure 7)

*Empresas Estatales*, or State Enterprises, produce vegetables, cooking herbs and spices, eggs, fruits. Orchards include varieties of banana, coffee, mango, coconut, avocado, and trees for wood and shade. *Empresas Estatales* are businesses owned by the state. There are two state-owned companies in Havana: one deals in livestock and the other in orchards for vegetables and fruits. (Figure 8)

## THE ROLE OF DESIGN

### 1.1 Limited Professional Roles

Designers such as planners, architects and landscape architects have historically played a limited role in the development of agriculture systems. According to scholar Charles Leshner, "professionals in urban landscape, ecology, and design are not including urban agriculture into their catalogues of urban assets." (Leshner 2008, 64) While food production has been disassociated from the design disciplines in the past, it is increasingly becoming relevant in the urban context. As societies begin to consider new forms and types of farming, designers could help to shape that work, especially in urban areas.

In the context of post-oil survival, the design disciplines could present useful agendas, advocacy and strategies for envisioning future cities. Architects, landscape architects and planners are poised to help ease the transition to a post-oil city, by visualizing new forms of farming, developing new technologies, systems and materials, and working to connect farming to contemporary city life. Traditionally, designers have acted as the gatekeepers for public space shaping; indeed many of the same issues that affect urban spaces also impact urban farming. For instance, food production in cities has the potential to be form-based, affordable, efficient, visible, and to represent the interests of all citizens.

Moreover, designers could benefit from opening up new terrain in their field, as well as new forms of interdisciplinary work. Engaging in the design of urban food systems would highlight broader issues of food security, thereby expanding the field. As the design disciplines move from largely aesthetic conversations to topics of utility and resilience, this kind of work serves to increase the relevance of the profession.

## 1.2 Obstacles

Political support is perhaps the greatest barrier to adopting new forms of urban agriculture in cities. Without access to affordable land and agricultural education, growers can hardly be expected to produce healthy and stable urban farms. Scholar Kathryn Peters reminds us that “Victory gardens and local sustainable agriculture reduce dependency on the established food production system, but, because the U.S. population is clustered in densely populated metropolitan areas, the majority of the population lacks access to land on which to grow food.” (Peters 2010, 205) While the design disciplines must adapt old models for food production to new urban surfaces, they cannot gain traction for such endeavors without government support.

## 1.3 Integrating Urban Agriculture into the Classroom

Perhaps the logical starting place for such a disciplinary overhaul would be in the classroom; it is here that design students (future professionals) develop their understanding of professional norms and their own design values. Design education could seed the topics of food security, productive landscapes, and climate change adaptation by exposing students to a much broader array of design precedents and attendant real-world issues. Indeed, urban agriculture, once marginalized as a topic relegated to fledgling non-profits and agriculture extension agencies, has recently surged in popularity, in no small part due to the activism of emerging design professionals.

## CONCLUSION

Cuba’s innovative approach to urban farming provides a blueprint for urban food security, with a host of formal recommendations that could be useful in other areas. While not originally planned into the city fabric, this country-wide initiative suggests logical land-use transitions, provides a model for agricultural education and offers up a variety of new formal garden typologies. Perhaps most importantly, Cuba presents a useful case study because the country has endured a food crisis brought about by oil scarcity, and has thrived.

A large-scale conversion to urban agriculture demands a shift in cultural and social values while also triggering concomitant formal and physical changes. Professor Alex Wall suggests that new forms of landscape urbanism must be “targeted not only toward physical but also social and ecological agents.” (Weller 2006, 79) Part of this transformation entails a disciplinary shift, through design, while another part of it is political and social, a shifting of language and thinking around what the city can and ought to be. A good example of this transformation can be found in Havana’s masterplan, which identifies a planning typology called a ‘Food Park.’ This new terminology illustrates the enlightened thinking of planners and residents, and suggests a way forward for other parts of the world.

Indeed, the urban agriculture practiced in Havana provides an important model for any city transitioning towards food independence. As global warming intensifies and energy, land and water reserves diminish, many see the value in a return to locavorism and the development of more resilient food systems. Cuba’s model---affordable, accessible, comprehensive, and de facto organic---could be particularly instructive for other nations seeking improved food security. And while Cuba was forced to innovate due to the food crisis of 1989, other countries have the opportunity to develop their own self-sufficiency before such a crisis unfolds. With the pressing threat of climate change waiting in the wings, designers have a responsibility to engage, perhaps by helping cities retrofit urban food systems for self-sufficiency.

## ACKNOWLEDGEMENTS

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# Defining challenges for future sustainable homes: A review of earlier experimental activities

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**ABSTRACT:** A renewed focus on innovation in the building sector calls for research strategies that will strengthen the position of holistic architectural knowledge for the benefit of a sustainable built environment. This paper presents research that focuses on future homes that will enable radical reduced resource use related to living. In order to reduce the environmental impact of living and dwelling we need to address not only buildings and physical structures but also user behavior and lifestyle choices. Contemporary housing development is defined by a view of the housing market based on surveys among limited groups of people and not on actual needs and wishes representing the wider population. Furthermore, the actual housing market does not deliver structures that will enable sustainable changes to the environmental impact of living.

The aim for the paper is to define architectural research for future homes in relation to a planned purpose built Living Lab. Research should support a radical reduction of the environmental impact of living. A review of 20<sup>th</sup> century housing research and development in Sweden and France provides insights from previous successes as well as failures in the field. Results point to the importance of involving end-users and to build on solid understanding of the use of homes. In addition, already explored innovation regarding space use can with advantage be repeated, as contemporary users are likely to react differently than users did in the past. We propose a three-step model for research starting with empirical studies of the use of homes among a large variety of households (i.e. regarding size, age groups, cultures etc.), prototyping of new architectural concepts (e.g. related to layout, interiors, equipment, products etc.) and test and evaluation of these in the Living Lab.

**KEYWORDS:** Living Lab, future homes, resource efficiency, dwelling habits, user involvement

## INTRODUCTION

At present, the building sector is concerned with most major societal challenges, including objectives for sustainable development, climate change, environmental protection, increasing urbanization, globalization, adaptations to changing demographics and anticipated large scale refurbishment of post-war housing. These challenges call for the development of new norms and practices and are among the main drivers for a renewed focus on innovation, not only in the building sector but in society at large.

The housing sector largely contributes to the national environmental footprint. Swedish households accounts for a fourth of the total national energy use and has been pointed out as a main area for action in order to reach the national goals for energy saving set for 2020 and 2050 (Environmental Agency 2013). Since the 1950s, household expenditures for housing and transport have each increased by almost 300% (Söderholm 2011). In addition, Sweden had in 2008 the highest spatial use per capita in Europe with 42,5m<sup>2</sup>/4574.7ft<sup>2</sup> per person, and the highest number of single person households (44%) (Dol and Haffner 2010). A recent study states the use of floor space as one of the most significant indicators for energy use in housing (Hille, Simonsen, and Aall 2011). The larger number of single person households also increases the total electricity use per capita (Elforsk 2006). Consequently, these contemporary living trends are in opposition to sustainable development.

Sweden has in recent years shown remarkable innovation in low-energy construction (Femenías and Kadefors 2011). These innovations regard mainly the adoption of technology and adaptation of construction methods. Alternative concepts for the design and layout of dwellings and homes that enable changes in priorities and lifestyles have not been subject to the same development, and still signify a more radical change of mind-set. A number of authors have claimed that economically justified energy-efficiency improvements will increase rather than reduce energy consumption (Sorell 2009) thus we question how advantageous energy-efficiency measures in housing design are when seen from a more holistic standpoint. Rebound effects of efficiency include the increase of embodied energy due to higher levels of insulation but also re-spending effects when households increase consumption of energy demanding goods and services as a direct result of cost-savings from efficiency.

20<sup>th</sup> century Swedish housing development led to a large increase in standard, comfort and quality of life for the wider population and was a corner stone in building the well-fare state. Central was knowledge about the use of homes and the needs of the users. Observations of mainly women using home environments was carried out by the national 'Homes Research Institute' 1944 until the early 1970s and led to new standards linked to generous loans for the construction of housing. These standards were transferred to the formal building regulations in the 1970s. Until the 1990s national surveys were regularly carried out about living and dwelling habits. In the early 1990s large changes in the national state's involvement in housing and construction led to the abolishment of finance for housing development and a deregulation of housing standards and no more national survey were carried out. Instead, contemporary housing standard and design are determined by norms within the sector, market surveys which map customers' willingness-to-pay, and regulations which do not sufficiently reflect the urgency to reduce energy and resource use (Hagbert et al. 2013). In fact, very little has changed regarding the typology and layout of Swedish housing since the 1970s, even less so to adapt to a growing awareness of the environmental and social impact of the built environment.

## **1.0 RESEARCH CONTEXT**

### **1.1. Challenges for housing development**

As outlined in the introduction, this research aim at merging two strands of importance for the planning of future homes. First, we have observed a lack of focus in recent housing development for holistic solutions which enable radically reduced resource use through changed habits and mind-sets. Second, contemporary housing planning suffers from a lack of knowledge about the actual needs of the wider population and their use of homes (Nylander et al. 2011). Through merging these two approaches we aim at reaching beyond a narrow focus on efficiency and belief in technological solutions by enabling radical changes in the way we perceive and use homes.

The introduction of new concepts, technology and systems in the building sector and the fulfillment of political ambitions have often been approached by experimental activities and demonstrations. During the 20<sup>th</sup> century national governments in many Western countries financed construction innovation as part of post-war re-building, industrialization and modernization of society. Considerable experimentation was concerned with industrialization to improve production rates but experimentation also focused humanistic aspects of housing. In the 1960s the US Government paid attention to the development and launched 'Operation Breakthrough' in a bid to mimic the fast development of industrialized production in Europe (US Government 1976). At times, specific problematic and politically important areas have been subject to experimentation, not least the search for energy efficient construction and the application of new energy sources in the built environment.

At present, we find advancements in housing innovation to be low. We explain this by lack of governmental finance and incentives for innovation and development, and aversion to economic risk related to experimentation in market-led development. In order to tackle problems related to households' resource use we see a need for increased innovation in housing development. The Swedish Government has announced considerable increase in finance for research in the built environment in the up-coming years through transdisciplinary

programs where industry participates in and partly finances research. Furthermore, there is a renewed interest in user-centered Living Lab settings as a means to address sustainability (Liedtke et al. 2012).

## 1.2. Aim and method

The aim for this paper is to develop strategies to advance research on future homes in relation to a planned purpose built Living Lab on the campus of Chalmers University of Technology, Sweden. Based on a review of 20<sup>th</sup> century housing research and development in Sweden and France, we give an outline for research in which we build on experiences from previous successes as well as passed misconceptions and failures. We also describe the kind of architectural experimentation which was researched in the past and the innovation i.e. implementation on a broad scale, from these.

Sweden never had any large national programs for general housing experimentation and innovation which was the case in for example France and the Netherlands (Schuyt and Blom 1994). As a reaction against the monotony of post-war large scale estates, countries such as the Netherlands and France invested in national programs focusing on quality and architecture in innovation of housing. Sweden, on the one hand focused housing research on developing empirical knowledge of the use of homes. On the other hand limited experimental activities have been driven by specific problems reflecting needs of the time (e.g. energy saving in the 1970s) and not seldom financed by the industry itself. To give a comparison to Sweden we present housing development programs in France. France has been chosen for the richness of data on housing innovation.

The method for the review is literature studies. We present preliminary results in-depth studies will be needed to secure the validity of results. Our focus is on housing for a broader public, which in Sweden and France means multi-residential blocks. Furthermore, most of these innovations have been carried out in public housing, or housing developments which has profited from governmental finance.

## 1.3. A purpose built Living Lab

A Living Lab is planned in collaboration between the academy, a cooperatively owned national real estate company, a larger nationally operating architect office, a science broker between the academy and the local industry, and a facility managing company at the campus. The Living Lab will include both student accommodation and research facilities and is financed through the European Climate-Kic program, and in part by the real estate company and the architect office. The student accommodation and the research facilities are not necessarily occupying the same space in the facility, but both respond to needs of the campus. Furthermore, the Living Lab is part of the SusLab NWE research program ([www.suslabnwe.eu](http://www.suslabnwe.eu)) with similar living lab facilities in other European locations. Focus for the Living Lab and SusLab NWE is radically reduced resource use in future homes through the meeting between technical and behavioral science.

The Department of Architecture has not been among the initiators of the project, which is the Department of Civil Engineering, but has been invited to take part. The question has been to define research which will advance architectural knowledge. Researchers from both Departments belong to an interdisciplinary research environment called *Homes for Tomorrow*.

This paper is one of several publications in which we define an architectural approach to living labs. We cherish the idea of co-creation of innovation between end-users, industry and academy, something which is also strongly favored by scholars in the emerging field of living lab literature (Leminen and Westerlund 2011). In an earlier paper we have explored the concept of a Habitation Lab, a laboratory for experimentation in habitation (Femenías and Hagbert 2013). We refer to similar laboratory experiments as the 'PlaceLab' at MIT ([www.architecture.mit.edu/house\\_n/placelab.html](http://www.architecture.mit.edu/house_n/placelab.html)) or the Norwegian design experiment 'TreStykke' (Thomsen and Tjora 2006). We also emphasize that the Habitation Lab will support learning and the development of shared values and frames of reference among students, researchers, and industry partners and thus support a social learning process, on personal and professional levels.

A paper by Bannova et al (2013) focuses on the idea of integrating a design studio in the planned Living Lab preferably a design-build-live project in which students will be engaged to design, partly build, and experience the habitation by living in the studio during a time-period.

The design of the planned Living Lab is in-itself an architectural challenge, not least as it is planned to be moveable (being granted a temporary building permit) and should be usable in whole or in parts in other locations. Furthermore, the lab should be designed in order to accommodate changes to exterior walls, interior settings etc. as part of technical experiments and research. These are all interesting topics for architectural research. However, as part of the *Homes for Tomorrow* research program, our research interests are sustainable housing and living environments.

## **2.0 REVIEW OF EARLIER HOUSING DEVELOPMENT**

### **2.1 Swedish housing development**

The social political program of constructing a 'People's Home' with good housing for everybody was launched in the 1930s as a corner stone in building a well-fare state. Interrupted by World War II the ideas were implemented in the late 1940s and 1950s. The architecture, created by prominent architects, a committed industry and generous governmental finance, resulted in what has been called the 'golden age' of Swedish 20<sup>th</sup> century architecture.

Central to developing the 'People's Home' were functional studies carried out in laboratory environments in which mainly women were observed when carrying out housework. The result was standards dictating minimum spatial requirement to ensure good functionality and hygiene. The results are good living qualities which are still appreciated today.

Housing innovation has been defined by the needs of the time. The period 1965-1975 was characterised by massive housing production focusing on industrialization and large-scale development. As a result of the first energy crises, national experimental programs were launched which focused on new energy solutions for housing.

Besides national programs, there have been grass-root activities for housing innovation, not least eco-villages which emerged in the 1970s and 1980s. SABO the umbrella organization for public housing has also financed research with limited budgets, for example in relation to participatory design emerged during the 1980s and 1990s.

At present the housing sector is concerned with challenges regarding changing demographics, affordability and sustainability. Low energy housing had a breakthrough in the first decade of the 21<sup>st</sup> century and now we see an increasing interest for social sustainability.

Flexible layouts, extendable homes, co-housing and shared facilities are ideas which has been tried out in the past and now have renewed actuality to limit the environmental footprint of housing. Earlier experiments show that flexible and extendable solutions worked for some time but quickly became fixed. Co-housing has re-emerged but rather than decreasing the space use, new co-housing increase space use as shared facilities are built at the same time as individual units have necessary facilities separately. The modern co-housing builds on facultative and not ideological sharing. Shared facilities for example common laundry rooms were standard in Swedish housing (public or private) until recently but are now disappearing. Modern requirements for comfort and privacy work in opposition to environmental sustainability.



**Table 1:** A selection of housing experiments in Sweden ~1940-2010.

<b>Experiment</b>	<b>Year</b>	<b>Experiences</b>
Extendable 'elastic' flats	1940s	One small flats between two could be added or separated – this soon became fixed.
Flexibility with moveable walls	1951	Flats that could grow with the family – the walls later became fixed.
Compact living	1950s	Including sliding walls and in some cases American kitchens to make very small 3-room-and-a-kitchen flats of approx. 50m <sup>2</sup> .
Shared facilities	1958	Four atrium housing encircled a 'mother-cell' for meetings, guest rooms and washing.
Concrete three-level slab construction with wooden villas	1960	The villa could fill the plot as the family grew – today all plots are fully built.
Eco-villages	1980s-1990s	Bottom-up and normally resident-owned. Eco-cycle thinking and community development.
Participatory design	1991	39 families participated in the design of unique building in Malmoe. Owned by the public, managed by the residents.
Cohousing	2008	Common rooms and fully equipped flats for elderly.
Housing with social spaces	2010	Cohousing from the 1960s revived with space for meetings but no obligations for sharing.
Compact living	2012	Single student house of only 8,8 m <sup>2</sup> and small garden. Do not comply with regulation – no further implementation.

## 2.2. Experimental activities in France

Early support to industrialized production made France a champion in the field in the early 1960s. The results were quickly subject to national critique over deficient quality. Furthermore, the results were not as innovative as planned and experiences were difficult to implement as the sector went from producing millions of homes to areas with only a few hundred dwellings.

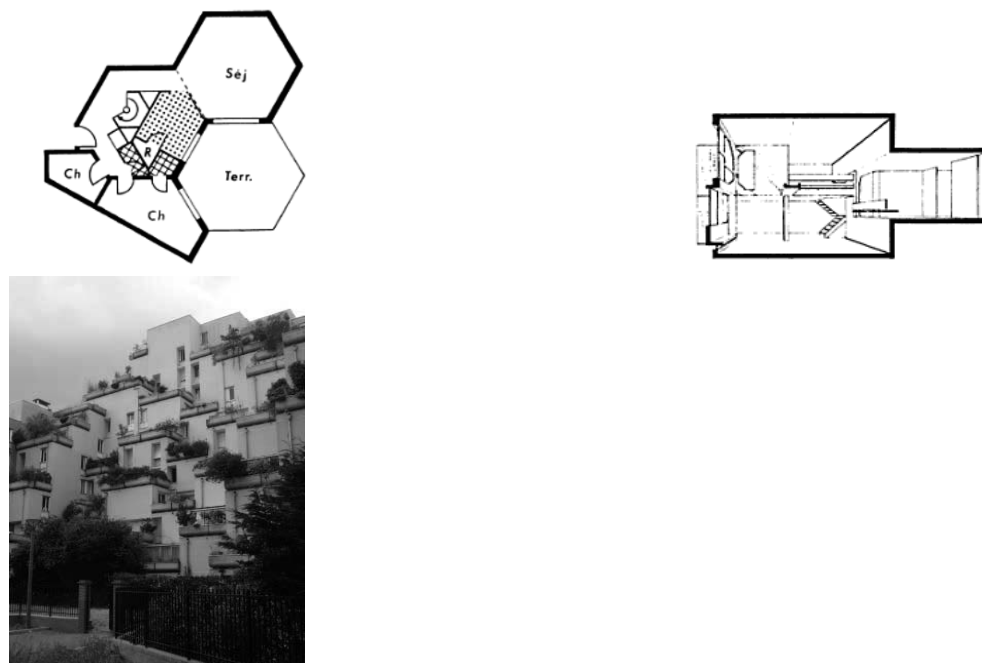
A recent publication gives an overview of the experimental activities driven by the governmental body PUCA during 40 years (PUCA 2012). The program was launched to create qualitative innovation to counterbalance large-scale developments of the 1960s. PUCA involved research driven by: experiments (testing of ideas); industry (production issues); concept/procedure (e.g. architectural innovations) and politics (e.g. environmental issues).

PUCA had different focus over the years. In 1973, activities were orientated towards energy efficiency. In 1978 a more experimental phase was introduced and a program called REX- 'Rélisations Expérimentale'. The first years of the 1970s, an era with technical innovations was inspired by three-dimensional 'meccano' systems and morphological studies. The latter part of the 1970s found inspiration in the city/urban challenges. With the arrival of a new director in the 1980s the direction changed towards a more humanistic approach, combing architecture and engineering with social and behavioral sciences. A usability approach to architecture was implemented in the program Habitat-88 having several projects with participatory design. In 1987, the 'Europam' competitions were installed. Through the years, Europam fostered a whole generation of architects and got the careers of e.g. Jean Nouvel and Gilles Perraudin started. During latter years, environmental issues (HQE-High Environmental Quality), urbanization, rehabilitation and changing demographics have been on the agenda.

**Table 2:** Examples of French experimental housing (Léger 1990; PUCA 2012).

Experiment	Experiences
Flexibility	Moveable elements quickly become fixed.
Extendable flats (flats unified/separated)	Difficulties to liberate two flats at the same time.
Polygonal apartment layout	Generally appreciated, difficult to furnish.
Open kitchen-living room	Visual disturbances, hard work to keep order among belongings (need of house-keeper!).
Entrance hall or not (enter directly in living room)	Efficient space use, no place to keep clothes.
'gradins-jardins', pyramidal housing with terraces	Appreciated among residents, improved use of outdoor space.
Double height apartment	Light and airy; Noisy, draughty, difficult to furnish.
Private, semi-private, public space	Well implemented ideas.

So were these innovations successful? Not all innovations were that successful. One reason is the lack of systematic evaluation, also over longer periods – more than 1-2 years (PUCA 2012). However, the lack of evaluation is not the only inhibiting factor. New technologies have been opposed by established markets, for example heat pumps and solar energy in the 1970s and 1980s. Further, some novelties were not accepted by the users. Legèr (1990) notes that inhabitants of public housing are not the appropriate customer for radical housing innovations. Higher social class inhabitants are more likely to appreciate these architectural qualities. Legèr reports that inhabitants for 'Nemausus' designed by Nouvel were specially selected by the public housing manager thus overlooking the queuing priority in order to get the 'right' tenants.



**Figure 1:** Examples of experimental housing in France. Left, hexagonal flat, Eventard/Angers. Middle, flat with double-height, Isle d'Abeau. Source: (Léger 1990); Right, 'Gradins-jardins'/Cité des Pyramides, Villepine. Photo: author

## 2.4. Comparison

A comparison of Sweden and France shows different approaches to housing innovation were France has invested in large programs. However, results of individual architectural experimentations, e.g. flexibility and extendable flats are the same. Building experiments reflect the needs and prevailing ideological stances of the specific time, a development which is mirrored in both countries. We also note that the same kind of ideas reappear in cycles. Cohousing was part of socialistic ideas in the early 20<sup>th</sup> century, revived in the 1970s, and is now subject to interest to break the solitude of a growing number of single households.

Both countries show the importance of involving the user in order to reach broad acceptance and implementation of innovation. In Sweden this succeeded due to empirical understanding of the use of homes. In France we can state failure as housing innovation was proposed by architects and did not fit the users of public housing.

We can state that although many ideas for spatial experimentation have already been tried out, also repeatedly, this is probably no reason to rule out new trials of the same, and for that time avant-garde, ideas (e.g. double height, flexibility, extendable flats). These innovations might be more successful with contemporary users which have another mind-set.

## CONCLUSIONS

Results of our review show the importance of involving end-users in housing innovation and to build on solid understandings of the use of homes among a wider population. As a conclusion, we propose an outline for research for future homes in three steps. The model is suitable to implement in relation to the planned Living Lab involving industry partners, and correspond to methods within the SusLab network.

1. Empirical studies of the use of homes (carried out in real homes using modern sensing technologies) among a large variety of households (i.e. size, age groups, cultures etc.).
2. Design and prototyping of new architectural concepts in collaboration with invited industry partners in Living Lab. We propose experimentation on topics such as optimized living space, increased use of shared facilities related to layout, interiors, equipment, products etc., and focusing on different functions within the home (e.g. culinaryities, rest, work, social interactions etc.). We propose experiments which have already been tried out in the past as these will be researched in new contexts and with users having a different mind-set.
3. Testing and evaluation of prototypes in the Living Lab with selected groups of users.

Among the limitations for the strategy are long-term uses which cannot be tested in the Living Lab (e.g. extendable solutions, changed user configurations). Furthermore, the involvement of industry could potentially inhibit the possibilities to radically question the very basis of contemporary market led housing development.

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# Creating an Islamic sense of place: Building conversion and the American mosque

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**ABSTRACT:** As an anomaly within the religious and ethnic landscapes of the United States, the American mosque serves as an intriguing focus from which to understand the construction of sacred spaces and religious identities. In this study, buildings converted into mosques were hypothesized to have a “vernacular intuitiveness” of the essential place attributes of the faith of Islam. These converted places of worship are common in Muslim communities in the United States, yet understudied. This study investigated eight of these mosques in Kansas and Missouri, relying on primary data gathered through site observations and interviews. Comparing and contrasting data from each mosque lead to an understanding towards intuitive and necessary elements to the creation of an Islamic sense of place. This was in large part defined by the accommodation of Islamic ritual and the fundamentals of faith. Differences between the mosques revealed diverse communities arriving at varying answers to these fundamentals as well as to conceptions of gender and the role of ethnic identity. Designing mosques in the American context must include an understanding of Muslim-Americans’ collective soul-searching and the intuitive ways identities are asserted through architecture.

**KEYWORDS:** sacred space; building conversion; Muslim-American identity; Islam in America

## INTRODUCTION

This study sought to uncover the ways Muslims adapt existing buildings into religious spaces in the American context. The focus of this study was important for several reasons. Firstly, converted spaces are pervasive within Muslim-American communities. A study on American mosques found that only 26% of mosques were originally built as mosques (Bagby, et al. 2001, 26). Secondly, converted spaces in the United States have been largely ignored, even in Kahera’s deconstruction of the American mosque (Kahera, 2002), effectively painting an incomplete picture for understanding how belief, practice, and ethnicity determine the creation of places for spirituality and Muslim-American identity.

Lastly, converted mosques can be considered sacred vernacular spaces which are a “direct physical embodiment of a way of worship and of a community” (Rapoport 1995, 32). These mosques tend to lack references to high-style Islamic architecture suggesting that these elements of Islamic design are inconsequential to creating a sacred place. Therefore, understanding how Muslim-Americans negotiate with a preexisting building might shed light on the question of how we embody the sacred in the built environment and, specifically, what is essential for the creation of a place for the Islamic faith and practice of Muslim-Americans.

Having framed this study around stories of building conversion, sacred space creation, essential faith and religious practices, and Muslim-American identity, there were several guiding questions on the necessities of a mosque, the dictates of faith, and the place of practice: How does a building become sacred Islamic space? How did converted mosques address the needs of an anomalous religious community?

## 1.0. THE MOSQUE IN ISLAMIC BELIEF AND PRACTICE

Prophet Muhammad, according to Islamic belief the last prophet of the Abrahamic tradition, described Islam as having five pillars (Al-Bukhari, Book 2, vol. 1:50), two of which have a bearing on the mosque as discussed below. These greatly inform a preliminary and necessary understanding of a mosque’s program to guide an analysis of the converted mosques in this study.

### 1.1. Islamic Beliefs and Practices that Define the Mosque

The first pillar is contained in the creedal formula: “there is no deity but God” (The Qur'an, Ch. 47:19). This relates directly to Islamic concepts of God as an un-bodied, immortal, and indescribable deity who is also omnipresent, omnipotent, and concerned with humanity. The core of a Muslim’s relation to this deity is the Qur’anic commandment to develop God-consciousness enacted through submission<sup>1</sup> and remembrance.<sup>2</sup> This requires the mosque to be iconoclastic, because all images come short in depicting God and falls into the category of idolatry.

The second pillar of Islam is the ritual prayers, or *ṣalāt*. It is performed five times daily and therefore has a particularly strong presence in the spiritual lives of practicing Muslims. It requires ritualized movements oriented in the direction of the *Ka’bah*, a cube-shaped shrine located in Mecca, Saudi Arabia. The principle purpose of the mosque is to establish a place for *ṣalāt* in congregation. It is narrated that the Prophet said: “prayer in congregation is superior to prayer by an individual by twenty-seven<sup>3</sup> degrees” (Al-Bukhari, Book 11, vol. 1: 618). Daily prayers are meritorious in congregation, however, as Katz (2013, 130) points out, “in the case of Friday prayer [congregational worship] is integral to the validity of the ritual.” Friday prayer is the Islamic equivalent to Sunday worship for Christians. The Qur’an, the seminal religious text for Muslims, calls this day “the day of gathering” which emphasizes the communal-aspect of ritual practice (Ch. 62:9).<sup>4</sup>

### 1.2. The Building Program of the Mosque

The programmatic needs of a mosque can be categorized as seen below, all of which can be found in the mosques in this study. This overview reveals some of the ways Islamic beliefs and practices factor into mosque design.

1. Large carpeted space for prayer<sup>5</sup> or *muṣallah* oriented in the direction of the *qiblah*, that is, towards the *Ka’bah* in Mecca. In the Midwest region of the United States, this direction is approximately towards the northeast. The space is gendered and has no fixed furniture to provide room for the required movements of prayer (standing, bowing, and prostrating) and the formation of worshippers in rows. A *miḥrāb* or prayer niche indicates the *qiblah*. The *minbar*, or pulpit from which the *imām*, or faith leader, gives a sermon prior to Friday prayer, is off to the side of the *miḥrāb*.
2. Auxiliary spaces for prayer such as gendered areas for the ablution ritual,<sup>6</sup> bathroom, and interstitial/transition spaces.
3. A *minaret* from which a call to prayer is chanted. In America, the call to prayer is not practiced so the *minaret*, if present, serves as a symbolic design gesture.
4. Gathering spaces for education and fellowship such as classrooms for children, youth, and adults, and occasionally dining spaces and kitchens.
5. Auxiliary spaces for management of the faith community, such as administrative spaces, mechanical rooms, and parking.

## 2.0. RESEARCH METHOD

Eight buildings converted into mosques in Kansas and Missouri (Fig. 1, Fig. 2) were chosen for their respective ease of accessibility from where I am based, the University of Kansas in Lawrence, Kansas. Expanding from personal contacts in the Lawrence Muslim community I was able to make contact with other Muslim communities.



**Fig.1.a.** Islamic Center of Topeka, KS

**Fig.1.b.** Islamic Center of Lawrence,

**Fig.1.c.** Islamic Center of Kansas, Olathe, KS

**Fig.1.d.** Islamic Center of Johnson County, KS



**Fig. 1.e.** Bosnian Islamic Center, St. Louis, MO

**Fig. 1.f.** Madina Mosque, St. Louis, MO

**Fig. 1.g.** Masjid Umar, St. Louis, MO

**Fig. 1.h.** Masjid Dar Al-Jalal, Hazelwood, MO

Site visits were documented with photographs and observations of space use and design changes carried out. There were eight primary male interviewees. Three of the male interviewees are *imams* in their respective communities. Two had served as directors, one had served on an administrative board, and another is a prominent layperson. The eighth interviewee is a contractor and freelance artist who worked on three of the mosques in this study. After preliminary observations and interviews, new questions surfaced and follow-up interviews were done. Many questions surrounding the place of women in the mosque lead to interviewing a ninth person, a woman from the Lawrence community. Questions during the interviews could be divided into two types: the first addressed the building conversion itself and the second inquired about the community.



**Fig. 2.a.** Islamic Center of Topeka

**Fig. 2.b.** Islamic Center of Lawrence

**Fig. 2.c.** Islamic Center of Kansas

**Fig. 2.d.** Islamic Center of Johnson County



**Fig. 2.e.** Bosnian Islamic Center

**Fig. 2.f.** Madina Mosque

**Fig. 2.g.** Masjid Umar

**Fig. 2.h.** Masjid Dar Al-Jalal

### 3.0. FINDINGS

The information gathered through interviews and observations was summarized in Table 1. The information was found to be most easily divided and further analyzed into six different design imperatives relating to the essentials of faith and the differing cultural and interpretive characteristics of each community.

#### 3.1. Adhering to Ideals of the First Pillar of Islam

Spatially, Islamic theology is expressed through the lack of images of the divine. The Islamic Center of Lawrence, a former church, renovated its stained glass window which once displayed a cross. Entrances and prayer spaces in the Bosnian Islamic Center, Masjid Umar, Madina Mosque, and the Islamic Center of Topeka were adorned with calligraphy rather than images to maintain the monotheistic purity of the building. Calligraphy was principally quotes from the Qur'an such as excerpts from Chapter 55 at Masjid Umar and Chapter 103 at the Islamic Center of Topeka.

### 3.2. Defining the *Qiblah*, the Orientation of Prayer

Masjid Dar Al-Jalal and the Islamic Center of Johnson County clearly express that a *mihṛāb* is unnecessary. A prayer rug for the *imām* and microphones for the congregation to hear his voice stood in contrast with more expressive indications of the *qiblah*. Among those mosques which chose to design a *mihṛāb*, the most austere ones were found in the more multicultural communities of the Islamic Centers of Lawrence, Topeka, Kansas, and Masjid Umar. The Lawrence mosque's arched *mihṛāb* stands over the original entrance to the former church and as a result, an entire reorientation of how one enters the building was introduced. The Bosnian Islamic Center and Madina Mosque both referenced traditional designs from Bosnia, appropriately representing the two communities' principle ethnic make-up. In the Madina Mosque, part of the north wall was further modified to run perpendicular to the axis of the *qiblah*.<sup>7</sup> In addition, the carpets in all but the Topeka mosque, whether decorative or not, had patterns which lined up perpendicular to the axis of the *qiblah*.

### 3.3. Creating the *Muṣallah* and the Gendering of Space

The former director of the mosque in Lawrence specifically mentioned *ṣalāt* as the principle purpose of the mosque. This led to the removal of the church pews in the Islamic Center of Lawrence and the Islamic Center of Kansas. The *imām* of the Topeka mosque spoke about the linguistic meaning of the Arabic word often used to refer to a mosque in American-Muslim communities: *masjid*, which means "place of prostration." The *muṣallah* of the Bosnian Islamic Center was originally the theatre room and had an inclined floor which had to be leveled—it was important that *ṣalāt* be performed on level ground, presumably for the practical reality of the ritual movements.

Accommodations for women were important in all the mosques in this study by means of a) a curtain dividing up a shared *muṣallah* or b) a separately-enclosed room especially for women (see Table 2). Following the Prophet's instruction (Muslim, Book of Prayer: No. 881), the original mosque in Madina<sup>8</sup> lined up men for prayer along the *qiblah* wall closest to the *imām* and the women behind them (Kahera, 2002). Only the Islamic Center of Topeka and the Madina Mosque continually utilize this method of gender segregation. The *imām* of the Islamic Center of Topeka spoke about a partial curtain as a compromise for different methods of gender segregation, offering women the choice to pray behind the curtain. In the Madina Mosque, women usually pray in the back of the main *muṣallah*. However, the former safe for the bank was converted into a women's prayer room for the Arab and Somali women in the community who preferred more defined separation.

Women of the Islamic Center of Lawrence community, through a petition, asked for the addition of a separate prayer space. The recent transformation of the former baptism area into a balcony serves as a convenient in-between space for women who wish to pray in the same space as the men but retain a level of privacy. A recent renovation at Masjid Umar replaced a curtained off space in the main *muṣallah* with a women's *muṣallah*. When the women's *muṣallah* becomes overcrowded at the Islamic Center of Kansas moveable screens are installed on one side of the main *muṣallah*, effectively maintaining clear gender segregation.

### 3.4. Creating Communal Spaces

Every mosque in this study utilized the building as a place for community. There were classrooms in every mosque focused principally on teaching the next generation about their faith. Every mosque's main prayer hall was also a flexible space, being used as a classroom and hosting community lectures. The Islamic Center of Johnson County and the Islamic Center of Kansas both lack interior community gathering spaces and regularly transform their *musallahs* into lecture halls and children's classrooms, often utilizing moveable furniture and screens. The Islamic Centers of Lawrence, Topeka, Madina Mosque, and Masjid Dar Al-Jalal all have community gathering spaces which serve as lecture halls and dining areas with adjacent kitchens.



**3.5. Adding Islamic Ornamentation (Table 2)**

Most mosques were ornamented interiorly and exteriorly. They also tended to be less identifiable in definitions of style, mixing architectural traditions and thus come off as *ad hoc*, undefined, and ambiguous (Kahera, 2002).

**Table 2: Ritual Elements and Ornamentation**

	<i>mihrāb</i>	<i>minbar</i>	foot sinks	<i>minaret</i>	calligraphy	other ornamentation
<b>Islamic Center of Topeka</b>	yes	steps	no	yes	yes	arched entry
<b>Islamic Center of Lawrence</b>	yes	yes	Only women	no	no	n/
<b>Islamic Center of Kansas</b>	yes	ye	yes	no	no	n/
<b>ICJC</b>	no	no	yes	no	no	n/a
<b>Bosnian Islamic</b>	yes	yes	yes	no	yes	carpet, artwork
<b>Madina Mosque</b>	yes	yes	yes	yes	yes	carpet, artwork
<b>Masjid Umar</b>	yes	yes	yes	yes	yes	carpet
<b>Masjid Dar Al-Jalal</b>	no	yes	no	no	no	carpet, arched entry

The arched elements over the entrances of the Islamic Center of Topeka and the men's entrance at Masjid Dar Al-Jalal appear to be paraphrases of Islamic architecture. The Islamic Center of Topeka has two *minaret* elements ambiguous in style and the recent renovation of Masjid Umar included a short *minaret* on the roof. The *minaret* at the Madina Mosque directly referenced the high-style *minarets* of Bosnia.

Interior spaces varied more in their expression of Islamic design or lack thereof. The Islamic Centers of Lawrence, Johnson County, and Kansas had the least design references to high-style mosques in their *muşallahs*, having simply designed *mihrābs* and *minbars* (or in the case of Johnson County mosque, lacking them altogether) with plain carpet whose stripes had the utilitarian purpose of indicating where to line up for congregational prayer. The carpets of the two Bosnian mosques were more decorative. The *mihrāb* in Masjid Umar is decorated with calligraphy and a symbolic lamp. Madina Mosque and the Bosnian Islamic Center both inserted semi-circular *mihrābs* with ornamentation referencing traditional mosques from Bosnia.

The *minbars* at Masjid Umar, Masjid Dar Al-Jalal, and the Madina Mosque were woodwork ornamented by calligraphic inscriptions from the Qur'an. These *minbars* and the ones designed for the Islamic Centers of Kansas and Lawrence all have the same basic design: a series of steps with railings and a place to sit at the top. The *minbar* in the Islamic Center of Lawrence is not ornamented at all and the mosque in Topeka essentially has no *minbar*, however, several steps were recently added and invoke the memory of the simplistic platform from which Prophet Muhammad gave his sermons.<sup>9</sup> The *minbar* in the Bosnian Islamic Center as well as its indulgent calligraphy was typical of Ottoman Islamic architecture.

## 4.0. DISCUSSION

### 4.1. Sacredness and an Islamic Sense of Place

Through this study it became clear that the sacredness of a mosque is not created by the presence of liturgical objects such as *minarets*, *mihrābs*, and *minbars* as it was not rare for conversions to disregard traditional Islamic architectural elements. These sacred objects reflect historic developments of Islamic architecture rather than essentials of faith and practice (Kahera, 2002; Kuban, 1974). The purpose behind these elements can be fulfilled without them, for example, whereas the *mihrāb* is not required, orienting oneself or the congregation towards the *qiblah* is obligatory.

A Muslim can perform their prayer anywhere provided that it is a clean place. A saying of the Prophet reads: “the [whole] earth is a mosque [*masjid*] for you, so wherever you are at the time of prayer [*ṣalāt*], make your prostration there” (Al-Bukhari, 855, Book 7, vol. 1: 331). The Arabic word translated as “mosque” is *masjid*, which linguistically recalls the act of prostration due to its tri-consonant root *s-j-d*. The addition of the *m-* in this case denotes place. As Kahera (2002) points out, this saying of the Prophet precludes the idea that a mosque is essential to the daily practices of the faith. In the place of a built mosque, the *masjid*, or place of prostration is in effect wherever one prays, an Islamic understanding referenced above by the *imām* of the Islamic Center of Topeka. Before offering *ṣalāt*, one must be ritually cleansed with water which may or may not be facilitated by adaptations to an existing bathroom such as foot sinks. When offering *ṣalāt*, the worshipper must also be oriented towards the *qiblah* which may or may not be indicated in the form of a *mihrāb* in a room which may have just served as a classroom moments earlier.

Converted mosques cannot be considered sacred in and of themselves. They are merely endowed with *opportunities for sacredness* which inevitably challenge us to redefine what “sacred space” means. Ingrid Mattson, an Islamic studies professor and former president of the Islamic Society of North America, comments on the above saying of the Prophet:

sacred space is created by the individual. It's not so much about a particular location, but the action that you do.... I think this is a kind of existential definition of Islam.... What you do creates the sacred time and space. Whether it is prayer, that ritual prayer, or having our encounters with people, giving them, imbuing them with this sense of meaning (Mattson 2008).

Similarly, as Michael Benedikt has it, “God” is what “we bring to life when and as we do good” (Benedikt 2007, xv). On this note of a spirituality in which one’s prayerful attitude and encounters with people could define a sacred space, we return to the common refrain of my interviewees: the mosque as community center. Whether viewed as a spiritual imperative or one of social unity, the “Islamic center” emphasizes the mosque as a *jāmi‘* and not just as a *masjid*. Because prayer can be performed anywhere, there is only one designated place where the community can gather to identify itself as a unified Muslim-American communities. This brings to the surface the necessity for a discussion on ornamentation and expressions of Muslim identities.

### 4.2. Ornamentation and the Essentials of Faith

Mosques can be adapted from a wide range of building types partly because conversions do not require the inclusion of high-style design elements. However, Islamic communities in this study engaged in some form of conversation on inessential aspects of mosque interior and exterior design. These design decisions involved paraphrasing (and occasionally direct quotations) of Islamic high-style elements, designs which would not be completely recognizable to the first Muslims, not to mention the Prophet who figure-headed the religion. Likewise, interviewees never referenced interior and exterior Islamic designs as inherently part of the building as a religious space. The former director of the Islamic Center of Kansas compared the usage of unnecessary ornamentation to the unwanted influence of immigrant culture on religious practice. More relaxed attitudes towards decoration in the Islamic Center of Topeka, Masjid Dar Al-Jalal, Masjid Umar, and the two Bosnian mosques were to create a sense of Islamic and cultural identity. Without being prompted on the matter, the *imām* in

Topeka, indicating the pointed arches and the *minaret*-like elements of his mosque, explained that it was for the purpose of making the building appear more “Islamic;” however, when speaking about the mosque itself, he explained it in other terms, discussing the word “*masjid*” and the importance of establishing a place for prayer and community.

## CONCLUSION

These findings begin to shed light on sacred space creation, essential faith and religious practices, and Muslim-American identities. Concepts of *masjid*, *jāmi‘*, and thinking of the mosque as endowed with opportunities for sacredness rather than inherently sacred in itself, are ways of challenging our underlying notion of “sacred space.” It reminds us that a sense of spirituality is tied to a ritual, community, and how we inhabit a space rather than the presence of liturgical objects. In addition, the creation of places of worship is not purely a spiritual endeavor. Ethnic identities and identifying with specific doctrines are formative factors.

This study’s discourse of essential versus inessential aspects of mosque-creation could lead to questions of how future mosques could more directly address the spiritual needs of Muslim-Americans, especially providing a sacredness that is deeper than mere additive ornamentation. One wonders, as Kahera does in his book, about the possibility of an American Islamic style of architecture which addresses the question of sacredness for Muslim-Americans.

The discussion on essentials, ornamentation, and the inclusion of inessentials point to the way mosques serve as reference points from which to construct, maintain, and assert Muslim identities. It therefore has profound meaning in the United States which is itself a country defined by the complex negotiations of immigrant experience and cultural compromise. Communities tend to reference fundamental Islamic concepts that the whole community can agree on or reach realistic compromises, such as the Topeka mosque’s partial curtain. However, conversations between the mosque and the ongoing soul-searching of American-born Muslims presents a layer to this complexity that is far less resolved as changing ideas about spirituality, religion, and gender in American life clash with traditional orthodox dogma and practice.

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## ENDNOTES

<sup>1</sup> Submission is the literal translation of *Islam*.

<sup>2</sup> "Remembrance" is a translation of the Qur'anic term "*dhikr*."

<sup>3</sup> In another narration it is twenty-five.

<sup>4</sup> Another Arabic term for mosque, specifically for large congregational mosques in predominantly Muslim countries, is *jāmi'* which means "place of gathering."

<sup>5</sup> This space is often referred to as the *muṣallah* ("place for ritual prayer") to differentiate it from the rest of the mosque.

<sup>6</sup> Ablution, ritualized washing (of mouth, nose, face, hair, ears, arms, and feet) must be done to gain a state of ritual purity to perform *ṣalāt*.

<sup>7</sup> It also created a closet behind the *miḥrāb*. Also, the original building had a similarly angled wall, probably to facilitate the original drive-thru for the bank.

<sup>8</sup> In modern day Saudi Arabia, north of Mecca.

<sup>9</sup> The steps can be seen in the lower right corner behind the lectern.

# Gangnam style again?

## The origins of South Korean urban modernity

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**ABSTRACT:** This study views architecture and cities as part of larger urban process that cannot be detached from the larger socio-cultural milieu, and this understanding begs us to delve with broader historical knowledge and deeper geographical understanding. Against conventional framework that espouses abstract economic mapping and hierarchical global city listings to address the locality, stories of Gangnam, a new city south of the Han River in Seoul, will represent emblematic unfolding of urban modernity in South Korea since early 1960s. The city is a showcase where, in Lefebvre's expression, "the industrial" and "the urban" did not proceed in a sequential order of historical development, but progressed simultaneously and complimented one another under the austere form of national ideology. Here the city illustrates more than its macro-economic spatial narration, and represents the distinctive socio-cultural and political conditions of its formation. Today, epitomizing upper- middle class lifestyle, Gangnam became a synonym for the new urban order where the new exchange value of space was expressed in the soaring price of once government-sponsored mass housings. Representing gradually territorializing urban consciousness, the culture and the symbolism of the new city strongly supported the consolidation of the fledgling middle class identity. Deeply immersed in both militarist and capitalist urban ideology, the city's emerging middle class embraced the segregated spatiality engendered by the Han River and projected its newly gained social status and citizenship on the identity of a particular urban space, Gangnam. Beyond dominant framing of a city in economic structuralism, what is emphasized here is the construction of place through finding confluence of variant conditions in particular time and space. From the urbanization story of Gangnam, reflected were the complex thread of social and political influences that realized the culture of capitalist spatiality, where the illegitimate turned into the legitimate, the irrational to rational, and the abnormal to normal.

**KEYWORDS:** Gangnam, Urbanization; Architectural Modernity, Seoul

### Introduction

Separated by the Han River to north and adjoined by the hilly green space of the National Cemetery to west, the ground lying on the Han River's southeastern edge was propitious template for a new urban ground. Nestled in the protective river, the old farming territory was called Gangnam, meaning south of the Han River. This naturally bounded region recently gains great attention from the global media due to a Korean Pop singer, Psy who sings *Gangnam Style*, a terse tribute to an urban youth who strolls in Gangnam. A male protagonist (Oppa) in the song describes both himself and his female partner as characteristic Gangnam persona who displays sleek urbanity, full of capitalistic lush and erotic attraction. Quickly appearing on various global pop charts, the song is often sung by many without knowing what those Korean lyrics imply.

... A girl who looks quiet but plays when she plays  
A girl who puts her hair down when the right time comes  
A girl who covers herself but is more sexy than a girl who bares it all  
A sensible girl like that...  
I'm a guy  
A guy who seems calm but plays when he plays  
A guy who goes completely crazy when the right time comes  
A guy who has bulging ideas rather than muscles

*That kind of guy...  
On top of the running man is the flying man, baby baby  
I'm a man who knows a thing or two...<sup>1</sup>*

Puzzled by the urban trope of Seoul the song describes, this research looks back the origin of Gangnam and reflects a history of Seoul's urbanization that brings those sensational descriptions on the lifestyle of Korean youths, "the Gangnam Style."

### **Overcoming the river and militarized urbanism**

Incorporating the expanded Seoul city limits of 1963, the initial plan for the New Seoul Project was visionary in its scale and reflected the state's desire to geometrically rearrange the surrounding rural area (Choe 1997). In a utopian plan reminiscent of the "Garden City," the plan of 1963 was a prelude to the phenomenal urbanization that followed over the next two decades. On the other hand the Han River had numerous undesirable conditions, which mandated the revision of development plan in order to open the way for large-scale urbanization to south. Urban expansion in Gangnam required an unusually high level of state investment in order to overcome the River's mile-long width and unpredictable tidal flow from the Yellow sea.

It is important to remember the political and socio-cultural context of South Korea in the late 1960s and the 1970s, when the country's industrialization established a symbiotic relationship with the urbanizing culture of Seoul. In Lefebvre's expression, "the industrial" and "the urban" in South Korea did not proceed in a sequential order of historical development, but progressed simultaneously and complimented one another under the austere form of national ideology (Lefebvre 2003). As with other projects of the time, the South Korean nationalism had overridden and guided these couplings of the industrial and the urban for the decades of rapid economic development. The urbanization of Gangnam reflected this complex thread of influences. Under the influence of state patronage, Gangnam was on its way to realizing its own culture of capitalist spatiality where the illegitimate turned into the legitimate, the irrational to rational, and the abnormal to normal.

Focusing on development south of the Han River, the state began to plan the expansion of the capital city based on a policy driven by militarist ideology, the policy directing Seoul's future development to the south of the Han River which had for the South Korean leaders strategic and military value (An 1996). While the public memory of the river being a natural defense line during the Korean War still lingered, Gangnam across the Han River continuously changed its profile that provided another dramatic urban growth stories in East Asia. At the beginning of the 1970s, the population of Seoul was almost reaching the mark of 3.5 million, more than double the population of the Korean War era. With the memory of the War only a decade old, state elites raised grave concerns of defending key national institutions in the event of another inter-Korean conflict, whence the defensive potential of the Han River came to the fore by justifying the policy direction of expanding Seoul (Moon 2005, Choe1997).

Yet inter-Korean rivalry played another role. Seoul's arch-competitor, Pyongyang, was a city built along the Daedong River where the major state buildings and national monuments were rebuilt along the shoreline after the city had been entirely leveled by the B-29 bombers during the Korean War (Lee 1993). Impressed by carefully arranged monumental architectures along the river shores in Pyongyang, the South Korean government sought to counter its rival's city spectacles beginning with the Yoido project, and find new ways in which massive urban projects could emulate the spectacles of the "enemy's" capital. Even in this competition, every urban structure is counted: a new concrete bridge over the Han River, the main bridge connecting Gangnam, had to be enlarged to surpass the width of a bridge over the DeaDong River (Son 2003). The regimes of both Koreas became caught up in a race to militate and fashion new urban environments. Preying on the "enemy" who shared the same Korean history, language, and ethnic identity, the South Korean government placed tremendous psychological pressure of fraternal contest on the public and engendered an unassailable rationale for drastic urban changes. In this sense, state-sponsored nationalism, through channeling the mass hysteria of fratricide and anxiety of another war not only produced mesmerizing effect on citizens complicit with militarizing social milieu, but also prevent them possible politicization

neutralizing the meaning of the state-led urban environments (Duncan 1990, HanGang GunSul and Han River Development Plan 1969). In the process the Han River became a natural line of defense that also demarcated the boundaries for a new round of urbanization. The existing city of Seoul was framed as a riddle of “undesirable” urban sprawl and a bulwark against possible North Korean attack, while Gangnam as a newly established security zone that was bounded for a safer and affluent space. Korea’s division and Cold War environment in the late 1960s provided the powerful exigency for the South Korean government to develop the vast stretches of farming land south of the river, avoiding the historical centers of Seoul.

### **State entrepreneurship**

Presenting state planners a with a “clean slate” for development, Gangnam, in addition to its security concerns, was planned as the showcase for the nation’s future modernization. In the process, it became the prime national project that presented to the newly formed but rapidly rising urban middle class space with unprecedented opportunities to accumulate private wealth by speculation. Underwritten by the state, promotion of private ownership and land speculation in Gangnam bred a highly materialistic urban culture that had become formulae to think about current forms of urban consciousness and of citizenship. Deeply immersed in both militarist and capitalist urban ideology, the city’s emerging middle class embraced the segregated spatiality engendered by the Han River, and projected its newly gained social status and wealth within the confinement of specific territory. In Gangnam, therefore, territorialized urban consciousness strongly supported the consolidation of the fledgling middle class identity, while the state leadership took advantage of this autonomous division and spatial segregation by lessening the chance for the poor to lay any serious claim to a new city (GangNamGu SangWhalGwon GiBon GaeWhekE GwanHan GiBonJoSaYonGu 1979, GaePoJiGu 1985, Dogok ApatuJigu 2000).

Moreover, this state-led class formation through urbanization was intensified with the emergence of closer ties between political and economic elites. As exemplified in numerous political scandals between government officials and corporate heads in the late 1960s and 1970s, projects favorable to the city’s laboring population were often rejected by state authorities and the vested interests of large corporations often protected (Shim 2004). With absolute monopoly over the mega urban projects allowing only a few selected private construction companies to participate, the government created a systemic base for those collaborating ones to evolve into huge construction giants, known as *chaebols* – business conglomerate (Son 2001, 2003). Establishing symbiotic relationships with only a few private corporations, the South Korean state was then at the forefront of privatizing efforts and deepened the speculative nature of capitalist urban space. Imagined as Korea’s paramount model city, Gangnam worked as an anchor to develop the Han River and in the process formed the dual characters of its spatial identity. That is, the area became as much a highly speculative property-based urban space buttressed against the risk of constant class encounter by inclusion, and as a defensive territory protected from the North Korean threat, a bastion immune to both social (domestic) and military (foreign) unrest. Coupled with phenomenal real estate hike, architecture and urban space in Gangnam began to embrace this imagery of conflict-free urban space, where only the “haves” had the right to the city.

### **Inevitable solution or state choice: Privileging the state’s “technical rationality”**

Apatu evolved as a term in the Korean language to designate modernist form of apartment housing, a multi-story residential structure of reinforced concrete. While this modern style collective housing first appeared during the Japanese colonial period, it really came to dominate the South Korean urban scene with the beginning of Gangnam development (Gang 2006). The urban proposition by CIAM (Congrès International d’Architecture Moderne) that envisioned a “tower in the park,” widely applied and tested in Europe and America at the time, was also a popular model and targeted planning paradigm in East Asia. This mass provision of modernist apartment came to the attention of Korean policy makers from various sources and would ultimately be chosen as the model for future provision of mass housing in Gangnam (Kim 2005). Apatu, an indigenous term for modernist high-rise apartment in Seoul, became a national prototype of mass housing inspired by the global planning practices of social restructuring and environmental determinism.

What was ironic is that, while in the West efforts to provide public housing in skyscrapers often devolved into ghettoized and dilapidated regions, Apatu in Seoul realized one of the greatest “success” stories of modernist ideas as a response to concurrent social restructuring and industrialization (Bristol 1991). Contrasting the ideal of early modernists to be a speculation-free housing for all, the inspiration for this Korean “success” was not for Seoul’s laboring population, but instead for a chosen few who were riding with the state’s privatization and speculative activity. Thus, describing Apatu as Seoul’s “public housing,” as Valerie Gelezeau has noted, is a misnomer that mistook state-initiated speculative housing development for social welfare policy (Gelezeau 2003, 2007). As in Gangnam’s case, the South Korean state fueled a highly speculative market system in which public demand was directed towards the collective consumption of modernist housing, well matched to status distinction. Preferred by the state to represent a new urban aesthetic, Apatu thus became a powerful medium where a commoditized urban consciousness of the emerging middle class found its cultural position confirmed by singular form of architecture.

The city government, as well as the housing authority of the Government (KNHC), framed the massive development of high-rise dwellings as the inevitable solution in response to unusually high population density in Seoul. This fixed framework worked towards normalizing alien building forms on which an intellectual discourse established the adoption of Apatu as a natural evolution that could mediate the conflict between the absolute lack of buildable space and a growing urban population. Under this rationale of cause and effect, the state, the conglomerates, and the emerging middle class created a developmental “myth” and stipulated visible evidence in the form of environmental novelty. Gangnam appeared to be, along with a distinctly American import of super blocks and immensely scaled grids designated for automobiles, the territory for new national center, where the built forms of Apatu would prove the Korean “miracle” that broke the agrarian society of the past in an unimaginable speed (Gelezeau 2007).

Behind the scenes of the Gangnam development, another social milieu surrounding Apatu fostered the greater cohesive power of nation building. In particular, through “Saemaul Undong (The New Village Movement),” the president Park Chung-Hee advanced a new discipline of the society contrary to past “ills” of laziness, dependency, and selfishness. “Diligence (Kunmyon),” “self-help (Chajo),” and “cooperation (Hypdong)” were to be the new social norms by which a person belonged to the membership of modern Korean nation was obliged to follow a set of state-sponsored ethical codes (ToSi SaeMaUI 1979). Although this moralization of individual behavior first began in the countryside, it would also appear in urban neighborhoods. Park believed that a “national renaissance” was only achievable through a change in the spiritual character of people, a belief that “spiritual posture is no less important than external and material posture.” This imagination for a future national society composed of self-disciplined and industrious individuals became the premise of Gangnam in which “Genuine modernization can be achieved only when material reconstruction is made on the basis of healthy national morality and social ethics”(Park 2005, Jager 2003). In the balance of material and spiritual ethics, the new aesthetic of modernism was chosen by the state to guide “a new way of living,” a “spiritual revolution of the people,” and the start of a “new history of the nation”(Jager 2003).

The state’s projection of the modern nation provided the overarching environment for the architectural culture in Gangnam, where naturalizing Modernist towers as the socialized and accepted aesthetics came to pass as a consequence of the scientific pragmatism that managed the city’s growth. With the state’s own nation-building programs running, this normalizing role of Modernist architecture and urbanism evolved into a generic built-environment prepared for the rising urban middle class. In Gangnam, architectural Modernism worked as a visualized manifestation that declared the state’s commitment to the development of a new face of the nation.

In this way, flagship developments of the large-scale Apatu complex and riverside highways in Gangnam represented national rejuvenation and modernization, which were, like Saemaul Undong reforming the anachronistic and ill-formed personal characters of the past, supposed to contribute to the emergence of a new urban self. In the evolution of Gangnam, an intensive



capitalist production of space took shape in the “public” form of housing and was channeled via the speculative actions of numerous individuals. While the popular discourses on Apatu cast it as a “rational” and “inevitable” choice, framing it as a solution for “urban problems” such as population density and inadequate land, the modernism of Apatu gradually dominated the public’s perception as a representative of specific class and social privilege.

### **Neighborhood unit**

Working as experts, elite Korean planners tried to combine the scientific justification of modernist urbanism with the new applicable ideas of idyllic community. The additional layer included most notably the Neighborhood Unit, another Gangnam approach for an exclusive and more splintered urban environment. In the hands of architect Park Byung-Joo, the super blocks of the riverside apartments had to correspond with community based Anglo-American design ideals (Perry 1939). Hence, first used in both the DongBulchonDong (1968) and the Yoido housing development (1971), the Neighborhood Planning Unit was applied to already repartitioned Apatu zones in Gangnam (Gang et al 1999, Son 2003). Following the examples proposed by Clarence Perry, Korean planners utilized the Neighborhood Unit in order to encourage the development where elementary school based pedestrian communities were emphasized. Traffic flows were separated from the residential areas in which necessary living amenities were placed within walking distance, creating the images of a neighborhood in Gangnam as a perfect educational environment for children. For example, in JamSil (1975) as much as 20 Neighborhood Units were planned. The radius of each Neighborhood Unit ranged between 500 and 800 meters. Within each boundary, garden areas and walking paths were designed to protect residents and their children from motorways (JamSil Basic Planning 1974).

Particularly interesting in the adoption of the Neighborhood Unit was its social ramification to South Korea’s frenzy competition for climbing up the social ladder: that is, Perry’s highly communitarian-based urban design intersected with the social milieu of South Korean society where upward social mobility and reproduction of social relations were mostly determined by a few premier colleges and their after-college social networks (Jung 2006). Acting aggressively on this critical point, South Korean state planners orchestrated the space of the Neighborhood Unit in such a way that they not merely imitated Perry’s young community with elementary schools, but also consolidated a long-term community better suited for status symbols with extraordinary educational quality. By the mid 1970s, top private and public high schools left their current places north of the Han River and were relocated among the modernist Apatu of Gangnam (Gang 2006). For emerging middle class families, the newly structured high school districts south of the river acted as the most powerful magnet, where neighborhood-based high school districts legislated by the Ministry of Education in 1978 to form the so-called “8<sup>th</sup> School District” of Gangnam (Palhakgun), an ideal neighborhood with all of the best college-prep schools in the nation (Lett 1998).

Having developed Gangnam, the state’s commitment to a prosperous urban community resulted in the promotion of special social privilege for certain groups and therefore social exclusion. As Teresa Caldera has noted, what once constituted a critique of the problems of industrial cities, such as the Neighborhood Unit and architectural modernism, trans-morphed in Gangnam and became the source of the destruction of its own democratic ideals (Caldeira, 2000). In Gangnam, translated both from Clarence Perry and Le Corbusier, spatial distinction created by the state’s flagship housing projects splintered the urban space of Seoul. Relishing social networking within homogenized groups, middle class Koreans then easily linked their own privileged school districts to the modernist housing and fresh infrastructure in Gangnam. In the state’s efforts to build Korea’s future model city, a distinctively exclusive city was created across the Han River, encouraging massive middle class exodus to the south (Seo 1991, Koo 1994).

### **Conclusion**

By the mid 1970s, while modernist planning fell under increasing criticism in the West, state planners in Seoul were busy applying architectural modernism to the new territory south of the Han River. Cultivating real estate speculation and spreading modernist aesthetics, they utilized state power in order to reshape Gangnam into the representative urban image of future Seoul. In the process, Apatu, a novel dwelling type, evolved into a popular housing form and an

aesthetic expression of newly gained wealth and property ownership (Jang 1994, Gelezeau 2003, 2007).

In such late development of modernism, the state's spatial restructuring along the Han River, despite the extensive production of modernist buildings, followed a trajectory quite different from the one envisioned in the early 20<sup>th</sup> century. That is, instead of providing for the "public good," "benefits of mankind" and therefore making a "public city," the South Korean state employed architectural modernism strictly for the utilitarian drive that ventured new urban space in order to complement rapidly expanding industrialization. Rather than inserting a grand master plan into a dense working class sector, state authorities explored areas beyond the existing Seoul and transformed Gangnam into a geographically protected enclave for the rising urban middle class. In the course, Apatu was chosen to lead South Korea's architectural culture. In stark contrast to the intentions of early European modernists, Gangnam development reversed the relationship between the role of the state and that of modernist architects. As James Holston has pointed out that, even though CIAM did not advocate the abolition of private property, it did espouse state power as the only safeguard against disorganized urbanization by private real estate developers. One of CIAM's important positions was that private interests were seen as an obstacle to the total design of the modernist city (Holston 1989). Paradoxically, the mega-scale of modernist planning in Seoul was accompanied by the state's powerful role as the "promoter" rather than the "suppressor" of private interests. While the state continuously emphasized the need for mega scale designs that aimed to convert Gangnam into the foremost façade of Seoul, the emerging spectacle of Apatu along the river in fact betrayed the ideals of the modernist city. In particular, the transformation of modernist ideology in Seoul was total betrayal to European modernists who had deplored land speculation as rampant irrationality of the private sectors. In the place of public responsibility, the South Korean state embraced this "irrationality" by deepening the capitalist urban culture of Gangnam through encouraging private speculation.

In order to expedite rapid urbanization, the South Korean state actively sought the ways in which accumulative "mechanism" through the state management of urban space engendered class oriented residential enclaves. As a new base for the urban hierarchy and an expression of propertied citizenship, Gangnam was not an ideologically neutral outcome of modernist urbanism, but rather a tightly woven capitalist grid that combined the state sponsorship of real estate speculation with the private pursuit of wealth and social status.

## ACKNOWLEDGEMENTS

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<sup>1</sup> <http://www.kpoplyrics.net/psy-gangnam-style-lyrics-english-romanized.html> Accessed on November 3, 2013.

# A Protest Against Academic Taylorism: A New Approach to Interior Design Education

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**ABSTRACT:** The design education helps to encompass many learning, synthesis opportunities and it has an interdisciplinary approach. However, even today, traditional educational models are developed in regard to academic taylorism, which are far away from an interdisciplinary and collaborative approach. In the present paper, we investigate the following questions; why a new approach is necessary for the structure of thinking and practice in interior design education? How can we restructure knowledge and design education in the interdisciplinary arena? Further, the paper presents a case study, discussing an educational model in interior design with a protest against “academic taylorism”. The proposed model and the educational approach has been actively used in the last six years. Some of the outcomes of the present model are; almost all students seem to be quite happy to gain an interdisciplinary view. They are also very productive since they have been working with the students in the program of cinema, painting, communication and also graphic design, this leads them to develop a common language. They also take part in national and international student competitions as a team.

**KEYWORDS:** academic taylorism, interior design, interdisciplinary study, multidisciplinary study, Bauhaus

## INTRODUCTION: Definition of the Problem and Taylorism

In traditional educational models, even today, academic taylorism uses a management approach which is far away from providing an interdisciplinary and technically competent professional education. In these models, the curriculum is divided into a series of courses each having its own outcomes. It is aimed to organize the content of each course “at the upper most level, highly productive”, however neither the students, nor the instructors are aware of the program outcomes. These mechanisms lead to piles of paperwork that often have little or no connection to teaching or what really takes place in the essence of the profession. However, one of the most frustrating aspects of academic taylorism has been the lack of “quality control” that are implemented from year to year, semester to semester basis. In Figure 1, the schematic view for education models which are structured in regard to “academic taylorism” are visible. In these models, each course is completed in itself, there is no connection, or a little connection with the course contents. There can be equal weight in disciplines (model 1), or unequal weight in disciplines (model 2) as seen in the figure below. However, there is no holistic approach in the lateral and/or the vertical structures.

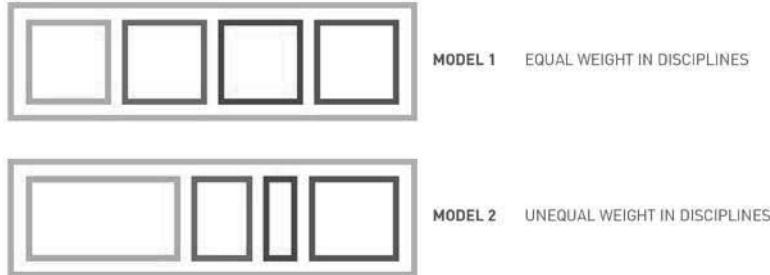
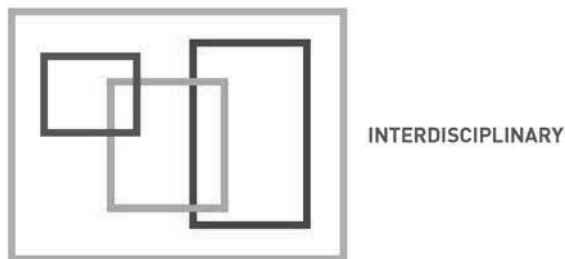


Figure 1: Taylorist educational models

Hence, the “design” education offers a holistic view to art, design and science by means of visual studies, computer skills, technology, history and art-crafts. The collaborative

interdisciplinary design studies augmented by lectures, seminars, workshops form the core of the program which offers the opportunity to integrate and synthesis what is being studied. (Figure 2). For interior design education, its unification with other disciplines are important. The interdisciplinary structure brings flexibility and supports creativity. In today's approach, boundaries between disciplines are moderated which leads to produce interdisciplinary projects. In other words, an interior architect can work with an electrical engineer and an industrial designer in order to design a lighting fixture. A design team can have an architect, an interior architect, an industrial designer who are specialized in their own professions and also they can create a project together as well. This approach is illustrated in Figure 3. The professional practice is essential for each discipline, however the forcefulness depends on the project topic and the content.



**Figure 2:** Interdisciplinary approach



**Figure 3:** Multidisciplinary approach

The proposed model highlights the importance of the unification of the various disciplines. The project team is composed of members from various disciplines ( as similar to the multidisciplinary view). Their strength in the project is similar to each other, and each member should be equipped with a “designer background”.

In this approach, “the design studio is the core of the whole system, it is a platform where students start to acquire the sense of decisions”. At the most general level, the design education helps to encompass many learning and synthesis opportunities.

The present paper investigates why a new approach is necessary for the structure of thinking and practice in interior design education? How can we restructure knowledge and design education in the multidisciplinary arena? This paper presents a case study, discussing an interdisciplinary education model in interior design with a protest against “academic taylorism”. The proposed model and the educational approach has been used actively in the last six years.

### 1. Basic Structure of the New Curriculum

A multi-disciplined model is offered for art and design education, with a special emphasis on project making ability. Today, more than ever, art and design education is an interdisciplinary practice without clear boundaries. Expanding on this point of view, the characteristics of traditional interior design education is turned into a holistic studio program into which all the compulsory and elective courses are incorporated (Rowe,1987).

The core of the model offers opportunity to integrate and synthesis the technical, artistic, theoretical and historical design-related issues. The goal of this program is to reveal the potential talents, as opposed to teach certain lectures to them the program helps students to explore their potential and therefore, find their own individual direction. The issues which are studied are as follows;

- the terminology related to basic design,
- the built environment at macro and micro scale,
- principles of construction,
- history of art and interior design,
- environmental sciences such as lighting, HVAC,
- material property and detailing,
- art / cinema, art / painting
- graphic design
- industrial design
- critical thinking and theory
- reuse of interiors / restoration and renovation

### **1.1 The Academic Staff Profile**

The role of the academic staff in this model is being involved in the design practice actively. The general principles of the forming staff profile are as follows;

- Basically every staff should be a designer such as an interior architect, architect, industrial designer, graphical designer, furniture designer.
- Each staff should take part in the studio work.

As a designer, to set-up a link between theoretical information and design education is essential. Such staff who is merely specialize in “architectural history” without having a “design” background can hardly be an advisor at studio classes and critics. It is expected to create a sort of informative link between a specific design problem with its historical background. The same approach is expected to be applied in the case of environmental sciences –lighting, acoustics, sanitary systems, as well as restoration, re-use and adaptability, and elective courses. The academic staff encourage students to be involved in design practice by exhibitions, competitions and sectoral coordination as well.

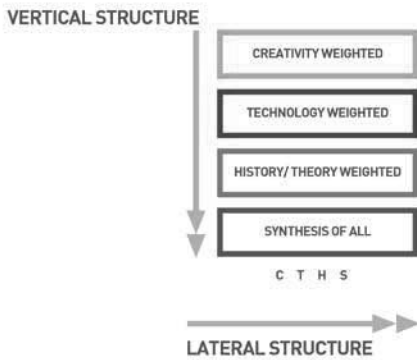
### **1.2 Cardinal Principles in New Approaches**

The undergraduate curriculum is redesigned and analyzed systematically where the education system is flexible and varies according to the individual talents; there is not a specific formula for all students, each student’s program is individualized in relation to his/her own field of interest and potential (Lawson,2008).

As Gharaati (2006) suggested, although the courses taught in architecture schools around the world vary between schools, they can be divided into two general categories. The first is the design studio and the second is the lectures or seminars, which are basically theory-oriented. In the proposed model, this philosophy is the main objective which is supported by a horizontal and vertical structure.

The horizontal structure links the courses given in a semester to each other by means of the content and the method of education. The vertical structure on the other hand suggests a continuity in the education philosophy by means of suggesting pre-requisite courses such as “the interior design studio”. All the other courses tend to be complementary or auxiliary to the design studio.

The proposed model is put in a context in which there is a challenge and a main theme for each year. Figure 4 illustrates these themes for the undergraduate curriculum. In the first year, “creativity” is the main theme, followed by “technology” in the second year. The third year, “history” is the core of the educational approach and the fourth year courses are designed with the main topic “synthesis”.



**Figure 4:** The structure of the proposed model

The structural system offers to design the following year’s curriculum and the main theme in regard to the “main theme and the outcomes” of the previous year. Therefore, “technology” comprises “creativity”, “history” involves “creativity and technology”, and “synthesis” includes all the three themes.

The educational approach in the proposed model is based on the principles which have been developed during Bauhaus and it can be summed up as follows;

**Learning by doing**

Students learn by doing, it is an interactive process, supplied by various elective courses

**Learn how to learn**

Students are encouraged to learn different research methods. The program is “student-centered”, hence it is aimed to increase the instructor’s awareness of students’ learning styles. Equipped with a well-rounded curriculum, students are qualified to build interdisciplinary and multidisciplinary relations throughout their educational life.

**Applying multi disciplined learning models**

Project making ability (an interior design Project with history, theory and space planning and furniture design issues, related to an art exhibition planning, brand image study for a big company etc) is practiced with a specific approach of the related discipline. The boundaries between disciplines are broken down which leads flexibility in teaching and collaboration between the professions.

**Applying productive evaluation techniques rather than controversial examination methods**

Paper presentation, take-home exam, presentation and discussion panels have been used instead of controversial methods. Also combined systems have been developed, that means, all those new examining techniques would cover all the subjects which have been dealt with during the term. Therefore, instead of several separate examinations, combined papers and/or projects would be applied.

**Team working ability-encouraging team work**

Students are encouraged to study in groups, take responsibilities and present as a team

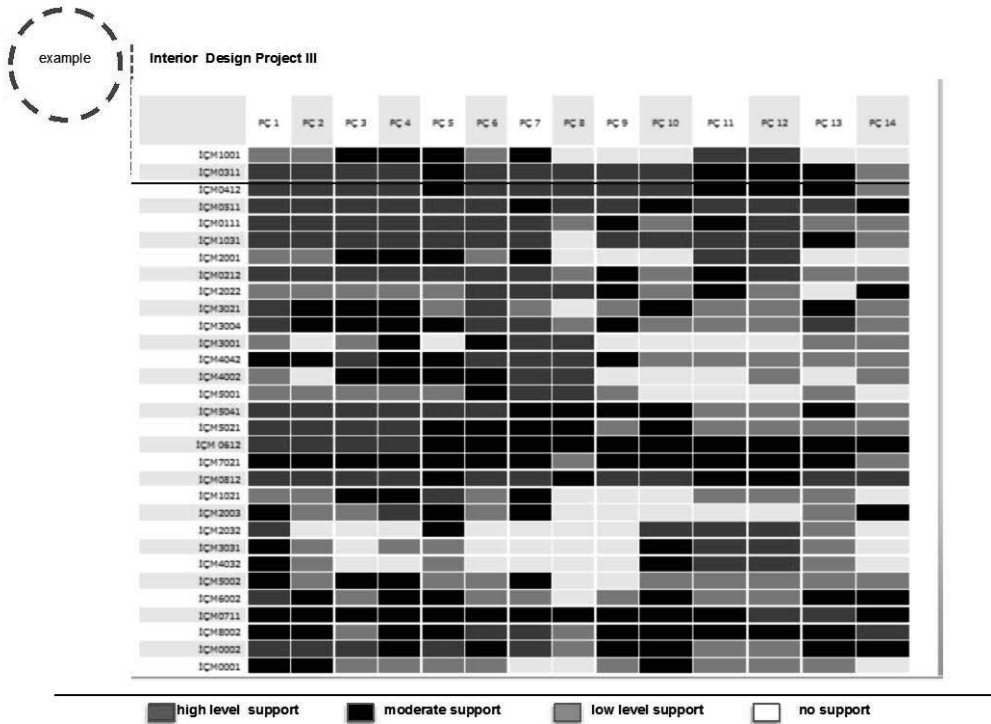
## **2.Application of the Curriculum/ The Case Study**

The undergraduate curriculum of the Interior Design Department was re-designed and a multi-disciplined education model was proposed in 2007. The curriculum is designed in respect to the “program outcomes” which are determined beforehand. The objectives can be listed as follows;

- Is within the architectural discipline, has local, regional, national and international knowledge regarding different space planning issues related to interior architectural design and planning.
- Sets up a substructure for design proposals which are people and community orientated , culturally and environmentally sensitive.
- Improves skill in developing design concept and planning. Acquaint with defining and investigating special problems on different space planning and design issues.
- Develops creative, novel, aesthetical and unique problem solving alternatives related to different space planning issues in the light of abstract and concrete concepts.
- Makes valuation on knowledge and skill in the relevant field by critical thinking and by dialectic decision method.
- Has self confidence and competence while carrying on with work in the relevant field, plans research projects within this period, takes part in application projects, takes mutual and individual responsibilities in interdisciplinary projects.
- Expresses oneself in writing, verbally and visually to be in collaboration with the related corporation in the relevant field.
- Has competence in using at least one computer aided drawing program as required by the relevant field.
- Has multidimensional line of sight for economical, environmental and communal sustainability norms and standards in the relevant field.
- Within human-environment relationship has respect to social and cultural rights, has conscious competence in making decisions on the protection of cultural heritage and natural property.
- Recognizes national and international values in art and design.
- Recognizes ethics and aesthetics in art and design.
- Knowing the duties and authorities of the profession, has competence in the protection of natural and cultural values, pays attention to occupational health and safety, offers solution to increase space quality.
- Has knowledge of norms, standards, laws and regulations of the profession.

Secondly, a matrix was developed in respect to each course in the curriculum. The logic of the matrix is parallel to the “likert scale” with a four level evaluation criteria; no support, low level support, moderate support and high level support. Figure 5 illustrates the matrix, the evaluation of the undergraduate curriculum in respect to the program outcomes.

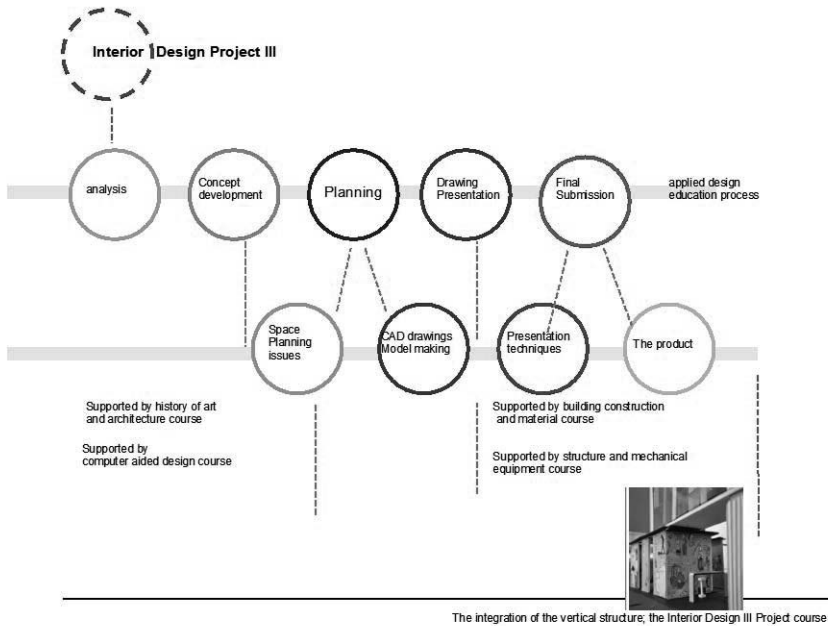




**Figure 5:** The breakdown of the matrix and evaluation of the undergraduate curriculum (IKU Interior Architecture and Environmental Design Undergraduate curriculum, (<http://www.iku.edu.tr/EN/108-2-48-82-1259-598-1-1-1/Course-Program-Outcomes-Matrix>))

The courses which are well integrated with most of the program outcomes are the interior design project courses. This supports the main principle of the curriculum; it is a project-based system and the curriculum shall be designed accordingly; the whole system shall support the Interior Design Project courses mainly by the technology based courses, the art and design history courses, elective courses on various topics as well as the building science courses. This approach is schematized in Figure 6 where the Interior Design Project III course is taken as an example and the lateral integrity of the structure is emphasized.

The proposed model encourages team work which brings flexibility and creativity in design problem solving practice. The student is in contact with different parties to gain project solving ability, to improve her/his presentation techniques, to unify building science issues and human comfort into the interior design project and also to learn how to express himself verbally and graphically in front of the professionals.



The integration of the vertical structure, the Interior Design III Project course

**Figure 6:** Integration of the Interior Design Project III course to the lateral structure

### 3. Evaluation of the Curriculum

A case study is expected to catch the complexity of a single case. It can be defined as the study of the particularity and complexity of a single case, coming to understand its activity within important circumstances. Though the case study seems a poor generalization because of studying only a single case, these sample studies can be studied in length. In the present paper, only a unique experiment is observed. Hence, there are various factors some of which can be included to enlarge the study. Sometimes, the uncontrolled factors in case studies make long term observations more difficult. Therefore, generalization might not be possible in our specific experimental study, only some proposals might be forwarded for future studies (Linda and David, 2002).

The only way of evaluating the new curriculum is the feedback from students, graduates and also from the staff. In particular, in the present system, students seem to be more satisfied from the staff who have a “design” background. A systematic approach has been established in order to collect different sides taking part in the application of the new system by means of buzz meetings. In these meetings, people from different sides are asked to be completely free to express their real expressions. In this approach, students and their families seem to be quite happy since the number of the new applications have increased in the recent years. On the other hand, at the end of each term, panel discussions are organized in order to make clear the problems which arise during the term.

### 4. Early Outcomes / Proposals for the Future

The idea of collaboration in architectural education is not a new trend as pointed out in Elnimeiri et al (2006). Two principles constitute the success of collaboration; first the importance of the holistic approach and understanding the role of each parties such as the town planner, the architect, the interior architect and the industrial designer. The architect needs to acknowledge that the industrial design is as much a design discipline as architecture, meanwhile industrial designers need to share the views of the architects in their technical solutions. This point of view reflects all parties involved in all issues of the building design and construction.

The presented approach and the curriculum has been actively used and developed in the last six years. The basic aim of the curriculum is to establish a link between all lecture courses and design studios. It is believed that the improvement in the ability of students is strongly based

on the collaborative work of the educational team, and also it is accepted that the team work of the educators would be affective on the performance of the students. The basic assumption is that, educators do not work separately, that means they are not free to act separately.

Another important point of the new approach is to establish a working environment in which not only design students, but also other art students are educated together in a unified system. At the end of each term, a type of buzz meeting has been organized in order to reveal different problems and unseen, unspoken points of the curriculum.

The points listed below have been noticed during the last three meetings;

- Today, various presentation methods shall be used in interior design education such as film making, advertisement et cetera. This approach leads to work with different professional groups which demolishes “academic taylorism” and improves creativity and flexibility.
- This new approach in interior design education enhance students to be productive in the field of cinema, painting, communication, as well as graphic design since most of them will have started to develop a common project. Traditional education methods did not encourage students to study at an inter-disciplinary arena.
- Almost all students seem to be quite happy being in co-operation with art students. This helped them to develop a common language in the field of art and design.
- They also take part in national and international student competitions as a team
- Since the university encourages team working, the quality of the products increased and also the number of the awards have increased. This success is supported by the university as well.

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# The Captured Gesture: Studio Performance at the Intersection of Thinking and Drawing

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**ABSTRACT:** Gestures are inevitable and invaluable acts of expression that occur throughout the architectural design process. Students struggle at times to put complex ideas in drawings and words. Without fail, gestures telegraph this struggle; they are fleeting yet momentous links between thinking and drawing and between one's personal design sensibility and the complex social and physical realm of architecture. This paper seeks to develop insights about the role and value of gestures in architecture by investigating their frequency, form and influence in the design studio. A proposed framework draws insights from sources such as psychology and art theory to speculate about the role of gesture in architectural design thinking. It assimilates different disciplinary perspectives in order to consider ways gestures as simultaneously personal and inter-subjective acts promote designers' heightened intentionality and awareness. The framework is then applied to a design exercise that encourages the theatricality of gestures as living diagrams that bring haptic shape, motion and meaning to design dialogue.

**KEYWORDS** (5 word max): Gesture, Communication, Design Process, Sensibility Representation (?)

*"When thought overwhelms the mind, the mind puts thoughts into the world." Barbara Tversky - Tools of Thought" Lecture, University of Oregon,*

*"Creative work calls for a double perspective... simultaneously on the world and on oneself, the external space and one's inner mental space." Juhani Pallasmaa - The Thinking Hand*

## 1.0 INTRODUCTION

A significant body of research points to the importance of gestures in communication and creative processes. Yet despite these scholarly contributions and pervasive use of gesture in the design studio setting, the topic has received little attention in architectural scholarship and education. This paper endeavors to enrich understandings of the multiple roles of gesture in the design studio environment.

This paper (1) affirms the ubiquitous use of gestures in the architectural design studio setting; (2) introduces and scrutinizes literature and research on gesture developed in disciplines other than architecture; (3) and develops, through comparative analysis and an ethnographic perspective, a preliminary theoretical framework for analyzing how architectural designers use gestures (intended to complement the larger body of research that exists on the topic and give some form and structure to the ways architects deploy gesture: how, how often, and to what purpose). Lastly it (4) describes intentions and outcomes of an assignment in a design course – the first of many intended to test this framework - that explores the ramifications for a learning community in a design setting when gestures are made explicit and where theatricality is encouraged.

## 1.1 DESIGNERS USE GESTURES

Frequently a mismatch exists between a designer's drawings and words: sometimes drawings carry the thinking and the verbal expressions are halting; sometimes a verbal presentation is more sophisticated than graphics (at other times, both narrative and drawings are unintelligible, but that is a topic for another paper). As has become increasingly evident to the authors from sustained observation of student 'performance' during studio reviews, the designer without fail fills the gap with gestures (they make diagrams with their limbs), spontaneous acts more often than not sophisticated and nuanced and that go some distance

in reconciling intention and execution/expression. Hands act as invisible chalkboards, helping the designer imagine and bring shape and meaning to an emerging idea. One thinks for example of Frank Lloyd Wright describing the inspiration for the design of the Unitarian Church in Madison Wisconsin by placing “his hands in prayer, illustrating ‘the expression of reverence and aspiration’” (Sekler 1965, 94).

By pointing out the clarity and potential significance of these acts, the educator/critic can help the designer direct subsequent inquiry with greater purpose and vigor. There is an opportunity to enrich the architectural curriculum and create a more mindful, critical and collaborative learning environment. As important as making the actor/author/designer aware of use of gestures, the effort to make public this dimension of design communication offers encouragement to the larger learning community to pay attention to the body language of others in order to help them clarify ideas and intentions (part of the larger obligation and opportunity to point out what may be obvious and overlooked and yet potentially meaningful and catalytic).

It warrants pointing out that there are those who are less articulate and animated gesturers. Just as there are designers who struggle with drawing or speaking, some seem less communicative with gestures and are more reserved. As one can improve facility with sketching or oration through formalized practice, the persuasive and effective use of gestures in the field indicates potential for instruction to improve the communicative capabilities of those with less skill.



**Figure 1.1:** Designers use gestures: instances of use gestures in the architectural design studio

## 2.0 EXISTING RESEARCH

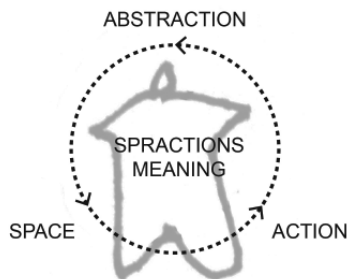
Barbara Tversky, Professor of Psychology at Stanford University, has produced some of the most influential and original research on gesture. She describes gestures as “depictive expressions of thought” that predate written and oral language (Tversky 2011, 499). In discussing ways they both express and *transform* thought, she organizes hand gestures in five types (Tversky et al. 2009, 121; Tversky 2013):

Emblem (thumbs up):	“...conventional meanings like words...waving, goodbye, O.K.”
Beat (first, second):	“...advance the discourse”
Deictic (a referent):	“...point to or indicate things in the environment.”
Iconic (resemblance):	“...resemble what they are meant to convey.”
Metaphoric:	“...metaphoric relations to the things they convey.”

It is not immediately obvious how one applies these five gestural typologies to ‘live’ design settings where intricate cultural and social factors and associations add complexity and possibility. Much of Tversky’s work on spatial mediums addresses tasks most frequently expressed in straightforward categories such as navigation (to direct) and construction (to build), but does not embed them within a social milieu – nor are the recordings (representations) of the captured gestures analyzed beyond their self-informing value (performers are separated from observer). Architectural design projects acquire meaning through a complex interaction of the actants and involve matters beyond mechanics of space and action. How subjects **interpret** other subjects in the theater of the studio is of particular concern.

Another dimension of Tversky's research, one highly relevant to architectural designers, pertains to ways meanings expressed verbally may be counteracted or reinforced by other means such as prosody, facial expressions, and gestures of the hands and other parts of the body. This perspective provides contrast to presumptions that meanings are neatly packaged by and best expressed through words. Designers continually move between mediums of communication, each providing a different form of support. Drawn diagrams and gestures are interrelated communicative phenomenon in that "diagrams can be regarded as the visible traces of gestures just as gesturing can be regarded as drawing pictures in the air" (Tversky 2011, 527). They are of complementary purpose and together allow for fuller comprehension and retention. Gestures provides a "second way of encoding information" that supports memory (Tversky et al. 2009, 121). This reinforces and parallels familiar discourse on media within design: modeling, sketching, and drafting are mutually supportive inscriptions and encodings of the world around a designer that facilitate ability to retain, analyze, discuss, prioritize, discriminate and act.

Tversky et. al. coin a hybrid term, "spractions," that refers to ways people manipulate expressions as a three-way interaction between space, action and abstraction. Spractions are "actions in space...that create abstraction in the mind and patterns in the world, intertwined so that one primes the others...(unlike language) they do so silently and directly" (Tversky 2011, 528). Gestures as spractions may be thought of as acts of network creation, interchanges that facilitate feedback between thoughts and actions and forms perceived in the outside world. Gestures help us circulate within this triangular relationship (space, action, abstraction) and in this way are deeply consequential in design.



**Figure 2.1:** Diagramming Tversky's "Spractions"

Focusing on "pointing" figures in pre-Renaissance paintings, philosopher and art historian Claude Gandelman provides an historical perspective on gestural demonstration. He introduces two broad functional categories, illocutionary (direct influence) and perlocutionary (indirect influence), akin to Tversky's deitic and metaphoric types respectively. Each contains subcategories summarized here (Gandelman 1991, 21-27):

**Illocutionary (direct)**

- Distancing: Relating the immersion into a painting "a presentation, not a representation"
- Indexing: Relating the indexed object (emphasis)

**Perlocutionary (indirect)**

- Gaze Directing: Toward a narrative trajectory, a "scan-path" (reading directionally)
- Ideological Directing: Toward a message (an agenda)
- Empathizing: Toward a sympathetic (relational) response

One can situate Gandelman's taxonomy within a rich philosophical discourse – linked to and building from Alois Riegl, Descartes, Merleau-Ponty, and Berkeley – that endeavors to deepen understandings of visual interpretation of the world. Riegl's semiotic categories point to a fundamental division between "optics" and "haptics." Gandelman writes: "The optical eye merely brushes the *surfaces of things*. The haptic, or tactile, eye penetrates in depth, finding its

*pleasures* in the texture and grain.” (Gandelman 1991, 5) It is these two perceptions of the world that structure the categories of demonstration (illocutionary and perlocutionary) mentioned above. With regard to the haptic and because emotional experiences are involved, observing an image is to engage a deeply meaningful conversation with the painter pertaining to a message or agenda. This pointing (direct and indirect) *in the direction of* and as what is significant is relevant in understanding the generation of architectural meaning.

Architectural theorist Juhanni Pallasmaa offers echoes of Gandelman’s haptic sensuality and notes its absence in contemporary architectural discourse. Pallasmaa describes the gap in representational thinking presented by the “flatness of surfaces and materials, uniformity of illumination, as well as the elimination of microclimatic differences” that remove the designer and create “sensory impoverishment” (Pallasmaa 2000, 321). Pallasmaa addresses the deficiency by attending to and reasserting the value of expressions (the ‘experience’) of the hand. He writes, “the intelligence, thinking and skills of the hand also need to be rediscovered” (Pallasmaa 2009, 21).

For Pallasmaa, the agenda or role of architecture is to mediate between the world and ourselves, the “horizon of understanding the human condition” (Pallasmaa 2009, 148). In a recent text, “The Thinking Hand,” Pallasmaa describes architectural thinking embodied in the hands that manufacture objects (or facsimiles of objects). The designer’s ‘workmanship’ centers on the hands; it is as though embedded in the hand is the entirety of the craft of architecture. The hand of a seasoned designer is not merely generating representations but constituting “a fully haptic and multi-sensory reality of imagination” (Pallasmaa 2009, 59). Pallasmaa endeavors to translate the haptic wisdom of the experienced and well-seasoned designer to the learning environment and to the unseasoned designer.

Pallasmaa introduces an important yet underappreciated dimension of architectural education. While he places emphasis on the craft of drawing in considering the central role of the hand, one could build on this and emphasize the hand as a locus of gestural competency and indicator of capability in other realms important to the designer (words and drawings). To what extent and in what ways are gesturing hands the source and symbol of haptic wisdom?

### **3.0 A THEORETICAL FRAMEWORK FOR CONSIDERING USE OF GESTURES IN ARCHITECTURAL DESIGN**

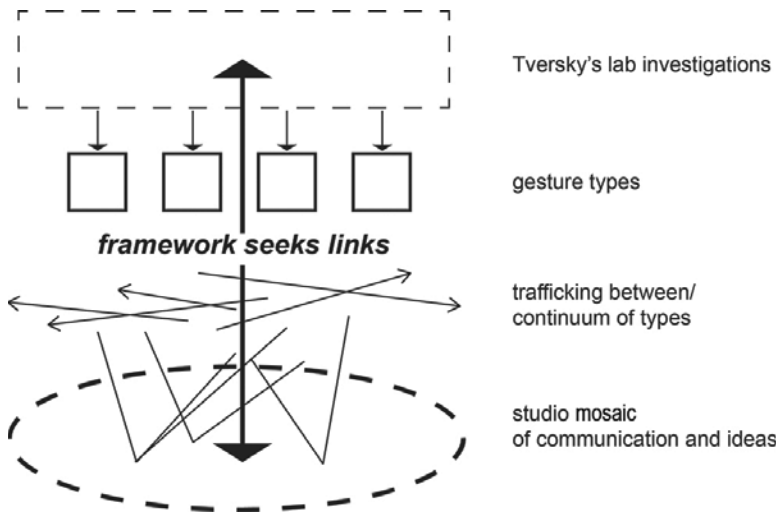
Tversky theoretical work and Gandelman’s research points to a gap in knowledge created by two very different systems of inquiry (analytic/qualitative). Our proposed framework, the basic outlines of which are suggested in Table 3.1, combines benefits of the two orientations.

**Table 3.1:** Comparing Gestural Frameworks

	<b>TVERSKY</b>	+	<b>GANDELMAN</b>	+	<b>AUTHORS</b>
<b>FRAMEWORK</b>	<u>Taxonomy</u> <ul style="list-style-type: none"> <li>· Emblem</li> <li>· Beat (first, second)</li> <li>· Deictic</li> <li>· Iconic</li> <li>· Metaphoric</li> </ul> <u>Synthesis</u> <ul style="list-style-type: none"> <li>· Spraction</li> </ul>		<u>Illocutionary</u> <ul style="list-style-type: none"> <li>· Distancing</li> <li>· Indexing</li> </ul> <u>Perlocutionary</u> <ul style="list-style-type: none"> <li>· Gaze Directing</li> <li>· Ideological Directing</li> <li>· Empathizing</li> </ul>		<u>Unification</u> <ul style="list-style-type: none"> <li>· Process/Activity</li> <li>· Space/Physical</li> <li>· Significance/Meaning</li> </ul>
<b>BENEFITS</b> Advantage for designers	<ul style="list-style-type: none"> <li>· Clear Taxonomy of the fundamental components</li> <li>· Understanding relationships between physical objects and spatial locality</li> <li>· Beginnings of temporal and conceptual integration, i.e. “spractions”</li> </ul>		<ul style="list-style-type: none"> <li>· Interpretation of qualitative meaning and significance</li> <li>· Responds to designers need to incorporate visually haptic responses (as promoted by Pallasmaa et. al.)</li> </ul>		<ul style="list-style-type: none"> <li>· Simple and directly relatable categories</li> <li>· Apply directly to a studio/design environment</li> <li>· Performers (faculty, students, etc.) are part of shaping useful gestures</li> <li>· Accounts for performer's diverse ideological and cultural backgrounds</li> </ul>
<b>GAPS</b> Limitations of Framework	<ul style="list-style-type: none"> <li>· Laboratory data applied to complex social environment?</li> <li>· Too generalized to extract/apply meaningful design application</li> </ul>		<ul style="list-style-type: none"> <li>· Correspondence of art theory to studio?</li> <li>· Too narrow: singular cultural reference (15<sup>th</sup> C. European painters)</li> </ul>		<ul style="list-style-type: none"> <li>· Highly preliminary; requires testing, exploration and application</li> <li>· Dynamic process is difficult to record/analyze all the parts – not in laboratory</li> </ul>

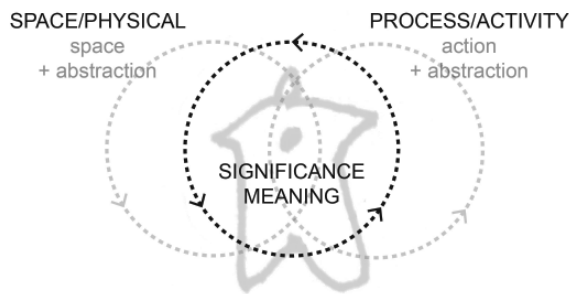
Tversky finds that the laboratory can “accelerate” the “natural testing cycle” in order to find “specific ends,” yet the categorical framework developed within the observational space of the lab does not translate seamlessly to more complex domains (Tversky 2011, 501, 527). The issue pertinent to design education is how to understand gestural acts directed toward multiple ends, as well as the value of those not entirely end directed. Observations in the studio setting over a prolonged period of time suggest more fluid categorizations, perhaps hybrids of Tversky’s deictic, iconic and metaphoric types. Multiple gestural types can be discerned within instances of expression; one can even recognize seamless sequences of type (transition from type to type) within one quick natural progression/movement (if what we are talking about are hybrids, they nevertheless exhibit sufficient structure to make communication, invitation, confirmation and the opening up of the space of dialog possible). Our idea is to build a framework organically, honoring the complex naturalness of gestures as they arise in a studio context (see Figure 3.1).





**Figure 3.1:** Diagrammatic Framework

We began a process of conceiving an integrative framework by capturing numerous gestural images in the studio environment. We then pinned them up on a wall and labored to find a pattern that explained their occurrence. We found a basic structuring and continuum of images based on broad categories of 'space/physical' and 'process/activity' as poles and with 'significance/meaning' operating as an intermediary (see Figure 3.2; note these categories translate the tripartite relationship embedded within Tversky's notion of spractions). A second continuum runs perpendicular and is based on scale with specific gestures (relatively full bodied expression and involving dialog between body and environment) at the other. The matrix of gestures described in Figure 3.3, built upon recordings and subsequent analysis, illustrates our basic framework (critically, the captions furnish the basic contexts in which gestural acts occurred).



**Figure 3.2:** Meaning Gestures at the Intersection of Space/Physical and Process/Activity



**Figure 3.3:** Diagrammatic Matrix: Continuums of Use of Design Gestures in the Architecture Studio Environment

What follows is a descriptive elaboration of the ‘gestural tendencies’ deployed along the horizontal continuum of the matrix (‘space/physical,’ ‘process/activity,’ and ‘significance/meaning’).

*Space/Physical:* The top set of images in Figure 3.3 describes how people employ their bodies as measuring devices and use gestures for scaling and proportioning. ‘Specific’ or ‘near’ body gestures (left side of continuum) involve use of fingers, hands, or arms in delineating planes, spheres, boxes, and the like. These embodied measures operate at a relatively high level of precision; the thumb and forefinger index a shape. Of a more open nature are those gestures relating posture of limbs and the presenter’s eye that invite the viewer to imagine the presenter’s visual projection. Whether the gaze is directed toward virtual objects above, below or directly ahead, it presents to others a measure of an imagined object in space, enabling them to fill out an implied shape. Most expansive are those gestures taking up the entire body – as gestural form, as being – in relation to objects and conditions at a distance. Forms are outspread wings arcing to a far horizon.

*Process/Activity:* The bottom set of images depict gestures of dynamic motion, ones that attempt to relate phenomenon such as emerging, upwelling, stepping, dissipating, other. Common in an architectural design setting are construction-related gestures that involve building and placement of structures. Also of frequent occurrence are animate process gestures pertaining to the social logic of a design undertaking (how to gather together a community to engage in complex design process, for instance) or to ecological/physical processes that deserve acknowledgment and that might have formative influence. Examples of process/activity gestures include water filtering, earth mounding, people and ideas meeting, walls barricading, settlements relocating, sun shining, etc. In all cases the designer *becomes* a dynamic medium communicating dynamic phenomenon.

*Significance/Meaning:* Images in the middle set operate at the intersection between space/physical and process/activity tendencies. Such gestures are ‘live’ diagrams that often reckon with and possibly assimilate both these dimensions while striving to go beyond in search of architectural meaning. These kinds of gestures are often less precise than others and attempt to grasp, uncover or discover one’s stance and motivation in approaching a design problem. They involve risk, exposure, disclosure, authorship and a level of theatricality in order to create a space for others (i.e. to arrive at inter-subjective agreement or approval or to invite controversy and debate). Significance/meaning gestures demonstrate the very

possibility of demonstration, that is, of displaying and reinforcing the capacity to arrive at a point of conceptual significance.

The categories are designed to provide a way to begin developing structured assignments while also accommodating the dynamism and variety of perspectives and approaches in a studio environment. The challenge is to produce assignments or projects that can absorb the natural flow of gestures while providing opportunities to reflect and study these ephemeral expressions through visual and haptic analysis.

#### 4.0 INCORPORATING EXPLICIT USE OF GESTURE IN THE DESIGN SETTING

In an initial attempt to assess the value of the framework, we crafted an assignment encouraging graduate and undergraduate students to gain greater self-awareness in using gestures. The course focuses on the role of different media in analyzing physical contexts and exploring landscape perception. The assignment required students to generate, manipulate and combine stills of hands in the act of 'describing' ecological and social processes pertinent to their studio project. Students were asked to add diagrammatic textures and elements of force (such as water, simplified as white) to help visualize their gestural images (Figures 4.1 and 4.2).



**Figure 4.1:** Gestures Presenting Ecological Processes. Graduate Student Work (From left): Alison Lewis, Kayla Byrne, and Ellee Stapleton



**Figure 4.2:** Social Gesture (left), Ecological Gesture (right). Student Work: Samuel Ridge

The assignment builds from the framework and emphasizes those gestures (those pertaining to processes) most relevant to the assignment. Students expressed the value of recording their gestures and combining stills with other media. It helped them to look at exchanges and intersections of mediums and tools in a more complex way; rather than a question of when to choose between or switch from analog to digital, the discussion instead focused on

continuums of manipulation of instruments (including parts of the body as instruments) and images and the usefulness of a given sequence. 'Virtual reality' in this context would seem to include gestural acts that place students at once in the studio and out into the landscape.

This recording and explicit consideration of gestures allowed for higher levels of both self-reflection and inter-subjective awareness. Students who chose the same ecological conditions ended up with decidedly different sequences of stills. Haptic personalities seemed more pronounced as students "looked" at their colleagues work with their hands – mimicking sensations and shapes. This led to valuable discussion about differing sensibilities, insights and perceptions of the physical world. Most importantly this exercise produced products (images) that inspired students' subsequent design investigations. Future studio centered assignments will build from this goal of finding variation and engaging discussion about creative impulse within a bracketed structure.

## **5.0 GESTURING TOWARD LARGER CHALLENGE IN ARCHITECTURAL EDUCATION**

A significant opportunity exists to better understand the role of gestures within architectural education in supplementing and trafficking between (other) mediums of design communication. While investigations of the design process often emphasize a sequence - first designers create, then they communicate - gestures are notable occasions when creativity and communication unfold simultaneously. To capture the act, to freeze emergence, is to shed some light on the contribution of the nonverbal and non-graphic. Gestures rupture a quiet emotive surface in order to relate, convince and seek consensus. Gesturing students become diagrams and dialogic subjects. They are the roof opening, the occupant gazing, and builder channeling the afternoon sun in order to make a case about a space's importance. In response to context, they are the sedges filtering, the land cupping, and an onlooker enjoying nature's unfolding.

Such thoughts on gesture point to a larger tension pertaining to emphasis in architectural education. Is architectural education primarily about gaining skills in dealing with preset (timeless) issues in the world 'out there,' or is it about gaining insight into one's bearing in the world, what Mark Johnson would describe as one's embodied mind? Should the focus be a rules-governed approach or ascertaining one's design sensibility, so one can contribute more effectively? Obviously architectural education is about both, and yet gesture makes us think more directly about the value of attending to the latter. Gaining insight into one's inclinations will help improve 'performance' in the social realm of architectural design. Further research will clarify the developmental stages from gestures to structures and the meanings that take shape within individualized design processes – particularly with regard to application in more speculative design inquiries, i.e. ecology, sustainability, etc.

The public act of architecture requires prolonged, sustained and tenacious effort. The particular nature of one's stake at a given moment in the project is clarified by paying attention to gestures that are diagrams of one's motivation as the possibility of architecture. Not unlike metaphors, embodied in their own way, gestures come so freely that they strike us as hardly warranting scrutiny. And yet because they seem to guide tenacious effort in ways we only begin to understand, they deserve further study. The intense, impassioned commitment of architecture students toward their work and the world is something to admire; critical, transitional moments in this process also warrant our careful attention.

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# 11° east: The intersection of Scarpa and Fehn

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**ABSTRACT:** On the advice of Jørn Utzon, Sverre Fehn travelled to Morocco in 1952. The influence on his own work of the architecture he experienced in Morocco is well documented by Fehn and scholars alike. His own essay published in the same year of his travel on the architecture of Morocco is a testament to the influence. It is clear from the scholarship that Fehn learned as much about himself and his Norwegian identity as he did the “primitive” architecture of Morocco. A decade later, Fehn travelled to Venice for the opening of the Nordic Pavilion at the 1962 Biennale. While in Italy he met with Carlo Scarpa and toured the recently renovated Castelvecchio museum in Verona. Less studied is the influence of Fehn’s trip to Venice and, for example Scarpa’s museum on Fehn’s own work and, specifically, the Storhamarlåven in Hamar.<sup>1</sup> This essay will demonstrate the intersections that exist between the two museums designed by Scarpa and Fehn. Importantly, the intersections reveal as much about the specificity of place and identity as they do the ability to transcend both. Oddly enough, both museums intersect at 11 degrees east.

**KEYWORDS:** Fehn, Scarpa, Storhamarlåven, Castelvecchio, precedent.

## INTRODUCTION

In the introduction to a monograph on Sverre Fehn from 1977, Francesco Dal Co makes the link between Carlo Scarpa and Fehn directly. He stated, however, that,

It is useless to try to establish precise analogies with the work of Carlo Scarpa, with whom Fehn, during those years, became acquainted while working on the Pavilion of the Nordic Nations in Venice. The relationship with Castelvecchio, Scarpa’s museum masterpiece, is direct and unequivocal. But this is only the result of a dialogue between two architects who share analogous ideas. Like Castelvecchio, Hamar possesses a critical intelligence and a selective culture. Every choice during the planning process was the result of an interpretation; each choice implies a risk. (Norburg-Schultz and Postiglione, 1997,15)

Notwithstanding this “direct and unequivocal” correlation between the two architects and their work, Dal Co does not name, describe, critique, analyze, or demonstrate any such relationship. To do so would be, as he states, useless. It is simply taken as fact. Oddly enough, the direct relationship between Fehn’s work in Hamar and Scarpa’s in Verona, however undocumented, persists. Many authors reference a relationship between the two architects as a clear statement of fact without ever definitively demonstrating any correspondence or dialogue.<sup>2</sup>

We do know, however, that Fehn was in Venice intermittently from 1958-62 while working on the pavilion that Dal Co references. Their meeting, as described by Fehn years later, was not exactly rich in dialogue. As Fehn recalled,

I remember my short meeting with Carlo Scarpa in Venice. I had an appointment, but he arrived very late. I talked about Oslo, but for Scarpa it was somewhere beyond the Alps, and he remarked, “For me, there is no culture north of the Alps.” (Fjeld, 2009, 64)

The dialogue mentioned by Dal Co, I would propose, was less between the two architects than between Fehn and Scarpa’s work. Fehn was certainly a keen observer and admirer of the Italian’s projects. In an article from 2003, Fehn references Scarpa’s approach to situating objects in the new context of a museum.

Carlo Scarpa had a fight with an object's place over the horizon. How many fittings of iron, metal, marble, tree, and concrete were created to hold the crucifix in one specific location in a room where it would meet its new light. (Gehn, 1982, 165)<sup>3</sup>

In an undated interview transcribed by Kirsti Krekling of the Maihaugen Museum in Lillehamar, Fehn responds to a similar question concerning the placement of objects.

It is a new room. There you are touching on an object's placement. How should you operate in the new room? How high should the object be placed above the ground? How do you re-create the object in a different environment? That is what it is. That is where Hamar is different. There I was inspired by modern Italian museums, where they work with objects that are torn from the context and entered a new, literary, form.<sup>4</sup>

It is easy to assume that Scarpa designed the "modern Italian museums" mentioned by Fehn—the Canova Plaster Gallery in Possagno and even, perhaps, the many exhibitions and gallery renovations that occupied Scarpa through the early 1960s. It is also clear, however, that not much direct evidence exists to support a rich and varied dialogue between Fehn and Scarpa. In the following sections I will demonstrate the similarities both situational and intentional between Fehn's Storhamarläven in Hamar and Scarpa's Castelvecchio in Verona. In doing so, I hope to shed light on a more productive approach to precedent.

## 1.0 SITE

Many similarities exist in both the site and program of each museum. To start, both were designed within existing buildings with a long history of use and re-use. In the mid 1950s, Castelvecchio's newly appointed museum director, Liciscio Magagnato, first enlisted Scarpa to renovate the west wing of the original building and clear away the partially demolished Porta del Morbio, a gate that had originally dated from the 12th c. This was simply the most recent in a long series of transformations to the complex. The Castelvecchio was originally a 14th c. fortified castle built into the city wall alongside the Adige. It was then converted to a military barracks while under Austrian rule and then finally transformed into a museum in the early 1920s. At that time the architect Ferdinando Forlati was hired by Antonio Avena to restore the building in a more appropriate manner. He did so by decorating the interiors to resemble an early Renaissance palazzo and masking the exterior with faux gothic details to include pointed, ogive and trefoil arches. Scarpa's renovations, radically different than Forlati's, removed the false Renaissance trappings and continued through 1973. The first exhibition designed by Scarpa was "Da Altichiero a Pisanello" in 1958. The work, along with the famous equestrian statue of the Cangrande, established the museum as one with direct affinities to the cultural heritage of Verona.<sup>5</sup>

Similar transformations occurred in Hamar. By roughly 800 CE Hamar was a regional center of religion and trade. After the introduction of Christianity into the region, Hamar was chosen to be the location of the bishop and the royal estate was taken over to become a cathedral and bishop's residence. This is one reason why so many archeological sites are in the region. The bishop's residence was fortified with a ring wall, ramparts, embrasures, palisades, and gate towers. The Reformation, in 1536, transferred political power to the King from the Church, and many bishops were then exiled to Sweden. The Bishop's palace in Hamar was converted to an estate for a feudal lord. During the Nordic seven-year's war, the estate was partially destroyed and then, at least 100 years later and under control of the crown, the barn buildings were constructed that form the basis of the existing museum. In 1947 excavation began and continues to this day. The Storhamarläven was intended to house the ongoing archeological discoveries of the site. Evidence of at least three buildings existed prior to Fehn's intervention and the detritus from each is still being unearthed. The objects on display are not considered, necessarily, to be art but do tell a very specific story relating to Norwegian identity.

## 2.0 ENTRY

In both museums the entry must be found. A visitor to Castelvecchio leaves corso Cavour and enters under a flanking tower on the south side of the original castle. One of the most fraught design decisions was to place the Cangrande to the far left of the courtyard where it is somewhat precariously raised up on an exterior platform. Arguably the most symbolic piece in the collection, the Cangrande becomes the keeper and guardsman of the museum and, indeed, this is how Scarpa referred to it. In counterpoint to the Cangrande is the actual entry, located on the eastern edge end of the façade. Scarpa moved the entry from the center of the façade to this new location. A double row of hedges prevents the visitor from making a direct route to the entry. The axuality of the hedges is parallel to, and foreshadows the organization of, the galleries. To enter, one makes a quick right and then left, goes past and around a small fountain, makes another left then right turn and, finally, enters into the museum. The entry half-wall directs the visitor to the museum and away from the exit stair descending from the second level. (See Fig. 1) The entry is certainly intended to slow the pace of the visitor prior to entering the museum and also to offer a variety of perspectives.

At Storhamarläven, Fehn has located the entry at what appears to be the back of the building. One leaves the parking lot on the northeast side of the complex, walks along the north wall and turns left directly in front of the ruins of the cathedral. Opposite the ruins, an opening in the stone wall is shrouded by a plate of glass in which a glass door sits and demarcates entry. Once inside, visitors find themselves under a large concrete ramp, standing on a dirt floor and looking out to a similar opening in another stone wall that now sits in front of them. Exiting through the glass door opposite the entry one finds a concrete ramp that extends up and around the courtyard and then, finally, back into the interior of the building. Once again inside and turning left, the ramp continues through the middle portion of the museum. (See Fig. 2) Along the ramp sit three concrete boxes inside of which are medieval artifacts uncovered from the site.

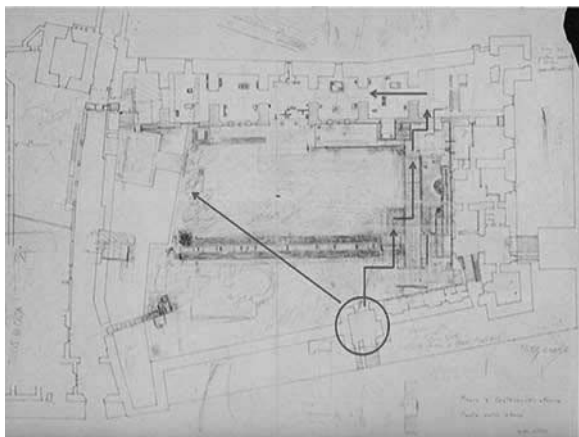


Figure 1: Entry sequence, Castelvecchio.

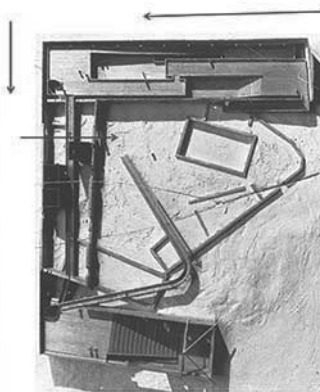


Figure 2: Entry sequence, Storhamarläven.

In both instances, the visitor is intentionally slowed down. For Fehn, this was central to the design of the museum. He described the museum experience as follows,

Let us stroll up to the barn, pause for a moment, still our lives and allow these ruins to enter our minds. (Fehn, 1993, 139)

The threshold into both projects is elongated and, with each twist and turn, the visitor very much becomes aware of their body in space. Further, both projects situate visitors within a cultural and physical horizon as part of the entry sequence. The Cangrande statue, so important to the story of the museum, was located and relocated many times before Scarpa finally placed it on the pedestal where it now sits. Even though the statue now sits perched at the west end of the northern façade, it is the first thing a visitor sees when entering the



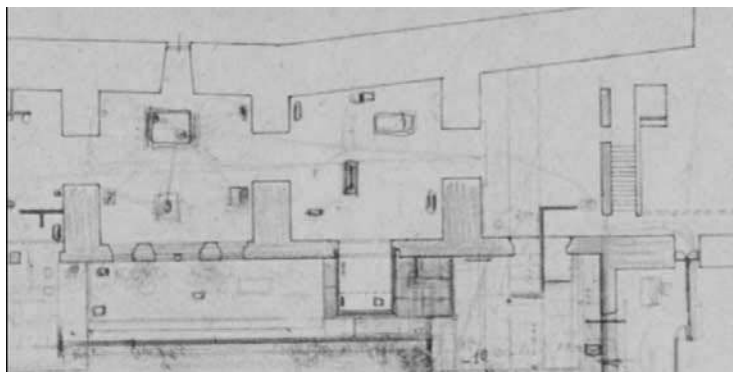
courtyard. Though separate from the museum, the pedestal supports the statue at the same level as the first floor of the museum, literally extending the horizon. At Storhamarlåven, the ramp also refers to a horizon, but here it is the actual horizon to which one relates. As you climb the ramp, just at the point where you begin to turn back to the building, your view is directed to Lake Mjøsa, the largest lake in Norway and central to the development of Hamar. (See Fig. 3)



**Figure 3:** View from ramp at Storhamarlåven.

### 3.0 INTERIOR

Once inside Castelvechio the visitor is on axis with an enfilade that cuts through five galleries on the ground floor. The organization of the floor was pre-existing and rather than deconstruct the centuries old building, Scarpa chose to work with it. In each of the rooms, however, Scarpa organized objects in very particular ways. Work is placed so that one rarely confronts it frontally. Nor is one able to walk into a room and quickly survey all of the work at once. Objects are placed at differing heights, with different orientations, and even in the floor. One enters and might notice the fall of a fabric in the light, set against another color, or perhaps the profile of a sculpture framed in the next room. One's interaction with the work is temporally varied and not equidistant; in a way it is more dance than wandering. One can see this in an early sketch showing a visitor's movement through each room. (See Fig. 4) From drawings we can also see that Scarpa intended the Cangrande to be viewed from a number of positions and over time. No one view is privileged, but rather the visitor's experience combines to form his or her own whole. It is essential that the experience of the work unfolds and occurs in time. The first floor galleries mimic the organization of the ground floor but Scarpa moves the circulation to the exterior wall alongside the river. At the conclusion of the galleries is a stair back down to the entry where the visitor is again confronted by the one-point perspective of the ground floor galleries.



**Figure 4:** Plan sketch showing object location as well as the path of a visitor. (Olsberg, 1999, 71)

A similar sequence unfolds at Storhamarlåven. Once inside, a concrete ramp dissects three concrete boxes, inside of which are the objects excavated from the Bishop's manor. The concrete bridge also allows the visitor to observe the walls of the original structure from an elevated perspective. Here, similar to the enfilade at Castelvecchio, one can choose to walk quickly through the exhibits or to pause and linger amongst the artifacts. Continuing along the ramp, past the three small concrete rooms and turning right into the northern wing one finds artifacts unearthed from the period after the site had been converted to a working barn. Objects in the north wing of the museum vary in size – from a boat to utensils – and allow for a much more varied display. The floors are pulled away from the existing walls and are cut away so that the floor only occupies half of the area thus allowing for double height spaces adjacent to each floor. The plan of this wing is a development of the Norwegian Forestry Museum, an unbuilt project that preceded the Storhamarlåven.<sup>6</sup> Similar to Castelvecchio, the circulation loops back around to the entry.

In both museums, the choreography of movement and the interaction with specific objects opens up to multiple readings of the same work; the visitor has the rare experience to see the familiar in an unfamiliar way. As Fehn stated,

It is the object that is constant, but the visitor experiences the exhibited object differently...The exhibitor injects a new personality into the object, but it is the visitor who decides if it is understood. (Fjeld 2009, 127-28)

For Scarpa, each room offered a dance where the visitor would enter and move around the room in concert with the various orientations of the work on display. The spatial condition of the Storhamarlåven (as a large hall) is different from that of the Castelvecchio (as a series of rooms). As a result of this, the objects on display at Storhamarlåven relate less to one another than those in Verona. Thus, Fehn carefully designed the location, orientation, and situation of each piece.

Fehn was well aware of the dangers in relocating artifacts. He asked,

Does there exist a greater loneliness than in that of a catalogued Egyptian mummy in foggy London lying in a shadow-less world of fluorescent light? All things excavated from the earth demand the magic of history. Artifacts must be reborn and find their 'space' in this new context." (Fehn, 1985 p.10)

Work on the display of the individual pieces was undertaken almost exclusively by Fehn – his office at that time consisted of himself and one assistant. Just as at Castelvecchio where Scarpa directs your gaze to the fall of a fabric in stone on the back of a sculpture, Fehn presents a visual dialogue with the work: a necklace that is set on leather to replicate the touch of skin; a scythe that casts a similarly slender shadow; a plow that cuts through a steel plate; a boat that is set on the opposite side of a balustrade so it can be seen from above as if it were in the water and, then, from below to notice the construction of the boat. (See Fig. 5) Many other examples exist. Though perhaps not unique in the contemporary world of exhibit design, work is not simply hung on the wall but the support acts as a key element in presenting a story of the work. In an interview in A+U, Fehn was quick to point out the deficiencies in the detailing between his work and that of Scarpa. That said, Fehn's approach is indeed quite similar.



**Figure 5:** Image of boat, outside of the gallery space proper, but able to be seen from above and below.

#### **4.0 RESTORATION**

Both projects are renovations to centuries-old buildings. This is a situational similarity. The understanding of the existing and the approach to new construction in Hamar, however, closely resembles that of Scarpa's work in Verona and is a much more intentional similarity. Neither architect attempted to restore the existing buildings to a particular time or period. Indeed, Scarpa's renovation removed the Renaissance interiors but left the "neo-Gothic" façade. Both projects were secured structurally. New construction was then carefully inserted into the old. In both projects the newer construction is often pulled away from the existing. This is seen in the new floor construction at Castelvecchio and the detailing of the glass panels over the openings at Storhamarläven. There, all of the glass in the project sits proud of the stone. It is important to note that only the south wing is conditioned and occupied in the winter months. At both Castelvecchio and Storhamarläven, none of the new structural elements come into contact with the medieval walls or ruins. A new roof structure is left exposed in both Hamar and Verona and each relate to respective vernacular barn construction. It was clearly not the intention of either Fehn or Scarpa to restore but to continue, rather, in the process of building.

#### **CONCLUSION**

James Joyce published *Finnegan's Wake* in 1939. An Italian publisher approached Joyce to translate the work from English into Italian. Joyce, who spoke Italian, was horrified by the direct translation and set out to write his own. Rather than simply translating the words into Italian verbatim, Joyce rewrote the text so as to capture all of the puns, word play, structure, and even sound and cadence of the original text into a new language. This is, I would propose, the sort of translation at play at the Storhamarläven. Rather than mimicking form, both museums re-figure an existing building and contain collections that are very much of the place. The issue of identity, however, is revealed in more than the collections. Indeed, both museums offer a constant renegotiation with site. Beginning with the entry sequences and continuing on to the interaction with the displays, visitors to both museums are situated within the larger landscape as well as the constructed interior landscape. And, this mode of translation offers a productive use of precedent. Fehn's translation of Scarpa's museum is not formal, stylistic, or even

referential, but rather, temporal, physical, tectonic, and situational. Oddly enough, both museums intersect at 11 degrees east.

## ACKNOWLEDGEMENTS

The author wishes to thank the two anonymous reviewers of the abstract and the three anonymous reviewers of the paper for their comments in helping to shape the essay. Thanks also to Anette Balestrand who provided all translations from Norwegian to English.

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## ENDNOTES

<sup>1</sup> As a note, the term Storhamarlåven refers specifically to Fehn's renovations and will be used through the remainder of the essay. Storhamarlåven translates as the "barn of Storhamar," the latter being the original name of what is now known as Hamar. The Hedmark Museum, a term typically used in scholarship refers to the larger complex of cultural museums in Hamar.

<sup>2</sup> Per Olaf Fjeld is still the best source for scholarship on Fehn and many references exist demonstrating the admiration that Fehn held for Scarpa's work. Very little evidence exists, however, that demonstrates a clear connection or line of influence. Two, of many, references include the following, first from the *Store Norske Leksikon* and then from the *Norsk Biografisk Leksikon*:

"Fehns arbeider er selvstendige, men arbeidene fremkommer ikke i et vakuum. Den Italienske arkitekten Carlo Scarpa har vært en viktig inspirasjonskilde, særlig for Hedemarksmuseet, som tydelig er influert av Scarpas museum i Verona."

Fehn's work is independent, but his work is not completed in a vacuum. The Italian architect Carlo Scarpa has been an important inspiration, particularly for the Hedemarksmuseet, which is influenced by Scarpa's museum in Verona."

Ketil, Kiran. "Store Norske Leksikon." Accessed November 2, 2013. [http://snl.no/Sverre\\_Fehn](http://snl.no/Sverre_Fehn).

"Fehns andre store arbeid fra denne perioden, Hedmarksmuseet (1967–79), er hans hovedverk. Med det beveget han seg bort fra den rene modernisme og skapte sitt personlige arkitekturunivers. I møte med en komplisert situasjon og et rikt historisk materiale utviklet han et byggverk som blir stående – sammen med Carlo Scarpas Castelvechio i Verona – som selve lærestykket på hvordan ny arkitektur kan møte fortidens spor."

Fehn's other large work from this period, Hedmarksmuseet (1967-79), is his masterpiece. With this project he moved away from pure modernism and created his own personal architectural universe. Meeting a complicated situation and a historically rich material, he developed a piece that remains standing – together with Carlo Scarpa's Castelvechio in Verona – in itself is a learning piece of how new architecture can meet the past.

Ulf , Grønvold. "Norsk Biografisk Leksikon." Accessed November 2, 2013.

[http://nbl.snl.no/Sverre\\_Fehn/utdypning](http://nbl.snl.no/Sverre_Fehn/utdypning).

<sup>3</sup> The original text reads as follows: "Carlo Scarpa hadde en kamp med gjenstandenes væren over horisonten. Hvor mange fitnesser av jern, metall, marmor, tre og betong ble skapt for å holde krusifikset på et bestemt punkt i et rom hvor det skulle møte sitt nye lys." Sverre Fehn, "Fragmenter av et museum og to utstillinger."

<sup>4</sup> "Det er et nytt rom. Der man er inne på objektene plassering. Hvordan skal du operere med det nye rommet? Hvor høyt skal gjenstanden settes over bakken? Hvordan skal den gjenskapes i et helt annet miljø? Det er det som er. Der skiller Hamar seg litt ut. Der var jeg inspirert av moderne italiensk museums...., hvor de arbeider med objekter løsrevet fra det litterære, og som har gått inn for deres form. Slik at formen kommer fram mest mulig."

<sup>5</sup> The equestrian statue is of Cangrande della Scala (1291-1329) who ruled Verona in the early 14<sup>th</sup> c. and is known for his military conquests. Today, he symbolizes Veronese identity.

<sup>6</sup> Fjeld quotes Fehn, "The Norwegian Forestry Museum is a forerunner to the museum in Hamar. This building has to do with a map and the river. It has to do with going down to the river, stopping and going back up again." (Fjeld, 2009, 112)

# Meta incognita: space, time and place in northern Canada

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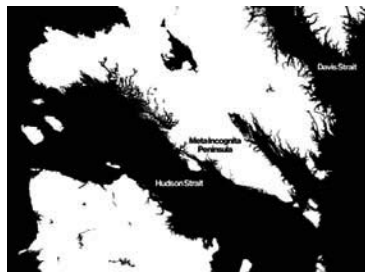
**ABSTRACT:** Development in northern Canada has recently come into the mainstream media as an increasingly prevalent issue: expanding shipping routes and increased mineral exploration have led to a dramatic surge in the geopolitical significance of the region, drawing attention both nationally and globally. And yet, this increased attention to the region has brought little in the way of understanding the complex relationship between people and place in these regions, particularly in the rapidly evolving cultural and political contexts of northern Canada. This paper addresses notions of space, time and place with the intent of developing a more holistic understanding of the problems currently affecting Canada's northern territories. The findings of the research present a compelling argument for the inclusion of both qualitative and quantitative factors in developing a meaningful understanding of the north as a basis for design.

**KEYWORDS:** Indigenous; Culture; Architecture; Ethnography; Systems Thinking

## 1.0 INTRODUCTION

### 1.1. The north

As the 21st century unfolds, it is increasingly evident that the world is trending towards a state of vast interconnectedness, systemic to an often incomprehensible degree. Events occurring internationally have the capacity to affect something as small as a single life in seemingly remote locales. The phrase *meta incognita* is an apt title for this project in several ways: most literally, the northern Canadian city where the primary research took place—Iqaluit, Nunavut—lies immediately north of the Meta Incognita Peninsula, a designation bestowed by Queen Elizabeth I in the late 16th century (McDermott 2001, 190). Translated from the Latin as “the unknown limits”, this designation seems entirely appropriate for the kind of strange world it must have been when Sir Martin Frobisher first arrived during his search for the Northwest Passage (Newbery 1995). Certainly we are in a much different era of exploration now—our ventures have rapidly shifted from continental cartography to subterranean mineral exploration. And yet, *meta incognita* is as befitting as ever, for while our society has succeeded in mapping the area geographically since Frobisher's time, the limits in many other respects are still uncharted, nebulous and indiscrete as ever.



**Figure 1:** Meta Incognita Peninsula, with Frobisher Bay immediately Northeast. Source: (Author 2013)

The impetus for this research project was spurred by the following questions: in an era now commonly recognized as the anthropocene (*The Geology of the Planet* 2011), what will the future hold for a land as extreme as Canada's north? More specifically, how can architecture play a meaningful role in the inevitable development of the north, a landscape that holds a vast wealth of natural resources and previously impassible shipping routes, the development of which entails a breadth of sensitive cultural situations? While these are broad questions, it is our assertion that a fuller understanding of these questions proves vital towards developing an architecture that has the capacity to improve the quality of human life in a manner much more developed than simply providing shelter.

In one of the many ironies of the north, the recently acknowledged impacts of climate change on northern latitudes have actually served to enable further resource exploration and shipping in the north, some of the very activities that contributed to climate change in the first place. As is often the case, ostensibly well-intentioned development projects have left a series of deleterious remnants, ranging from seemingly harmless artifacts such as abandoned shipping containers to the lasting chemical impact of contaminant bioaccumulation in the lipids of Arctic mammals (Wheeler 2012). In much the same way, one can draw an analogy between the poisonous legacy of chemical contaminants and the psychological trauma associated with the imposition of Southern Canadian culture: while Northern expansion can be well-intentioned, the effects of this expansion have transformed the way in which the Inuit people live, for better and for worse. To point out the maladies of a loss of culture is beyond the point—whether present or past ways of life were better is subjective, unquantifiable, and arguably a reductive and simplistic approach to questioning the issues associated with indigenous cultures in the north. Instead, our intention is to engage in a holistic analysis of Canada's North by embracing the inherent complexities and contradictions that so often derail this type of analysis.

## 1.2. Structure, methods & aspirations

This paper is broken down into two primary sections characterized by distinct methods of inquiry. The following section provides a contextual overview of several prevalent issues effecting the north. The subsequent section utilizes an ethnographic approach that is the outcome of the author being immersed within the research environment for a total of nine days. During this time, a qualitative study was conducted with the goal of developing a holistic understanding of the ways in which the northern environment affects its inhabitants.

In traditional design processes, one begins with an issue at hand: a lack of housing or an ineffective urban plan. In actuality, these are not issues at all—they are solutions. In order to effectively address a design problem, we must first discover *what the problem is*. As Hill notes, “we need to find productive ways of articulating questions in order to better understand the nature of the problems we now face, in terms of the architecture of the problem” (Hill 2012, 15). As capital investment increases, mineral exploration escalates and sea ice recedes, the demand for housing, infrastructure and governance forces designers to act hastily; too often, this results in the failure to adequately conceptualize the true problem at hand. To this end, the methods employed for this research intend to be broad and inclusive with the ultimate goal being to develop a conceptual framework that allow designers to comprehend the systemic nature of these problems and develop design solutions that are meaningful, appropriate and effective. In other words, the present research intends to *condition the mind* of the designer by enhancing their capacity to conceptualize complex situations in their entirety.

## 2.0. CONTEXT

### 2.1. Northern issues

Prior to 1942, Iqaluit (then Frobisher Bay) was one of many small camping grounds used by Inuit hunters as they tracked the migratory patterns of caribou and sought desirable fishing grounds (Newbery 1995). Due to their dependency on the land and the sea for sustenance, the Inuit were forced to relocate camps depending on the changing of the seasons. While it is easy to jump to the conclusion that this way of life was primal and unsophisticated, it is a reality of the north, where permafrost negates any possible attempts at agriculture and food production.

As a result, permanent dwellings only became possible once shipping by air and sea allowed goods from the south to be transported north to the extent that they could facilitate permanent residence, particularly by those unskilled at hunting and fishing. Effectually, this shift in mode of dwelling marked the beginning of a series of rapid transformations to the ways of life in the north. As one would expect, with the benefit of hindsight no less, a multitude of issues followed this shift. One of the most publicized maladies are the extremely high suicide rates in the north: as of 2007, Nunavut an average of 71 deaths by suicide per 100 000 people (Statistics Canada 2012). To contextualize this, out of countries ranked by the World Health Organization, Lithuania ranks number one with an average of 36 (World Health Organization 2013), while Greenland averages 88 (Danish Architecture Centre, 2012). Iqaluit's Director of Planning, Arif Sayani, noted that the developmental path of Nunavut was several decades behind Greenland—a particularly worrisome thought given the present state of these particular statistics.

Troublingly, suicide is only one of the many maladies that disproportionately effect those in the north. On average, the self reported body mass index in Nunavut is five percent higher than the national average for the years 2007-2011 (Statistics Canada 2012). Bearing in mind that these statistics are self-reported, and vary considerably from year to year, it is entirely plausible that this difference is significantly higher than the reported five percent. Perhaps even more troubling are infant mortality rates for Nunavut: from 2005 to 2009, Nunavut's rate was 9% higher than the national average—a considerable variation that is unmatched by any other province in the country (Statistic Canada 2012).

While these statistics are startling and illustrative in their own way of the issues at hand in Canada's north, it is difficult to discern the root of these issues without a broader, more holistic study of the culture that precipitated them. To understand the true nature of these problems, it is necessary to develop a comprehension of the system in its totality, a complex network of history, politics, geography and economics.

### **3.0. IQALUIT, NUNAVUT: AN ETHNOGRAPHY**

#### **3.1. Introduction**

The following section of the paper will be presented as a series of three vignettes. Rather than isolating specific variables within a system that is vast in scope and interconnected in nature, three broad themes—space, time, and place—are focused on with the intent of embracing the richness of the north and elucidating some of the larger themes at play in such a unique environment. The present research was executed in partial fulfillment of the degree Master of Architecture by the first author. The research efforts and subsequent scholarly explorations were a collaborative venture between the first author and his graduate supervisor Dr. Brian R. Sinclair.

#### **3.2. Space**

Peering out the window as the aircraft descends from a calm three-hour flight north from the Ottawa, it is difficult to distinguish what is cloud, land or sea. In the middle of February at latitudes north of sixty degrees, both Baffin Island and Davis Strait are an endless expanse of ice, rock, and windswept snow: an immeasurable field of white. It is the Meta Incognita Peninsula we are flying over—the *unknown limits* (McDermott 2001). The landscape seems indifferent to the scale of man; glaciation and plate tectonics seem more appropriate at first glance. And yet, a look around the truncated cabin of the airplane depicts another side of one of the many dualities of life in the north: a mixed group of Inuit and Caucasians, we are all heading north, albeit for vastly different reasons.

Save for the distant whine of snowmobiles and sled dogs chained to the ice, Frobisher Bay was dead silent upon landing. Marked by snowmobile freeways created by the constant flow of seal and caribou hunters, the sea ice covering the bay appeared endless, unsympathetic to the scale of man. The experience of space in the north is a humbling one: it is a land that cultivates a "certainty of [one's] own cosmic insignificance" (Wheeler 2013, 135). Standing on



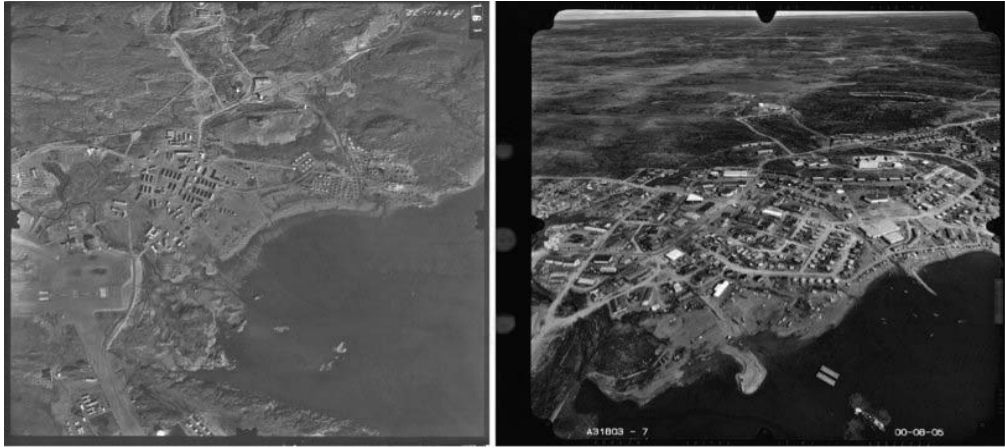
the edge of the tidal zone, demarcated by a field of boulder-sized chunks of ice, one feels as if they are on a spatial precipice: on the one side of the tidal divide is a small, provincial capital in charge of governing a vast territory; on the other, a sweeping expanse of coastline and sea, of rolling hills and blowing snow.

From a corporeal perspective, the concept of space is equally extreme, particularly when one contrasts interior and exterior space. Borne out of the necessities to conserve heat and maximize the utility of extremely scarce building materials, dwelling sizes were traditionally very small. Both igloos and bone-and-hide tents were indeed tiny relative to the number of people that inhabited them, thus maximizing the capability for shelter from a finite amount of building materials. For similar, albeit modernized reasons, dwellings in modern-day Iqaluit have remained relatively modest. Due to Iqaluit's isolated geographical location and lack of harvestable local building materials, all materials must be shipped in during the sea lift in the summer, an exercise that considerably increases the cost of such materials. The resulting condition is a dwelling type that is spatially constrained, creating a striking contrast between the expanses of the exterior and the spatially constricted characteristics of the interior.



**Figure 2:** Traditional igloo dwelling. Source: (Author 2013)

The third perspective on space centres on the ostensible lack of constraints in planning amongst a place characterized by an abundance of space. In conversation with Arif Sayani, Director of Planning for the City of Iqaluit, it became evident that like many of the smaller hamlets of Nunavut, Iqaluit was developed into its present state with a lack of any kind of discernible urban plan; rather, developers embraced more of a build first, plan later approach, creating a city that is facing a series of infrastructural and urban planning issues as they try to retroactively plan an expanding city. Furthermore, the city is constricted by the airport, parkland, watershed and the sea, which allows expansion and further development to occur only to the southeast (towards the suburb of Apex). In essence, all of this amounts to the fact that space, in terms of development and planning, is never endless, regardless of its apparent endlessness.



**Figure 3:** Aerial views showing Iqaluit’s development from 1966 to 2000. Source: (Iqaluit Lands Department, 2013)

### 3.3. Time

The nine days spent in Iqaluit were characterized by a perceived absence of time: much like the apparent endlessness of the landscape, the fundamental notion of time seemed distorted, hazy and indiscrete. Circadian rhythms in a constant state of disruption, one’s perception of time in these lands is a deeply personal reflection of geography, climate and culture. These three factors are inextricably interdependent: climate is dependent on geography, culture influenced by climate, and so forth. However, it is the confluence of these factors that contribute to the unique sense of time that one experiences in the north. Time is stretched to the extremes, becoming at once a suffocating force of isolation and a psychologically liberating sensation.

Of the three factors put forth, geographic location is the most immediately experienced: regardless of time of year, when an outsider is placed at these coordinates, the arc of the sun and the length of the day are a shock to the system, a yearlong oscillation between the midnight sun and months of only nighttime and dusk. Even on the days when sunlight shines for eight hours, the arc of the sun merely hovers above the horizon, creating extended periods of twilight.

The environmental qualities of the north affect one’s perception of time in a very different way: the extreme climate of the north—the debilitating cold, the biting wind and lack of windbreak all contribute to a compressed experience of time in the winter. What seems like hours of leaning against the wind in actuality is minutes. Hours spent inside, protected from the elements are not immune from this distorted notion of time: the shifting periods of daylight and indeterminate weather patterns skew ones perception of time in a similar way.

Perhaps the most striking notion of time that I came upon was not explicitly regarding time at all; rather, it was the cultural significance of time in the Inuit language, Inuktitut. Having been invited to attend a concert held in the local Inuksuk High School, I listened as two young women provided introductions for each performer, first in Canada’s two national languages—English and French—and then in Inuktitut. Prior to the final act, the two girls told the audience in English that we would be taking a twenty minute break before the final act. In French, we were told the show would resume in *vingt minutes*. When it came time for the Inuktitut translation, an English phrase caught my attention about halfway through: “twenty minutes.”

And yet, as much as the perception of time becomes distorted in the short term, extended by geography and climate, the notion of time on a cultural scale has had the effect of being

compressed. In sixty short years, the cultural transformations that the Inuit people have undergone is immense—it is an utterly incomprehensible experience to see someone walking down the street in Iqaluit, wearing their fur-lined down coat and mittens, and reflect upon the fact that in the early 1950s, they were still living a nomadic lifestyle, moving bone-and-hide tents from hunting ground to hunting ground, migrating with the seasons. In relative terms, the broader scale of time has been shortened, forcing a rapid transition from a pseudo-hunter-gatherer society to an Arctic version of the post-industrial society.

### **3.4. Place**

In a way, if space and time are considered thematic vignettes, place must be considered more broadly, as a form of meta-theme. Certainly, one cannot ignore space when considering time, nor time when considering space, but the notion of place is so intrinsically dependent on the former themes discussed that it only makes sense to discuss it last. In this sense, space and time are only two of the many aspects that contribute to place in the broader sense of the word. Place is, in its very essence, an amorphous concept that is dependent as much on one's own personal experiences as it is upon the morphology of a particular environment. What follows is a series of three experiences that provide an introspection into the notion of place in the north.

As I sat in the back of a cab as it snaked through the hills between Iqaluit and Apex, the cab driver told me the story of how he came to live there. This was not uncommon in my experience; it was as if this explanation was a prerequisite for any kind of introductory conversation, as if there must be an extraordinary story behind one's decision to inhabit such an extreme environment. In this instance, the cab driver was a recovered addict from Montreal who had moved here to work as a counsellor. Another duality of the north, the story of this man proved that the isolation that he desired is a double-edged sword: having counselled many troubled souls in the north, he had sent handfuls to rehabilitation centres in the south, only to have them relapse once returning to the isolation of the north, unable to cope with the suffocating emptiness, hearing only their own thoughts and the blowing wind.

Similar stories were relayed by other individuals: as we drove through the outskirts of town en route to a territorial park, another taxi driver reflected on his twenty-seven years spent in the north. This individual was also a recovered addict, drawn to the north by the idea of a new beginning. Having married an Inuit woman when he initially migrated here, Iqaluit was now his home, his sense of place bolstered by the family surrounding him. He spoke of his time here with a kind of cold indifference that seemed a necessary character trait to be able to endure decades of harsh cold and desolation. Speaking of his family, and some of the troubles they have undergone in their life here, he offhandedly commented that the bridge that we had just drove over was where his nephew had hung himself. As I sat there, speechless, the driver kept up the pace of his story, as if these kinds of events were merely facts of life in the north.

In a land of such extremes, the notion of place becomes at once magnified and diminished—the endless expanses create a kind of placeless geography, only to be supplanted by the placemaking capacity of community. An Inuk hunter once told Jean Malaurie, "The more I think as an individual, the less I feel I exist" (Malaurie 1982, 151). As the last story alluded to, the relationship between the individual and the group is largely unpolluted by geography; if anything, the merciless isolation of the north necessitates a different sense of place, one that is more psychological than physical, where community reigns supreme over morphology. Looking over old black and white photos in the Nunatta Sunakkutaangit Museum, it is evident that this is how it always was: dwelling was temporary, but community was constant.

### **3.5. Reflections**

On the day of my departure from Iqaluit, I went for a long walk, climbing several of the hills on the outskirts, reflecting upon my time spent and, in a way, viewing my surroundings through different eyes. As I stood upon one of the taller hills above the newly developed and predominantly Southerner-inhabited Plateau neighbourhood, a badly weathered Canadian flag rippled in the relentlessly cold February wind. Perched there, one can't help but wonder

whether this image, an icon of nationalism in a tattered state of disrepair, isn't symbolic for our imposed presence in the north. Does this land, geographically a part of Canada, truly belong to us? As southerners, we often feel a sense of guilt for our despicable assimilationist policies towards indigenous peoples of the past, resulting in the current system of land claims and tax breaks. We feel, or feel as if we ought to feel, that we have stolen *their* land. Standing there, looking out over a small city of winding streets and diesel fumes amidst a sea of white, I am certain that this land does not belong to anyone—we *belong to it*.

#### 4.0. Conclusion

It is tempting to become depressed, despondent and discouraged by these experiences, falling into a rhythm of complacency. The question, however, is more urgent than ever: how *can* architecture play a meaningful role in the inevitable development of the north? As the past several decades have shown, development in northern Canada is accelerating rapidly as the geopolitical and environmental climates evolve. Designers, in turn, are expected to do more with less, pressured into performing a kind of triage. Unsurprisingly, these situations give preference to the quantifiable: how many can we house at what cost, and when? Ultimately, this type of design process neglects vital factors that are critical both to the health of the design and to the environment to which it contributes. As the world looks north, it is evident that we must begin to think in a manner that enables a deeper, more nuanced comprehension of these issues in order to produce an architecture that better advocates for users, better resonates with needs, and, in the end, proves more successful, sustainable, and meaningful.



**Figure 4:** View east from recently developed Plateau neighbourhood. Source: (Author 2013)

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# Dislocation, Disconnection, Dilemma: Exploring Urban | Rural Disparity in Contemporary Mongolia

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**ABSTRACT:** Informal settlements present thorny challenges for environmental designers, politicians, civil servants and, most directly, residents. Mongolia's ger (felt-lined tent/yurt) districts, unique manifestations of slums, provided the focus for the present ethnographic and environmental design research. Problems of the ger districts, and difficulties of finding innovative and potent vehicles with which to improve quality of life therein, are many and complex. Mongolia's informal settlements are most notably found in Ulaan Baatar (UB), the capital city of over one million inhabitants. Upwards of sixty percent of UB's population live in the sub-standard conditions of ger districts. The current research analyzed context and conditions in Mongolia, including comparative ethnographic study of residents of city (urban dwellers) and country (pastoral nomads). Mongolia's long history includes rich traditions of nomadic life – an existence which sees herdsman move regularly with their animals and which deeply respects the environment, celebrates spirituality and demonstrates sustainability. Upon migration to the city many values, behaviors and conditions shift dramatically. In sharp contrast to the environmentally-oriented and ecologically-respectful existence of the herdsman, ger district living highlights serious concerns including hygiene, health, security, comfort and happiness. The researcher, through immersion within the various sub-cultures, developed thick descriptions and colorful narratives aimed at characterizing lifestyles, values, obstacles and opportunities.

For over a decade the author has ethnographically researched and extensively delineated the lives of both urban ger district dwellers and rural nomadic herdsman. This work has been a fundamental aspect of, and necessary complement to, ongoing design and planning work aimed at improving quality of life in Mongolia including and urgently within the perplexing urban ethos. The present paper presents compelling narratives documenting life in city and country, considers the immense challenges of the status quo and explores ideas, innovations and opportunities for moving in new and promising directions.

**KEYWORDS:** Mongolia, ger-districts, culture, sustainability, ethnography

## OVERTURE



**Figures 1 + 2 + 3:** Ulaan Baatar Ger Districts in Center City + Several Images from Outskirts (Source: Author 2013)

*A slum is defined as a group of individuals living under the same roof lacking one or more of the following conditions: access to improved water; access to improved sanitation facilities; sufficient living area, not overcrowded; structural quality/durability of dwellings; and security of tenure. This is an operational definition that reflects conditions that characterize slums in the world. (United Nations Habitat 2003)*

Informal settlements, in many cases characterized as slums, are home to a significant portion of the world's population. With limited formal land planning and poor quality from an architecture and construction perspective, such informal settlements routinely develop as unhygienic, chaotic, under-managed and often unsafe environments. In many instances densities are high, infrastructure is weak or absent, and living conditions are sub-standard. Attracted to urban centers for many reasons, including most commonly the lure of employment, slum dwellers quickly become caught in an inescapable cycle where money is scarce, demands are high and difficult housing / lifestyles become accepted. While conditions are often problematic, there are many dimensions of community that surface and prove to introduce some order and routine into daily lives. For example, the presence of water stations prove rally points for members of a given community. The range of conditions and types of informal settlements is wide and intensive, varying based on such factors as geography, culture, climate, resources and economy.

The present research focuses on the ger (felt-lined tent/yurt) districts, or informal settlements, of Mongolia with a focus on said districts within the capital city of Ulaan Baatar. Mongolia is a mysterious isolated country intensely locked between Russia and China. With a population of approximately 2.5 million and a land area (17th largest country in the world) larger than Western Europe, Mongolia stands as one of the least dense nations on the globe. It also is undeniably one of the poorest, with over a third of the population living below the poverty line (one half of these people residing in urban areas). Mongolia is ranked 118<sup>th</sup> in the world with respect to the Human Development Indicator. While there are small settlements dotting the landscape, the country is largely comprised of communal land inhabited by nomadic families. Standing in stark contrast to the rural landscape is the capital city of Urga (now Ulaan Baatar). With a burgeoning population, Ulaan Baatar (UB) is a city rich in complexity, diverse in culture, yet rife with challenges. Leading the pack in terms of urban problems are the informal ger settlements which wrap the city proper. Recent accounts place the ger settlement population at almost 60% of the urban count. These sprawling settlements are informally planned, lack infrastructure, and present massive dilemmas from a quality of life/health perspective.

Over the past decade the author, a member of the Union of Mongolian Architects, has ethnographically researched and extensively documented the lives of both the urban ger district dwellers and the rural traditional nomadic herdsmen. This work has been a fundamental aspect of, and necessary complement to, ongoing design and planning work aimed at improving quality of life in Mongolia including and urgently within Ulaan Baatar's remarkable ger districts. This paper, presenting compelling narratives documenting life in both the countryside and in the informal settlements, considers the immense challenges of the status quo and explores ideas, innovations and opportunities for moving in new and promising directions.



**Figure 4 + 5:** Ulaan Baatar Ger District Aerial (Source: GoogleMaps 2013) + District Excerpt Sketch by Author

## BACKGROUND + CONDITIONS

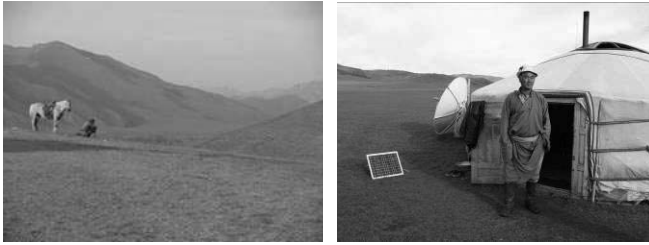
*In the center of the ger, directly underneath the roof ring, is the cooking fire. In the early twentieth century, a type of iron hearth called tulga was used. A large cauldron is placed on top of the tulga, and the smoke from the fire rises through the roof ring. The tulga is the symbol of the home, and many aspects of fire worship, with which it is closely associated, survive today. (Bikaes 2001)*

Our human journey, and human condition, is richly colored and deeply varied. A major objective of the present research work was to 'paint a picture' of life in Mongolia. While the focus of this research primarily considers the urban areas, most notably the ger districts of Ulaan Baatar, it was nonetheless deemed essential to concurrently explore and delineate the more traditional, rurally-based nomadic lifestyle. It is important to understand that many, though not certainly all, of the ger district residents come directly from herding backgrounds. Many residents of these slum areas have arrived to Ulaan Baatar from the countryside following years, if not generations, of nomadic existence. As these newcomers arrive to the city they are commonly ill-prepared and inadequately equipped to succeed. With novel circumstances, unclear regulations, and an atmosphere of chaos, disorder and at times corruption, adaptation to urban life is often difficult and turbulent.

Over many years of research the author spent extensive field time with both urban and rural dwellers. Equipped with a set of 'city' and 'country' base questions, the researcher observed, queried, explored and examined a broad spectrum of issues that together illustrate key Mongolian lifestyles. Deploying ethnographic methods and aiming to collect and generate 'thick' descriptions, the researcher often expanded and navigated beyond the base questions in order to gain clarity and to build better awareness around activities, values and traditions. As a part of the immersive experiences the researcher often participated in national pursuits (such as horse riding), partook in local cuisine (such as chanasan makh; boiled meat and innards), and lived within the communities (such as sleeping in gers on the Asian steppe). While this approach in no way placed the author into a position of authority on Mongolian life, it did serve to enrich understanding so as to better inform thinking around the development of a more appropriate, sensitive and meaningful design and planning framework for the Mongolian context. This direct immersive experience also served to build respect and appreciation for other ways of seeing the world, of interacting with fellow beings, and of valuing life and our place in the ecosystem.

It is important to understand how attitudes and approaches relate and vary between country and city dwellers. In many cases concerns are shared, yet in many ways behaviors were seen to vary dramatically. It can be argued that much changes, and indeed much is lost, in the transition from country to city living. Many aspects of life that are clearly valued in rural existence seem to be discounted or abandoned through taking root in the urban fabric. Reasons underlying these differences are many and complex. While the present paper does not aim to fully explain (e.g., sociologically or psychologically) the reasons for and nature of such differences and losses, the ethnographic portraits certainly convey rich and colorful information shedding light on the issues. The researcher crafted concise 'vignettes' that attempt to characterize ways of life, values and traditions, etc. These vignettes are not cast as universal, extensive or definitive, but rather aim to provide a limited and albeit somewhat personal glimpse into the researcher's experiences, thoughts and interpretations gained through the culturally immersive field component of the present work. Following each vignette (i.e., country and city) short excerpts from actual interviews are presented to provide further color, context and 'personal' aspects of the ethnographic endeavors.

## COUNTRY VIGNETTE: LIFE ON THE STEPPE



**Figures 6 + 7:** Nomadic Herdsman with His Horse + Herdsman with Ger + Energy Systems  
(Source: Author 2013)

For thousands of years Mongolian people have lived as nomads on the Asia steppe. Living in gers and moving around in response to available grazing lands, the herdsman's way of life proves highly connected to nature with a deep respect for the land. They live off their herds, wasting nothing. They burn dung as fuel. In some cases modern herdsman experiment with new technologies such as solar panels, micro-wind turbines, televisions and cellular phones. Often their transportation is provided by their animals, although with increasing frequency one finds herdsman with cars, trucks and motorcycles. They accumulate only what they can carry, knowing that the nomadic lifestyles requires common movement in search of feeding lands. Through the present research, and the ethnographic efforts therein, a picture was shaped of the present day Mongolian herdsman. Primary aspects of the lifestyle center on the ger, or tent, that pragmatically provides shelter and symbolically represents the cosmos. The ger sits gently on the landscape with its door always directed to the south. At the north of the ger resides a Buddhist shrine, a constant reminder of the crucial place of spirituality in the culture. The ger is organized internally with sleeping, cooking and living areas. Food is ritualistically prepared and stored. The ger as a living machine is readily adjusted in response to climate and circumstances. As winter approaches additional layers of felt are added to ensure protection from the severe chilling winds. As a people the herdsman are welcoming and open. That said, they have clear social order and well developed skills for survival on the harsh steppe. Over the period of the present field studies the researcher was impressed with the remarkable connections of the herdsman to the environment, of their understanding of their role in the ecosystem, of their respect for nature and life, of their joy of family and respect for others, of their commitment to a life of hard work and honest living, and of their happiness and pleasure. Seldom was a herdsman heard to say that s/he wanted to abandon nomadic life to move to the city. Rather, comments were commonly voiced expressing the hardships and difficulties of rural living yet underscoring its undeniable benefits and rich rewards.

### EXCERPTS FROM A COUNTRY INTERVIEW:

#### Countryside east of UB

- *Man age 59 years old.*
- *Originally from western Mongolia.*
- *How long in this area? Approximately eight years. Why did you move here? Western Mongolia is too far from big markets. Also wanted children to attend university in UB.*
- *Three people live in ger. Husband, wife and a son (with job in UB).*
- *The family visits UB quite often, perhaps two-three times per month. Why? Father owns a wooden house and yard in UB. Youngest son works for the railway and lives in the father's UB house.*
- *He has five children all together. Four of them live together in his UB house. Son with railway. Daughter with railway. Daughter a university teacher. Daughter who does sewing.*
- *Animals? Total herd is about 350. 270 sheep. 70 goats. Then horses.*



- *How is life in the countryside? He cares greatly about his animals. Likes freedom of being a herdsman.*
- *Sells meat. Making some profit. It's important to support his children.*
- *He moves his ger a minimum of four times per year. When does he move? Seasonally. He checks lunar calendar to decide right date and time. Follows lunar calendar for many decisions.*
- *He owns a quite new truck.*
- *Uses the truck for moving the ger. Also sometimes uses it to go to the city.*
- *Each day he wakes at 5am then goes to sleep around 11pm. Summer days are very long.*
- *At present he does not own a TV although he had one before.*
- *Has a small solar panel that powers a light in the ger.*
- *Has a mobile phone. Charges the phone using the cigarette lighter in his truck.*
- *Ger? He has two gers. Uses the smaller one for more mobile travel. He has had his large ger for about 37 years. The smaller one is over 60 years old – he received it from his grandparents.*
- *Small ger includes a Buddhist shrine.*
- *Democracy versus socialist period? Not a lot of change for herdsmen. But today prices for goods are increasing. University fees are very high. One million T (Mongolian Tugrik is the currency in Mongolia). This is very hard.*
- *More people are building fences today in Mongolia. And creating plantations. Such actions are taking away valuable herding land. This is a real problem.*
- *People are also digging around and ruining streams. It seems there is less good water today in Mongolia. Worsening water quality. This is hard on animals.*
- *Future? When he is older it will become more difficult to care for the animals. Perhaps then he would consider a move to the city.*
- *Will a move to the city be hard? Yes, for sure. He is not looking forward to this possibility. He knows there is bad air and a poor life in the city.*

#### CITY VIGNETTE: URBAN DWELLING



**Figures 8 + 9:** Ger Settlement in Ulaan Baatar + Young Girl within Fenced Yard In Ger District (Source: Author 2013)

Many of the residents in the ger districts come from rural nomadic backgrounds. As is the case with slums areas around the planet, many arrived to the city in search of work and a better life. Despite such dreams the conditions of the city, and life in the ger districts, proves demanding, difficult and often depressingly disappointing. Homes in the many ger districts of Ulaan Baatar are varied in size, organization and definition. Many yards have one or more gers as the primary residence. In some cases, usually where dwellers are more established and with some means, yards contain so-called wooden houses (in some cases they might be constructed with concrete, bricks and/or metal). Most yards display ambiguity and disorder as regards positioning of the fence and size of the property contained. In some cases local governmental administration and policy plays a role, often closer to the urban core. At the peri-urban edges policy and order assume a background role as the city attempts to informally accommodate an influx of migrants. Typically many individuals live within a ger district dwelling. In some cases multiple families live within a yard (khashaa), and commonly multiple generations of a given family dwell together. Yards are routinely protected with high wooden and/or metal fences, with doors, dogs and locks providing a heightened level of security. Pit

latrines are dug nearby yet downwind of gers as migrants arrive to the city. Once a given pit is filled a new pit is dug in the yard, often adjacent to the initial pit. In some areas of the city, most notably the inner areas, some yards are so replete with spent latrines there is no more available land and the full extent of the property is contaminated. Typically electrical wires are dropped into ger districts (or unofficially spliced in) with residents paying the government for services. Beyond electricity few services are available. Infrastructure is desperately lacking. Wooden slats are burned in open stoves inside dwellings in the summer. In winter dirty coal is burned, resulting in unimaginable air pollution. Seldom in the city is use of alternative energy witnessed – such as solar panels, wind turbines or biofuels. Water is a major issue in the ger districts, with clean water purchased at local kiosks (water is trucked to these kiosks by the government). Often ger district residents need to travel significant distances to fetch water. In some cases wheeled carts are used to move the water yet in other cases (and commonly) the researcher saw very heavy canisters being moved manually (and often by young children). In the transition from the country life to the city herds are sold off, resulting in the need for food, fuel, and other goods to be purchased or traded in Ulaan Baatar. Garbage is a major problem in the ger districts, with trash piled in leftover spaces, collected by the city in some cases (in best case scenarios once or twice a month), left to rot in many instances and in other circumstances set afire. Public space is scarce in the ger districts and where found is often ill kept and unmanaged. In numerous instances the researcher witnessed ger district residents urinating and/or defecating on the streets of these communities. Public toilets are non-existent. Throughout the interviews conducted in the ger districts of Ulaan Baatar a strong and overwhelming sense of hopelessness was expressed. Concerns about health, safety, isolation, fear and disconnection were commonly voiced. In very few cases in the city interviews did the researcher note happiness expressed about the present situation nor optimism raised about the future. More often than not there was serious concern about a very poor quality of life, a desperation regarding chaos and disorder, and a real apathy about individual ability to make any positive difference.

#### **EXCERPTS FROM A CITY INTERVIEW:**

##### UB northeastern area

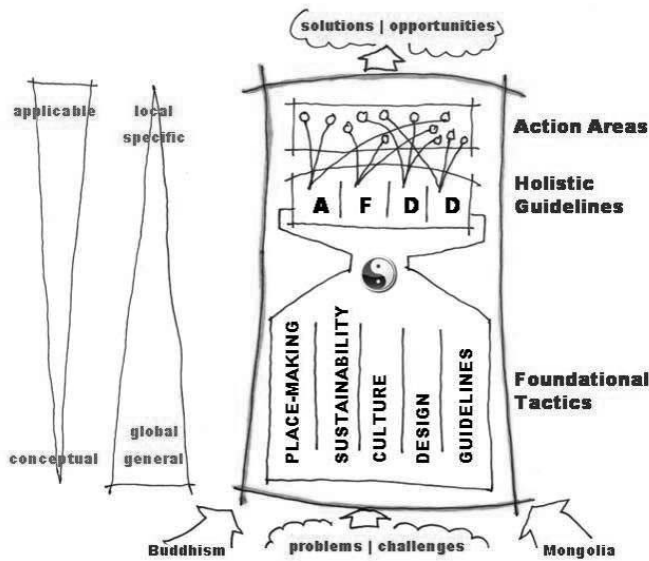
- *Woman age 53 years old.*
- *Lives with three of four children – boy (19), girl (18), girl (14) - and her father (age 90). Older boy lives in South Gobi.*
- *She retired one year ago. Was in telecommunications in rural town for over 30 years.*
- *Moved to UB one year ago. Why? To have children closer to schools.*
- *UB. She likes living here – a lot of work opportunities.*
- *Big yard is owned by relatives. She lives on property in exchange for helping to guard yard.*
- *Ger areas. Too many street children. High unemployment. High alcoholism.*
- *University fees are too high in Mongolia.*
- *Many people in UB don't seem to care about things.*
- *Her father was a herdsman.*
- *In Mongolia today the high ranking people are taking all the money. Very hard for poor people to survive.*
- *It is much harder now than in the socialist era.*
- *Too much unemployment now. Limits of age are a problem – government is forcing people to retire too early. Then very hard to live.*
- *Water supply is very far away.*
- *Fuel is expensive. Very far away.*
- *Democracy has meant wide range of treatment of people. Varied quality and often unfair.*
- *Need state supplied water delivered directly to houses.*
- *Mother and daughter (14) collect water – approximately one bus station away (800m). Fetch water every day.*
- *Buy fuel from the landowner.*
- *Electricity fees are expensive and increasing.*

- *Food. Mostly buy in downtown area. Buy meat from the countryside.*
- *Usually have to take the bus to get places, such as downtown.*
- *Public transportation is very poor.*
- *14 year old daughter – stays at home and helps mother. Likes to attend some activities with friends, but often quite far away.*
- *Making food to sell in city center every day.*
- *Safety. Not so safe outside the fence.*
- *Medical treatment. She has not visited yet. It is quite far away.*
- *Ger. Quite good to live in, but would prefer a two-three room house.*
- *Currently they live in a ger without a full floor (only partial) – problem.*
- *She wanted to live in UB for quite a long time.*
- *Her father (very elderly) doesn't care where he lives. Too old. Just happy to be alive.*
- *Sleeping in ger: father on east side. Mother and daughter on west side.*

## **HOLISTIC FRAMEWORK FOR DESIGN + PLANNING**

*In the excitement over the unfolding of his scientific and technical powers, modern man has built a system of production that ravishes nature and a type of society that mutilates man. If only there were more and more wealth, everything else, it is thought, would fall into place. Money is considered to be all-powerful; if it could not actually buy non-material values, such as justice, harmony, beauty, or even health, it could circumvent the need for them or compensate for their loss. The development of production and the acquisition of wealth have thus become the highest goals of the modern world in relation to which all other goals, no matter how much lip-service may still be paid to them, have come to take second place.*  
(E.F. Schumacher 1973)

The challenges of design + planning for and in informal settlements are many, difficult and perplexing. Often there are particular agencies and organizations involved that, by necessity and efficiency as driving rationale, tend to have specific agendas and their own approaches to problem solving. This situation, while understandable, is insufficient. Such approaches, due to pressures of managing complexity, are commonly narrow and usually uni-disciplinary. A good example might be the need for a medical clinic where the main goal becomes building a physical structure as opposed to more fully considering an array of environmental conditions that seriously, and negatively, impact public health. While it is undeniable that many problems must be tackled using quite circumscribed procedures and manageable methods (i.e., there is a definite need and place for focused expertise and specializations), it is also true that such constraints should be coupled with a solid understanding of the 'bigger picture'. The author's approach arguably deviates from more conventional approaches in its attention to this broader 'umbrella' scale, in its focus on interdisciplinary thinking, and in its proposed framework which by intention and invention assume an overarching and holistic posture.



**Figure 10:** Schematic Diagram Exploring Problem Seeking & Problem Solving (Source: Author 2013)

A significant, extensive and long-running research effort by the author has been directed at the conception and construction of a model, or FRAMEWORK, with which to approach design + planning writ large. In the case of the present research the immediate challenge is, of course, concerned with Ulaan Baatar's extensive and troubling ger districts and improvements to the milieu contained therein. Said framework includes an underlying knowledge base, cast as Foundational Tactics, and comprising the topical areas of PLACE-MAKING, SUSTAINABILITY, CULTURE, DESIGN and GUIDELINES. This knowledge, taken collectively, provides a firm base with which to better analyze, understand and hopefully more productively impact design + planning efforts in the ger districts (and by extension urban settlements more broadly).

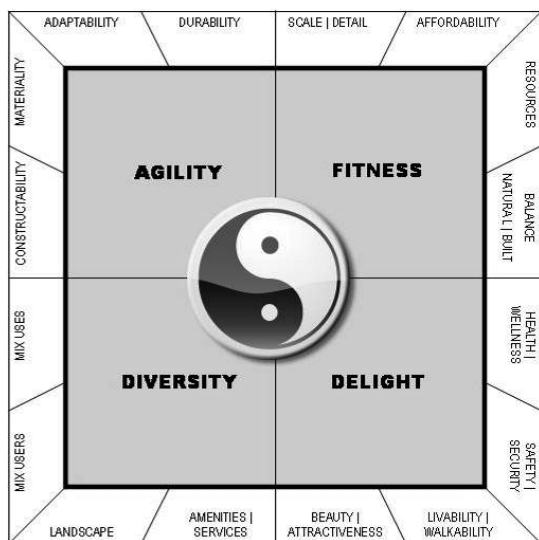
While the aforesaid knowledge categories are foundational and underpinning, the GUIDELINES are crafted to be overarching, inspiring and suggestive. The model or FRAMEWORK proposed within this paper assumes that decision makers and environmental design professionals will necessarily be equipped with this base knowledge (such as functional knowledge of sustainability) as part of their preparation for very demanding design + planning activities. This base knowledge should be seen as requisite for the severe urban-oriented work in question. The Holistic Guidelines, on the other hand, point these folks in important directions for critical inquiry relative to local conditions and specific needs. Said guidelines prove relevant to particular cases through their ability, at the sub-category level, to be tailored and customized. The Holistic Guideline subjects, namely AGILITY, FITNESS, DIVERSITY and DELIGHT, are seen by the researcher as common to most urban environments and yet highly relevant and applicable to particular case in point of the informal settlements of Mongolia. While the present paper considers the unique instance of ger districts, these four Holistic Guidelines prove germane to urban improvements beyond the developing world – for example in urban areas of global cities like Boston, Berlin or Beijing, Toronto, Turin or Tokyo. Where the fine-tuning and customization comes into play is at the next level of detail – that is, within the sub-categories or Action Areas sitting under the Guideline subjects of AGILITY, FITNESS, DIVERSITY and DELIGHT. It is at this Action Area level where local traditions, values, knowledge, policies and politics prove most apropos and meaningful.

Such work is impenitently subjective and imperfect – arising through the interpretation of variables in place and at play, considering the aforesaid knowledge areas (e.g., PLACE-MAKING), and both informed and inspired by the rich ethnographic stories told by Mongolians themselves (including ger district residents, herdsman, architects, planners, scientists,

politicians, civil servants, etc.). While the crafting of Holistic Guidelines and the associated Action Areas is influenced by evidence, the exercise is undoubtedly a *mélange* of both art and science. Like design + planning more generally, the enterprise of conceiving and constructing the present model or framework is a marriage of *telos* and *techne* – it is an inexact exercise that explicitly acknowledges the complications, contradictions and complexity inherent in human habitation. This goal, when all is said and done, of the proposed framework, is to positively impact thinking and by extension improve the ger districts in ways that respect culture, protect the environment, and enhance quality of life.

The Holistic Guidelines should be applied in a cooperative and collaborative manner, understanding all hold equal value and significance. The Action Areas underlying the guidelines of AGILITY, FITNESS, DIVERSITY and DELIGHT are seen as having great flexibility and capacity for customization. These Action Areas are case specific and as such are subject to change and modification as conditions suggest and context dictates. For example, some ger districts are close to the urban core and as such gain benefit through striking distance to established infrastructure (e.g., district heating). Outlying edge districts, on the other hand, are entirely disconnected and therefore must look to other solutions. Openness to a range of options, and open-mindedness, are essential to the success of the model and vital for the crafting of pertinent and potent Action Areas. For each Guideline the researcher has proposed and developed four Action Areas. These specific Action Areas are not definitive but rather should be seen as explicatory. A developed list of Action Items for a given problem or project, such as a particular ger district, could be larger and/or different from the proposed sets depending on funding, personnel and/or perspective.

As this Framework sees actual application in the field much greater attention must be paid to details, data and conditions. When developing and crafting more finite guidelines careful attention will be required as pertains the appropriate level of detail, the appropriate use of language, and the most appropriate means of communication to ensure most effective awareness, application and implementation. Further, and critically, each of the Action Areas needs to be cross-referenced with concerns about place-making, sustainability (including triple bottom line thinking), culture and design.



**Figure 11:** Sinclair Holistic Framework for Design + Planning (Source: Author 2013)

The four Holistic Guidelines, and their associated Action Areas, should be seen as an interrelated set – a rich system of give and take where classification is less important than consideration. In developing this approach the researcher viewed the four guidelines as intensely connected and entirely complementary. Further, it is the contention of the researcher that successful design + planning interventions, and successful environments (e.g., interiors,

buildings, landscapes, spaces and places) thereafter, most regularly arise when attention is given to both poetics and pragmatics. The trilogy of ‘firmness, function and beauty’ needs to be imagined as a three legged stool – to weaken or remove one leg serves to destabilize or destroy the system. While many argue that informal settlements should be tackled with a pragmatic approach only, it is the researcher’s belief that even the poorest of the poor deserve joy, respect and dignity in their lives. The fact that someone lives in a slum does not discount the need for beauty, balance and happiness in their lives. It is perhaps these very individuals and their communities that need even more attention therein by the decision makers, politicians, architects and planners vested with the creation and management of buildings, streets, parks and neighborhoods that comprise cities. The present Framework, comprising the nested or layered components of Foundational Tactics, Holistic Guidelines, and Action Areas, proves unconventional and in many ways indeterminate and discretionary. That said, the real value of this set of knowledge bases, guideline topics, and action areas, comes via looking at the world, and problems, in new ways. For an engineer to consider delight is a good step. For a politician to imagine agility is helpful. For an architect to embrace diversity is beneficial. And for all players to critically envision and ensure fitness of environments and people is vital to the realization of communities that are healthier, more livable and more successful. No small charge for sure, yet necessary and important nonetheless.

### SUMMING UP + MOVING AHEAD



**Figures 12 + 13 + 14:** Ger Sited Near UB Outskirts | Ger District Near City Center | Forces Sketch (Source: Author 2013)

*Already there are conflicts between communities and nations over land, water, oil, fish, ‘pollution rights’, acid rain, genetic resources, forests and many other resources. And such conflicts can be expected to intensify and to exacerbate already frayed relationships between women and men, between peoples of differing cultures, races, and faiths. Some of the conflict will be motivated by greed, some by extreme poverty, and some by despair. (Barney, Blewett & Barney, 1999)*

Mongolia is at a critical crossroads where it confronts desperate poverty and massive slums at the same time looking to optimize development (with international partners) of its vast natural resources and mineral reserves. Despite being one of the world’s poorest countries Mongolia has a remarkably rich history, an impressive land ethic with regard to nomadic life, and a genuine desire to move more fully onto the global stage. To reach towards and begin to realize its aspirations, Mongolia will need new ways of seeing, thinking and acting. Mongolians will need to innovatively and potently partner, among key stakeholders within the country and between the country and a plethora of professionals, aid agencies and non-governmental organizations beyond its borders. The current paper delineated research that considers both the urban and rural conditions of modern Mongolia, and highlighted some dramatic contrasts therein. The present holistic model developed by the author over the past few years is intended in a more comprehensive manner to tackle design + planning with cultural sensitivity and a serious push to greater sustainability. It takes an overarching view of a complex ethos and, through an integrative method, aims to develop solutions and generate opportunities that are more appropriate for the context and conditions arising in the informal settlements of Mongolia. No small task and yet one which affords hope and promise at the current juncture.

To advance civilizations we need to have the ability to see through others eyes, to grasp the need for and see value in differences, and to substitute arrogance with acceptance & intolerance with respect. Education proves a necessary and effective vehicle for change. Values must be discussed and positions debated. Service learning approaches are needed. Internationalization of curricula is warranted. More integrative, comprehensive and embracing strategies must be developed to move our world forward. Our greed must give way to compassion. Modernity must be inclusive. Perspectives must be multiple. Metrics must be manifold. Mongolia's future, as a developing nation with a strong colorful history, rich natural resources, and profound spiritual traditions, should be considered in light of such pressing parameters and critical issues. Future research by the author will examine in greater depth the challenges of the ger districts in light of similar problems faced by informal settlements globally, as well as underscoring lessons learned through deeper study & thicker descriptions of the nomadic herdsman who remain intensely connected to the land, ever respectful of the environment, and connected as interdependent beings in their remarkable cosmos.

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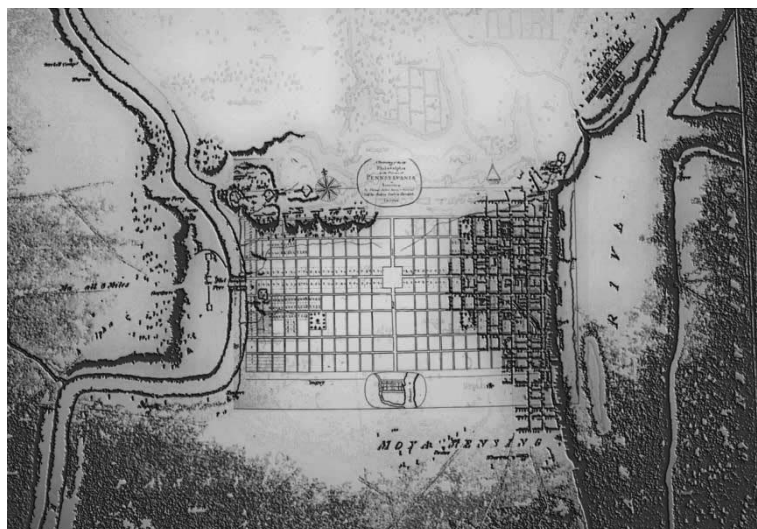
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# Philadelphia's Historical Maps and Green Initiatives

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**ABSTRACT:** The 'Greene Countrie Towne,' William Penn's seventeenth century vision for Philadelphia, has served as the spatial framework for the city throughout its history. Penn's settlement in the New World in the 1680s was focused on equality and religious freedom. The city layout reflected and housed his ideal settlement. Throughout history, the initial city plan has been a central force guiding Philadelphia's urban imagination. Penn's vision of a 'Greene Countrie Towne' is responsible for initiating and driving idea of 'green' that characterize Philadelphia. With Penn's plan and vision as guide, Philadelphia's ideas of 'green' along with the city's green infrastructure have developed over time and have served as a driver of Philadelphia's identity. This paper outlines the thread that links Philadelphia's initial plan and vision to the current day. Current planning and policy initiatives for Philadelphia include a new idea of 'green,' a focus on the sustainable city and a pledge by Philadelphia's mayor to become the country's greenest city by 2015. William Penn's city vision and plan continue to guide the city's consciousness and initiatives. The reflective quality of the sustainable city, directly linked to the 'green' vision for Philadelphia, has the potential to impact the urban imagination in a new and innovative manner while building on the historical thread that links back to the vision of the 'Greene Countrie Towne.'



**Figure 1:** The 1683 Penn-Holme Plan of Philadelphia overlaid with the 1779 British Encampment Plan by William Fadden. The two together clearly show the relationship of the ideal plan to landscape features on the site.

## 1.0 The green context

Philadelphia was one of many cities on the eastern seaboard of the United States that were initiated in the seventeenth and eighteenth centuries, but one of only a handful that was propelled forward by such a strong vision of urban identity. The development of Philadelphia's urban context can be followed by examining the relationship between spatial planning alongside the role of civic and institutional organizations. Where urban infrastructure development was slow, taking about a century and a half to fully develop, civic institutions and



cultural identity, guided by Penn's vision and its meaning for a city in the New World, kept the vision for Philadelphia alive. This is clearly seen in the manner in which Philadelphia's green infrastructure and the idea of 'green' have developed over time. In addition to the urban plan, Philadelphia's green infrastructure has included a focus on public space and recreation, botany and horticulture, and public health and well-being, all attributes that support the initial values of the city and all which are reflected in parallel spatial and institutional development; the development of the idea of 'green' as part of the city's civic consciousness has consistently referenced the city's spatial infrastructure throughout the city's history.

### 1.1 City vision and site

Philadelphia's urban form gets its character from the grid. The 1683 ideal plan for Philadelphia was delineated by Thomas Holme, the Surveyor General of Pennsylvania, and was guided by William Penn's vision for the town. The Penn-Holme ideal grid is a strong conceptual image but also a strong ordering device. The plan, entitled *A Portraiture of the City of Philadelphia in the Province of Pennsylvania*<sup>i</sup> measures one mile north to south and two miles east and west. The platting of the city was guided by the initial plan, and as an image to promote the city to potential investors, the drawing presented an opportunity to highlight the city as an ideal environment. The divisions, layout, and street measurements are based on the numbers five and ten. The city has five squares, a central square and four additional squares in the four city quadrants, all of which are represented in the plan delineated by Thomas Holme as green parks linked together to form a network of public spaces within the city grid.<sup>ii</sup> The occupation of the grid as a city of gardens, the 'Greene Countrie Towne' was envisioned for Philadelphia and importantly the limits of the site between the rivers delineated the grid's enclosure and recognized it as a centralized system that supported the overall vision for the city. The city was conceptualized according to innovative planning principles of the time, a site both beautiful and practical by nature and design. Within each city block and on each individual site, green garden areas were envisioned as settings for individual structures. The gardens add to the overall beauty of the town, and the distance between structures was considered to be the best way to prevent the spread of fire.

The Philadelphia plan is situated according to natural features and existing conditions of the site. The city plan was sited at the shortest distance between the Delaware and Schuylkill Rivers just north of the area where the two rivers merge. East and west limits locate the plan in an area that was relatively easy to level while still accommodating the watersheds within a peninsula. The site's malleability comes from the alluvial soil deposited between the two rivers in an area that was fairly firm and uniform. In larger geographic terms, the ideal grid lies in the eastern US Coastal Plain, just below the eastern Piedmont that cuts through Philadelphia. The Piedmont and Coastal Plain juncture can be discerned where the city topography rises at the north edge of the Penn-Holme plan. It is represented in the plan in the northeast corner by Faire Mount. The ideal plan's southern limit is just at a point where the soil was solid enough to settle, just north of the wetlands that characterized the peninsular site in the 1680s.

With plan measurements corresponding to natural features, it is possible to think of the ideal plan as a framework that reveals site characteristics. As such, settlement bound by a grid became a measure of the site, incorporating its geomorphic structure, using surface features and adding vegetation as ordering and envisioning devices. The use of the site's natural features was further supported through the architecture; buildings were made out of bricks from the soil of the site.<sup>iii</sup> The grid was laid fairly true to Holme's plan, and also proved to be flexible as it incorporated major water courses and topographic features. In addition to Faire Mount and the Piedmont to the northwest, the plan was delineated by the Cohocksink Creek, the large stream and wetlands area to the northeast. At the eastern edge of the plan the large bay-like body of water, The Dock, was accommodated within the plan.<sup>iv</sup>



**Figure 2:** John Paxton's 1810 map showing city districts and long distance roads out of the city center.

The Penn-Holme plan took approximately a century and a half to complete. There were changes and adaptations that occurred while it was platted and after its completion. The change that most significantly affected Penn's vision beginning in the first half of the eighteenth century was the unevenness of settlement. Where in the ideal plan Penn conceived a city with equal density of building from river to river, the garden sites in the eastern quarter of the city along the Delaware were given over to a denser urban fabric due to the intensity of commerce and activity in that part of town. The Penn-Holme plan proved to be flexible enough to allow adaptations over time. In its present form the plan remains representative of the overall form and vision that was conceptualized in the 1683 plan.<sup>v</sup> And importantly, the initial vision that the plan represents continues to hold unprecedented value as an image of the city.

### **1.2 Regional growth and urban space**

Philadelphia's plan was one of three commissioned by William Penn representing three scales of settlement: the city, the region and the state. Plans of the city and the region were delineated by Thomas Holme in 1683, and the state was delineated by John Thornton in 1681. Three scales of envisioning correspond to scales of occupation. Land in the city, the region, and sometimes even the larger realm of the state was part and parcel of investment and settlement by individuals or families. Penn's settlement provided a comprehensive framework for obtaining real estate in the new world setting. The conceptual understanding of Philadelphia – the *City of Brotherly Love* - within the state of Pennsylvania - *Penn's Woods* - completes the visionary idea; Pennsylvania provided the larger context of a natural world and the region provided the agricultural setting for the city.

The 1683 plan suggests a centralized and finite city. The Penn-Holme plan's ideal character is expressed as a clearly delineated and centralized grid system; the five squares that occupy the center of the grid represent a strong urban idea that continues to be discernible in the Philadelphia city scape. But the grid by nature is an open ended system and Philadelphia's development extended beyond the seventeenth century plan's limits to expand the city through extension and adaptation. The city was surveyed over time beginning at the eastern edge of the Delaware River and moving westward. By the time the grid was fully inscribed onto the landscape in the first half of the 1800s there were extensions beyond the limits of the initial plan. Roads connected other nearby settlements out of the city center, often located along former Indian paths and long distance trails. Passyunk Avenue headed south and southwest across the wetlands and the Schuylkill River and connected with other roads southwest of the

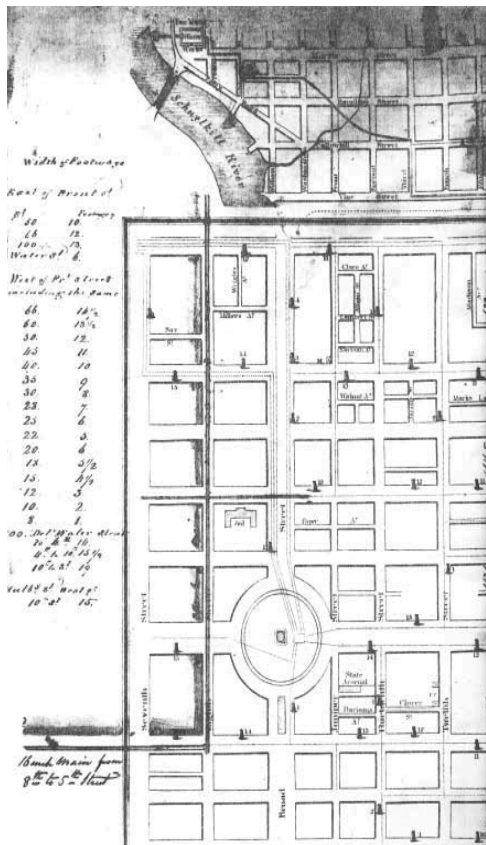
city towards Baltimore. Frankford Avenue headed northeast towards Frankford, following the Delaware River and continuing northwards towards New York. Germantown Pike and Ridge Pike headed northwest, the first road to the settlement of Germantown; the second followed the high ground along the Schuylkill River connecting the city with sites in the region and the state. These were the links to the state's natural and agricultural resources. When the grid spanned over the site's natural features such as wetlands and streams, it extended and adapted the grid system by incorporating other nearby settlements. It is in this manner that the city grew substantially along the Delaware River in the 1700s. Northwards this included Kensington and Port Richmond and southward included Southwark and Moyamensing. The early extensions from the core of Philadelphia added character and variation to the grid as they followed water and land features and stitched the outlying context to the ideal plan through these junctures. Maps throughout the nineteenth century show the Philadelphia grid developing through the incorporation of distinct domains.<sup>vi</sup>

Through the early years of the nineteenth century, only the two squares in the northeastern and southeastern quadrants were incorporated into the city fabric. Maps from the time continued to represent the five squares as green, tree-lined parks set within the urban fabric, even though permission was granted for the two eastern squares to be used as burial grounds. All of the squares hosted other uses that were not in keeping with the public park vision set forth in Penn's *Portraiture*.<sup>vii</sup> For example, Center Square included a place for public hangings and the site of the southwest square was an area of the city that was focused on brickmaking. Use of the squares as public parks for all citizens for the purposes of recreation and leisure continued to be part of the public dialog, but as a secondary conversation at a time when the city's attention was focused on growth of industry and commerce. And with the city not fully platted, public space was a secondary issue because there was still an abundance of woodlands in the western areas of the city. But the strength of the urban plan along with historical reflection on Philadelphia's origins kept the goal of the five interconnected public squares in the city center as an important manifestation of Philadelphia's identity. Towards the mid-nineteenth century the squares in the Penn-Holmes plan emerged as a system of urban public parks, at the time unique in the American city. Importantly, the ideal plan as a centralized system held the urban infrastructure together while the flexibility of grid structure allowed for growth and change as the city expanded. With the five squares and four quadrants in place, the order of the city was anchored in the central plan.<sup>viii</sup> With time, each square adapted in relation to the needs of the city and place in the grid.<sup>ix</sup>

### 1.3 Civic and cultural development

Philadelphia's culture is reflected in its institutions and industries, many of which were initiated early in the city's history. With Philadelphia an important national center in the nation's early years, institutions were in the forefront of intellectual development. Included among these was the American Philosophical Society (APS), an organization that continues to be actively engaged in the promotion of knowledge in the humanities and sciences. Founded by John Bartram and Benjamin Franklin, the Society's promotion of 'useful knowledge' overlapped with Bartram's role as a botanist and horticulturalist and Franklin's role as a diplomat and inventor. Throughout its history, APS boasts many prominent intellectuals and citizens in its membership, who were authorities in a range of fields. The Society's activities included national and international topics, but also had local impact. One of note in the early nineteenth century was the role APS served in relation to the Lewis and Clark Expedition. Its members were advisors and the institution served as a destination for specimens from the expedition. The plant and animal specimens sent from the continent's uncharted territory were at the time unknown to the Philadelphia audience. The introduction of plants into the eastern context had the potential to be useful and beautiful, as demonstrated through the use of species in the developing urban environment. Seeds from a tree species from the Rocky Mountains, collected by the Lewis and Clark Expedition, were among those used for the fifty varieties of trees planted in the newly designed square in the southeast quadrant of the city.<sup>x</sup> It is interesting to reflect on the significance of the fifty varieties of trees in the public garden in one of Philadelphia's five squares, at the time when the city's green infrastructure was finally realized. Their planting would have had the effect of offering to the public increased knowledge

of plant species and the territories from which they came. The symbolic act reflected the importance of the city in relation to the opening up of the North American continent, one of the most important events of the time, connecting the city to world events of the time. The impact would have been world changing, supported by the activities of one of Philadelphia's preeminent institutions.



**Figure 3:** Benjamin Latrobe's early 19<sup>th</sup> century plan of the first water system in Philadelphia.



**Figure 4:** Lindsay and Blackiston's consolidated plan of Philadelphia, 1855.

The field of horticulture has important roots in Philadelphia through John Bartram. His forays into the woods and forests of the eastern seaboard of the United States provided Philadelphia with a connection to the natural world of the North American continent. Bartram's discoveries of plant species and his seed and plant business contributed to the importance of Philadelphia as an international center for horticulture in the eighteenth century. Through his children, Bartram's horticultural enterprise thrived into the nineteenth century. And a half-century after Bartram's death the horticultural thread would continue in the public realm with the founding of the Pennsylvania Horticultural Society (PHS). In 1829, early on in its existence PHS initiated a flower show that continues to be held annually and has grown to national importance. But the horticultural society also has had impact on the greening of the city. The city-wide network of volunteers and educational programming has made PHS an institution that is well-woven into Philadelphia's cultural fabric. City-wide community gardens have expanded the city's green network into neighborhoods. More recently the *Plant One Million* initiative, organized by PHS and carried out with regional partners, seeks to restore the tree canopy in the region by increasing the number of trees in the metropolitan area by thirty percent. Where in its early

years the Pennsylvania Horticultural Society advocated for the city's beauty by noting the number and variety of trees, it is interesting to note that almost two centuries later the advocacy for tree planting for the city's overall health to impact public well-being continues to be led by PHS.

Greening of Philadelphia in the nineteenth century was also initiated for health reasons. The architect Benjamin Latrobe was commissioned to design Philadelphia's water system in the first years of the nineteenth century and Frederick Graff expanded and improved the system in a second phase of design. It was the first major water system in the country. The first phase included a pump house on Center Square and a network of log pipes that distributed water. Relying on the city streets to run the underground network of pipes and Center Square, Faire Mount, and other open spaces in the public domain to house the above-ground parts of the system, the waterworks had the auspicious role of also supporting the city's green infrastructure by siting the system in primary areas of the city that were in the public domain. As the city grew in population, the need for fresh water increased and the water system needed additional green infrastructure along the Schuylkill River to assure a clean water supply. Plots of land were acquired by the city, beginning just north of Faire Mount and continuing northwards in the watershed along the Schuylkill River. This eventually resulted in the establishment of Fairmount Park in 1867, extending the watershed area to include 2800 acres stretching from Fairmount Waterworks to the northwestern edge of the city.

## **2.0 Finding the landscape infrastructure**

Philadelphia was a series of separate political entities until 1854. With consolidation of municipalities that were working closely together, there were opportunities to re-envision Philadelphia as one complete network for municipal services and one expanse of land rather than a series of separate municipal entities. The transformation is clearly depicted in speculative maps from the mid-nineteenth century. A grid of dashed lines on maps laid over the areas north and south of the center represented future plans for growth. In maps from an earlier period, such as the Paxton map from 1810, settlement was characterized by growth that accommodated ridge roads, valley roads and stream beds, and other natural features of the Piedmont and Coastal Plain. The vision of Philadelphia at the time of consolidation shows a desire for uniformity that comes from a continuous rectilinear grid. Laying the grid to the north, west, and south of the center resulted in cutting and filling of the land to achieve a degree of uniformity. Development of the Philadelphia grid in the mid-nineteenth century was carried out in a manner that tended to ignore the natural features of the site.

As the city expanded, the five squares in the center of Philadelphia also experienced change. Center Square was eventually covered by City Hall, a behemoth of a building completed in 1901 that covers a large portion of the open space on the 10-acre site. City Hall has a courtyard that serves as Philadelphia's locational center. City Hall and the courtyard fundamentally changed Center Square. But with Broad and Market Streets crossing in the center of the interior courtyard, the courtyard provides a central point of orientation from which to conceptually understand the overall plan of the city, its four quadrants, and the interconnectivity of public spaces through the five squares. In other words, in the dense city that developed using the Penn-Holme plan as a framework, City Hall and its interior courtyard emphasize the ideal plan and make it discernible. Of the four remaining squares, Rittenhouse, in the southwest quadrant, emerged as the square truest in form to the original plan of Philadelphia. It is a distinct six acre site that is surrounded by buildings of a scale that holds it within the urban environment. Washington Square in the southeast also has these qualities, but with its location adjacent to the State House grounds behind Independence Hall, it became the initiator of a network of small urban neighborhood parks and green spaces during mid-twentieth century urban renewal. Franklin Square in the northeast quadrant and Logan Square in the northwest were incorporated into major urban plan changes. Now they each serve as part of larger infrastructure that reaches beyond the city. On its east flank, Franklin Square is adjacent to the landing point of the Ben Franklin Bridge, in theory serving as the open space to welcome those arriving by automobile. In the northwest quadrant the southeast-to-northwest

diagonal uses Logan Square to guide the direction of the tree-lined Ben Franklin Parkway. The parkway, built in the early twentieth century, is urban infrastructure that best exemplifies the City Beautiful Movement in Philadelphia. The Parkway connects City Hall to Fairmount Park, bringing landscape infrastructure directly into the center of the city.<sup>xi</sup>

The spatial and cultural dimensions of Philadelphia and its green infrastructure were fully realized in the twentieth century. The city is well illustrated in the 1967 image looking westward that is included in Edmund Bacon's book, *Design of Cities*. The image is a re-envisioning of the ideal plan, showing incorporation of the changes made in the twentieth century, including the network of green spaces in the southeast quadrant of the city and the extension of green spaces that begin at Center Square and continue through the northwest quadrant connecting to Fairmount Park and beyond. The image is a testament to the 'green city' narrative that propels the understanding of Philadelphia's ideal city plan forward.

## 2.1 Green initiatives

Current planning initiatives in Philadelphia consider both the spatial and institutional dimensions of city greening. Philadelphia *Greenworks*,<sup>xii</sup> an initiative by the Philadelphia Office of Sustainability, has as its primary goal to make Philadelphia the greenest American city by 2015. The terms *Energy, Environment, Equity, Economy, and Engagement* are used as guiding principles to frame initiatives. To accomplish the goal, *Greenworks* relies on the power of collaboration. Links between private institutions and government agencies are important, relying on the civic and cultural capacity of the city. The Philadelphia City Planning Commission's 2035 Comprehensive Plan<sup>xiii</sup> is a spatial framework that has incorporated the sustainable initiatives for the city. Cross-agency alignments enhance these efforts. The 2035 Plan considers, for example, economic development alongside green initiatives, and seeks coordination with initiatives such as *Green City Clean Waters*<sup>xiv</sup> by the Philadelphia Water Department, and Vacant Land Management<sup>xv</sup> by the Philadelphia Redevelopment Authority. Some of the most innovative thinking about green initiatives considers the current conditions and context of the city and poses ways to reverse negative aspects of the changed environment. For example, a land bank has recently been initiated in Philadelphia. With the ability to consider larger areas for development, urban blight has the potential to be reimagined and positively transformed through development. Stream restoration is another initiative. This work addresses regional infrastructure and is part of an ongoing effort to reform storm water management in a city and region where population growth has impacted services for more than a century.



**Figure 5:** 1898 United States Geological Survey Map, Philadelphia.

The Philadelphia Water Department, fully aware of its legacy and importance as one of the first municipal water systems in the United States has been an active leader in transforming the green infrastructure in Philadelphia. The *Green City Clean Waters* initiative includes solutions for storm water management in the densest part of the city. Underground infrastructure is at the heart of the effort, but the infrastructure is also exhibited to the public through green areas on the ground surface. Like many post-industrial American cities, density in low income areas parallels the lack of trees, and extensive pavement that in turn creates urban heat sinks that have a negative impact on the quality of life in the affected neighborhoods. Initiatives in these areas include additional park and recreational spaces and green areas for communities. Infrastructural improvements include creation of water retention basins underneath the ground, introduction of green roofs wherever possible, recharge areas in public places such as schools, increased use of pervious pavement, greening of streets along with improved street drainage. The initiative also encourages individual property owners to implement change. *Green City Clean Waters* includes practical goals for property owners such as decreased utility costs, and for the city the buy-in of individuals has a positive impact through increasing the quality of urban spaces and daily life experiences for residents. The effort is aided by other initiatives such as *Plant One Million* through the PHS and its partners, demonstrating once again the importance of institutional efforts guided by an urban vision.

### 3.0 Conclusion

The Philadelphia Planning Commission's current planning framework is expressed in the 2035 Plan for Philadelphia. Where the 1960s era Philadelphia plan directly referenced the 1683 Penn-Holme central plan of Philadelphia, the current city plan presents Philadelphia as a more complex whole. The city is presented as a network of systems and neighborhoods in multiple maps and diagrams. The images present the whole of Philadelphia up to the borders that were established after consolidation in the mid-nineteenth century. The image of Penn's city in relation to the whole city is present in the 2035 plan, but the overall complexity of Philadelphia and its extensive grid predominates. In the images of the city, Penn's 'Greene Countrie Towne' appears to be less significant. Importantly, the historical importance of vision and plan together are still at work. In a similar fashion to the process of building the initial plan for Philadelphia, the 2035 plan will be fully realized and is kept alive through civic dialog and urban institutions. The current plan is process based and relies on connections within the city as a whole and in the larger contexts of the region, the state and the continent.

Philadelphia's urban imagination has always included ideas of 'green' and a green infrastructure, recognizing the importance of ideal values in driving prominence and innovation. Themes that support the Philadelphia's green vision and help to develop the city's green infrastructure include the need for public space in the urban environment, the role of horticulture in the development of a green infrastructure, and the importance of a green landscape infrastructure for a city's health and the well-being of its citizens. Now and throughout the development of the city, all of these themes are reflected in the physical plan through aspects that are both practical and beautiful and have shaped urban innovation. Current dialog about sustainability includes all of these themes. The goal to be the greenest city in the United States supports the utopian vision of the city as a green environment that has always been present in Philadelphia. Current methods used by the city planning commission and the mayor's office recognize the opportunity for Philadelphia as a leader in shaping sustainable cities in the 21<sup>st</sup> century. As such, the ideal plan framework continues to serve the city, but less for the specifics of the plan and more for the inherent values of planning, flexibility in the planning process that allow the city to innovate according to current urban needs. This posits Penn's plan and vision less as a fixed entity and more as a system for finding inherent values that drive the vision.

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<sup>i</sup> Referred to in this paper as the Penn-Holme plan.

<sup>ii</sup> For more information see for example, Read, Gray, *The Miniature and the Gigantic in Philadelphia Architecture: Essays on Designing for the Human Scale*. Lewiston: Edwin Mellen Press (2007).

<sup>iii</sup> For more information see Heinzen, Nancy M., *The Perfect Square: A History of Rittenhouse Square*. Philadelphia: Temple University Press (2009). Chapters 1 and 2 have detailed information about brickmaking in the southwest quadrant of the city prior through the first half of the 19<sup>th</sup> century. Also, the 1796 Peter Varle plan (and other plans) shows ponded areas around Rittenhouse Square in the southwest quadrant of the city, brickmaking sites in the 18<sup>th</sup> and early 19<sup>th</sup> century prior to expansion into that quadrant of the city.

<sup>iv</sup> The present day Dock Street is an unusual diagonal street in the plan. It covers a channeled stream and gives the original water body a continued presence in the city.

<sup>v</sup> For more information about the uneven development see, Milroy, Elizabeth, "Repairing the Myth and Reality of Philadelphia's Public Squares," *Change over Time*. vol. 1, number 1. Philadelphia: University of Pennsylvania Press (Spring 2011): 52-79.

<sup>vi</sup> The Frankford Historical Society plan (1810) shows the city at a time of transition.

<sup>vii</sup> For a thorough account of ownership, legal parameters, and use of the city's five squares in the first century and a half of Philadelphia see: Milroy, Elizabeth, "Repairing the Myth and Reality of Philadelphia's Public Squares," *Change over Time*. vol. 1, number 1. Philadelphia: University of Pennsylvania Press, Spring 2011): 52-79.

<sup>viii</sup> Read, Gray, *The Miniature and the Gigantic in Philadelphia Architecture: Essays on Designing for the Human Scale*. Lewiston: Edwin Mellen Press (2007): 1-20. Read discusses the plan in relation to architectural traditions that were to build on and within the city.

<sup>ix</sup> Milroy, Elizabeth, "Repairing the Myth and Reality of Philadelphia's Public Squares," *Change over Time*. vol. 1, number 1. Philadelphia: University of Pennsylvania Press (Spring 2011): 72.

<sup>x</sup> Milroy, Elizabeth, "Repairing the Myth and Reality of Philadelphia's Public Squares," *Change over Time*. vol. 1, number 1. Philadelphia: University of Pennsylvania Press (Spring 2011): 63.

<sup>xi</sup> It is important to note that the architect Paul Cret was connected to the redesign of three of the four squares – he designed Rittenhouse Square, he designed the Ben Franklin Bridge at Washington Square, and with Jacques Greber, he designed the Benjamin Franklin Parkway which incorporates Logan Square.

<sup>xii</sup> <http://www.phila.gov/green/greenworks/index.html>

<sup>xiii</sup> <http://phila2035.org/>

<sup>xiv</sup>

[http://www.phillywatersheds.org/what\\_were\\_doing/documents\\_and\\_data/cso\\_long\\_term\\_contr\\_of\\_plan](http://www.phillywatersheds.org/what_were_doing/documents_and_data/cso_long_term_contr_of_plan)

<sup>xv</sup> <http://www.econsult.com/projectreports/VacantLandFullReportForWeb.pdf>





## **Methods**

Agents of Change in Changing Paradigms.  
Scientific, Technological, Strategic,  
Intuitive, and Pragmatic.



# Design for Resilience: mitigation, adaptation and transformative design

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**ABSTRACT:** From case studies of highly capitalized, architect-designed buildings confronted by natural and manmade disasters of the last decade, this paper extracts exemplary cases of mitigation, adaption, transformation design (before, during, and after) disaster instances globally. Based on resilience attributes from biology and complexity theories (Zolli and Healy, 2012), these cases, prepared with graduate students in courses on resilience and research methods, examine attributes that map onto architecture (i.e., simple cores/complex edges, modularity, etc.). Cases question how architects and designers can begin to address other resilience attributes that architecture does not (i.e. capacity for flocking/swarming). Disaster mitigation strategies of Ito and Suzuki in Sendai, Japan, adaptation design with shipping containers during 5000 earthquakes aftershocks period (2011-2012) in Christchurch, New Zealand, and transformative design strategies that changed the identity of Greensburg, Kansas via LEED designed buildings are cases abbreviated in the paper. Third, architects' roles before and after disasters have become well defined. In contrast, roles during disasters are absent from the literature and practice of architecture Efforts to better ascertain critical roles for architects during relatively predictable disaster events (i.e. hurricanes, wildfire, storm surge, sea level rise, etc.) are next.

**KEYWORDS:** Resilience, case study, case method

## 1.0. A Midwestern American Provocation

Though growing in popularity, due to the relatively modest scale of sustainable strategies globally, it is now too late for sustainable strategies alone to reverse climate change in the decades ahead. The onset of significant environmental degradation and sea level rise is well underway. The energy waste stream in making and operating buildings globally is among principal causes. Long time advocates of sustainable design, myself included (1973-present), have not achieved critical mass despite compelling scientific evidence and we will not in the foreseeable future. Evaluation of current architectural practices through the lens of the sustainability triad—environment, economy, and equity—provides ample evidence.

1. *Economics:* In much of the world of architecture, a disproportionately large number of firms are committed to sustainable design to the extent that their clients are--committed to sustainability in attitude but not behavior. Firms market sustainability, but upon closer inspection, offer design for sustainability as a business strategy. They do sustainable design to the extent of LEED certification, a little understood designation some clients have learned to value. At the College of Architecture and Planning (CAP), our alumni board gave the distinguished alumnus award to the principal of a major US-based international firm who told us with pride about flying to China and back just for a meeting shortly after telling a captivated audience of the firm's stand on sustainability; apparently the waste was no paradox to him.

2. *Environment:* Ecological footprints are not shrinking; they are growing. Collectively, humans we drive more, flying more, consuming more, etc. Locally, high school students like those at Muncie Central High School students, rarely ride a bike to school instead of driving a car though they are representative of tech-savvy, information saturated, high school students peer pressured nationally. Continuing the aforementioned paradox, several faculty colleagues advocate sustainability and net zero building design in the most compelling ways in Muncie, Indiana and then drive home sixty miles to Indianapolis daily. A visiting LEED trainer said, "LEED enables us go the wrong direction at 40 MPH rather than 80 MPH." I remind students and faculty of this selectively because it may discourage idealizing minds to hear. Globally, much of the rest of the world has aspirations of living like Americans.

3. *Equity*. From an equity perspective, little to no aspiration for equalizing the distribution of wealth on the planet is apparent; nor do we show signs of re-defining the meaning of wealth on the planet. Care about the first cost rather than the life cycle cost of things prevails. With each gas price increase, television media features citizens bitterly complain about rising gas costs, complaints heeded by political “leadership.” Neither political party dared having a climate change related platform during the 2008 or 2012 presidential campaigns for fear of losing votes. Perhaps techno-optimists who bypass human behavioral concerns with tools and inventions offer more realistic solutions to behavioral shortcomings and their consequences. In *Hot, flat and crowded* (2009), Friedman’s proposed the solution lies in the search for “cheap and easily accessible electrons.” In a related vein, comprehensive anticipatory design scientist, Bucky Fuller asserted that we would only abandon our economic accounting system of what wealth is when we all feel our lives threatened (Fuller used the WWII example when our economic accounting system was suspended when the country sensed a life and death moment). Less palatably, he also warned that if totalitarianism is to return, it might do so under the banner of environmentalism.

Based on embellishing distortions of the American reality, others in the world want to live at the level at which Americans are perceived to live. The momentum of humans pumping CO<sup>2</sup> into the environment is actually accelerating and has now gone beyond the point of return. The consequences will be a period of unfolding human and capital loss of untold proportion.

## 2.0. Design for resilience

During this critical transitional time, interim strategies must teach present and future architects to mitigate the effects of pending disasters in their buildings and environments, to successfully adapt to disasters as they are occurring and to help with transformations of built environments of all scales after disasters end. This new strategy, design for resilience, may be better attuned to our seemingly un-restrain-able behaviors. Resilience design strategies anticipate significant detrimental climate change, sea level rise, and the attendant extreme weather changes that we are already experiencing with increasing frequency. Globally, costs resulting from natural and man-made disasters are increasingly dramatically (Minnery 2011, Fisher 2012). In response, *Bloomsburg Business Week* reports that a huge construction industry is growing up around it rapidly. A Florida Emergency Response Team interviewee reported that the \$60 billion federal funding for Hurricane Sandy had Florida contractors, builders, craftsmen and others leaving because they can get paid three times as much in NY/NJ area work. While civil, structural, mechanical and other engineers have been part of the decade long resilience discourse undertaking research and populating professional and scholarly meetings of government and commercial sponsorship (FEMA/NIBS/NIST and McGraw Hill for example), architects have been few in number and relatively recent arrivals. The opportunity for architects to participate has been taken up by a small growing number of market savvy firms already (i.e., AIA Firm of the Year BNIM). In the American Institute of Architects (AIA), this year for the first time, programming for the AIA Convention moved significantly from sustainability concerns to a near equal focus on resilience practice. Presenters describe significant roles for practicing architects *before* and *after* disasters and an expanding scope of potential architectural services through the World Wide Web. In contrast, roles for architects *during* disasters are poorly defined, and are one of the emphases of my current research.

Beyond resilience defined as simply bouncing back, Zolli and Healy (2012) offer patterns of resilience that emerge from biology and complexity theories. Resilient systems:

1. Have feedback mechanisms to determine when an abrupt change is nearing
2. Ensure continuity by dynamically reorganizing
3. Decouple the system from underlying material requirements
4. Have beneficial modularity: simple internal modular structure with components that plug into one another
5. Are diverse at the edges but simple at their core
6. Flock or swarm when time is right and to break into islands when under duress (See Figure 1. Svalbard Global Seed Vault)
7. Cluster, bringing resources into close proximity with one another as needed
8. Are not robust, not redundant, and do not attempt to recover to original state
9. Have failure options as essential.



Figure 1. Svalbard Global Seed Vault. Norway. Architectural “swarming”

In part, my resilience studies test these theoretical constructs and inquire which attributes successfully map on to architecture and which others hold potential for new design strategies. The past four years, I have developed the cases of a syllabus with design for resilience courseware using *case-based pedagogy*, a teaching method that empowers students to learn through decision-making. The creation of a new interdisciplinary syllabus for design and planning students will help them prepare for this rapidly emerging area of architectural practice. The course materials also aspire to better enable a critical mass of design and planning faculty to make strategic shifts in teaching design for resilience. 47 case studies of highly capitalized, architect-designed buildings, confronted by natural and manmade disasters (2001-present) have been aggregated. They cover a myriad of issues related to architecture. Representative resilience sites of the forty-seven studied include:

1. Earthquake: Christchurch, New Zealand, Sendai, Japan, San Francisco, CA, Los Angeles, Port au Prince, Haiti, Sichuan, China
2. Hurricane and storm surge: New Orleans, New York City, Miami, Kauai, Hawaii
3. Flood: Brisbane, Queensland, Nashville, TN, Des Moines, IA, Bangkok
4. Man-made: New York City, Boston, Mumbai, Chernobyl, Ukraine, Indianapolis Airport and state fair stage
5. Climate change/sea level rise: Byron Bay, New South Wales, Outer Banks, NC
6. Tsunami—Sendai, Japan and Sri Lanka
7. Tornado and windstorm sites: Joplin, MO, Norman, OK, Greensburg, KS, St Louis Airport, Dallas/Ft. Worth and Lubbock, Texas, Tuscaloosa, Alabama, Charles de Gaulle Airport, Metrodome, Minneapolis
8. Wildfire sites: Colorado and New Mexico, central Texas, Sydney, Australia

### 2.1. Method of Research

To abbreviate the case studies into teachable cases for decision-making on disaster scenarios before, during and after disasters, the following steps were taken:

1. *Literature Review*: the body of knowledge concerning design for resilience is growing rapidly. Students and I have been engaged in continuous reading, to maintain currency and search for emerging resilience solutions globally
2. *Case study* related modes of inquiry that developed these cases include:
  - a. *Historical methods*, particularly archival search
    - a. *Observation*: On-site professional observer studying 3 phenomena: disaster mitigation evident in anticipatory design, disaster adaptation evident in functioning building design during event, and disaster transformation evident in new building and community design following an event. In addition to visual observation, photography and videography were used to record data.
    - b. *Interviews* with key informants: Structured interviews with questions specifically focused on mitigation, adaptation, and transformation strategies that enabled design and planning professionals make more effective decisions
3. *Data collection and analysis*: data (text, photographs with captions, transcriptions from recorded interviews, etc.) is aggregated chronologically into 3 categories/phases—mitigation, adaptation and transformation. Each case had one or more underlying themes related to the



course (i.e. operating rationally within chains of command and standard operating procedures, operating politically in relation to control of decision making or resources, etc.). The underlying themes for the case emerged as the case unfolded. For each category/phase, critical decision-making events in which two or more compelling alternatives were present were identified (i.e. staying in place versus evacuation). From this smaller data subset within the category, the critical events were attributed a theme/lesson tag (life safety, business interruption, etc.). The themes/lesson tags were prioritized as it/they related to the overall emerging theme of the case. The single most salient event per phase (the one that best relates to the overall theme of the case) per phase was selected to be the decision point. Thus, three decision points for discussion became the subjects of discourse and decision within each case.

4. *Findings*: in the form of cases. Format for each case has been consistent:

1. Phase 1 intro: Pre-mitigation data presented in case format (data set 4-8 pages of text and/or visuals in multiple media)
2. Phase 1 decision point/discussion: Mitigation decision point reached in which there are two or more compelling answers requiring student discussion and decision making (D/DM)
3. Phase 1 conclusion: What actually occurred revealed. Associated resilience attributes discussed.
4. Phase 2 intro: Pre-adaptation data presented in case format (data set 4-8 pages of text and/or visuals in multiple media)
5. Phase 2 decision point/discussion: Disaster adaptation decision point reached in which there are two or more compelling answers requiring student D/DM
6. Phase 2 conclusion: What actually occurred revealed. Associated resilience attributes discussed.
7. Phase 3 intro: Pre-transformation data presented in case format. (Data set 4-8 pages of text and/or visuals in multiple media)
8. Phase 3 decision point/discussion: Transformation decision point reached in which there are two or more compelling answers requiring student D/DM
9. Phase 3 conclusion: What actually occurred revealed. Associated resilience attributes discussed.
10. Case Conclusion—discussion with students of the meaning of the case, its related decision and summary of resilience attributes.
11. Endnotes and References

### 3.0. Representative Cases of the three phases of resilience

Sections of cases will be presented, but it is not possible to present the entire case in this brief report. Representative mitigation, adaptation and transformation decision points (steps 2, 5 and 8 above) have been singled out in three exemplary cases.

3.1. *Case 1: Sendai Mediatheque (1995-2001) and the 2011 Tohoku earthquake (3/11/2011) excerpt.*

Case topic: mitigation through taking design risk as resilience

*Part 1.1* At the *mitigation decision point* (step 2 above): competition entry architect/engineer team, Toyo Ito and Mutsuro Sasaki, had to choose between equally compelling design choices: either state of the art *shin taishin* (anti-seismic) structural design strategies as presented in the Japanese building code with no potential legal upside in the event of an earthquake or the risk of a relatively untested design alternative that offered a new aesthetic and structural design model. Is this design alternative an acceptable risk? Are they exercising the legally required “reasonable standard of care?” If you were a member of the selection team, would it be responsible to select a design departing from prevailing wisdom?

*Part 1.2 Outcome.* After considerable deliberation, they decide (step 3 above) to pursue an alternative to convention and bring biomimicry in structural design at building scale. (Figure 2 below).

*Part 2.1* Ten years later, the 2011 Tohoku earthquake (magnitude 9.0 Mw), the most powerful earthquake to ever strike Japan occurred in the ocean a short distance away. Nearly 1 million buildings, including hundreds of highly capitalized multi-storied buildings were damaged or destroyed. In the earthquake, (Step 5--adaptation decision/discussion point) how did this building perform?). Will its experimental design strategy be its undoing, needlessly harming

untold numbers of people in its effort to advance a design idea?  
<http://www.youtube.com/watch?v=heh5ITmYbRs>.

*Part 2.2 Outcome.* Damage was limited to broken glass on the first and third floors, part of a window on the double-glazed south side, a section of ceiling that had fallen on the top floor, solar equipment, and a rooftop air duct (Huxtable 2011).

*Part 3.* By August 2013, over 1000 aftershocks had struck Japan. Transformation discussion questions include: Which resilience attributes readily map onto the Sendai Mediatheque? Will the success of this alternative design strategy have impact: on Japan's building code? On other architects/engineers to replicate its structural system? To transform even further? To test other new aesthetic ideas? To improve survivability in countries without the expertise of Japan? (See OpenQuake at Global Earthquake Model).

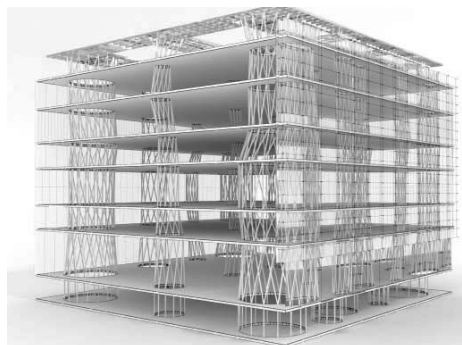


Figure 2. Biomimicry structure of Sendai Mediatheque. Ito and Suzuki

*Case 2: Christchurch, New Zealand aftershock. Adapting to 5000 aftershocks to the 9/4/2010 earthquake.* Case topic: Business decisions and urban design scale resilience.

*Part 1.1.* Mitigation question for seminar discussion: evacuation to new sites/locations distant from seismic activity or rebuild/remain in place? Precedent: a story of profound building performance adaptation failure at the Superdome fiasco in New Orleans.

*Part 1.2.* Christchurch, New Zealand story stands in fairly stark contrast. On 9/4/2010, a magnitude 7.1 earthquake struck the Canterbury region. Shortly thereafter, a mitigation strategy for damaged buildings remediation/preparation for any future events included upgrading existing building code and the prioritization of structures that needed immediate remedy, second order structures, tertiary, etc. The time between initial earthquake and major aftershock was too short for significant implementation. Efforts to shore up effected properties had only begun when 2/22/2011 aftershock of 6.3 magnitude occurred, effectively destroying a square mile of Christchurch's central business district's (CBD) already weakened building stock.

*Part 2.1.* Adaptation decision/discussion point (step 5 above): 5000 or more aftershocks followed in the year after the devastating earthquake 2/22/2011. Like post Katrina New Orleans, some residents have moved away, but most residents and businesses have elected to remain despite living in sustained disaster mode with periodic aftershocks of varying magnitude.

*Decision point question:* As an architect and building owner, what do you do amidst continuing series of aftershocks to resume business operations:

a. Evacuate CBD due to poor sub-soils, continuing aftershocks, inadvisability of investing in commercial/institutional grades architecture/highly capitalized buildings when there are more commodious sites outside the CBD or

b. Remain in place and take risk in alternative design strategy?

*Outcome.* In Christchurch, they have designed and built an interim/provisional CBD zone--an adaptation of shipping containers shopping zone (See Figure 3). In the parlance of Zolli and Healy, this is the modularity resilience attribute at urban design scale. Further, early signs are that this project will be transformative.

*Part 3. Transformation discussion:* Many/most of Zolli/Healy resilience attributes can be found in this design response. More work is following of similar creativity suggesting transformation

implications of what has been done: Shigeru Ban cardboard Cathedral of Canterbury (see figure 3b)



Figure 3a. Modularity adaptation. Shipping container mall, Christchurch New Zealand, 2012.



Figure 3b Transforming. Christchurch Cardboard Cathedral replacement, Shigeru Ban 2013.

*Case 3: Greensburg, Kansas and the tornado 5/4/2007. Identity and transformation. Case topic: Disaster, sustainability and identity at city/town scale as resilience.*

*Part 3.1.* An EF-5 tornado destroyed conventionally built town with little architecture. Due to the nature of the disaster event, a tornado, there was no time for adaptation. The town was leveled. (See Figure 4). Transformation stage decision point choices (step 8) are:

- a. Leave this destroyed town site, take replacement dollars, and move to nearby towns where the infrastructure and community structure is still intact.
- b. Take the risk of reinvestment of replacement dollars in rebuilding the town the look the way it was before the tornado (the post World War II Dresden solution, and one adopted in Joplin, MO) to re-establish historic identity
- c. Take risk of reinvestment of replacement dollars in new architectural language for the town.

*Part 3.2 Outcome:* Change Greensburg, Kansas identity via LEED designed city/town scale. Figure 4.

Resilience attribute discussion: Greensburg ensured continuity by dynamically reorganizing. Among its other resilient systems, feedback mechanisms determine when an abrupt change is nearing, clustered its design strategies around LEED, bringing resources into an alignment with one another that has re-invented the town which as now become a tourist destination. Notably, this new configuration defies engineering-based resilience definitions: is not robust, not redundant, and does not attempt to recover to original state.



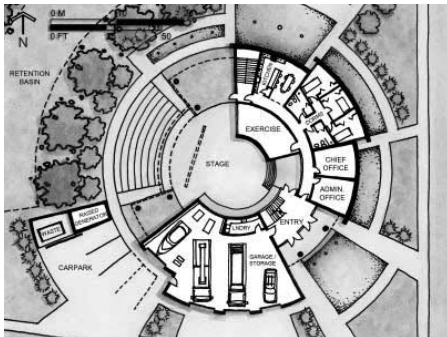
Figure 4. Aerials of Greensburg, KS, before and after tornado.



Figure 6b. dispersible unit of a pod system—a flocking/swarming strategy

#### 4.0 Summary

Testing Zolli/Healy's theoretical constructs has yielded new understandings of architectural potential in resilience. Over time and more comprehensive development of these cases, multiple levels of risk and decision-making emerge. Indeed many of the studied hazards are not single hazard, but multihazard events (Sendai—earthquake and tsunami; Hurricane Sandy—wind and storm surge; Katrina—wind, man-made levee collapse, and flood, etc.) necessitating more comprehensive programming before designing responsive buildings. As one result, in courses that have used the cases as design precedent, the move to multihazard design response has been accompanied with design studies for a new building prototype, the *multihazard response and refuge center*. Starting from a fire station, additional community hazards historically addressed by a widespread array of facilities in a region are consolidated into single modular structures or flocks of structures. (Figures 6 a, and b).



Figures 6a. New building prototypes: the multihazard response and refuge center—fire station archetype.



Figure 5. Greensburg's new identity via LEED buildings replacing conventional buildings

## 5.0 Conclusions: Roles for Architects

Architects have had continuing roles in disaster assistance historically. Concurrently new roles are emerging now as an industry is birthed in response to the need and as some perceive it, the “opportunity of disaster.” (Gunewardena 2008). Mitigation roles before disaster are substantially well defined. Already many architects participate on design and planning commissions with resilient community goals; serve on building codes advisory groups, undertake site specific research for preventative requirements in place, are active in training, and advise clients on resilience strategies. Roles after disaster (transformative and otherwise) are similarly well-defined. Architects with abiding commitments to their communities help clean up debris, offer damage assessment through, manage communications with a multitude of constituents and those affected. In some cases, architects are outspoken and attempt to lead communities from shock into visions of a future. Entities like the National AIA Disaster Assistance teams have state and international equivalents.

In contrast, roles during disasters seem relatively undefined. Despite the strong positive correlation between disasters and building failure, architects are rarely in the public eye during disasters. For the most part, architects are absent from the literature and practice of disaster adaptation. Several reasons readily emerge. Architects may be perceived as a reactive profession, one that responds to client interest and a need of our work. Frequently, architects are not seen to command relevant data for the related disaster. Admittedly this varies among disaster types and there is a strong positive correlation between the type of disaster and the likelihood of architect’s making strategic intervention to save life and/or property. Hurricanes, earthquakes, sea level rise, wild and manmade building fires, and some instances of terrorism have time frames in which architects readily respond. Tornadoes, tsunami and other disasters of short unpredictable time frames do not. The architect’s relationship to the community is also paramount. Will people listen? Can you mobilize others to help? Architects’ relationships to location’s leadership (governmental, religious, etc.) seem directly related to consulting in ways that make a difference. Functioning under the extreme stresses of disaster situations tests the capacity to cope and an architect’s mental and physical capable of assisting.

Conversance with readily available technology transfers for temporary shelter/building solutions and technology for communications may limit an architect’s participation. The genius of crowdmapping in Ushahidi Haiti (2010. See <https://crowdmap.com>) was the capacity of digital native college students to mobilize and sustain a global phone network needed to ascertain a data-filled map of Port au Prince long before government institutions. Some architects are resolute in their commitment to payment for services. They may see “giving it away” pro bono services like these as undermining the profession. In other cases, the law is the problem in that it affords no protection to architect from lawsuit for any damage done. Trial attorneys in half the states block Good Samaritan laws. Unfortunately, some architects have also used the post Hurricane Katrina opportunity to pass out business cards in unbecoming situations.

According to Zolli and Healy, to work in resilience design, effective participants have several attributes. First, they must have the capacity for trust and collaboration. Second, they must be capable of forming informal networks under a wide array of circumstances. Thirdly, among them must be translational leaders who bring the capacity to read and articulate the environment and its potential are essential in compelling ways. These attributes are well within the architect’s grasp as they are essential parts of professional preparation and practice. During this critical transitional time, teaching future architects to design to mitigate the effects of pending disasters in their buildings and environments, to successfully adapt to disasters as they are occurring and to help with transformations of built environments of all scales after disasters end seems a goal worthy of our attention.

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# Transcultural Tectonic Connections: The Utzon Paradigm

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## ABSTRACT:

*“Comparable in subtle ways to the protean achievements of Le Corbusier, Utzon’s architecture emerges today as paradigmatic at many levels not least of which is the manner in which from the beginning of his career; he would totally repudiate the assumed superiority of Eurocentric culture”*

Kenneth Frampton

This paper presents an understanding of Jørn Utzon, as one of the most profound exponents of a transcultural and tectonic approach to modern architecture in the late twentieth century. The paper will examine the sources of inspiration, intersections and connections in Utzon’s architecture; which have been informed by his understanding of boat-building, reference to nature, extensive travels and broad transcultural influences; as an exemplary paradigm for humane, poetic and innovative contemporary architecture.

Jørn Utzon’s architecture ranges from the modest to the monumental; from the Kingo courtyard houses, the finest Scandinavian example of humane housing, to the sculptural abstraction and technical innovation of the Sydney Opera House; an iconic work of modern architecture that has come to symbolize not only a city, but also a multi-cultural nation, due to its highly original and innovative synthesis of many diverse and non-Western cultural influences, in specific relation to its context.

Utzon’s work embodies a visionary approach to architecture that is site specific and poetic, tectonic and humane; informed by a profound appreciation of nature and diversity of human cultures, as sources of inspiration and analogy, combined with an intuitive sense of architecture as art and a pragmatic, yet innovative approach to the use of technology pushed, according to Utzon to the “edge of the possible,” that is ever more relevant today.

KEYWORDS: Jørn Utzon, Sydney Opera House, Tectonic architecture, Transcultural influence

## INTRODUCTION

According to the architectural historian Kenneth Frampton, Utzon’s work is, “Comparable in subtle ways to the protean achievements of Le Corbusier, Utzon’s architecture emerges today as paradigmatic at many levels not least of which is the manner in which from the beginning of his career, he would totally repudiate the assumed superiority of Eurocentric culture” (Frampton, K. in Mullins, M. and Carter, A. (ed.) 2003: p.6)

Frampton’s reference to Utzon and particularly his Bagsværd Church, was previously in relation to a focus on Critical Regionalism in modern architecture, as described in Frampton’s seminal essay *Towards a Critical Regionalism: Six Points for an Architecture of Resistance*. Frampton limits his interpretation of Utzon’s Bagsværd Church to purely Occidental reading of allusions to traditional Chinese and Japanese temple architecture in timber in combination with the Nordic vernacular of stave churches. However, as I hope to suggest, Utzon’s range of transcultural influences are even more diverse, than suggested by Frampton’s interpretation of Bagsværd Church. It is Utzon’s fascination with ancient vernacular building cultures throughout the world and architecture that is appropriate to context, local climate, building materials and honest expression of its making, which inspires Utzon’s own architecture. In the process making Utzon both an exemplar of a critical regional approach, but also more significantly a

major exponent of tectonic architecture; as emphasized by Frampton's chapter on Utzon in *Studies in Tectonic Culture*, which Frampton very appropriately entitled *Jørn Utzon: Transcultural Form and the Tectonic Metaphor*.

Certainly Utzon's architecture demonstrates a profound poetic understanding of world culture, which he combined with an appreciation and use of modern building technology. His is an architecture that eschews kitsch historicism and the superficiality of ubiquitous universal civilization, but rather emphasizes the authentic use of materials and tectonic clarity of construction; which explains why the Sydney Opera House is such an enduring and ever increasingly appreciated work of world architecture; that has thus come to define both a city and nation.

The canonical importance of the Sydney Opera House and the brilliance of Utzon is becoming increasingly appreciated, particularly within the last ten years, furthered by the establishment of the Utzon Research Center in his hometown of Aalborg in Denmark and access to the Utzon Archives, together with increasing stream of publications and also symposiums, that consider themes within his work and design methods. In 2003 Jørn Utzon was at last awarded the Pritzker Architecture Prize, in recognition not only of his design of the most daring and iconic monument of the twentieth century, the Sydney Opera House, but also in a wide range of equally seminal works. That ranges from the most modest, yet handsome and humane Kingo houses, to the supreme sculptural abstraction and technical innovation of the Sydney Opera House and the understated monumentality of the Bagsværd Church with its poetic undulating ceiling, through to such visionary unrealised projects as the submerged Silkeborg Art Museum that still fire the imagination.

### **1.0 The making of an architect in youth**

As Utzon's himself has said it is, *"around the age of 18, plus or minus 5 years, are the years one becomes an architect"* (in an interview with Henrik Sten Møller) certainly in Utzon's case one should go back even earlier to find the roots of his architecture. As the son of a Naval architect and engineer, he moved from Copenhagen with his family when only a few months old from to the provincial Danish harbour city of Aalborg, where his father Aage Utzon became the chief engineer of the local shipyards. As Utzon explained to me it was his childhood experience of seeing the huge hulls of ships under construction in dry-dock in the Aalborg Shipyards, that his father was responsible for, that was later to not only give him the formal language, but also the self-confidence to realise the huge boat-like roof-shells of the Sydney Opera House that so profoundly and fittingly defines its magnificent harbour setting and in so doing has created Sydney's emblematic image.

Utzon's father had also gained an international reputation for designing yachts renowned for their speed and distinctive curvature of their stern forms, known as *Spidsgatter*, that are curved at both the bow and stern. A design of boat which had its origins back in the original Viking Longboats, that sailed from the area. It was through working with his father on the design and actual building of boats, that Utzon first came to experience the joy of seeing something physically take shape, gaining an understanding of the forces and stresses in construction and an appreciation of the inherent qualities of different materials. It is this understanding of boat building that gave Utzon his initial and lasting belief in the need for tectonic integrity of construction and form, together with the appropriate use of materials, which is honestly expressed. He learned also to think of complex three-dimensional forms by means of two-dimensional plans and sections. This is evident in the material submitted for the Sydney Opera House competition (1957), which included a beautifully rendered plan, simple sections and elevations, but no perspective illustrations of the exterior. For Utzon, "the plan" as Le Corbusier states in *Towards a New Architecture* "is the generator". (Weston in Holm, M, Kjeldsen and Marcus, M (ed.) 2004: p.28)

His father Aage encouraged in the young Utzon a deep appreciation of nature as a source of insight and inspiration, most particularly as a designer. Aage Utzon studied wave forms and the movement of fish, as a means to making modifications and improvements to the design of his boats, to make them go faster. For Utzon, nature was not only a source of inspiration; it was also where he found joy and refuge from school. Suffering as he did from dyslexia, of



which there was little comprehension or consideration of at the time, Utzon did not do well academically and did not enjoy being confined within a classroom, preferring being out in nature and most particularly on the water, sailing. As Malcolm Gladwell has written about in his book *David and Goliath* (Gladwell, 2013), it is often those that have to overcome disadvantage in their youth that over compensate in other areas and achieve most, later in life. Utzon and other notable architects, including Antoni Gaudi and Richard Rogers, have had to cope with dyslexia and have compensated by more greatly developing their visual and spatial faculties. In Utzon's case it was his abilities to draw that enabled him to enter the Royal Danish Academy of Fine Arts to study architecture, despite having very poor final grades from school that had denied him the possibility of following in his father's footsteps in becoming a naval architect.

Utzon was fortunate though that his artistic abilities had been informed by leading artists of the time, including the Danish artist Poul Schrøder and most notably the Swedish painter Carl Kylberg, with whom his family had close connections. These artists inspired Utzon greatly and while he was already an accomplished draughtsman through assisting his father; Utzon learnt from Schrøder how to draw freehand with soft expressive lines and from Kylberg, Utzon gained a painter's eye for nature, in terms of the relationship between colour, form and light. Utzon was also particularly fortunate that his uncle Einar Utzon-Frank was a distinguished sculptor and Professor at the Royal Danish Academy of Arts, who encouraged and supported his application to study architecture there.

As a student, Utzon persuaded the then semi-retired Professor Steen Eiler Rasmussen, the renowned author of *Experiencing Architecture*, and the leading Danish architect Kay Fisker to be his tutors. These mentors were instrumental in forming Utzon's subsequent thinking in architecture. It was Fisker, who extolled the ideal of 'constructive logic' as exemplified by the entirely brick built Grundtvig Church, in Copenhagen by P.V. Jensen-Klint, that established Utzon's total commitment to authentic tectonic approach that was to become a lasting principle in his own work and encouraged his fascination with the tectonic integrity of anonymous vernacular architecture that he found around the world, such as the mud brick buildings he experienced in Morocco in 1947 on his first travels outside Europe, that provided him with inspiration.

While it was Rasmussen, who passed on his considerable fascination with China, and introduced Utzon to the essential reference works on Chinese architecture, most significantly the *Ying Tsao fa Shi* the Chinese building manual of the enlightened Sung Dynasty (960-1279); which Utzon was to use later as an inspiration for the construction of the Sydney Opera House. As well as these insights to ancient architecture, Utzon also became familiar with the contemporary developments in architecture at the time; with the early volumes of Le Corbusier's *Oeuvre Complète* playing an important role in Utzon's education. Inspired by such sources of inspiration both ancient and the most modern, Utzon reacted against the austere formal international modernism as practiced by Arne Jacobsen, whose buildings it was jokingly said could all be modelled with a box of matches, "flat, it was a housing scheme; standing on its long edge, an apartment block; on end, an office tower" (Weston, 2002: p.18). Already as a student Utzon, who had little interest in either the Classical tradition or similarly formalist modernist architecture, was through the study of vernacular buildings and forms in nature seeking other sources of architectural form.

## **2.0 The Inspirations of Travel and Personal Connections**

On graduating in 1940, Utzon left German occupied Denmark and moved to Stockholm in neutral Sweden, like so many Danish and other Nordic architects at the time. Stockholm, particularly following the famous Stockholm Exhibition in 1930 had been the place of intersection and dissemination of new ideas within architecture in the Nordic countries, where connections were made between the International Style and the transformation of Nordic Classicism to Functionalism, and between architects from the different Nordic countries. It was in Stockholm that Utzon had his first direct experience of Japanese architecture, the Zui Ki Tei teahouse built within the grounds of the Ethnographic Museum. The refined post and beam construction made a profound impression on Utzon and upon other Nordic architects at the

time; as did the surgical like precision of the Japanese carpenters and the understanding that they crafted their own tools.

Though Asplund had died two years prior to Utzon's arrival in Stockholm, his work still provided the inspiration and catalyst for a developing Nordic Modernism. The renowned Finnish architect Alvar Aalto saw Asplund as a father figure within modern Nordic architecture and Utzon, who worked briefly with Aalto, was greatly influenced by these two leading Nordic architects in his own further development of a contemporary architecture that was humane, socially responsive, related to landscape and inspired by nature. As significant an influence, as Asplund and Aalto, during Utzon's early career, was his connection to the Norwegian architect Arne Korsmo. As Korsmo's father was a professor of botany, they found they shared an interest in the logical structures and forms found in nature, as a source of inspiration. They also understood that everything in nature was constantly undergoing change and evolution; that there was no form in nature that was final. This principle they believed should be extended to architecture and rather than create buildings as completed works that neither could be added to or subtracted from without disturbing their perfection of form, they felt architecture should express growth and change.

An organic conception of form was, for Utzon and others, confirmed by D'Arcy Thompson's *On Growth and Form* (1917), in which D'Arcy Thompson argued that the shape of all plant and animal life has a physical and mathematical basis and thus "form is a diagram of forces" whereby nature takes the most economical course of action according to physical laws. It was on the basis of this understanding that Utzon stated in 1948 in what was a personal architectural manifesto, that

"The true innermost being of architecture can be compared with that of nature's seed, and something of the inevitability of nature's principle of growth ought to be a fundamental concept in architecture"

Utzon's idea of organic growth can be clearly seen in his highly original competition design in 1953 for the Langelinie Pavilion in Copenhagen, which also combined transcultural influences of Chinese and Japanese pagodas, including notably the East Pagoda of the Yakushi-ji shrine in Nara, as well as the then contemporary inspiration of Frank Lloyd Wright's Johnson Wax Laboratory Tower (1947).

From the influence of Steen Eiler Rasmussen and other colleagues, Utzon was well aware of the benefits of travel and no doubt as a consequence of his dyslexia, had a great desire to experience the world and its architecture first hand. Once the limitations of mobility that the Second World War had imposed were removed, Utzon wasted no time in travelling as extensively as possible. Fired by images of Islamic architecture, Utzon set off for Morocco in 1947 for a few months, where he was to work on a project for a paper factory and a housing scheme. Stopping in Paris en route, he met with the Cubist painter Fernand Léger and Le Corbusier, as well as significantly the sculptor Henri Laurens, from whom "Utzon learned how one builds forms in the air, and how to express suspension and ascension" according to Sigfried Giedion (Giedion, 1982: p. 672). In Morocco, Utzon was greatly impressed by the cohesion and architectural integrity of the desert villages of courtyard houses built entirely with local clay, which unified them with the surrounding landscape. This unity of material and landscape was what Utzon had in mind when he later designed the Kingo houses and housing at Fredensborg. For Utzon as with many of his contemporaries, who shared his fascination with organic natural form, there was also a fascination with vernacular architecture, long before the subject was widely popularised by Bernard Rudofsky's pioneering classic *Architecture without Architects* (1964). Vernacular architecture, like structures in nature, having invariably been developed and refined through a continual process of evolution. Also what appealed to Utzon about vernacular architecture was its anonymous organic character in harmony with nature. As Philip Drew has commented

*"It was precisely this quality that Utzon wanted for his architecture; buildings without a signature that were distinguished by their quality of rightness and by how well they fitted in. and that possessed the same qualities of fitness,*

*economy and appropriateness of form as his father's yachts. This was much more important to Utzon than having his own name identified with a particular work.” (Drew, P. 1999: p.73)*

Utzon made another significant trip in 1949, having been awarded a travel scholarship, which enabled him and his wife Lis to visit the United States and Mexico. On this first trip to the United States, Utzon met Frank Lloyd Wright, while staying at Taliesin East. Jørn and Lis Utzon travelled across the United States, together with Arne and Grete Korsmo. On the same trip Utzon met with Eero Saarinen, who some years later was to play such a pivotal role in the judging of the Sydney Opera House competition and also had a more formal meeting with Mies van der Rohe, gaining the opportunity to see the then newly completed Farnsworth House. They then travelled west to visit Taliesin West, to see the Case Study Houses in California and most importantly for Utzon to meet Charles Eames, whose house assembled from mass-produced materials and components, with its somewhat Japanese-like aesthetic, he greatly admired. The influence of these individuals and their work upon Utzon was to be profound. The organic nature of Wright's work, its focus on landscape and dramatic horizontality, Mies's very different minimalist reinterpretation of a classical temple as a more extreme development of the work of Asplund and the generous open plan and industrialisation of the Case Study Houses and the Eames House, combined with his appreciation of Japanese vernacular architecture and influenced his own subsequent open-plan housing design, initially with the design of his own house (1952) and later development of the similarly open-plan and also open-ended Espansiva housing system (1969).

From the United States the Utzon's travelled to Mexico, visiting the pre-Columbian ruins at Chichen Itzá, Monte Albán and perhaps most significantly Uxmal, which bears the most similarities to the Sydney Opera House. The Mayan and Aztec architecture that he experienced there made a lasting impression upon him. With its great stone platforms and monumental stairs rising above the dense jungle to reveal the distant surrounding view, it convinced him of the potential of the platform in architecture; which was to firmly establish a defining element in his later major civic projects, most significantly as the podium of the Sydney Opera House.



**Figure 1:** The Sydney Opera House. Photo: Adrian Carter

### **3.0 The Sydney Opera House**

In his response to the remarkable location and the competition brief, it was Utzon's vision, alone among all the competitors that recognised that this unique site needed to be understood

in terms of its surrounding landscape and being visible from many surrounding vantage points required a sculptural solution with regards what Utzon described as the “fifth façade”. Without having actually visited the site, but with a mariners ability to read the topographic charts he had obtained of the Sydney Harbour, he was able to appreciate the particular morphology of the Sydney harbour basin, with its characteristic headlands that rise up just prior to falling into the sea; which he so eloquently emulated in the forming of the podium. Thus the podium, with its origins in the ancient architectural idea of the raised platform, becomes in Sydney a continuation and evocation of the local natural terrain, developing further upon Aalto’s notions of building as artificial landscape. This can be seen in the original section drawings of the Opera House, which show the podium shaded as a continuous landform running back through the Botanic Gardens

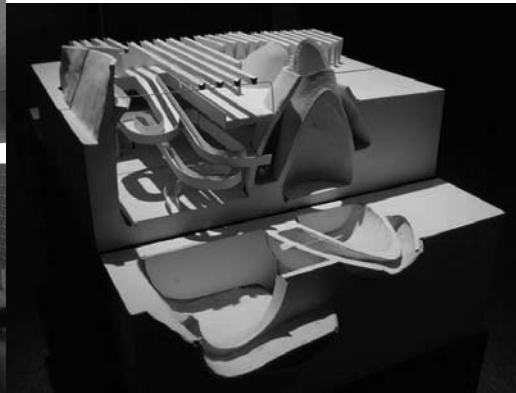
Seemingly floating above the podium, the Sydney Opera House’s signature sail-like roof shells were expressed by Utzon in his conceptual sketches as being like clouds hovering above the sea, both as experienced in nature and as evoked in ancient Chinese and Japanese temple roofs floating above a stone base. The choice of a combination of matt and glossy ceramic tiles to accentuate the sculptural character of the shells was both practical and also poetically intended to evoke the experience of freshly fallen snow; and owes its inspiration to one of Utzon’s favourite buildings, the Great Mosque in Isafahan. While initially the interior of Major Hall of the Sydney Opera House was to have had a multi-faceted ceiling, akin to Islamic musqarnas (Weston, 2002: p. 164) the crystalline-like “stalactite vaults”, that Utzon had admired at the ‘Friday Mosque’ in Isafahan. While the subsequent more acoustically appropriate convex curved interiors that Utzon eventually intended to be realised, were to be vibrantly articulated in red and gold, and blue and silver inspired by the traditional Chinese use of colour.

Part of the sacred experience of the building is the timeless, almost archaic experience of the podium incorporating the amphitheatres, enclosed within the cathedral-like arches of the roof shells. As the Australian architect Richard Leplastrier, who worked with Utzon, said during its construction “you could not really tell if it was coming up or coming down,” it had such a powerful presence like an ancient ruin. The Sydney Opera House is now perhaps the world’s most iconic building and has inspired so many, often desperate, visually orientated attempts to copy its success since. However Utzon’s own approach to the design was developed on the basis of the intended human experience of using the building, rather than mere image. The area in front of the podium steps provides a huge plaza for public gatherings and events, as Richard Weston has suggested it is possibly the greatest public space created in the 20<sup>th</sup> century. According to Utzon’s mentor Professor Steen Eiler Rasmussen “The architect is a sort of theatrical producer, who plans the setting for our lives.” For Utzon the grand stairs of the podium are intended to provide an almost sacral sense of rising above the humdrum everyday world, in the process providing a grand panorama of the harbour prior to entering the dramatic cavernous interior for the actual performance, having been sublimely prepared for a profound experience.

The realisation of the Sydney Opera House proved to be much more costly than anticipated and became the basis for a political campaign that eventually resulted in Jørn Utzon being forced to leave the project in 1966, long before its completion. Despite vociferous protests in support of Utzon from leading international architects and academics, as well as Australian architects, it was to no avail and Utzon left the country and moved with his family to Hawai’i, to teach at the University of Hawai’i at Manoa and be able continue to enjoy a climate to which he had become accustomed. Also to be closer to Sydney, should the political decision be taken to ask him to return as he expected; but which unfortunately did not happen until towards the end of Utzon’s life. Despite the later detrimental political machinations, enough of Utzon’s architectural genius and integrity was actually realised in a sufficiently unadulterated form, for the Sydney Opera House to achieve its iconic status. However the political smear campaign and false accusations against Utzon did great damage to his possibilities for commissions and subsequent architectural career.

#### 4.0 Bagsværd Church and other works

Fortunately the suggestion of a church in the published drawings for a competition entry for Farum Town Centre in Denmark that Utzon had submitted caught the eye of Pastor Svend Simonsen, who was seeking an architect for the proposed new parish church of Bagsværd, north of Copenhagen. As a result, Utzon was commissioned in 1967 to design what would become his single most significant built work in Denmark. The initial inspiration for the building was Utzon's constant fascination with clouds hovering above the horizon. In this case the actual cloud formations that triggered Utzon's design were those he experienced far from Denmark on a beach in Hawai'i. The interior of Bagsværd Church is conceived as a spiritual space for the congregation to gather in an evocation of the Danish open horizontal landscape beneath billowing concrete ceiling vaults, as if under rolling clouds, through which diffused light enters. Remarkably for the design of a Protestant Church it is possible to see in his initial sketches for the section of Bagsværd Church, Utzon's interpretation of Arabic calligraphy and an Islamic prayer to heavenly light, in which Utzon saw great aesthetic beauty. The multivalent transcultural layering of many diverse influences from world culture in combination with modern building methods, results in an authentic and yet contemporary sacred space, that avoids resorting to kitsch symbolism. While in tectonic terms the curvature of the ceilings provides structural strength relative to the minimal thickness of the in-situ concrete, as well providing a beautiful quality of diffuse light and excellent acoustics. The modest, pre-fabricated industrial character of the exterior, was both a pragmatic necessity to be able to finance the interior within the limited overall budget, but also serves to heighten through contrast the experience of the sacred space.



**Figure 2:** Bagsvaerd Church. Photo: Adrian Carter **Figure 3:** Model of Silkeborg Art Museum. Photo: Adrian Carter

Amongst Utzon's unrealised works, is one of the outstanding un-built projects of the 20<sup>th</sup> century, the Silkeborg Museum (1963), designed to house the work of Asger Jorn. Inspired by the Yungang caves near Datong in China, which contain numerous often giant Buddha figures carved out of the stone; the Silkeborg Museum with its cavernous submerged galleries, shaped like emerging crocus bulbs, was intended to liberate the art within sensually curved spaces, which because of their curvature would seem to disappear. The cave-like character of Silkeborg Museum is the natural complement to the platform Utzon was simultaneously working on in Sydney and reveals his equal fascination with the idea of the cave and the notion of prospect and refuge, as also in his own remarkable reinterpretation of a Mediterranean

house, Can Lis (1971), on Mallorca, where as in so many of works he creates a profound sense of the archaic and timelessness.

## CONCLUSION

That Utzon's work was influenced by such a wide range of transcultural influences, most from direct personal experience, cannot be doubted. However his travels were so extensive and his sense of observation so constantly acute, that it is difficult to say with complete precision where exactly the specific transcultural references for each particular project came from and this was also the case for Utzon himself. When I asked him directly about the associations between his works and possible influences, he would usually agree that there was a likely connection, but then add many other possible contributors, that left he himself unsure as to the original source of inspiration. Thus the podium and steps of the Sydney Opera House, most associated with the Mayan temples of Mexico, could also have been influenced subconsciously by memories of Engels great white cathedral in Helsinki, approached by a grand broad staircase from the Senate Square, which Utzon experienced as a young impressionable architect working in Helsinki with Alvar Aalto. Similarly the proposed golden interiors suggested in the competition perspective for the Sydney Opera House, could owe as much to the famous Golden Hall of the Stockholm City Hall, that Utzon knew from even earlier in his career, as much as his fascination with Chinese architecture.

While it may not be possible to say with complete certainty where all Utzon's particular influences came from, only make educated and reasonable assumptions based upon his own statements, together with the evidence of his travel sketches, photographs and films. It is clear that without his enthusiasm for travelling and openness to transcultural experiences, his architecture would not have been as rich or as significant.

Utzon personally always distanced himself from theoretical interpretations of architecture. He had no need of theories to validate his approach to design; rather he had a thirst for universal knowledge and sought out inspiration in the intersections and connections that he experienced in the wider world around him, in a dynamic on-going process that constantly re-informed his work. Utzon's dedicated explorations and refining of significant universal themes in architecture will continue to provide an enormous resource and inspiration for architects. His timeless organic approach to design, design methods and process, rather than historic style also ensures his continued relevance. While the humanity of his artistic vision, its tectonic integrity and sensitivity to place combined with a contemporary use of technology to achieve these aims, provides a source of inspiration for innovative, humane and meaningful architecture in the future.

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# Re-contextualizing the architectural learning experience: an alternative perspective (part v)

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**ABSTRACT:** Canadian Indigenous students struggle to situate their cultural knowledge within a Eurocentric academy, in part because indigenous ways of knowing are informed by a philosophy that is characterized by 'interconnected' relationships rather than an isolated system of thought. In response to this division of minds, the most immediate and intuitive approach is to counteract this perception with a series of strategically placed discussions across a diverse cast of research actors with the intent to reconfigure and *emerge*<sup>1</sup> with a renewed sense of cultural understanding while escaping the nuances that strain Indigenous-Western relationships.

Viewed as an act reciprocity this relates to architectural learning when one considers many of today's contemporary schools of architecture are desperately seeking to establish a restored balance between the complexities of architectural praxis; namely those that are engaging with complex social systems and where the profession is not only being pressured from afar but also from within to respond in creative ways that go beyond traditional means of Western research and conventional practice.

Operating from an Indigenous paradigm, this presentation offers a set of ideological tools for analyzing non-Western cultures, which aim to diminish the risks and avoid the dangers of the misinterpretation of indigenous archetypes and their personal impressions. Another reason the discipline ought to remain open to an Indigenous paradigm, to raise questions of relevant research regarding the design of Indigenous communities that allow for young Indigenous people to contribute, help redefine, and bridge the critical discourse of architectural rhetoric in the 21<sup>st</sup> century. In turn, addresses the need for academia to take part in the preservation of Indigenous knowledge systems, thereby encouraging Laurentian University, Canada's newest School of Architecture in 35 years to facilitate an ethical middle ground (or space) for architectural learning that does not exclude an Indigenous worldview while helping to re-contextualize Indigenous traditions.

**KEYWORDS:** emergence, epistemology, indigenous, paradigm, reciprocity,

## 1.0 Addressing the need for inclusion of indigenous culture in the architectural academy

This article represents a piece of writing within a larger body of *design-based research*<sup>2</sup> aimed to address the absence of an Indigenous epistemology across Canadian Schools of Architecture. In doing so, what is created is the expansion of an intellectual space – *toward an ethical middle ground*<sup>3</sup> - for cultural dialogue that is both intuitive and counter-intuitive to an indigenous worldview. As expressed by Smith and Schank-Smith (2003), in *Perspectives on Diversity and Design*, "Architecture and the built environment can never embrace the challenges of the future without the infusion of new ideas, technologies and especially diverse individuals and approaches. If we refuse, we are destining ourselves to be suspended in the past."

When viewed as a pressing inadequacy, where many global academies - not just Canadian - are unable to bring the indigenous person closer and into direct contact with something or someone representative of their worldview then, a greater obligation is placed upon that academy to uphold the ideal. If universities are a place for universal discussion and serve as repositories of universal knowledge then, without trepidation the academy must remain open



without scrutiny and judgment of the cultural knowledge future indigenous architectural students and scholars will bring forward in the years to come. This deficit not only relates to both the architectural academy and indigenous students of design, but also, it positions favorably a renewed future by calling on all people of Indigenous cultures in the academy to be preservers of indigenous knowledge informed by the creation and recreation of designed stories. Moreover, calls into the action the instructor who serves to benefit the student first with their knowledge and, hopefully, reciprocates a course of design action where intelligence is challenged, extended and held with integrity between all others. Such demands indicate that now may be the time to consider an alternative perspective with which today's indigenous student of design can help redefine and address this academic challenge.

## 2.0 The political context that preempted a culture's isolation in the academy

Now having to address a more significant issue – *the demoralizing and historical effect residential school systems have had on indigenous peoples in the academy* - not because it engages with a long-standing strenuous relationship held between Canadian institutions and the indigenous peoples within them, but rather, because it reminds us of the continued challenges indigenous peoples have to overcome and still do when concern for indigenous knowledge is persistently appropriated, articulated, and reframed for the Western ideal. For far too long indigenous students in the academy have been socially entrenched without having the opportunity to engage and grapple with the historical trauma imposed upon their peoples as a result of the residential school system (Figure 1). As a result, the indigenous person not only surrenders their individual identity, but also continues to surrender the authority of their cultural creativity along with any ontological style they might employ to rightfully position them self in the academy alongside others.<sup>4</sup> Although this is *not* the central investigation of the article, it drastically reminds us of the inflicted learning conditions – the way schools were architecturally designed - placed upon Canada's Indigenous people.



Fig. 1 Cree students in Residential School, Saskatchewan, Canada, 1945

The historical and political context imposed upon Canada's Indigenous people sets precedent for the culture's isolation in the academy that exists to this very day. As an undertone to the development of this article, it is imperative to raise the political consciousness of the reader and to bare all truisms that reveal why there may not be any previous architectural criticism offered by a person of indigenous identity. The simple reason is, schools at one time were used as instruments (or tools) of oppression imposed upon Aboriginal people since the early 17th century, when European missionaries established schools for Aboriginal people on Reserves. Since Aboriginal children were seen as the segment of Aboriginal society that would be the most receptive to the imposed standards of Western civilization, assimilation through education became a primary concern of the Canadian Government (Cardinal, 1999).

Therefore the ensuing challenge for any Canadian school of architecture with Indigenous students is to provide an education that is meaningful, culturally relevant and, if possible, supported with quality enhancing education standards. Unfortunately though while

improvements that address indigenous learning styles and ways of knowing have been made at the elementary level, it is still the higher schools of thought, namely our universities that continue to be based on Eurocentric models of education. As a result, today's Indigenous student in any discipline of study – not just architecture - is caught at the extremities, between the margins of society, outside the dominance of Western modalities, always in tension and fully aware they are in prime position to renegotiate their personal senses, values, ethos and ontological traditions in relation to the Other.

### 3.0 The Indigenous paradigm

As we have come to understand, Western architectural traditions have long-established modes of delivery. It is a credible profession that increasingly branches out into individual rational sciences, each with an isolated sense of order. As a result, the epistemological<sup>5</sup> dichotomy – Western versus Indigenous - forces Aboriginal students of architecture to justify their ways of knowing to and for the dominant culture while the academy enjoys fresh opportunities for cultural enrichment (Turner, 2006). When viewed as a dichotomy the “indigenous paradigm” emerges. The indigenous paradigm deals with a culturally specific discourse based on indigenous peoples premises, values, and connectivity to the world. Rigney (2001) argues that an indigenous paradigm reflects our epistemologies (ways of knowing), our axiologies (ways of doing) and our ontologies (ways of being). Notwithstanding these multiplicities, an Indigenous paradigm across design-based disciplines means pushing the boundaries ‘in order to make intellectual space for indigenous cultural knowledge systems that were denied in the past’. Take, for example, the following table that positions Western (Scientific) Knowledge to that of Indigenous (non-Scientific) Knowledge. The inherent differences may seem rudimentary but they bring into focus a fundamental division of thought in terms of economics, relationship to environment, philosophy and architecture. The more detailed the comparisons, the more obvious the differences become in almost every category; in many cases they are complete opposites and inform different epistemological stances.

Western (Scientific) Knowledge	Indigenous (non-Scientific) Knowledge
<b>Economics</b>	
Concept of private property a basic value; includes resources, land, ability to buy and sell Nature	No private ownership of resources; no concept of selling the land; human beings are part of nature
<b>Relation to Environment</b>	
Conquest of nature celebrated; living beyond nature's limits; humans viewed as superior	Respect natures limits; no desire to change landscape; humans are not superior
<b>Religion and Philosophy</b>	
Linear concept of time; technology dictates; machine over manual; the dead are gone	Time is measured according to natural cycles; manual over machine; dead regarded as spirits
<b>Architecture</b>	
Construction designed to survive human life; hard-edged forms imported; earth covered with concrete.	Construction designed for changing life-styles; soft-forms; local knowledge; earth is not paved.

Table 1: Inherent Differences. Source: (Mander 1991)

Whether we want to acknowledge, undermine or reject notions of an indigenous paradigm, many Western scholars - past and present – have ignored the indigenous paradigm and its epistemological value. Why? As stated by Kuokkanen (2000), “Western scholars often treat indigenous ways of knowing as primitive, primordial, unsophisticated or in other ways inferior, simply because of their reluctance and, in some instances, total ignorance to want to grasp the totality of an indigenous worldview or Native American approach to life.” Fortunately though,

proactive scholars have started to rationalize the need for an alternative perspective specific to architectural education.

In this case, Smith and Schank Smith (2003) state, “similar to a pendulum in motion, the paradigms governing architectural education swing with trends, movements of philosophy or approach. Within such change new concepts can be realized, since, the voids left by the pendulum’s movement can be filled by the marginal. Here we define margin as a part of anything, for example a society or organization that is least integrated with its center, least often considered, least typical, or most vulnerable. The marginal represents people, ideas or things not included within the center. Those on the edge can be the most unpredictable but also more interesting. It is within this margin that a diversity of ideas exists. We believe that by “creating an environment allowing a degree of play” it becomes more possible to successfully engage the marginal, encouraging diversity. This is not only the diversity of gender and ethnicity but also of approaches to design and basic tenets that can then be integrated into and influence architectural education. The swings of the pendulum might reflect changes in culture, but in the case of a school of architecture this reflection may constitute the profession or the academic environment.”

#### 4.0 Personal Impressions

The strength and value of an interdisciplinary design approach invites a larger and more critical discourse of cultural action<sup>6</sup> to be established. Not only does this approach overtly reveal the social, cultural, and imaginative qualities of the individual being interviewed but also, provides us with genuine glimpse of the cultural differences or personal impressions we have toward each other. As we shall read, whether expressed as an unspoken idea or a paradigmatic way of knowing, instructors with different cultural backgrounds start to see and understand how an indigenous student struggles to establish a deeper and more intellectual sense of connection to their peers. This begins, strategically, by questioning the perceptions of the instructor with a different set of hermeneutic principles (or interpretation values).

#### Interview with Dr. John DiNova

Dr. Joanne DiNova is a Ryerson University instructor in the Faculty of Communication and Design and is of Aboriginal heritage (Anishinawbe Métis). In her interview, she describes an indigenous way of knowing as a type of oral-literature binary located in many cultures. Afforded with Joanne’s discussion is an opportunity to explore some of the perceived shortcomings associated with an indigenous realm of thought, but also the acknowledgment of how Western thinkers were at one time able to think purely in the abstract without any connection to reality and how this disconnect is one of the major differences in the way Indigenous and Western cultures express themselves. The interview went as such:

**KC:** One of the design challenges I am experiencing is how we connect *with* materiality knowing indigenous cultures have undergone a shift from oral-based societies to one that is written (hints of Walter Ong).

**JD:** In relation to my own research, I did not focus on indigenous thought and literature at first. When I started getting fascinated by Native literature, I found that, in general, it was not understood in the critical mainstream. It was usually read against an oral/literate binary, as the product of a less advanced culture that was only recently shifting from orality to literacy. Oral cultures, the thinking went, had just recently acquired writing, so they were not as cognitively advanced. So the literature was mapped against a linear progressive model of language, which I totally reject. I looked at two different worldviews, the Aboriginal worldview and the Western worldview. Then I pulled them apart – in reality, they are not entirely separate – and did a comparison and contrast thing, and then brought them together in the end, a kind of dialectic.

In general, the dialectic is rooted in the ordinary practice of a dialogue between two people who hold two different ideas or ideals and wish to persuade each other. The presumption is

that even if they do not agree in total they at least share some meanings and principles of inference (conjecture), something that is revealed in Joanne's discussion.

**KC:** Tell me more about your experience when you brought an indigenous way of knowing to the academy? How did the structure of the university take to that? How did they embrace it?

**JD:** It was definitely challenging and a real struggle, and having to assert that this knowledge was worthy of critical attention. Also, there was a growth period for myself personally because I came in wanting to study Shakespeare. In regards to Aboriginal literature, there tends to be a contest over the scholarly territory or something, a real struggle over who really has the right to speak authoritatively on matters of Aboriginal literature. Will it be the people whose literature it is? Or the people whose academy it is? It's really hard to stay in that battle for a long time.

Joanne expresses a common experience among many Aboriginal students and scholars and that is, the uneasy relationship with indigenous forms of knowledge because they have been assigned the task of representing their communities (and often other indigenous communities) in the intellectual world of dominant cultures. Again, reinforcing the dilemma Aboriginal students encounter when they are required to justify their ways of knowing to, and for, the dominant culture while the academy enjoys fresh opportunities for cross-cultural enrichment (Turner, 2006).

**KC:** What kind of medium, message or symbol can you identify with throughout your research? What did you use to help you with the narration?

**JD:** With my thesis, *Spiraling Webs of Relation*, it was the Dream Catcher – where everything is connected, only it's not static - it continuously shifts. That kind of model informs Aboriginal literature and the indigenous way of knowing. With the Western way of looking at thought, everything is seen as linear and evolving. So Western thought is seen as up here (motion of hands above head) and it has evolved from what are considered more primitive forms of thought. But Western thought had something like the spiraling web. You can see it with words such as a "spell" and "spiel." The words have the same root. To put a spell on someone is to spin a spiel. You story something into existence, same with the words "spirit," and "respiration," and "inspiration." The spiritual is buried in the English language as well. If you go far enough back, it's there. It's something that was lost. Some variation of the indigenous way of knowing is in every culture. When Western thought lost it, though, Western thinkers were able to think purely in the abstract, without any connection to reality, which can be very powerful, and a very dangerous, thing to do.

**KC:** That is a very interesting comment that they lost the abstract. When you look at indigenous cultures and how we maintained it, how a complete generation may have lost the language, do you think that is the strength we have right now?

**JD:** In terms of Ong and the notion of evolution towards the abstract, I think we were hugely abstract thinkers already, and quite comfortable with the abstract, because the abstract and the spiritual go together, they may be the same thing, and for traditional indigenous thought, there wasn't a division between the abstract and the material. I think that was and still is the big difference. Even though we have something embedded in us – embodied knowledge – it's in every culture. I think the Aboriginal way of knowing – always finding connections to everything – will try to find some relation to contemporary Western thinking. There can't be an absolute split between Aboriginal and Western ways. Somehow we have to find a way to relate with each other's way of knowing, even if it is imposed or emerging.

Key to this interview with Joanne is the notion indigenous people are able "to move freely and quite comfortably in the direction of the abstract" since much of their traditional customs are

informed by a type of secular thought. She attributes this to be a significant strength with the way Indigenous students come to understand their place in the world and now more recently, across academic settings. As a result, indigenous students will often express themselves in terms of a type of creation story, splicing their story into existence, perhaps even with simple artifacts like the Dream Cather that allows them to combine material exploration with a metaphorical construct (or sub-creation) of their own. From this perspective it becomes evident that the knowledge associated with the making of an object or artifact is connected with the tacit wisdom of the body. The term tacit being understood or implied without being openly stated, not spoken and, perhaps, even seen as “an unspoken idea”.

### **Interview with Marco Polo**

Seeking to counterbalance the indigenous perspective offered up by Joanne the following interview with Marco Polo, an Associate Professor in Ryerson University’s Department of Architectural Science was conducted. Marco’s research interests include Criticism: Contemporary Canadian Architecture, History: Canadian Architecture since 1945, Regionalism in Canadian Architecture and the Cultural Dimensions of Sustainability. He is non-Aboriginal and describes in great detail the essential role narrative techniques have played in establishing first principles of architectural representation and its ordering systems.

Marco’s interview gets to the core of architectural structuralism, both in a linguistic and meditated sense while shedding light on the affordances an indigenous way of knowing has to offer but in a more paradigmatic way – namely, narrative techniques allow for the development of a social and cultural construct which can be interpreted as a form of cultural continuity that allow for living cultures to maintain traditions, adapt to change and to invent and reinvent in the context of changed locations while adhering to their histories and traditions.

**KC:** What is your understanding of The Primitive Hut and how do you use this theoretical piece as a narrative, which is in fact a type of artifact, throughout your course of research and teachings? Moreover, what other themes of interest do you draw upon from architectural history?

**MP:** The Primitive Hut is a fundamental paradigm in architectural theory. It’s about taking architecture back to first principles. Many theorists have talked about it in those terms, each with a slightly different stance but it’s the same story just told in a different context. Essentially the Primitive Hut is a different thing to different people so it depends on the story you want to tell. The question then becomes, which primitive hut do you go back to? What is the cultural lens you are going to use? I can tell you some of the different lenses people have used to tell that story in the West. Fundamentally it’s about origin myths - the origins of architecture – again, where different theorist have spun it different ways to tell different stories. We are also a story telling culture [in the West]. The difference is we formalized our stories to such an extent that we now treat them to be true, when in fact they are still just stories with elements of truth, along with a lot of embellishment and conjecture. Also, there is a lot of filling in the gaps so there is a lot of spinning the story to suit a particular outcome. So for me, teaching architectural history and theory is interesting because they are based on the stories people and cultures concoct for themselves and there are a lot of different ways to interpret those stories. In the end, of which there really isn’t one, the story is never told the same way twice. It simply spirals continuously.

The process of narrating is a natural way of recounting experience, which can also be a practical solution to addressing fundamental problems in life that allows for the creation of reasonable order with the unknown. Very often, the concept of narrating, or the narrative is used in connection with how to represent a quantitative research study. Others have claimed that the narrative approach is not a method but rather, an established or reconfigured frame of

reference (purposeful strategy) in a design research process wherein the narrative also serves as artifactual piece and can be seen as producers and transmitters of a constructed reality.

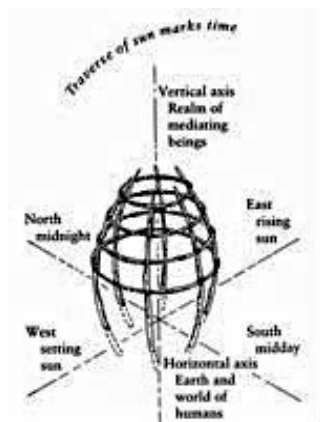


Fig. 2 Indigenous Axis Mundi, Nabokov and Easton, 1989

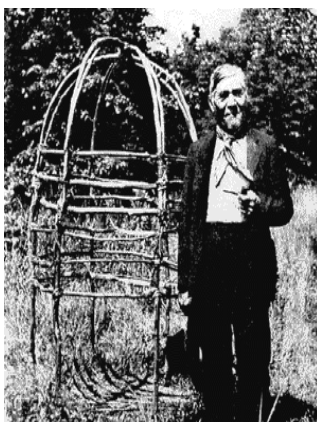


Fig 3. Shaman and his dwelling. Nabokov and Easton, 1989



Fig 4. Venice Biennale: Gravity & Airflow Artifact Installation, 2008

Marco also states that the origin of dwelling associated with Laugier's continues to give us enduring starting point for the recreation and mediation of the Primitive Hut at any time and place in history. It became the primary vehicle for a philosophy on architectural discourse and origins or architectural veracity in any writing thereafter when, in actual fact, the Primitive Hut is a piece of architecture conjecture, which theorists use as a way to discuss their theories that allow them to express their knowledge of human speech, community and culture, perhaps, even serving as an essential structural frame that allows for architectural form and reasoning. This type of philosophy on architectural reasoning can be seen and understood in the "conjuring lodge" wherein the indigenous shaman enters - *he is at the center of his world* – a place where he can make immediate contact between two figured worlds: the horizontal world of humans, and the vertical world of mythological beings (Figure 2 and 3, Nabakov, 1989) (Figure 4, Chakasim, 2010)

**KC:** Moving forward. Aside from borrowing from other pieces of architectural history and its first principles, what have you utilized to narrate your story, a type of metaphor?

**MP:** That's interesting. First of all, what I understand is that when stories come together, where certain themes could co-exist and other themes couldn't coexist, *there is a dimension of thought we enter and we do it unconsciously.*

This is a very interesting and critical comment provided by Marco. First, it involves the idea and ability for a person to develop a deeper mental construct with the way stories can come together, which, coincidentally, is derived from Noam Chomsky's theory of how the mind generates language. Chomsky (1968), in *Language and Mind* holds that the mind has the innate ability to organize the world and to frame this understanding with structured language. The reasoning is that architectural forms and form making processes must be generated from innate orientations within the mind, very much the way in which human language is oriented from the body – observation through movement.

**MP:** For instance, where there might be a model or framework a person can work from, he or she will go over their material over and over but they are not going at it in the same way. What they reveal or withdraw from the individual(s) is the retelling of a story but they keep hearing and telling it at a different level. The first story is everything. It's true to an extent that it controls a person's life completely. The next level is that you start to see it as

something else, *you can still feel it* but it doesn't govern your behavior to learn how to cope and, later at another level it becomes something else. Expressed as a metaphor, again, the ideal would be a spiral, by going deeper and more focused in thinking. The story doesn't change, but the individual's perspective and their role in the story changes radically. A lot of this stuff is complex so when we say, it spirals continuously, I find that very interesting.

As with the previous interview, Marco identifies the spiral as a paradigmatic symbol in the sense it is one of the major metaphors used to describe an architectural ordering system. What is more interesting is how Marco expresses the spiral as a procession towards the unknown or across the unknown - which is fundamental to an indigenous worldview and the oral based narrative structures Aboriginal students continuously create for themselves - connecting personal linkages between natural points of change.

Marco iterates that individuals within certain traditions are impervious to change where there are key opportunities to capitalize on this continuous change. In fact, according to McMinn and Polo (2005) in *41<sup>o</sup> to 66<sup>o</sup>: Regional Responses to Sustainable Architecture in Canada*, "An emerging body of scholarly work supports the perception that the time is ripe for an approach to sustainable architecture that goes beyond technological considerations to address a variety of intangible but essential cultural values." In other words, emphasis is placed on "approach" with the intent of "grasping" the conditions that make those cultural values acceptable at the moment.

As we have heard and read from the interviews conducted with Joanne and Marco, it is understood that one's figurative language becomes immediate, more so than writing, because of the mind's ability to organize the world and to frame this understanding with a structured language – even if it seems abstract and contradictory to opposing worldviews. Moreover, it is a proactive way of drawing out comparisons in the form of narrative. As much as any narrative is a string of symbols, gestures and mediations that allows for different knowledge structures to be heard or understood, we must *not* limit ourselves to a single course of action, method or mindset if we are to create pedagogical spaces inclusive to indigenous people worldwide.

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<sup>1</sup> The term emergence, of course, implies the appearance of something new, something unexpected. Although it may be hard to capture as a design process it raises interdisciplinary questions as to how we must prepare for the rise of an enormous Canadian urban Aboriginal population.

<sup>2</sup> Design-based research is an emerging paradigm aimed to capture the study of learning through systematic design and/or instructional strategies. Design-based research can help create and extend knowledge about developing, enacting, and sustaining innovative learning environments (Brown, 1992; Collins, 1992).

<sup>3</sup> The term 'middle ground' is synonymous with the term 'ethical space' and is informed when two societies, with different worldviews, are positioned to engage with each other. It is the space in between them that contributes to the development of a cultural framework from which this report aims to achieve.

<sup>4</sup> The notion of an ontological style – *ontology: nature of being* – is associated with the theoretical underpinnings associated with Heidegger and the supportive role of reflexive strategies. Wherein reflective equilibrium is characterized by deep thought in relation to others (humans), reflexive strategies take account the role of the researcher and the type of self created work being investigated for discussion or debate - an essential binary (or twofold) of sorts.

<sup>5</sup> In general, epistemology is the philosophy of knowledge. It asks simple questions we have long taken for granted: "What is knowledge?" What is indigenous knowledge? What is the difference between the two types of knowledge?" In short, it is a vital cultural debate to the issue of knowledge because it represents and may help fulfill the academic needs of Aboriginal people.

<sup>6</sup> The term 'cultural action' promotes the understanding and acceptance of values, beliefs and the stories we choose to tell about ourselves – it is culture at work.



# Design of a Sustainable Housing Complex in Haiti through Energy Modelling and Simulation Process

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**ABSTRACT:** This paper presents the results of design research for the development of a sustainable housing complex in Haiti using the energy modeling and simulation processes. This study explores architectural and sustainable design strategies to design a prototype sustainable housing complex in a tropical climate that applies specifically to Haiti. In this research, the history, geography, and culture of Haiti are briefly analyzed in the context of family unit, community and economic aspects. The climate conditions are analyzed in the context of residents' comfort, and the general guidelines are presented on how to design sustainable housing in tropical climate. The main research focus of this study is on the effectiveness of natural ventilation in the design of the Haitian housing complex. Due to the consideration of the poor economic situation of Haiti, especially after the massive earthquake in 2010, the design is focused on the passive strategies, not considering active mechanical cooling and heating systems. So, natural ventilation, as the main sustainable strategy of this study, is the key parameter to investigate using the EnergyPlus simulation program. Another following important parameter is the "adjusted comfort zone for Haitians." The energy modeling and simulation technology is extensively used to make design decisions in this regard. The summary of this paper includes the proposed optimal design options and the adjusted comfort zone for Haitians. The effect of natural ventilation is also presented showing the improved indoor temperature and humidity levels of the proposed design compared to those of the conventional construction of Haiti.

**KEYWORDS:** Natural ventilation, Haitian comfort zone, EnergyPlus simulation, Haitian housing complex

## INTRODUCTION

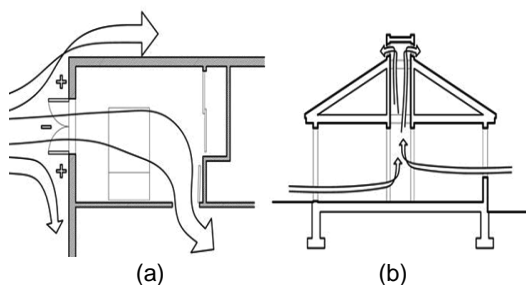
Haiti is one of the poorest and least developed countries in the world with 8.7 million residents. Haiti has struggled with many problems in recent years such as political chaos, severe environmental degradation and an annual barrage of hurricanes. On Jan. 12, 2010, a massive earthquake struck Haiti, changing its capital's face, Port-au-Prince, to wreckage. Even before the shocking earthquake, Haiti had a feeble economy. Haiti has the lowest level among the world's lowest levels of gross domestic product per capita. Public education is not widely available. Infrastructure, health and social services are often worse than in sub-Saharan Africa. 80% of the population is living under the poverty line and 54% of them are living in abject poverty (Central America and Caribbean: Haiti 2013).

Haiti's geographic coordinates are at a longitude of 72° 25' west and latitude of 19° 00' north. It is located in the subtropics on the western third of Hispaniola between the Caribbean Sea and the North Atlantic Ocean. The climate is mild-hot and varies with altitude. However, since Haiti is a Tropical Island and surrounded by warm water, temperatures do not vary much over the course of the year. That is why the relative humidity ranges from 75-85% in early morning to 55- 65% during the afternoon. A classic household in Haiti consists of main family members and in some cases young relatives. House style and construction material in Haiti varies from region to region. For example in dry area, most of southern Haiti, houses are constructed of Hollow Block Concrete (HBC) or stone. In wet area, which is most of Northern Haiti, houses are made of Hispaniola pine and local hard woods or wattle and are daub with mud. Haiti also has inadequate energy resources. The country has no petroleum resources, little hydroelectricity potential, and quickly diminishing supplies of wood fuels (CIA 2013). Having

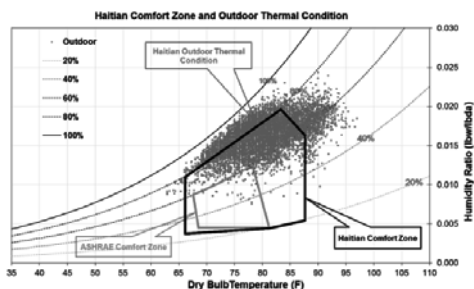
virtually no access to electricity, Haiti's poor people depend on the cutting of trees for the production of charcoal. Therefore Haiti government needs to focus on sustainable development that protects the environment and produces local jobs by creating a clean energy economy.

In regard to the poor economic situation of Haiti, especially after the massive earthquake in 2010, the passive strategies are mainly used in the housing design process instead of active mechanical cooling and heating systems. This research focuses on energy saving strategies that reduce the demand for energy in Haiti and emphasizes on the use of natural ventilation, as one of the important sustainable passive strategies in the region during the housing design process. To evaluate the effectiveness of natural ventilation in the design of the Haitian housing complex, two optimized Haitian houses with a slight difference in footprint and zone orientation have been modelled and simulated in EnergyPlus (USDOE 2010). The thermal conditions of the cases are compared to those of the traditional Haitian house.

Natural ventilation generally depends on breeze in the hot seasons to remove heat from the building and provide air movement to cool the occupants. Natural ventilation can be divided in to two categories: cross ventilation and stack ventilation. Cross ventilation drives air through openings in the building using pressures generated on the building by the wind, where air enters on one side of the building, and leaves on the opposite side (e.g. Fig. 1a). Based on natural ventilation principles, the opening of the windward side has to be less than the leeward side to get fresh, comfortable indoor air (Lomas 2007). Stack ventilation also is a passive cooling approach that takes advantage of temperature stratification (e.g. Fig. 1b). When air gets warm, it becomes less dense and rises then ambient air replaces the air that has risen. This natural convection generates an air current, where warmer air is depleted at a high point roof vents, and cooler outdoor air is brought in at a lower level (Kwok and Grondzik 2011). These types of high opening vents collect the hot air near the ceiling and are most useful for night-flush cooling (Lomas 2007).



**Figure 1:** Natural Ventilation categories: a) Cross ventilation through Inlets provides air movement in occupant level inside the house, and b) Stack ventilation configuration. Source: (ClimateConsultant 2008)



**Figure 2:** Haitian comfort zone and outdoor condition in comparison with ASHRAE comfort zone. Source: (Authors 2013)

As mentioned, Haiti has a humid tropical climate with hot temperatures throughout the year, so in most of the time Haiti's weather temperature is out of ASHRAE comfort range. ASHRAE Standard 55 specifies conditions in which a specified fraction of the occupants will find the environment thermally acceptable. The revision of Standard 55 includes the addition of the PMV/PPD calculation methods and the concept of adaptation (ASHRAE 55-2004). According to the adaptive hypothesis, contextual factors and past thermal history affect building occupants' thermal expectations and preferences. One of the predictions of the adaptive hypothesis is that people in warm climate zones prefer warmer indoor temperatures than people living in cold climate zones (De Dear and Brager 1998). Moreover, new Adaptive Comfort Standard (ACS) allows warmer indoor temperatures for naturally ventilated buildings during summer (Brager and de Dear 2001). However, based on the above discussion, Haitians have been adapted and strengthened toward harsh climate conditions due to poor living conditions and limited energy resources. Thus, it is reasonable to define a new Haitian comfort range based on the specific conditions in Haiti. Figure 2 shows the Haitian comfort zone on the psychometric chart in comparison with ASHRAE comfort zone. Red points on the psychometric chart show the outdoor condition during the year.

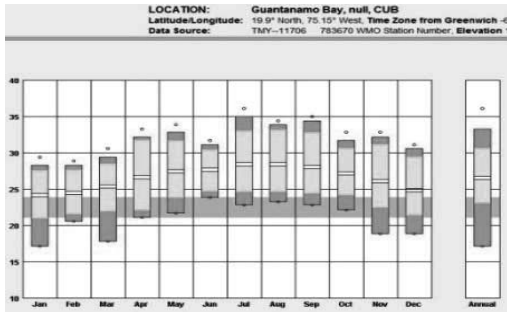
### **1.0. HAITI WEATHER CONDITION**

Haiti has a humid tropical climate with hot temperatures throughout the year, which becomes more mild and fresh with an increase of altitude. The dry season starts from December to March and wet season begins from April to November. Port-au-Prince, ranges in January from an average minimum of 23° C (73° F ) to an average maximum of 31°C (88°F ); in July, from 25–35°C (77–95°F ). The rainfall pattern is varied; however, Port-au-Prince receives an average annual rainfall of 137 cm (54 in). In the study, due to the lack of weather data information about Haiti, the three models have been simulated using the weather data from nearest country, Cuba. Figure 3 shows the outdoor temperature range during the course of the year in Guantanamo bay, Cuba.

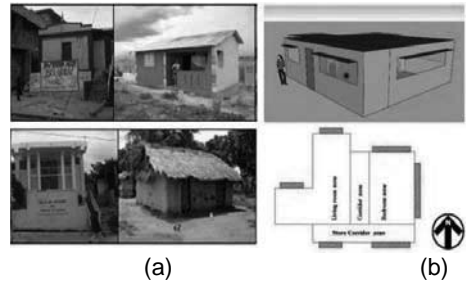
## **2.0. SUSTAINABLE HOUSING COMPLEX DESIGN PROCESS IN HAITI**

### **2.1. Haitian Base-case house (Traditional house)**

The majority of Haitian houses have a simple rectangular form for two main reasons: flexibility for future extension and solar heat gain (e.g. Fig. 4a). Building housing in Haiti is a lifetime project which is executed in many phases because of the economic hardship. Consequently, the rectangular shape house gives the owner great flexibility for enlargement and adding rooms to the rectangular shape house whenever needed. Moreover, because of Haiti's geographical proximity to the equator, the sun passes almost directly overhead which makes the maximum heat gains on the east and west sides. The rectangular shape of traditional Haitian houses which is oriented along an east-west axis is a response to reduce solar heat gain. Haitian base-case model in this study is a model of traditional house with four zones based on their orientation. All four zones have some features in common such as: short or no plenum, short room height, minimal window shading, small glazing ratio, hollow block concrete wall, small or no insulation, and no stack ventilation (e.g. Fig. 4b).



**Figure 3:** Guantanamo bay, Cuba weather data: Ambient air temperature (° C) range during the course of a year. Source: (Generated using Climate Consultant 2008)



**Figure 4:** a) Haitian base-case traditional house, and b) Zoning arrangement in Haitian base-case model. Source: (Authors 2013)

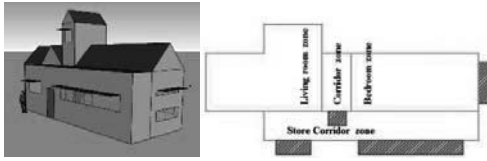
## 2.2. Design scenarios (Optimized house models)

To achieve sustainable housing design, it is recommended to consider some of the passive strategies in design process of the optimized houses in Haiti to improve energy performance of the buildings. These strategies lead to more sustainable and durable buildings in Haiti and will help the people in poverty to easily handle the poor economic condition. Some of the important strategies which are used in the design of optimized house in this study are mentioned here; Adding window overhangs (Designed for Haiti's latitude) or operable sunshades which reduce summer and fall afternoon heat gain, increasing the north glazing area with vertical shading, increasing the height of the rooms in order to reduce the room temperature, using wall and roof insulation, and using adobe brick as a construction material for walls instead of concrete blocks. Since outdoor air temperature is in the Haitian comfort zone over the course of a year, in the next step, we have provided vertical distance between air inlet and outlet in the *corridor zone* to produce stack ventilation when wind speed is low. Moreover, large well-shaded windows are oriented to predominant breezes, to facilitate the cross ventilation inside the house. The combination of cross ventilation and stack ventilation inside the optimized Haitian houses help reduce air conditioning in hot seasons.

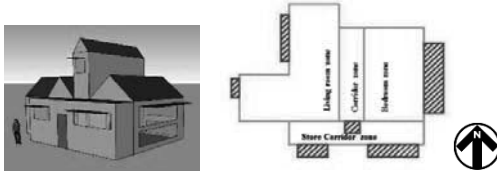
## 3.0. SIMULATION PROCESS

### 3.1. EnergyPlus general input parameters (Geometry)

Since EnergyPlus performs a zone heat balance, the first step in preparing a building description is to break the building into zones. Based on the EnergyPlus manual, a zone is a thermal, not a geometric, concept and includes an air volume at a uniform temperature plus all the heat transfer and heat storage surfaces inside of that air volume. The general regulation to specify the number of zones inside of the building without fan systems is to organize the zones based on their location inside the building such as south zone, north zone, west and east zone. In the study, after applying the mentioned sustainable design features to optimize the energy performance of traditional houses in Haiti, two new models (Option-1 and Option-2) were developed and simulated in EnergyPlus, using Cuba weather data with special zoning arrangement and internal gains (people, light, equipment) (e.g. Fig. 5-6) for each option. Tables 1, 2 and 3 show the characteristics of each option used in simulation process.



**Figure 5:** Zoning arrangement in optimized Haitian house (Option-1). Source: (Authors 2013)



**Figure 6:** Zoning arrangement in optimized Haitian house (Option-2). Source: (Authors 2013)

**Table 1:** Geometry characteristics of Haitian base-case, Option-1 & 2 model. Source: (Authors 2013)

Geometry Characteristics	Area	Height of rooms	Height of corridor	Height of attic	Projection Factor	Glazing ratio
Base-case house	77 m <sup>2</sup> (825 ft <sup>2</sup> )	2.4 m (8 ft)	2.4 m (8 ft)	-	0.5	0.2
Option-1	65 m <sup>2</sup> (705 ft <sup>2</sup> )	3.65 m (12 ft)	6.7 m (22 ft)	1.5m (5 ft)	1	0.2
Option-2	77 m <sup>2</sup> (825 ft <sup>2</sup> )	3 m (10 ft)	6 m (20ft)	1.5m (5 ft)	1	0.4

**Table 2:** Construction characteristics of Haitian base-case house. Source: (Authors 2013)

Construction	Layer 1 m (in.)	Layer 2 m (in.)	Layer 3 m (in.)	U-value W/m <sup>2</sup> .K (Btu/F.ft <sup>2</sup> .hr)	
Wall	Exterior Wall	Stucco 0.0254 (1)	Heavy Weight Concrete 0.2 (8)	Gypsum 0.012 (1/2)	2.377 (0.418)
	Interior Wall	Gypsum board 0.019 (0.75)	Wall air space resistance	Gypsum brd. 0.019 (0.75)	-
Roof	Flat Roof	Roof Membrane	IEAD Roof Insulation	Metal Decking	0.358 (0.063)
Floor		Heavy Concrete 0.2 (8)	Carpet pad	-	1.862 (0.327)
Door	Interior and Exterior Door	Wood 0.025 (1)	-	-	-
Window	Normal Window	SHGC=0.25 VT=0.11	-	-	5.84 (1.028)

**Table 3:** Construction characteristics of Optimized Haitian house Option-1 & 2. Source: (Authors 2013)

Construction		Layer 1 m (in.)	Layer 2 m (in.)	Layer 3 m (in.)	Layer 4 m (in.)	Overall U-value W/m <sup>2</sup> .K (Btu/F.ft <sup>2</sup> .hr )
Wall	Exterior Wall	Brick 0.1 (4)	Insulation board 0.05 (2)	Wall air space resistance	Gypsum 0.019 (0.75)	0.449 (0.079)
	Interior Wall	Gypsum brd. 0.019 (0.75)	Wall air space resistance	Gypsum brd. 0.019 (0.75)	-	-
Roof	Sloped Roof	Roof Membrane	Metal Decking	-	-	4.035 (0.710)
	Attic Floor	Gypsum 0.012 (1/2)	Attic Floor Insulation	Gypsum 0.012 (1/2)	-	0.3 (0.052)
Floor		Heavy Weight Concrete 0.2 (8)	Carpet pad	-	-	1.86 (0.327)
Door	Interior Door	Wood 0.025 (1)	-	-	-	-
	Exterior Door	Metal surface	Insulation board 0.025 (1)	-	-	1.18 (0.207)
Window		Optimized window	-	-	-	1 (0.176)

### 3.2. EnergyPlus natural ventilation function (System)

As mentioned, natural ventilation can play a significant role in enhancing the energy performance of the buildings. Moreover, this parameter can be even more efficient in countries such as Haiti with poor economy in the way to achieving the more sustainable buildings. This study examines the natural ventilation effect in an optimized Haitian house design through the whole-building energy simulation using EnergyPlus simulation tool. *Air flow network group* in EnergyPlus includes the airflow network model which provides the ability to simulate multi zone airflows driven by wind and also by a forced air distribution system. Much of the information needed for the air flow calculation is automatically extracted from the building description for thermal modeling. This includes things like the volume and neutral height of the zones, and the orientation and location of the building surfaces that contain cracks or openings through which air flows. In the present study, we have tried to locate the windows and doors in an appropriate place to facilitate the air flow inside the house (e.g. Fig. 7).

The Air flow Network model consists of three consecutive phases: pressure and airflow calculations, node temperature and humidity calculations, and sensible and latent load calculations. (US. DOE 2010).



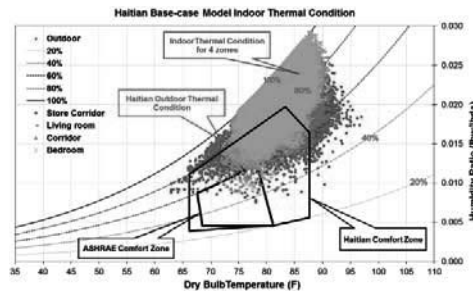
**Figure 7:** Wind flow during day time through: a) Optimized Haitian house Option-1 and b) Optimized Haitian house Option-2. Source: (Authors 2013)

Ventilation control mode is one of the input parameters in air flow network model in EnergyPlus that specify the type of zone level natural ventilation control. Based on the EnergyPlus algorithm for natural ventilation if the zone temperature increases and becomes more than outdoor temperature and set point temperature simultaneously, then ventilation control mode assumes that the operable windows and doors are opened and venting availability schedule allows venting (US. DOE 2010).

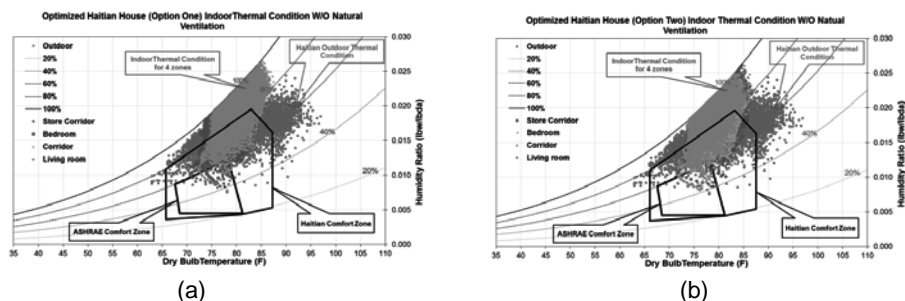
#### 4.0. SIMULATION RESULTS AND ANALYSIS

Three whole building simulation models were developed based on passive energy strategies and air flow network in EnergyPlus for traditional Haitian house, optimized Haitian house Option-1, and Option-2. In the present study, we have compared the thermal comfort condition inside of each building zone with natural ventilation and without that, to evaluate the effect of sustainable design features and natural ventilation in enhancing the Haitian building energy performance. In this process we have used psychometric chart which enables us to have a better perception of Indoor temperature and Haitian comfort zone in each building.

Based on the simulation results (e.g. Fig. 8-9) the indoor temperature and humidity ratio for each zone in three different buildings (Base-case house, Option-1 and Option-2) have been illustrated on the psychometrics chart, not using natural ventilation during the day and night. The red points show the outdoor condition and the larger polygon demonstrates the Haitian comfort zone boundary.



**Figure 8:** Haitian base-case house indoor thermal condition without natural ventilation. Source: (Authors 2013)



**Figure 9:** Optimized Haitian houses indoor thermal condition without natural ventilation for: a) Option-1 and b) Option-2. Source: (Authors 2013)

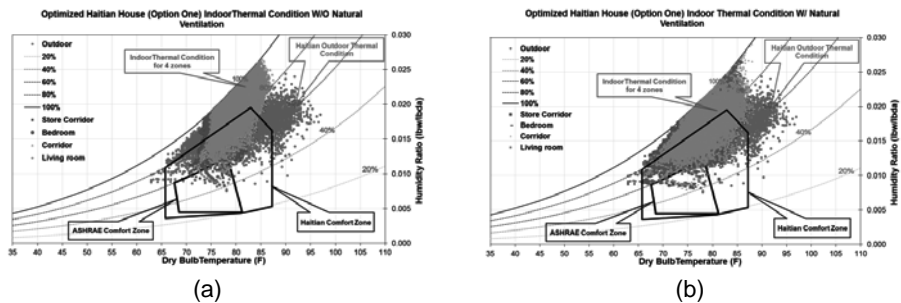
Comparing figure 8 and 9 shows the effect of utilizing passive strategies in the design of two different house plans in Haiti. These passive strategies not only reduce the indoor temperature but also cause to improve the comfort condition inside the houses even without using natural ventilation. Table 4 shows the percentage of hours in the Haitian comfort zone for each building's zone. According to table 4, in optimized Haitian house Option-1, the percentage of bedroom's comfort hours are improved from 21% to 59%, while this amount is from 21% to 49% for optimized Haitian house Option-2 compared to Haitian base-case. Having greater window area in the east and north side of the optimized Haitian house Option-2 might be a good reason for the difference in percentage of hours in Haitian comfort zone between Option-1 & 2. However, the average percentage of hours in Haitian comfort zone for whole building shows that the overall building performance in optimized Haitian houses, Option-1 & 2, has increased in comparison with Haitian traditional house. As mentioned before, Haiti has the relative humidity ranges from 75-85% in early morning to 55-65% during the afternoon. Adding people and equipment to the EnergyPlus model also increase the latent heat and relative humidity inside the house, thus it is plausible to have higher relative humidity and condensation inside the house during cold days and nights.

**Table 4:** Percentage of hours in Haitian comfort zone for three cases *without natural ventilation*. Source: (Authors 2013)

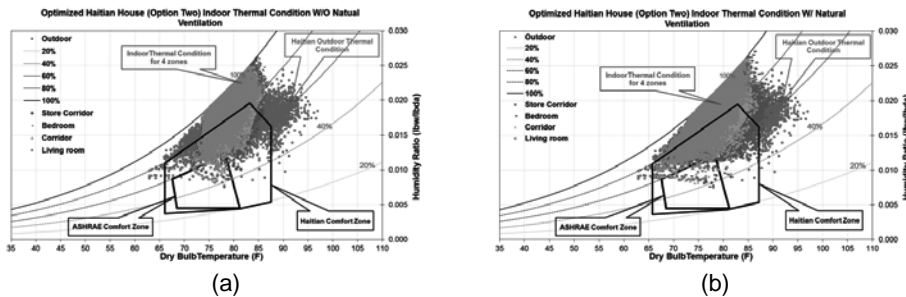
	Store corridor (%)	Living room (%)	Corridor (%)	Bedroom (%)	Average Percentage of whole building (%)
1) Haitian Base-Case	38	32	10	21	25
2) Optimized Haitian house-1	85	52	57	59	63
3) Optimized Haitian house-2	69	68	80	49	67

After utilizing passive strategies and evaluating the buildings thermal comfort, natural ventilation was added to the simulation models to examine the effectiveness of natural ventilation on the percentage of hours in Haitian comfort zone for the optimized Haitian houses, Option-1 & 2 (e.g. Fig. 10-11). Figure 10 and 11 respectively shows the optimized Haitian house-Option-1 and optimized Haitian house-Option-2 thermal comfort conditions with and without natural ventilation. It is obvious that considering the natural ventilation in the design causes to increase the percentage of hours in comfort zone.



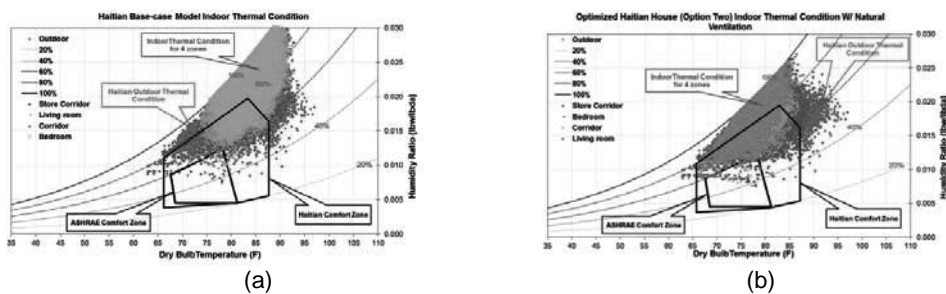


**Figure 10:** Comparison of Optimized Haitian house Option-1 indoor thermal condition (a) Without natural ventilation and (b) With natural ventilation. Source: (Authors 2013)



**Figure 11:** Comparison of Optimized Haitian house Option-2 indoor thermal conditions (a) Without natural ventilation and (b) With natural ventilation. Source: (Authors 2013)

In figure 12 the indoor thermal condition of Haitian base-case house and optimized Haitian house Option-2 have been compared together to illustrate the ultimate effect of considering natural ventilation and passive strategies on the building performance during the design process of Haitian housing complex. Moreover, comparing the percentages of hours in Haitian comfort zone for each zone in two optimized buildings indicates the best configuration of the zones in terms of natural ventilation.



**Figure 12:** Indoor thermal condition comparison between (a) Haitian base-case house and (b) Optimized Haitian house Option-2 with natural ventilation. Source: (Authors 2013)

Table 5 briefly compares the average percentage of hours in Haitian comfort zone for Option-1 & 2 Haitian houses in each building zone using natural ventilation. Table 5 shows that zones in the optimized Haitian house Option-2 have better thermal comfort condition than zones in optimized Haitian house Option-1 and it might be because of the larger area for the corridor zone with higher height. Therefore, the effect of stack ventilation increases and in combination with the cross ventilation effect makes a better thermal comfort condition compare to optimized Haitian house Option-1.

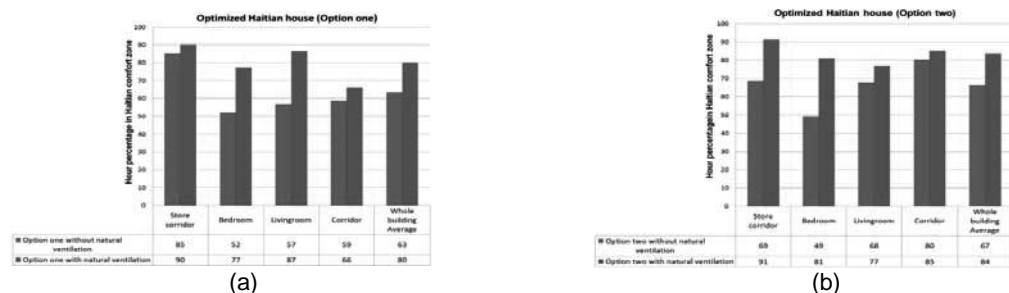
**Table 5:** Percentage of hours in Haitian comfort zone for optimized Haitian houses, Option-1 & 2 with natural ventilation Source: (Authors 2013)

	Store corridor (%)	Living room (%)	Corridor (%)	Bedroom (%)	Average Percentage of whole building (%)
Optimized Haitian house (Option-1) with natural ventilation	90	87	66	77	80
Optimized Haitian house (Option-2) with natural ventilation	91	77	85	81	84

Table 6 enables us to compare Haitian base-case house with optimized Haitian houses, Option-1 & 2 to evaluate the natural ventilation effect. As we can conclude from table 6, with the opening of doors and windows to use cross ventilation and stack ventilation, the average percentages of hours in Haitian comfort zone increase in the optimized Haitian houses compare to Haitian base-case house.

**Table 6:** Average percentage of hours in Haitian comfort zone for three different Haitian houses with and without Natural Ventilation. Source: (Authors 2013)

	Haitian Base-Case (%)	Optimized Haitian house (Option-1) (%)	Optimized Haitian house (Option-2) (%)
Average Percentage of hours in Haitian comfort zone <i>without</i> Natural Ventilation	25	63	67
Average Percentage of hours in Haitian comfort zone <i>with</i> Natural Ventilation	—	80	84



**Figure 13:** Comparison between percentages of hours in Haitian comfort zone W/ and W/O natural ventilation for each zone in Optimized Haitian house: (a) Option-1 and (b) Option-2. Source: (Authors 2013)

Figure 13 also shows the improvement of each zone’s percentage of hours in Haitian comfort zone in Option-1 and Option-2 houses after adding natural ventilation to the base model in EnergyPlus.

## CONCLUSION

Due to the deep economic hardship in Haiti, buildings are required to be more durable with less maintenance and minimal energy consumption, utilizing local labour and materials. Sustainable design strategies, including renewable resources, should be the main approaches for Haiti to be able to achieve the sustainable long term goals. Two different energy models have been developed for this study using EnergyPlus. These models were then optimized by adding some sustainable design features such as increased ceiling heights, operable windows with appropriate shading devices, improved wall insulation, and sustainable construction materials such as adobe bricks instead of concrete blocks for walls. The EnergyPlus simulation results showed that the thermal comfort condition was improved ranging from 25% up to 67% for the optimized Haitian house Option-1 & 2 cases compared to the traditional Haitian house case. These house models do not have mechanical systems. In the optimized Haitian house models, *corridor* zone was placed in the middle of the house with the higher height than other zones and so enhanced the stack ventilation effect besides cross ventilation. Moreover, locating the *store corridor* zone in the south side of the building as an intermediate space prevented the penetration of direct heat and sunshine into living space. In addition, the air flow network object was added to the optimized Haitian house Option-1 & 2 models to evaluate the effect of natural ventilation. The glazing ratio in the north side of the building was increased with proper shading to facilitate the air movement inside the house. New EnergyPlus models were developed to evaluate the influence of natural ventilation on the thermal comfort condition. The results indicated that after adding natural ventilation to the models, the average percentage of hours in Haitian comfort zone substantially increased ranging from 63-67% to 80-84%. To put it in a nut shell, based on the simulation results and graphs, it was concluded that implementing the sustainable features in designing a house in Haiti, using cross ventilation during the day and night and taking advantage of stack ventilation in building, increased the thermal comfort condition inside the Haitian house.

## ACKNOWLEDGEMENT

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# Human Physiological Signal Based Building Environmental Controls for Visual Comfort

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**ABSTRACT:** People spend more than 90% of their time in buildings in the U.S. (“US Environmental Protection Agency | Report to Congress on Indoor Air Quality” 1989). This significant time length in a daily life naturally strengthens the importance of indoor environmental quality (IEQ), especially in an office environment, where the occupant’s work productivity and health are highlighted. Among the IEQ components (thermal, air, lighting, acoustic, and spatial quality), the lighting environmental condition has the most significant effect on an occupant’s visual comfort and sensations due to its instantaneous involvement into his/her environmental perceptions. However, depending on an individual’s physiological characteristics, the preferred lighting conditions may vary and a single lighting setting will not be acceptable in all the cases due to various personal preferences. Therefore, this study is intended to identify a novel diagnostic method for developing a visual sensation model as a function of human physiological signals to provide an accurate estimation of individual visual perceptions. The purpose of this research is to investigate the potential use of human pupil sizes and their fluctuations to estimate a human subject’s visual sensation for a diagnostic model to evaluate ambient lighting conditions that could detect any stressful condition, such as glare or high luminance, in an office workplace environment. This research included extensive human subject experiments, conducted in an environmental chamber, that collected human physiological signals (i.e, pupil sizes), while the ambient lighting conditions were being changed to coincide with a range of typical office building lighting conditions. For the experiments, a pupilometer was used and a visual comfort and sensation survey method was adopted, with 15 university students participating as the experimental human subjects. The research outcome showed the potential for using pupil sizes and their change rates as quantifiable input variables for diagnosing an individual’s visual sensations.

**KEYWORDS:** physiological signal, human-building interaction, pupil size, visual comfort, visual sensation

## 1. BACKGROUND AND SIGNIFICANCE

People spend more than 90% of their time indoors in the U.S. (US Environmental Protection Agency 1989). For this reason, indoor environmental quality (IEQ) building components are extremely essential for maintaining the environmental health and work productivity of occupants in office workplace environments, as are their individual physiological conditions, which also have an impact. Recent studies have reported that 65% of building occupants are adversely affected by inappropriate lighting conditions in their workplaces, with glare problems, in particular, causing serious visual stress (Wilkins 2003). In spite of their significance, most office buildings have adopted guidelines that were empirically developed, primarily by the Illuminance Engineering Society of North America (IESNA) (“IES Guideline” 2010). Since those guidelines were developed mainly based on a conventional paper-based task work environment, their application could cause unnecessarily high lighting intensity in a computer-based task work environment, which is the most prevalent condition in today’s workplace. In addition, depending on an individual’s physiological conditions (age, pupil color, ethnic origin, personal cultural background, etc.), preferred lighting conditions vary considerably with different people. Their diversity in preferences may limit the successful adoption of current guidelines for application in various environmental and physiological conditions.

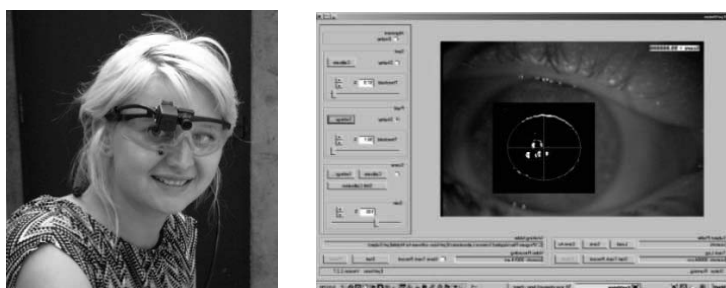
The human body has an autonomic function that regulates its physical responses to minimize any environmental stress, such as hot or cold temperatures or excessively bright conditions (Bitsios, Prettyman, and Szabadi 1996; C.-J. Choi et al. 2011; Taylor, Allsopp, and Parkes 1995; Noguchi and Sakaguchi 1999). For example, depending on the intensities of various

stressors, the skin on a human body could sweat or control the surface body temperature to balance heat losses or gains caused by ambient thermal conditions, and pupil sizes could shrink or dilate in response to variations in light. Therefore, this research adopted human pupil sizes as a feasible physiological signal to estimate visual sensation conditions (based upon the principle of reverse engineering) that could illustrate subjective lighting sensations as a function of objectively measured physiological signals. The end result would be a novel method for visual quality assessment, such as a lighting simulation program and high-dynamic images, as compared with conventional methods that have primarily depended on pre-assumed human environmental reactions, instead of real human physiological responses.

## 2. METHODS

This research conducted extensive experiments using human subjects in an environmental chamber located in the School of Architecture at the University of Southern California. The chamber was equipped with multiple data collection devices and lighting and mechanical systems to generate a range of lighting and thermal settings that simulate real office work environmental conditions. The study also used a questionnaire survey to collect each subject's visual sensations and comfort levels in each revision of lighting condition. At the end of each revision, the subject was asked to report his or her visual sensation and comfort level on a 7-point scale answer sheet. It consisted of seven different options ranging from "dark (-3)" through "bright (+3), with a "neutral" condition (0) at the mid-point of the scale. The comfort level was also marked on a 7-point scale: "very dissatisfactory" (-3) through very satisfactory (+3) with neutral at the mid-point (0).

For collecting data on human pupil sizes, the experiment used a pupilometer (Model: ASL Mobile Eye XG), which is a wearable sensor similar to a ski goggle, that can measure a pupil size in pixels (Figure 1). The measurement was recorded at a frequency of 30Hz, and the collected pupil size data were transmitted to the database in a data acquisition computer through an interface developed using the LabView software with a sensing interval of 1 second. Through the interface, the test subjects reported their visual sensations and comfort levels by moving the 7-point scale bar button. Fifteen voluntary subjects participated in the test, and the data collected from 13 of the subjects were considered for use in the study analyses. The research was approved by the University Internal Review Board (IRB), and the demographic information about the study subjects is summarized in Table 1 below.



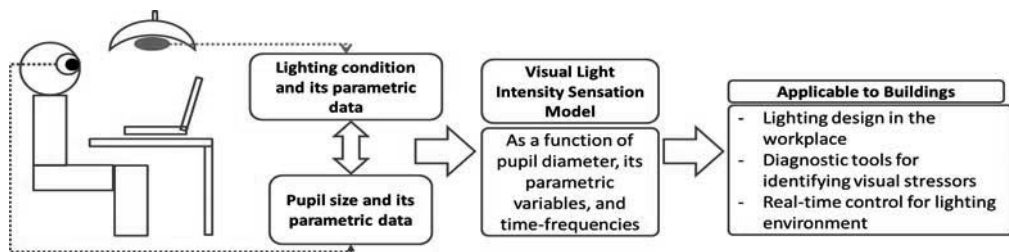
**Figure 1.** One of the PI's students wearing the pupilometer and the data collection software for pupil sizes

**Table 1.** Demographic information of the subject samples in the study

	Gender		Age		Eye color		Myopic	
	Male	Female	<25	>=25	Blue	Brown	Yes	No
Sample size	10	3	8	5	2	11	7	6
Percentage	77%	23%	62%	38%	15%	85%	54%	46%

The study selected illuminance and luminance as the lighting parameters to control in the chamber tests. The lighting setting was decided based upon a typical range of illuminance in

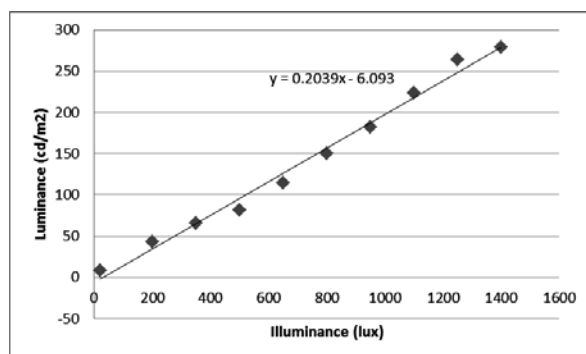
the office environmental settings that were investigated in the PI's previous post-occupancy evaluation study of 29 office buildings within the U.S. (J.-H. Choi, Aziz, & Loftness, 2010 & 2009). The selected illuminance levels ranged from 50 lux up to 1500 lux, with 10-step changes that followed the order of lowest to highest, or vice versa to assure random variations in the experiments. The overall luminance was also estimated for each illuminance setting by using PhotoLux software, based on four pieces of fish-eye images that were captured with different aperture, and timing settings of a camera (Model: Nikon Coolpix 8400). For the lighting control, 14 units of 8 W-dimmable LED lamps were installed on the ceiling surface of the chamber, with each light bulb featuring 530 lumens (49 fc) in brightness and a color temperature of 2,700 K (4860 R). Only one subject was allowed to stay in the chamber for each test, with 5 minutes given for a visual acclimation in each lighting step change, and then data collection was made for 2 minutes. At the end of each step change, a visual comfort and sensation survey was reported by the subject, based on his/her visual perceptions about the lighting condition during the final 2 minutes, prior to the survey. Overall procedures followed in the study are summarized in Figure 2.



**Figure 2.** Procedures for data acquisition, and potential applications of the research findings (J.-H. Choi, Zhu, and Johnson 2013)

### 2.1. Illuminance and luminance settings in the chamber test

The illuminance level of the test chamber was controlled based on a 150-lux change step interval. The overall luminance was also estimated using PhotoLux software, as discussed in METHODS. As illustrated in Figure 3, there was a linear relationship between illuminance in the workstation and the overall luminance. The estimated correlation index was 0.99, with a statistical significance of  $p=0.000$ . Based on this linear regression formula (illustrated in Figure 3), all of the overall luminances in this study were estimated using the illuminance measured during this experiment.



**Figure 3.** The correlations between illuminance and luminance of the experimental settings.

### 2.2. Pupil size data and its standardization per individual

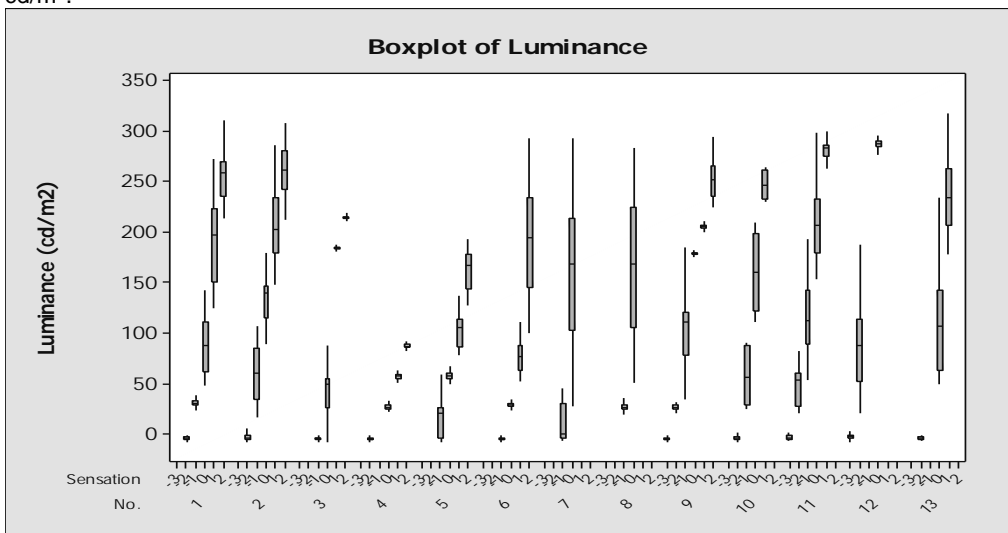
The pupilometer adopted in this study uses the pixel as a metric for measurement. It detects the size of a pupil by the micro-camera facing the subject's eye while tracking the path of eye movement. As discussed in the authors' previous study (J.-H. Choi, Zhu, and Johnson 2013), the raw data of individuals' pupil sizes are not comparable because pupil sizes and shapes

vary in different individuals (Jones 1990). For this reason, normalized (i.e., standardized) data for each individual was used for data analysis using the formula introduced in the authors' previous study (J.-H. Choi, Zhu, and Johnson 2013) as follows:

$$\text{Standardized\_Pupil\_size(\%)} = \left( \frac{\text{Pupil\_size}(i) - \text{Pupil\_size}(\text{neutral\_sensation})}{\text{Pupil\_size}(\text{neutral\_sensation})} \right) \times 100 \quad , \text{ where } i \text{ is an eye's response to luminance intensity.}$$

### 3. RESULTS AND DISCUSSION

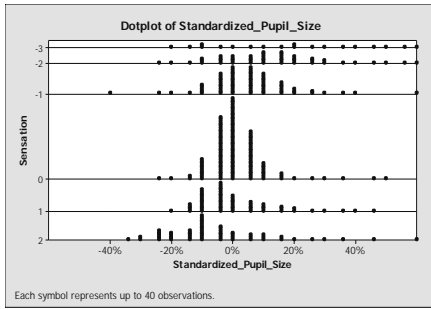
Overall, subjects reported dark sensations on lower luminance, and brighter sensations on higher luminance. As shown in Figure 4, a confidence interval for each sensation of an individual clearly showed an increasing pattern, while the generated luminance was increasing. However, their perceived luminance levels were very different depending upon the individual. For example, Subject No. 1 reported a “neutral” sensation when the luminance was around 100 cd/m<sup>2</sup>, while Subject No. 6 described a “neutral” sensation with a luminance lower than 50 cd/m<sup>2</sup>.



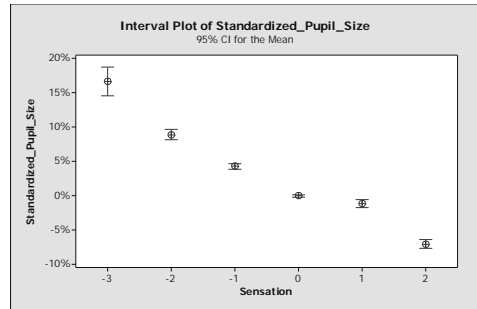
**Figure 4.** Luminance distribution in each subject's test and the 95 % confidence interval for an individual eye's response to luminance intensity (“No.” indicates a subject ID).

Figure 5 illustrated the pupil size patterns for visual sensations based on the combined data of all individuals. Overall, the standardized pupil sizes decreased while the generated luminance intensity was increasing. The analysis of variance (ANOVA) test showed a statistically significant p-value that was lower than 0.05. This finding is clearly summarized in Figure 6. The chart contains basically the same data as Figure 6, but it shows a 95% confidence interval for pupil sizes per visual sensation. The interval lines are clearly differentiated from each other, and the length of an interval at neutral sensation is shortest, which indicates that the pupil size for a neutral sensation is more stable than for other sensations.



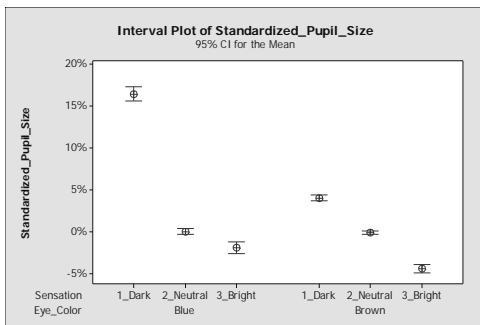


**Figure 5.** Overall standardized pupil size distribution per visual sensation to luminance intensity.

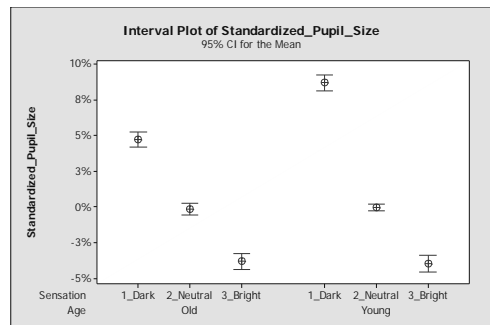


**Figure 6.** Interval plot of standardized pupil size per visual sensation to luminance intensity.

To check the consistency of pupil size changes per visual sensations for individuals, the study conducted comparison tests between subject groups of different physiological characteristics, (i.e., eye color, ethnicity, age, and myopic conditions). Since 13 subjects were selected for this study, the surveyed visual sensation data were grouped into “Dark” (i.e., visual sensation levels of -3, -2 and -1), “Neutral” (visual sensation level of 0), and “Bright” (visual sensation levels of +1, +2 and +3). As shown in Figure 7, the data were grouped by eye color. The distributions of pupil sizes were clear enough to differentiate the perceived visual sensations, and the ANOVA revealed that a p-value lower than 0.05 was statistically significant. The subjects were also grouped by age for a comparison test between age groups. The study used age 25 as a threshold to divide the 13 participants into two groups: younger than 25 (subject size: 8) and older than 25 (subject size: 5). Figure 8 illustrates a statistically significant difference between visual sensations in each group. Consistently, the pupil size differences were more than 5% in each age group between the Dark and Neutral sensations and between the Bright and Neutral sensations.

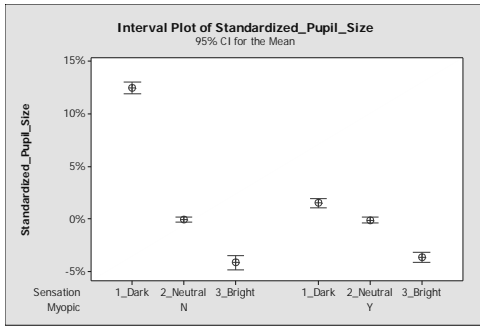


**Figure 7.** Comparison of overall standardized pupil size per visual sensation between eye color groups.

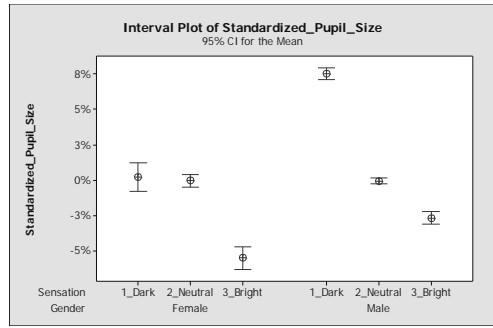


**Figure 8.** Comparison of overall standardized pupil size per visual sensation between age groups.

The study also compared the pupil size change patterns between myopic groups. In Figure 9, “Y” indicates the group who wore glasses, and “N” is those who had no glasses. The N group shows a significant difference in pupil sizes between the visual sensation levels, while the Y group shows only minimal differences. Even though the ANOVA tests of both groups show p-values lower than 0.05, that are statistically significant, the actual differences in pupil sizes between visual sensation levels in the Y group could be difficult to detect in reality. Figure 10 also summarizes the comparison between genders. The male group showed a statistically significant difference in pupil sizes, but the female group was not clear enough to show a difference in pupil sizes, especially between the Dark and Neutral sensation. The t-test of the pupil sizes between the Dark and Neutral sensations in the female group revealed a p-value of 0.632, which is not statistically significant.



**Figure 9.** Comparison of overall standardized pupil size per visual sensation between myopic groups.



**Figure 10.** Comparison of overall standardized pupil size per visual sensation between gender groups.

#### 4. CONCLUSIONS

Pupil sizes that are controlled based on the principles of the human autonomic nervous system, vary depending on individuals. Many existing references support the concept that visual sensations and pupil sizes are also different, depending on physiological characteristics. As an early stage study, this research conducted experimental tests using 15 human subjects in an environmental chamber, and investigated the differences in pupil sizes caused by different visual sensations resulting from varied luminance intensities. A comparison study between different subject groups by gender, age, myopic, gender, and eye color were also conducted. Data analyses showed that, overall, there were significant differences in pupil sizes with various visual sensations. In particular, the average pupil size between two different visual sensations was estimated to have a 5% or higher variance. However, the female and the no-glasses groups did not show any consistent pattern in the whole dataset (i.e., a stable pupil size with at neutral sensation, and larger sizes in a range of dark sensations, or vice versa).

There were several limitations to this research that warrant further investigation. As shown in Table 1, the subject sample size was not sufficient to support a robust statistical analysis. In spite of the significance of physiological characteristics that affect pupil sizes, the inadequate sample sizes may weaken the study findings, and may not validate the research discoveries. Therefore, additional experiments with larger samples and a balanced-size subject group should be included in a future study.

In addition, even though each experiment began by the test subjects receiving instructions about how to correctly report the perceived visual sensations and comfort levels, some subjects were confused by the surveys. For example, a higher sensation was reported, in spite of lighting conditions that had lower illuminance or luminance levels. Such inconsistent answers jeopardized the analyses of relationships between visual sensation and visual comfort levels, as compared to pupil sizes. Therefore, more simplified and systematic instructions are need for test participants in future studies.

#### ACKNOWLEDGEMENTS

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# EBD Using Daylight-Mimicking LEDs for Improved Health Outcomes in Older Adults at St Francis

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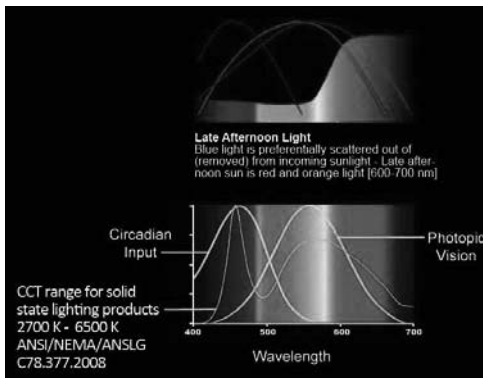
**ABSTRACT:** The American Medical Association recently declared that light at night results in adverse health outcomes. The effects of light at night are particularly relevant for the characteristic long-term care or skilled nursing facility that is in operation 24 hours per day, 7 days per week. Clinical trials are underway at St. Francis Country House to evaluate the efficacy of using daylight-mimicking LEDs to stimulate human receptivity to the non-visual aspects of light to enhance cognitive functioning and improve health outcomes for the older adults in residence there. This 24hour/7day per week lighting system will be installed in the Transition Wing of the 4th floor dementia unit at St Francis and evaluated using clinical trial methods. The Evidence-Based Design (EBD) research will evaluate the efficacy of the LED lighting system to help ameliorate the residents' symptoms of dementia.

**KEYWORDS:** circadian rhythms, dementia, health, LED lighting, older adults

## INTRODUCTION

In June 2012 at their annual meeting in Chicago, the House of Delegates (HOD) of the American Medical Association (AMA) declared that light at night results in adverse health outcomes (Blask 2012). The Council on Science and Public Health recommended that the AMA support the need for developing and implementing light technologies at home and work to minimize circadian disruption while maintaining visual efficiency. Adverse light effects can be minimized by using natural daylight or daylight-matching electric light during the day and a new HOD policy recommends dim red lighting in the nighttime indoor environment.

Research has shown that individuals working in natural sunlight are more productive, more effective, and happier than those who work under the current generation of artificially-generated lights (Perrin 2004).. Natural changes in daylight synchronizes the body's various circadian rhythms, which regulate all aspects of physiology and behaviour, such as sleeping and eating patterns, brain wave activity and hormone production (McEachron, 2012). Disrupting circadian rhythms can lead to jetlag, Seasonal Affective Disorder (SAD), delayed sleep phase syndrome (DSPS), and is implicated in various diseases and disorders, including cancer (McEachron, 2012). Furthermore, the Council on Science and Public Health recognizes that exposure to excessive light at night, including extended use of various electronic media, can disrupt sleep or exacerbate sleep disorders, especially in children and adolescents (Blask 2012).



**Figure 1.** Correlated Color Temperature (CCT) for solid state LED products compared with optimal range for circadian effect and photopic vision. Most of the late afternoon light spectrum is in the red to orange range (adapted by Author from various sources 2011).

Researchers have partnered with lighting industry to develop an LED luminaire that mimics natural daylighting in its full diurnal changing color spectrum and light intensity during the day and changes to dim red lighting during the nighttime hours. The unique characteristics of LEDs include: compact size, long life and ease of maintenance, resistance to breakage and vibration, good performance in cold temperatures, lack of infrared or ultraviolet emissions, instant-on performance, and the ability to be dimmed and to provide color control. Mixed LED sources have a higher theoretical maximum efficiency, potentially longer life, and allow for dynamic control of color (DOE 2013). Compared with either electric filament or gas lamps, LEDs most closely match the full spectrum of natural daylight (Figure 1). The 24/7 LED luminaire being developed mimics the full spectrum of natural daylight in both color temperature and light intensity. Through a combination of white and RGB (red, green, blue) LEDs the luminaire is programmed to change color throughout the day to mimic the full spectrum of natural daylight from dawn to dusk; to change in color from the amber rising sun to the red setting sun and to illuminate the indoor environment with a low-intensity red light throughout the nighttime hours (Ellis et al. 2013b).

Clinical trials at St. Francis Country House are under way to demonstrate the efficacy of the daylight-mimicking LED luminaire to improve sleep and global function of individuals with dementia, potentially opening a lucrative market for photobiology therapy. This integrated daylight-mimicking LED luminaire will be installed at St. Francis Country House. The discussion to follow describes the Evidence-Based Design (EBD) research underway, which is ongoing and provisional research. EBD methods are being used to evaluate effects of the LED luminaire on health outcomes. The research at St Francis will fine-tune the lighting spectrum and levels required to help ameliorate symptoms of dementia in the elderly and improve sleep patterns to establish a lighting “prescription” that can improve health outcomes for this population.

## 1.0 PROJECT BACKGROUND

### 1.1 Older Adults and Alzheimer’s Disease

There are 50 million people in the U.S. that have sleep disturbances in addition to the 5.3 million Americans that have some form of Alzheimer’s disease (AD) or dementia, which is the sixth leading cause of death (Alzheimer’s Association 2010). More than 50% of people aged 65 years and over experience sleep changes, due in part to alterations in circadian rhythms. The elderly are at particular risk for circadian rhythm disruption due to a combination of reduced retinal light sensitivity (Turner 2008, Shikder 2011) and deterioration of internal clock function (Farajnia 2012, Schmidt 2012). Such abnormalities appear to be even more pronounced in persons with AD (McCurry 2000). The development of disturbed sleep-wake rhythms, reverse day-night patterns, and agitation frequently result in institutionalization of persons with dementia.

Residents in dementia units have special needs beyond the provision of assistance with activities of daily living (ADL). Alzheimer's residents experience "sundowner's" (agitated behaviour toward the end of the day), difficulty sleeping at night, and a need for mobility and wandering possibly due to disrupted circadian rhythms (Ellis 2013a). These symptoms not only reduce the quality of life of the individual with dementia, such sleep disruptions and behavioural disturbances also contribute to the burden on family and formal (paid) caregivers. The hypothesis is institutional lighting levels fail to provide residents with the full spectrum of changing lighting levels throughout the day and fail to provide total darkness at night, which contributes to circadian disruption and, in turn, exacerbates dementia symptoms. The hypothesis is that human circadian systems evolved in an environment with a gradually changing light spectrum and intensity (including darkness at night) and it is this environment which best synchronizes those rhythms and maintains internal temporal coherence. Light therapy is a highly promising treatment alternative for AD and individuals with sleep disturbances. The use of therapeutic light has the potential to improve the quality of life of persons with sleep disturbances and dementia, including their family caregivers, and delay institutionalization.

## **1.2. LED Luminaire Solution**

A daylight-mimicking, energy-conserving integrated light-emitting diode (LED) luminaire for commercial and residential applications is being developed to reduce the symptoms associated with dementia in Alzheimer's disease and to increase sleep efficiency in individuals with sleep problems and Seasonal Affective Disorder (SAD). This daylight-mimicking luminaire is a retrofit fixture that can easily replace the standard 2' x 2' and/or 2' x 4' fluorescent luminaire characteristically installed in the suspended acoustical tile ceiling systems of most commercial and institutional applications.

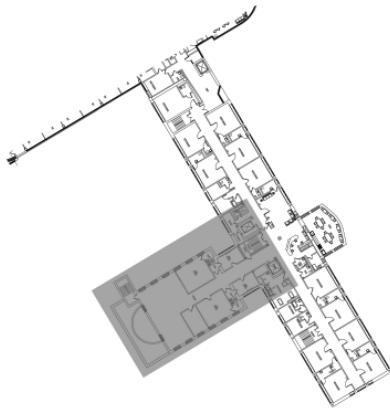
## **2.0 ST. FRANCIS COUNTRY HOUSE CLINICAL TRIAL**

### **2.1. St Francis Existing Conditions**

St. Francis Country House is a 273 bed skilled nursing facility located in Southeastern Delaware County near Philadelphia. St Francis offers physical therapy, occupational therapy, speech therapy, post-surgical care and IV therapy, as well as post-acute care services to support the transition from hospitalization to home. The research team was invited as an Alzheimer's disease consultant to evaluate its fourth floor dementia unit to make interior design recommendations that could support quality care for the older adult population living there. The initial site visit noted low lighting levels and a lack of access to natural daylight for the majority of the residents, which resulted in an initial recommendation to reconsider the lighting system. The research team has been working with hospital administration and nursing staff since then to develop a lighting program that can help ameliorate symptoms of dementia for the residents.

### **2.2. LED Lighting design Parameters**

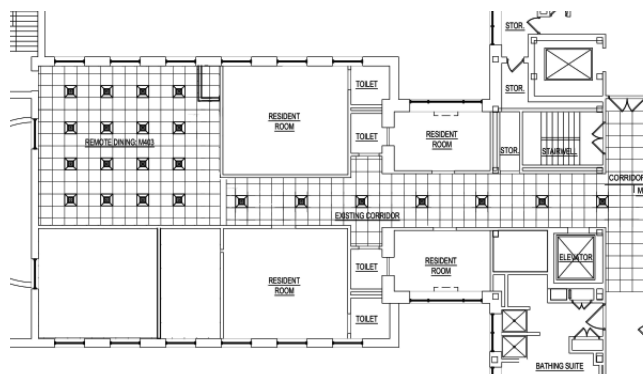
The fourth floor dementia unit has (14) 3-Bed rooms, (2) 2-Bed rooms and (2) 1-Bed rooms to accommodate a total of 48 residents (figure 2). The daylight-mimicking LED lighting system will be installed on the Transition Wing, the southwest wing of the fourth floor, which has eight residents total in (2) 3-Bed rooms and (2) 2-Bed rooms (figure 3). Although the lights are off in the resident rooms at night, the corridor lights are always on. The daylight-mimicking LED lights will be installed in the adjacent corridor but not in resident rooms. Instead, the four resident rooms have red night lighting in the room to assist with going to the bathroom at night when the lights are off. The windows are fitted with blackout shades to prevent any incident light at night entering the rooms from street lights or other external sources. The end condition of the Transition Wing has been redesigned to provide for a Remote Dining Room, which is where all the residents take their meals. All residents will be affected by the lighting system during mealtimes, except in those rare instances when a resident might be unable to leave the sleeping room. Sixteen light fixtures will be installed in the Remote Dining Room and seven light fixtures in the Corridor (figure 4). The eight residents will be exposed to the LED lighting system 24 hours per day/7 days per week.



**Figure 2.** Floor Plan of Fourth Floor Dementia Unit at St. Francis Country House (shaded area Transition Wing). Source: (Author 2010).

Typical Schedule for the 4<sup>th</sup> floor dementia unit:

- 7-9:30AM Residents wake up
- 7:30AM BREAKFAST – Trays come up for breakfast  
The goal is for all 48 residents to eat breakfast in the Remote Dining room
- 11:30AM LUNCH
- 2:00PM Snoezelen or Sensory Room for lowest functioning/agitated residents  
This room is used for individuals who need stimulus – may be unnecessary with new lights
- 5:00PM DINNER



**Figure 4.** Reflected Ceiling Plan of Transition Wing. Source: (Author 2013).

### 3.0 LIGHT THERAPY FOR OLDER ADULTS WITH ALZHEIMER’S DISEASE

Aside from providing illumination for visual processing, environmental lighting has a number of additional impacts on human behaviour and physiology. These can be classified as: 1. Direct stimulus-response; 2. Phase-shifting of biological, especially circadian, rhythms; and 3. Altering the underlying frequency of circadian rhythms. When considering the design of environmental lighting, it is critical to weigh these impacts in terms of desired outcomes.

### 3.1 Direct stimulus-response

Humans are primarily diurnal organisms and react positively to the presence of light. Experiments have shown that exposing humans to bright light, especially in the blue-green range, will increase alertness and performance (Vandewalle 2006, Perrin 2004).

### 3.2 Phase-shifting of biological, especially circadian, rhythms

Phase-shifting effects are related to the primary mechanism by which organisms synchronize themselves with the geophysical cycle of day and night (a process called entrainment). Circadian systems vary in light-sensitivity across their circadian frequencies (which are typically close to, but not exactly, 1 cycle/24 hours). To entrain to day/night cycles, circadian systems typically undergo a repeating pattern of phase shifts which align the internal circadian clock with the external environmental cycle. Light exposure at times other than those promoting synchronization can shift rhythms dramatically, increasing the chances of both external and internal desynchronization (See McEachron, 2012 for review).

### 3.3 Altering the underlying frequency of circadian rhythms

Many circadian systems, including the human circadian clock, show a sensitivity to light intensity by altering the internal frequencies based upon the intensity to which the organism is exposed. This involves both absolute intensity and duration. Thus, the frequency expressed by the human circadian clock differs with respect to seasonal changes in photoperiod resulting in changes in the observed daily rhythm. For example, during the summer, the period of the underlying circadian rhythm becomes longer and this is expressed in a phase delay of the entrained rhythms; in winter, the opposite occurs, resulting in a phase advance.

All of these impacts, as well as typical visual processing, occur within a complex system of multiple clocks and oscillators that are not yet fully understood. That these factors impact human behavior and physiology, however, is quite evident. For example, a repeating depression known as Seasonal Affective Disorder (SAD) is associated with changes in photoperiod. The version of SAD which occurs during the winter months has been successfully treated using light therapy, exposing the individuals to light in order to either phase advance certain rhythms or lengthen the photoperiod (Magnusson 2003). These results have promoted a wider consideration of chronotherapeutics in the treatment of various mood disorders (Benedetti 2011).

### 3.4 Light therapy for Alzheimer's and dementia

Light therapy has been used on numerous occasions in an attempt to ameliorate symptoms of depression and cognitive dysfunction in elderly residents living in residential or nursing facilities. The majority of studies have followed the winter SAD model, exposing residents to light boxes for fixed periods at certain times of day (Royer 2012, Riemersma-van der Lek 2011). Most studies reported a significant improvement in mood or cognitive variables over placebo although not all (Loving 2005). Both mathematical models of biological rhythms and experimental observations of circadian rhythms in organisms support the hypothesis that a gradual onset and offset of light intensity will generate a far more powerful and sustained synchronization than light pulses (McEachron, 2012, Chapter 6). Thus, the lighting system described should create a more sustained effect on rhythms and, therefore, the cognitive and mood issues experienced by elderly residents.

Two aspects of entrainment are of importance in this design: light perception and timing. In terms of perception, photoreceptors known as the intrinsically photosensitive retinal ganglion cells (*ipRGCs*) have been identified to perceive light that cues the circadian system via the suprachiasmatic nuclei (SCN) for the purpose of synchronizing internal circadian clocks with day-night cycles (Berson 2002). Interestingly, these cells have an absorption spectrum shifted towards the blue-green section of the visual spectrum (Turner 2008, Figure 1). This means that visual and circadian light sensitivities are slightly offset from each other justifying the use of the luminaire approach which provides wavelength adjustments matching the appropriate spectrum for maximum effects. In terms of timing, imposing a typical square wave lighting system (such as turning lights on at 6 am and off again at 6 pm generating a LD 12/12 cycle) might be used, but such an approach is not optimal for entrainment of circadian rhythms. The signals generated by such a LD (light/dark) cycle are perceived by the circadian clock not as a



single timing signal but rather as a mixture of many sine and cosine waveforms (consider the Fourier analysis of a square wave pattern). These conflicting signals reduce the efficacy of the LD cycle as a synchronizing agent (McEachron 2012, See Chapter 6). Thus, the use of a more appropriate sinusoidal light intensity waveform with suitable wavelengths represents the most powerful approach that can be practically implemented in this setting

#### 4.0 ENGINEERING CRITERIA FOR LIGHT THERAPY METHODOLOGY

The therapeutic effects of light are widely reported for Seasonal Affective Disorder (SAD) (Sumaya 2001) as well as for Alzheimer's disease and related dementia (ADRD) patients (Hanford 2013). However, the mechanism by which light therapy ameliorates symptoms of dementia in older adults is not yet understood (Deschenes 2009) and the intensities, timing and durations of light therapy have not been precisely identified for this population (van Hoof 2012, Forbes 2009, Fahey 2006). It is clear that further research should be conducted to determine the minimum light levels and duration required to impact the circadian systems of those patients – essentially a lighting “prescription”. To date, there has been no long-term day-to-day study where the lighting environment is a permanent built-in 24/7 solution that can be reprogrammed and adjusted to optimize health outcomes based on occupant response. Furthermore, as identified by van Hoof (2012), the criteria needed to characterize the indoor lighting environment are complex and varied with numerous possibilities for error in evaluating results. Considering the engineering methodological issues to address and the technical pitfalls to avoid, the research at St. Francis to document and evaluate the effects of light therapy to help ameliorate symptoms of dementia in its elderly residents includes: 1) description of the light measuring device, 2) establishing light evaluation parameters, 3) description of the building and its interaction with natural light, and 4) identification of lighting design standards for older adults.

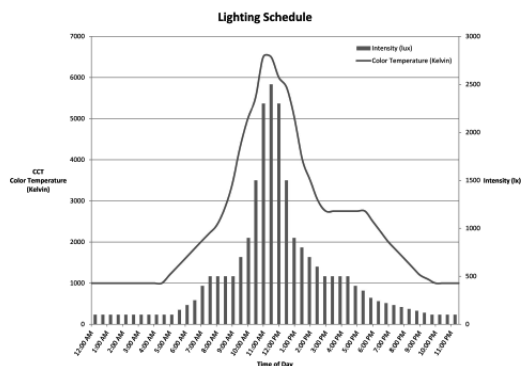
##### 4.1. Light measuring devices

Color temperature, the spectral distribution or composition of the light in Kelvin, is measured by a colorimeter or chromameter. Color temperature is an important aspect of color appearance that characterizes how “cool” (bluish) or how “warm” (yellowish) nominally white light appears. Correlated Color Temperature (CCT) is a metric that characterizes the color of the emitted light from a source and is given in Kelvin (K). However, CCT distills a complex spectral power distribution to a single number, which can create discord between numerical measurements and human perception. For example, two sources with the same CCT can look different to the naked eye, one appearing greenish and the other appearing pinkish. The wavelength or spectrum of light is measured using a spectrometer, for example, the data shown in Figure 1. A spectrophotometer measures the Color Rendering Index (CRI), which is a measure of fidelity or how “true” a light source appears when compared to a familiar, or reference, source. A score of 100 indicates that the source renders colors in a manner identical to the reference. However, two light sources with the same CCT and CRI may not render colors the same way (colors may still look different). The light measuring device used in this research is the Konica Minolta Illuminance Spectrophotometer model CL-500A, which measures CCT, CRI, illuminance levels (lx), and conforms to both DIN and JIS standards.

##### 4.2. Light evaluation parameters

Color Rendering Index (CRI), indicated by  $R_a$ , is the quantitative measure of the ability of a light source to reproduce the colors of various objects faithfully in comparison with an ideal or natural light source. Correlated Color Temperature (CCT) can shift of up to 2,000K due to a change in ambient temperature. Light Reflectance Value (LRV) is the total quantity of visible light reflected by a surface (e.g. floorings, ceilings, walls and furniture), *at all wavelengths and directions* when illuminated by a light source. Illuminance is measured in lux-units (lx),  $E_h$  = horizontal illuminance (table top) and  $E_v$  = vertical illuminance (gaze direction). Lumens (lm) are the luminous flux, which is a measure of the total “amount” of visible light emitted by a source. For example,  $1 \text{ lx} = 1 \text{ lm/m}^2$ . The difference between the units *lumen* and *lux* is that lux takes into account the area over which the luminous flux is spread. A flux of 1000 lumens, concentrated into an area of one square meter, lights up that square meter with an illuminance of 1000 lux. The same 1000 lumens, spread out over ten square meters, produces a dimmer illuminance of only 100 lux.

### 4.3. Clinical trials at St Francis Country House



**Figure 5.** 24-hour day Lighting Schedule indicating changes in color temperature (CCT) and intensity (lux) with respect to time of day. Source: (Authors, 2013)

The test site for the daylight-mimicking LED luminaire lighting system intervention is the Remote Dining Room and the corridor approach located on the 4<sup>th</sup> floor Transition Wing of the Dementia Unit. The corridor receives no other light except the LED luminaires in the reflected ceiling above. The Remote Dining Room is exposed to daylight from the northwest and the southwest, which could affect indoor lighting conditions after 2:00PM. However, since the objective of the lighting system is to match natural lighting conditions, this should not greatly affect indoor lighting measurements and is considered negligible for the purposes of this study. More germane, could be the effect of light at night entering the four resident rooms. For this reason, these rooms have black out shades to prevent incident light from street lights. Night lights to guide the residents to the bathroom located in these rooms are red. Lighting levels are as per the Lighting Schedule in Figure 5. Lighting levels will shift from low-intensity red during the nighttime hours, to amber at sunrise, peaking at 2500 lux at 6500K during the noontime hour when the residents are having lunch, light intensities will reduce in the afternoon, and the lighting will slowly shift back to amber then red in the evening. It will be important to characterize the interior environment of the Remote Dining Room and the Corridor by measuring the CCT and CRI of the luminaire and the LRV of all the horizontal and vertical surfaces.

### 4.4. Lighting design standards

The Pennsylvania Department of Health Long Term Care Facilities Licensure Regulations sets the minimum illumination standards for skilled nursing facilities and refers to the Pennsylvania Code Title 28 Health and Safety to determine requirements for existing and new construction, including special electrical requirements. The Pennsylvania Code, Chapter 205 Physical Plant and Equipment Standards for Long-Term Care Nursing Facilities Section 205.68, provides the minimum lighting levels for long-term care facilities. On the other hand, the ANSI/IESNA RP-28-07 *Recommended Practice for Lighting and the Visual Environment for Senior Living* recommends slightly different levels. In general, ANSI/IESNA guidelines recommend slightly higher illumination levels for active resident areas and lower illumination levels at night in areas where resident sleep quality might be impacted (Table 1). ANSI/IESNA is a comprehensive analysis of the visual environment for the elderly that provides the complex criteria to design indoor environments to promote both visual acuity and improved living conditions. For example, although ANSI/IESNA recommends higher lighting levels in some instances, emphasis is also placed on the quality of the light and considerations such as discomfort/disability glare, flicker, light/dark contrast, shadows, and backlighting.

**Table 1:** Lighting levels as per code. Source: (Authors 2013)

	Pennsylvania Code	ANSI/IESNA RP-28-07
Area	ambient light in lux-units (lx)	ambient light in lux-units (lx)
<b>Public Areas</b>		
Administrative and lobby areas, day	500	300 (500 at task surfaces)
Administrative and lobby areas, night	200	100
<b>Therapeutic Areas</b>		
Physical therapy	200	300
Occupational therapy	300	300
<b>Group Activity Areas</b>		
Recreation area	500	500
Dining area	300	500
Barber and beautician areas	500	500
Chapel or quiet area	300	300
<b>Nurse's Station</b>		
Nurses' station, general, day	500	300
Nurses' station, general, night	200	100
Nurses' desk, for charts and records	700	500
Nurses' medicine cabinet	1000	1000
<b>Circulation</b>		
Corridors and interior ramps	200	300 (day) / 100 (night)
Exit stairways and landings	50 (on floor)	300
Doorways	100	100
<b>Resident Rooms</b>		
Resident care unit (or room) general	100	300
Resident care room, reading	300	750
Toilet and bathing facilities	300	300 (600 shaving/make-up)

The Pennsylvania Code for Long-Term Care Nursing Facilities specifies illuminances for skilled nursing facilities, but the standard does not specifically include color temperature or wavelength. Furthermore, the standard lighting levels are *minimum* requirements, not necessarily optimal solutions. Most literature recommends light levels in the range of 2,500 to 3,000 lx (ten times the minimum requirement by code, see Table 1) (Sloan 2007) at a color temperature in excess of 6,500K (van Hoof 2012, Sinoo 2011, van Hoof 2009) within the blue spectrum of a shorter wavelength in the range of 460nm (Brainard 2001). The minimum averages required by code are horizontal illuminances ( $E_h$ ) measured at 30 inches above the floor, which is not necessarily where the eye of the older adult actually is. To adequately measure light coming into the eye, the lighting level must be measured as a vertical illuminance ( $E_v$ ), or in the “gaze direction”, which still is not necessarily where the eye of the older adult is *looking* (for example, the person may be looking down at a tabletop, at the floor or across the room).

## 5.0 EVIDENCE-BASED DESIGN RESEARCH METHODS

The study consists of five phases: screening procedures and informed consent, collection of baseline data, the experimental condition, the collection of post-test data, and the collection of follow-up data at two points in time following the experimental condition and post-test data

collection. A pre-test/post-test design will be used to determine the effects of LED luminaire on patient's global function, and sleep and activity pattern.

**Measures.** Sleep and activity pattern will be measured using wrist actigraphs. An interview schedule with open ended questions will ask staff caregivers about their perceived changes (positive or negative) of a patient's mobility, language, alertness, motor coordination, time spent doing purposeful activities, self care abilities, level of anxiety, or agitation will be used to assess global functioning of patients.

Phase 1. After obtaining Institutional Review Board (IRB) approval, the study will be explained to potential participants deemed competent to make medical decisions and to their legal guardian(s). Full consent will be obtained from patient's legal guardian(s) and participants who are deemed eligible to participate. Residents will be medically cleared for study participation by the facility medical team.

Phase 2. Baseline data on sleep and daytime sleepiness will be collected for 7 consecutive days on the nursing home residents. A wrist actigraph will be worn continuously for 7 days to collect data on sleep characteristics; measures of daytime sleepiness will be collected at each meal.

Phase 3. Daylight-matching LED luminaires will be installed in the Remote Dining Room and in the corridor leading to it (Figure 4). As per the Lighting Schedule (Figure 5), starting with the dim red-light night condition (100 lux at 1000K), the lighting will gradually increase in intensity to the bright noontime condition (2500 lux) color-shifted toward the blue range (6500K) to stimulate the residents' circadian clocks. The lighting levels will gradually decrease and then maintain ANSI/IESNA recommended lighting levels (500 lux) for the rest of the day to support visual acuity for the aging eye. At dinner, the lighting will gradually decrease in intensity and begin the shift toward red nighttime light to prepare the residents for sleeping.

Phase 4. The fourth phase includes data collection on sleep and activity pattern, and global function 30 days after intervention.

Phase 5. The fifth phase includes data collection on sleep and activity pattern, and global function 3 months and 6 months after intervention.

Data Analysis. Descriptive statistics, including frequency distributions, percentage distributions, and means and standard deviations will be used to describe the sample of participants with dementia. The impact of the luminaire on global function will be explored through interviews with staff caregivers for each participant by using a descriptive qualitative approach. Baseline value corresponding to response variable will be used as covariate in univariate analyses. The adjusted means will be used for calculation of effect sizes.

## CONCLUSION

The EBD research at St Francis will advance knowledge in design of the indoor environment by establishing a new, dedicated metric for quantifying light for circadian regulation for the elderly, by evolving a new lighting design for modern healthcare design, and by demonstrating how architectural interiors can become indoor ecologies that improve building occupant health outcomes. Clinical trials at St. Francis Country House and Evidence-Based Design research will validate the broader application of a daylight-matching luminaire to aid in sleep and global function of individuals with dementia and will open a lucrative market for this potentially FDA-approved luminaire for photobiology therapy. Additionally, this EBD research has the potential to impact current and forthcoming safety guidelines offered by the Illuminating Engineering Society (IES).

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# Engineering without the engine: An integrated panelized passive shading system for transparent façades

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**ABSTRACT:** During the latter half of the last century, architects emphasized lightness and transparency in buildings, with trends towards fully glazed building envelopes, including glass façades, atriums and roof structures. However, these glass facades presented challenges such as, the structural design of the envelopes for safety, durability of joints, as well as daylight glare control, thermal insulation and solar heat gain. Today's changing paradigm for design, places an ever-greater emphasis on integrated solutions that are not only aesthetic and experiential, but embrace environmental influences. Environmental imperatives necessitate an agent for change that integrates environmental concerns with the human experience.

Two contradictory factors influence the design of glass envelopes. On the one hand, stylistic design overemphasizes the benefits of maximizing transparency (the desire to create 'glass cathedrals'). This infatuation with transparency results in unintended consequences, namely, that glass facades are generally heavy and energy inefficient, resulting in solutions that are more expensive and wasteful of the planets resources. Therefore, there remain significant challenges for resolving the functional aspects in building facade designs. Whereas designs that are driven by pragmatic functional parameters are generally only concerned with the performance of a building, this in turn sacrifices the aesthetic form of a building in the interests of high performance.

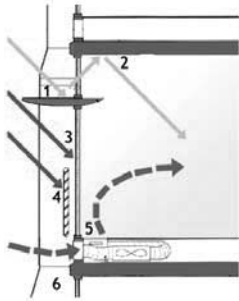
We address this conflicting issue by, considering both stylistic and pragmatic functionality, through an integrated passive solution. We address this by integrating "macro form" through function, related to occupancy and overall massing, with "micro configurations" through functional technology driven parameters. Thereby we adopt an integrative approach, which embraces multiple agents of interconnectivity that address aesthetics, energy, light, structure, materials, transparency, form and function. Our approach is to merge macro scale with micro function thorough what we call a "functionally graded" façade system. The system passively integrates these multiple agents within a single customized solution that uniquely responds to the specifics of building program, site and geographical location.

In this paper, we demonstrate how such a novel façade system may function at the intersections of architectural design - aesthetics - structural - energy performance and human comfort, as a an effective high performance solution for transparent façades, with an exciting range of expressive aesthetics.

**KEYWORDS:** glass structures, shading system, translucent glass, micro function, functionally graded façade

## INTRODUCTION

The function of a façade is to separate a comfortable interior space from the elements of the outside world. There are different functions that a façade serves: it defines the architectural appearance of the building, provides views to the inside and outside, resists wind loads, bears its self-weight, modulates heat transfer between internal and external temperatures and transmits light to the interiors. In addressing these functional parameters, various advanced facades solutions have drastically altered the appearance of the building envelope, and incurred extensive costs in an attempt to maximize light transmission, minimize energy losses and maximize transparency, by adding various components to improve system performance. (CIBSE 1997). (Fig. 1)



**Fig. 1:** Façade functions - advanced solutions, (CIBSE 1997)

### Passive Façade Example

1. Integrated light shelf for shading and reflected light.
2. Ceiling provides reflectance of daylight
3. Multiple glazing with between-pane adjustable blinds
4. Balcony and shading devices.
5. Fresh-air inlet

Windows are a dominant feature in a building's appearance. They can be highly reflective, translucent or completely transparent. The traditional purpose of windows was to provide light, view and fresh air. As completely sealed, mechanically ventilated and electrically lit commercial buildings became the norm, the original primary role of windows were altered, demanding a new paradigm for the building envelope function. One of these paradigms created the concept of "advanced facades" (Fig. 1) (CIBSE 1997) which have significantly altered the building envelope landscape, creating a plethora of accoutrements that are now attached to facades to enhance envelope performance, to the overall detriment of appearance and human experience. In contrast, windows are still valued entities in the building envelope that contribute to the satisfaction, health and productivity of the building's occupants. (Carmody 2007) However, a disfunctional schism exists between architects who usually pay attention to exterior design features, and the mechanical engineers who focus on selecting windows to control solar heat gain, meet energy codes and downsize mechanical equipment. Advanced facades have attempted to address this challenge, however this has resulted in an additive system of functional components (shading louvers, triple facades, light shelves, glazing films and the like) in an attempt to produce energy efficient, healthy and economic buildings, to minimize environmental impact. (Carmody 2007)

In response to today's changing paradigm, that prioritizes environmentally friendly design, facades are better suited for more integrated concepts to avoid component layering. This provides multifunctional performance characteristics that embody aesthetics, light transmission, experience and structural performance within an all embracing passive strategy. We are proposing a new paradigm that effectively transitions "macro form" with "micro function" at the intersection of architectural design, structural efficiency and energy efficiency.

### 1.0. METHODOLOGY

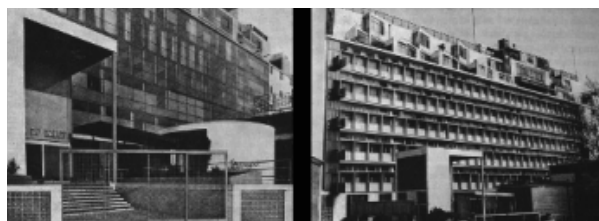
This paper proposes an approach towards redefining facades as an integrated shading panel system, where the shading elements are structurally layered between the two glass panes. The geometrical configuration of the shading elements allows for a geometrical transition to be created within the system, that responds to various interior functions, both locally within a floor plan and generally across the overall façade. In order to evaluate the performance and relative effectiveness in comparison to various façade solutions, we have developed a methodology for determining the efficiency of this system according to a set of metrics that both quantitatively measure environmental and structural performance using computer simulation and experimental testing, and quantitatively measure user experience based on surveys and subjective assessments.

The intention of this paper is to create the argument for the need of a new paradigm based on past experience and lessons learned from precedent case studies; and then to propose a new paradigm that can be fully evaluated through future research, highlighting the essential behaviors of the various façade components and showing the initial results of research carried out by the authors in this area and to propose next steps towards establishing a fully evaluated paradigm.



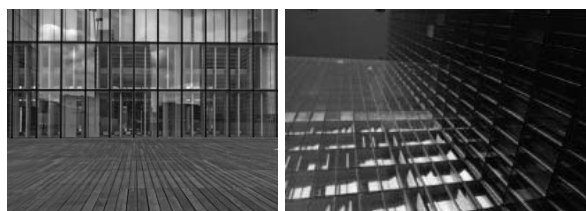
## 2.0. PRECEDENT CASE STUDIES

Designing glass envelopes brought transparency and light into buildings on one hand, but caused unintended thermal and structural problems on the other hand. For example, the *Cité de Refuge*, a building with a large glass envelope, designed by Le Corbusier in 1932, was the first documented case of overheating with serious health consequences for the occupants. (Banham 1984) In order to reduce the heat gain through the glass façade, Le Corbusier applied a type of macro scale “*brise-soleil*”, as an external shading system. It was comprised of horizontal shelves and vertical fins distributed over the entire extent of the facade, which appeared like a large external egg-crate. This significantly influenced the external appearance of the building, which diverted from the original intended building appearance. (Fig. 2)



**Fig. 2:** Le Corbusier's Cité de Refuge: original project (left) and with shades (right), (Banham 1984)

In the Bibliothèque Nationale de France, the library was originally conceived as a complex of ethereal glass buildings filled with light. (Anonymous 1997) After construction, it was necessary to introduce additional interior full floor to ceiling height wooden shutters to avoid direct sunlight and potential damage to the books within, at great additional expense. However, this approach still failed to effectively control solar heat gains within the building, since the wood panels were placed inside the glazed façade, to preserve the original intended external sheer glazed appearance of the building. (Fig. 3)



**Fig. 3:** Bibliothèque Nationale de France and the interior wooden shutters, (author, 2013)

These case studies demonstrate the significant impact of heat and lighting considerations in the design of a glass envelope, together with the consequences of not taking these into account during the design stage and how this can significantly alter the original concept as well as the user experience of the building both internally and externally.

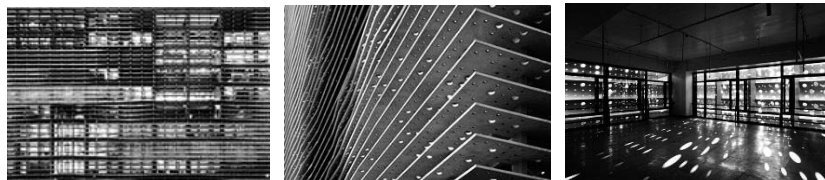
## 3.0. MULTIFUNCTION APPROACHES TO FAÇADE DESIGN

### 3.1. Transitional passive shading devices on glass envelopes

The use of passive shading devices (SDs) on glass facades provides benefits in terms of reducing solar heat gain. Fixed SDs can reduce thermal loads during summer daylight, enhance vision experience (transparency) and reduce glare. (Mandalaki 2012) Louvers and blinds may be composed of multiple horizontal or vertical slats, which are used not only for solar shading, but also for redirecting daylight. Fixed or moveable horizontal louvers provide shading similar to an overhang with improved daylight potential. (Lee, et al. 2002) In a study, Mandalaki referred to Brise-Soleil as horizontal and vertical louvers, in a large-scale window.

Then he showed that this exterior surrounding shading system, called Brise-Soleil facade, creates the lowest energy demand on heating, cooling and lighting as compared to other systems. (Mandalaki 2012) In another study, Kim demonstrated that external shading devices are much more efficient than any other form of internal devices since the internal devices absorb solar heat, which radiates to the interior. (Kim 2012) Gratia and De Herde suggested that in the case of a double-skin facade, the blinds could be integrated in the cavity. The shading device is thus protected from inclement weather and pollution. (Gratia and De Herde 2007) However, past research has not addressed how the integrated shading devices can have a structural role in glazed facades, in addition to their shading function. In other words, intermediate venetian blind systems will not only have thermal benefits, but also they can potentially provide extra stiffness and strength to a double glazed system that can lead to a reduction in glass thickness, saving on material costs and weight.

One elegant example of using transitional shading was implemented on a building by, Mehrdad Hadighi from “Studio for Architecture”, who designed a wavy “graded” concrete facade for Shantou, China headquarters for the Lafayette 148. This building houses all the functions of the Lafayette 148 clothing label and is organized around the flow of production, literally from conception to shipment of the final product. The real magic occurs on the exterior where a double-skin façade elegantly wraps the east, south and west side of the building. The façade is composed of twisting concrete panels that create a continuously varying or graded pattern on the building exterior. (Fig. 4) Size and shape for the grading not only corresponds to programmatic elements inside, but also addresses environmental concerns. The perforated panels aid in the assembly of the façade, and create different plays of light and shadow on the interior that enhances the user’s experience. (Neveu 2012) However in many instances, visible transparency is compromised against prioritizing the external appearance and does not fully address all the necessary parameters that need to be addressed, such as the need for good views out and limiting of high maintenance costs on the external panels

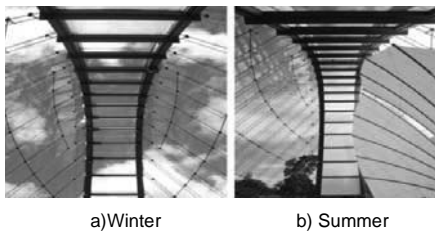


**Fig. 4:** Mehrdad Hadighi’s design for Lafayette 148 in Shantou, China, (Neveu 2012)

However what is demonstrated is that interior and exterior designs can be effectively addressed using vertical or horizontal shading blind systems. This is an effective method for controlling solar heat gain of glass facades as a customized approach related to a building’s specific functional requirements.

### **3.2. Active shading devices for glass envelopes**

Active shading devices have been used in various building envelope solutions. One example is the Alpine House, which is an all-glass enclosure in Kew Botanic gardens, which used a system of winches and pulleys with a retractable fabric to provide adjustable shading in order to shield the interior against the morning and afternoon sun. This in turn altered the appearance of the building envelope. (Wilford 2007). The retractable fabric shading operates on the east and west sides of the glasshouse independently, in order to shade against the morning and afternoon sun respectively (Fig. 5).

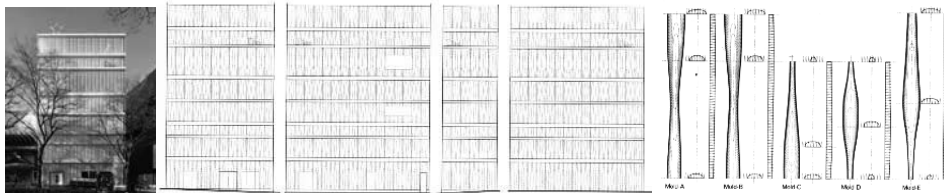


**Fig. 5:** a) Winter mode and, b) Summer mode Davis Alpine glasshouse requires a dynamic shading device to be deployed during hot summer months; within a double-layered 6mm toughened glass panes. (Finch, 2005)

However, an interior fabric both increases cost and does not address the heat gain issues associated with internal shading, albeit an effective solution for controlling the lighting dynamically. Although this may be an efficient solution for greenhouses, the opposite is true for occupied buildings and as such needs a different approach that integrates building function with energy performance.

### 3.3. Translucent light emitting facades in glazed buildings

Glass can be transparent or translucent as a device for transmitting or diffusing daylight to different effects. There are instances where transparency is not essential, yet light transmission is, and in some cases, this can be related to programmatic function. As an example, in the Christian Dior building in Tokyo designed by SANAA, glass was deployed in layered vertical planes as a way to obfuscate the slab. (Bell and Kim 2009) SANAA's ideas created a dramatic result that boasts a skin of flat glass panels over acrylic thermo-formed panels that appear like folded fabric. (Philips 2004) These half-transparent curved acrylic screens are located in the interior and make the façade entirely non-transparent but light transmitting. (Fig. 6)



**Fig. 6:** Dior building in Tokyo designed by SANAA, (Bell and Kim 2009)

Another similar approach was adopted on the Maison Hermes building located in Tokyo. In this case, translucent glass blocks were used as a device to focus the building user experience to the interior, (i.e. the goods on display) by avoiding any transparency to the outdoors yet providing a delightful light emitting experience from within. Inspired by traditional Japanese lanterns, Renzo Piano designed a façade that drastically changes the building's expression from day to night. (Brown 2009) (Fig. 7) This would otherwise not have been possible with a fully transparent façade or one that is heavily shaded.



**Fig.7:** Maison Hermes in Tokyo designed by Renzo Piano, (Brown 2009)

Another approach that transitions between clear and translucent glazing to different effect, related to function, where, for example, translucent areas are created across the building structural, services and utility parapet areas. Transparent areas are only located in the vision band, whereby a gradual density of translucency is created between the solid and transparent zones. Christian de Portzamparc created a five-story hotel named Arc de Triomphe, using undulating glass ribbons that form a large interwoven glazed plait. Transitional transparency is created using a ceramic frit that grades the translucency density between the lower part of the glazing, to prevent users from experiencing vertigo and the upper part which is fully transparent. (Fig. 8) (Kristal 2011)



**Fig.8:** Arc de Triomphe hotel, the lines of fritted glass gradually change from bottom to top, (Kristal 2011)

Translucent facades provide a high quality of diffused light into a building. However, by functional consideration, it obscures the view to the outside and may increase direct glare from the facade, consequently reducing user comfort.

Therefore, an appropriate solution may be one that combines functional components to control light, visibility, solar transmission and energy gains within associated zones that seamlessly enhance performance within an integrated solution that is multi-functionally passive.

#### **4.0. A LAYERED FUNCTIONALLY GRADED FAÇADE SYSTEM**

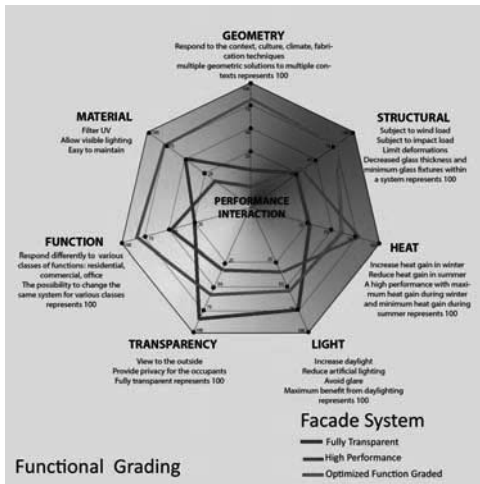
##### **4.1. Functionally graded programmatic parameters**

Window design is not just glazing selection, but requires architectural elements to inform the space itself. "Any discussion of windows without considering the means to temper and control light in an integrated manner is incomplete." (Carmody 2007)

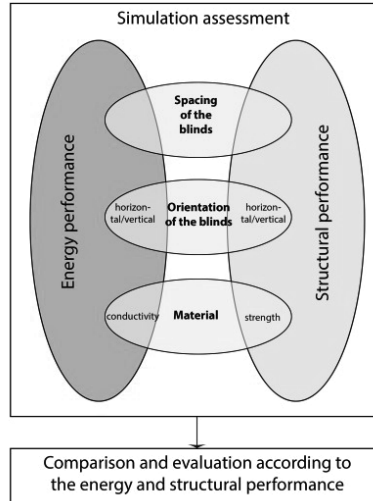
We have demonstrated a number of approaches to solving a façades functional requirements, that have failed and others that have been opportunistic towards a particular goal. However fully integrated systems that are cost effective and optimally solve all the complex functional issues, remain elusive. The authors' proposed approach is for solar controls to be considered not only as one-dimensional elements for energy control, but can also provide a more dynamic multi dimensional response to both internal function and external appearance, by integrating them within the glass layering. This offers further structural efficiency and provides a new aesthetic that represents a multifunctional solution. This in turn offers a wide variety of aesthetic opportunities and reflects the customized nature of a buildings function and performance requirements. The functional parameters that a façade needs to respond to, are demonstrated in the following diagram ( Fig. 9). If a façade solution was able to address all these functions simultaneously, we could create the optimal façade solution. Despite many historical attempts to optimize façade system performance, there are always compromises that result in an "either/or" solution. We are attempting to minimize these compromises by proposing an optimized functionally graded façade system that continuously varies across its elevation in response to changing performance, functions, programmatic and appearance requirements. Fig. 9, qualitatively demonstrates an optimization strategy that weights a selection of façade solution performance metrics according to a range of objective and subjective criteria. The largest areas covered in all categories, represent an optimal solution compared to conventional fully glazed and existing advanced façade systems that have less coverage and are skewed in one direction or the other, compromising important performance requirements. These could be better balanced by achieving similar and higher performance in all categories.

## 4.2. Functionally graded technological parameters

In the context of proposing a functionally graded façade system, our technology investigations are exploring heat, light, materials and structural metrics of a double layered glass system, evaluated for various shading configurations, on the environmental performance of a building. This includes a thickness for the glass panes at 3 mm each and the depth of the shading panel system around 100mm. The primary dimensions are based on structural codes governing the glass structures' design. By integrating the shading panel system within the glass cavity, as the depth of the whole structure increases, the thickness of the glass panes can be kept constant in a particular span, compared to typical glass systems, where the glass thickness increases with increases in spans. The optimization process that relates the two interfacing energy and structural performance parameters with integrated component design considerations, are summarized in Fig. 10.



**Fig. 9:** Functional grading by performance characteristic: comparing different façade systems, (authors 2013)



**Fig. 10:** – System summary - interfacing façade components in the integrated systems design for both Energy and Structural performance parameters, (authors 2013)

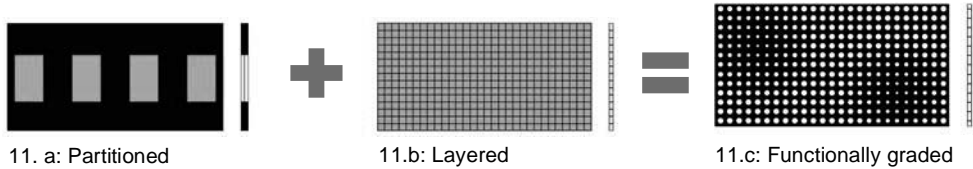
In the following section, we elaborate further on the proposed configuration imperatives and propose approaches for developing a functionally graded façade system, based on the basic principles developed for an innovative and integrated façade structural system approach (Giles 2008), which monolithically attaches an inner core element in the intermediate air space, to a double glazed sheet, to create a structurally composite façade configuration which is very efficient and lightweight. This approach has the potential to further quantify how the core elements provide a structural role as well as a shading function that also results in overall thermal benefits and reflects internal function. This interactive functionality also enhances the external appearance of a building envelope, by creating a rich and varying textural grain to the entire façade.

## 4.3 Functionally graded window systems

### 4.3.1. Partitioned system

A common window system used in many buildings, including churches, castles, residential and commercial buildings, is partitioned. Figure 11a shows this layout that includes punched windows in an opaque wall. This system combines transparency (for light and views) with opacity (for solidity, cost, and thermal efficiency). This approach in window design minimizes the glass surfaces, according to the needs of every interior space. The strategy that considers

different functions related to adjacent spaces, is energy efficient, which has a recognizable effect on the appearance of the building. This approach addresses each interior function independently and does not attempt to integrate form with function in a single building envelope. New approaches to materials, construction and energy efficiency have permitted the industry to adopt more contemporary approaches to unified and multifunctional building envelopes, driven by the 'curtain wall' construction concept, where the windows are still partitioned or cover entire facades as discussed before.



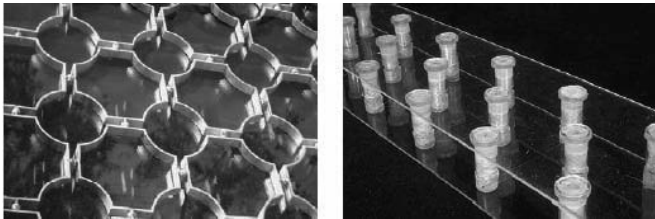
**Fig. 11:** Deriving a “functionally graded system” by combining a “partitioned” and a “layered” system, (authors 2013)

**4.3.2. Layered system**

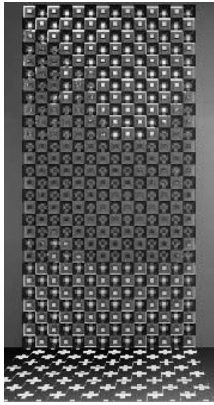
More contemporary approaches have attempted to create envelope systems that are ubiquitous in form, towards larger light emitting facades. The solutions are still somewhat contained within curtain wall assemblies and in some instances, full floor to ceiling clear or transparent facade approaches. This requires the use of excessively thick glass to work structurally, together with addressing the excessive heat gains experienced in such fully glazed systems.

Layering of a hybrid sandwich to enhance the structural efficiency of a transparent panel has been researched as shown in Figure 12. This layering can serve to enhance structural efficiency as a composite panel system, with integrated shading elements.

According to Wurm, “The acceptance of sandwich construction to glass architecture depends on how much can be achieved with automated manufacturing processes in terms of economy and quality standards.” (Wurm 2007) The build-up of these sandwiches, selection of materials and the geometry of the layers varies, which opens a wide scope of possibilities for manufacture, function and design. SITUMBRA, which is an innovative structurally monolithic transparent facade system, creates a shading function through various geometric configurations of the connected core elements, as way to integrate structure with shading function in a single façade system. (Giles 2008) (Fig. 13)



**Fig. 13:** Quad cell, (Giles, 2008)



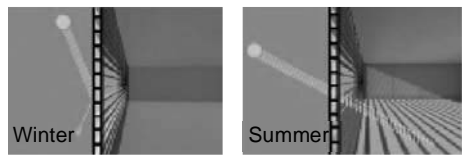
**Fig. 12:** Concept models for interactive sandwich construction design, (Wurm, 2007)

#### 4.3.3 Macro versus Micro grid system

There are three types of grid that can be used to provide floor to floor shading. Firstly, a “macro” system which includes floor to floor ledges and fins; secondly a “medium” system which is based on a 4 or 6 inch deep cavity using spacing of similar dimension; and thirdly, a “micro” system which is based on a 1 inch cavity with an internal venetian type of blind. (Fig. 14) The depth of the louvers in each scenario is proportional to the dimensions of the grid-shaped glass divisions. Similar to Le Corbusier’s solution, horizontal and vertical shading devices can be used in a glass façade system, but scaled down to a medium and micro grid system. In another words, the “large grain” shading louvers can transform to a “medium grain” brise-soleil system that is integrated within the cavity of a double-layered glass system, instead of adding an additional layer external to the facade. This fixed cavity inner structural core, which connects to the inner and outer transparent window material, can meet multiple specifications including enhanced thermal performance of the facade as well as playing a structural role for the whole system. (Fig. 15)



**Fig. 14:** Three different types of grid: a) Micro, b) Medium. c) Macro (authors 2013)



**Fig. 15:** The shading system functionally integrated between two glass panes. (Giles 2008)

#### 4.3.4. Graded system

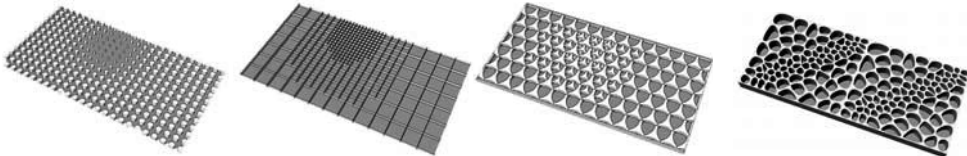
It is postulated that a façade system may be configured to combine the primary capabilities of a partitioned and layered system into an integrated system that embraces multi functions (Fig. 9), thus represented as a system that also expresses its functions. For example, a geometric grading (Fig. 11c) may both represent the layout of internal spaces such as the macro scale in the Lafayette 148 building façade represented in Fig. 4), combined with a structural composite configuration such as the SITUMBRA system represented in Fig. 13). This approach also provides the necessary shading, by locating the shading elements by internal function (similar to the transitional grading of the glazed fritting on the Arc de Trimophe hotel façade represented in Fig. 8). Learning from the design solutions for the Dior and Hermes buildings (Fig. 6 and 7), the final solution may be fully or partially translucent, depending on the building program, or graded across various modes of transparency. Therefore, our proposed system effectively morphs a “functionally partitioned systems” and an “integrated layered system”, to become a “functionally graded system” (Fig. 11c & 16). In this approach, a core system is still compositely sandwiched between two separate glass panes to achieve excellent structural efficiency. This core system may have a progressively varying geometry, graded by the interior spaces’ functions and/or light transmission characteristics. The core plays a role in providing

shade, and also stiffens the glass surface to provide a light weight glazing system. The change rate of the geometry is not discrete but occurs through generative parametric modeling. This approach in designing a micro system has the potential to address all the building's requirements parametrically, such as solar angle dependency, orientation and interior function.

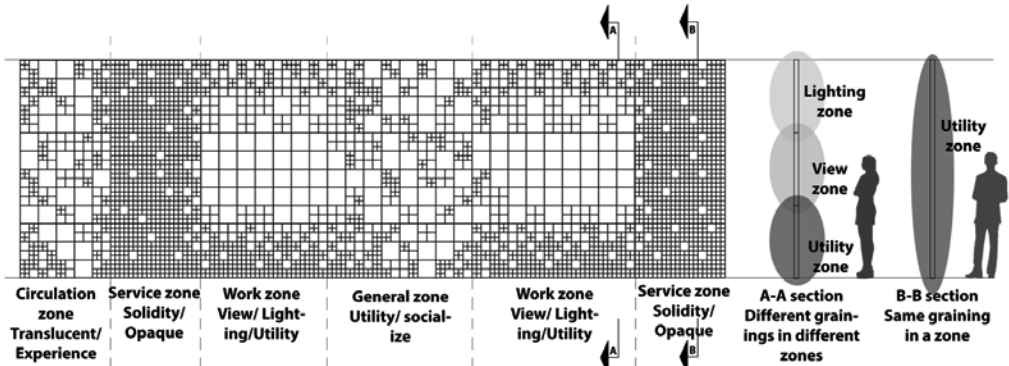
**4.4. Functionally graded façade geometries**

In order to fully embrace the functionally graded components in the design of a glazed façade system, the many parameters, including the building's needs, the core geometry and its variation's, the core's material and the available fabrication techniques are being addressed in a series of geometric and manufacturing studies that optimize on system performance. There is an ongoing exploration on the possibilities of the design and fabrication of the functionally graded core systems. We have started this process by designing a rectangular grid system that may vary by interior function.

Another design approach uses a circular pattern that varies depending on its distance from an attraction point. Several geometric patterns based on fractal variations are also possible, using a rectangular layout (Fig. 16). Further studies that transition the actual interconnecting cells between glass layers are being carried out to create an interspersed micro to macro grid configuration, such as those demonstrated in Figure 17 below.



**Fig.16:** Creating a functionally graded shading system, based on generative component geometries, (authors 2013)



**Fig. 17:** System wide graded façade concept applied to functional zones across part of building elevation, (authors 2013)

**5.0. CONCLUSION**

A façade's configuration can be an explicit representation of its functions. There are multiple functions within a building and sometimes a dominant function imposes a configuration that dominates all the other functions. In contrast, we propose a functionally graded façade system that creates a smooth geometric transition in response to different programmatic building functions, by grading the facade's geometry in response to these functions. These transitions are also meant to represent a system that follows a number of functional rules, categorized by space and technical performance, which vary gradually in their geometrical form.

In addition, a layered glazing system that integrates a shading system in the cavity of two glass panes can enhance the role of the blinds from "one-dimensional functioned element" to "multi-



functional element” which not only increases the energy efficiency of the system, but also plays a role in the structural efficiency.

The concept of a “functionally graded layered glass system” pushes this boundary even more and adds other functional aspects to the system including a wide variety of aesthetic, more dynamic, multi dimensional responses to internal function and external appearance that proposes a richly varying customized appearance that reflects a buildings function and performance requirements. The enhanced performance of this system has been validated through computer simulation and also lab measurements. In addition, a unique fabrication technique has been developed which is capable of manufacturing structurally integrated cell system. This research will further explore various geometries and associated fabrication techniques for those geometries, in an attempt to refine and optimize the multifunctional capabilities of the proposed functionally graded façade system.

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# Multidimensional Space: The Intersection of Architecture and Engineering in the Realm of the Senses

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**ABSTRACT:** The historically lush and varied sensory environments we evolved in have paled to a relatively bland homogeneous palette. With ever-increasing technological accuracy, the environments we now design and build are controlled to narrowly acceptable ranges of temperature, light, smell, sound and color. To address the comparatively impoverished sensory environments prevalent in contemporary architectural/urban design practice, this paper explores the intersection of the design and engineering professions as they overlap in the realm of the senses. The paper presents a new framework for design of sensory spaces including light, color, temperature, smell, sound, touch and the personal and communal spaces brought to life through habitual use patterns. Each of these sensory dimensions is identified as an independently shaped space with attendant characteristics of location, boundary, intensity, duration, etc. which may coincide with or only partially overlap the architectural geometric space of solids and voids. The multidimensional design framework outlined in the paper explores how these sensory spaces may be either congruent, reinforcing each other for an intense nodal experience, or dissonant, diverging to create an illusion. To accomplish the paradigm shift required to implement the framework, the paper addresses the current silos of design and engineering professions and explores a collaborative relationship between them, where architects and urban planners move to embrace the traditional engineering realm of environmental controls and engineers claim their due place in the design arena.

**KEYWORDS:** Sensory Design, Architecture, Urban Design, Phenomenology

## 1.0 Attenuation of the Sensescape

The historically lush and varied sensory environments we evolved in have paled to a relatively bland homogeneous palette. Ocular-centric contemporary design practice prioritizes visual impact over engagement of the other senses. With ever-increasing technological accuracy, the environments we now design and build are controlled to narrowly acceptable ranges of temperature, light, smell, sound and color. This homogeneity of sensory experience arose from an egalitarian desire to provide a base level of comfort for all and to leverage the efficiency of flexible, universal design. As designers of the physical realm, architects and engineers were empowered to take this approach in the mid-twentieth century by engineering advancements that gave them precise control over a building's environment and by what appeared to be unlimited energy resources available to maintain this narrow band of sensory conditions. (Banham 1969) The resulting environments established a cultural "norm" with closely controlled ranges of temperature, light, smell, and sound. Experiments were conducted to understand comfort level preferences for the 80% peak of the population bell curve. Comfort charts were drawn; light levels were targeted; and elaborate electrical/mechanical systems were engineered to maintain these identified "comfort conditions" over every square foot of building space through every occupied hour of the day.

Historically, mankind has benefitted greatly from the elimination of environmental extremes that these systems guaranteed. Incorporated into generally accepted standards like ISO, ASHRAE, ANSI, etc., these environmental regulations saved workers from the poor air quality and dimly lit interior spaces of earlier times. But the rigid replication of this approach has resulted in spaces that are everywhere the same and nowhere special - environments that are acceptable but not inspiring, comfortable but not comforting, predictable but not memorable. The systems to maintain this consistency overdraw the earth's resources, returning in exchange environments with no sense of place, time or cultural identity.

At the urban scale, this attenuation of the sensescape may act to obscure or even obliterate the cultural identity of entire neighborhoods. The traditional activities of an area's occupants include associated sensory qualities that imbue that place with a familiar and recognizable sensory culture. Too often, urban rehabilitation projects attempting to recreate a pre-existing cultural identity mimic the visual symbols of culture while obliterating other more "problematic" sensory cues (smells, sounds, textures, etc.) that are essential to the cultural experience. Pardy calls this a de-politicizing of space (Pardy 2009) which makes these rehabilitated neighborhoods "sites of *display* rather than sites of *dwelling* where authentic engagement with diversity is avoided and a palatable non-confronting version of multiculturalism is promoted." (Palipane 2011, 3)

## 2.0 Sensory Design – An Intersection of Disciplines

The challenge of addressing the relatively impoverished sensory environments generated by these current architectural/urban design practices is exacerbated because the field of sensory design resides between traditional disciplines of study. In addition to the fields of architecture, engineering and urban planning, disciplines like psychology, physiology, sociology and anthropology provide vital information on how people actually perceive space and develop preferences (either individually or culturally). Thus the design of the sensory realm falls at the intersection of multiple responsibilities and frequently gets overlooked in the transfer from one to the other. This paper explores in particular the intersection of the design and engineering professions as they overlap in the realm of the senses, and touches on the other areas as needs for future work.

The built environment professions have evolved toward a separation between the architect or urban planner who designs the space and the engineering professions which regulate their sensory phenomena. The resulting silos of responsibility represent the right brain/left brain, heart/mind, emotion/logic dualism in our contemporary approach to problems. This duality sometimes plays out in stereotypes of the professions. Architects may characterize engineers as rigid and non-creative; engineers may portray architects/designers as emotional, unrealistic and impractical. To accomplish the paradigm shift required to implement full sensory design, the current silos of design and engineering must evolve to a new integrated/collaborative relationship. As the rewards of this new design paradigm unfold, architects and urban planners move to embrace the traditional engineering realms of environmental controls and engineers claim their due place in the design arena.

## 3.0 Sensory Design Reawakening

Numerous voices throughout recent decades have provided wake-up calls to remind us of the rich sensescape that is our heritage. Christian Norberg-Schulz, for example, reminds us that in Prague, "The illumination is not continuous and even; strongly lit and dark zones alternate, and make us remember the times when a street lamp created a place." (Norberg-Schulz 1980). Lisa Heschong's *Thermal Delight in Architecture* recalls the vitality of varied temperatures that drew people to cozy fireplaces in winter, cool courtyards in summer - spaces that invoked memories and a sense of place (Heschong 1982). Juhani Pallasmaa admires the capacity of the human ear to carve a volume into the void of darkness. (Pallasmaa 2005) And Victoria Henshaw invites us to take a walk with her through the urban "smellscape." (Henshaw 2013)

Benedikt examines the difference between vision-centric "exteriorist design," which places us as observers outside the space and sensory rich "interiorism," which places us within an enveloping spatial experience. In exploring this, he acknowledges that, "the lack of a way to describe and map sensory experience and to make it a part of design plagues the field to this day." (Benedikt, 2002, 4) Responding to this need, this paper develops a language and design framework to conceptualize the sensory dimensions and suggests changes to education curricula to ensure that future generations of designers are equipped to design within the multiple dimensions of sensory experience.

#### 4.0 Multidimensional Sensory Approach

Multidimensional space is the term this paper uses to describe this framework of overlapping sensory spaces. Merging the poetry of design with the science of engineering, the multidimensional design framework moves designers beyond the myopia of a vision-centric experience to a full multisensory approach. This conceptual framework involves understanding sensory spaces as volumetric shaped spaces that can be inhabited - spaces of warmth, color, light, sound, smell, texture, and the personal and cultural spaces brought to life through habitual use patterns. These spaces are understood as existing independently from the geometric space of walls and openings. Each of these spatial dimensions has identifiable characteristics of location, shape, boundaries (rigid or porous), intensity, duration, etc., that can be designed and perceived just as we design the geometric space. The multidimensional framework lets us comprehend the experience of entering and leaving these sensory spaces. It lets us examine whether they are congruent with each other or dissonant - whether they build to intensify a cohesive experience or diverge to create an illusion (or just a bad design).

At the urban scale of sensory design, the multidimensional framework explores both the shape and rhythm of sensory spaces. Is the streetscape experienced as a series of human-scale spaces alive with sounds, smells and tactile enticements from sidewalk vendors and musicians or as a monotonous tunnel droning with vehicular traffic and exhaust?

To better appreciate the potential impacts of sensory space, the following sections explore individual sensory dimensions of light, temperature, and smell.

#### 5.0 Light Space

The experience of light space is perhaps one of the easiest to understand as, like geometric space, it is experienced through sight, the predominant human sensory mode. It is an axiom of lighting design that we can't see light unless it is reflected off an object. Although scientifically accurate, this belies our kinetic experience that a volume of light exists between the light source (whether it is the sun or an electric light) and the surfaces it illuminates - a three dimensional volume of light nestled between three dimensional volumes of shadow. David Abram captures this whimsically as he explores the realm of shadow, noting that, "one of the countless signs that our thinking minds have grown estranged from the intelligence of our sensing bodies, is that today a great many people seem to believe that shadows are flat." (Abram 2010, 15) To the contrary, on exploring his own shadow, Abram experiences, "a precisely bounded zone of darkness that floats between my opaque flesh and that vaguely humanoid silhouette laid out upon the pavement ... The actual shadow does not reside primarily on the ground; it is a voluminous being of thickness and depth, a mostly unseen presence that dwells in the air between my body and that ground." (Abram 2010, 16)



#### **Light Space**

*The evening lamp on the family table is also the center of a world. In fact, the lamp-lighted table is a little world in itself, and a dreamer-philosopher may well fear lest our indirect lighting cause us to lose the center of the evening room.*  
(Bachelard 1969, 170)

**Figure 1:** The inviting cone of light space that envelops a dining room table

This experience of three dimensional volumes of light/shadow presages the rich possibilities of light space. Originating in the theater lighting profession, lighting design has long carried the power to create mini-environments within a larger setting. Just as the theater spotlight defines

a small cone of activity within the larger stage, so creative architectural lighting can generate light spaces that feel separated from the space around them (Fig. 1). Some light spaces occur naturally, such as the cozy glow of a window seat in direct sunlight or the shady recess beneath a willow tree. Others are more intentionally designed with carefully crafted window openings and custom electric light fixtures. Good lighting designers use these effects to advantage to create volumes of light (or darkness) not confined by physical walls. They create glowing spheres of light around restaurant tables to envelop intimate diners. They entice us with glimpses of bright volumes of light bulging out from behind walls or produce a dazzling pavilion of light to celebrate the intersection of two long hallways. In each of these, the occupant knows when he/she has entered and left the light space, senses how intense it is and how porous or abrupt its boundaries appear.



### **Thermal Space**

*Marcel Proust poetically describes a fireside space, as sensed by the skin: "It is like an immaterial alcove, a warm cave carved into the room itself, a zone of hot weather with floating boundaries." (Pallasmaa 2005, 50)*

**Figure 2:** The inviting thermal space of an inglenook. Photograph courtesy Colleen Duffley Photography

Lighting designers may even intentionally camouflage a room's geometric shape by creating an illusion with a contradictory light volume. For example, the designer may intentionally lower the apparent height of a room by creating a light volume that stops short of the actual ceiling height. This can be done with dropped pendant lights or downlight fixtures in an open grid offset from the dark ceiling cavity.

However in most buildings today, especially work environments, this richness of lighting design is neglected in deference to the goals of flexibility and universality. In the vast majority of commercial buildings, the architect finishes the spatial design and then hands it off to an engineer who uses standardized spacing criteria to lay out a regular grid of electric lights in the dropped ceiling throughout the building. Even in break rooms and lobbies, where the range of activities doesn't require it, the uniformity of light levels persists. This is not because architects don't care how the space is experienced, nor that engineers can't creatively respond to higher design goals, but rather that sensory design has not been prioritized in the multitude of considerations required by the design process.

## **6.0 Thermal Space**

This same uniformity is the default condition for other sensory modes. Some environmental designers have coined the term "thermal beige" to describe the monotone nature of contemporary thermal environments. How often any more do we experience moving in and out of warm cozy nodes like the inglenook fireplace set off from the main body of a living room (Fig. 2) or the warm abode of a window seat in sunshine? In *Thermal Delight in Architecture* Lisa Heschong jogs our collective memories of humankind's history of seasonal migration to these thermal spaces, the patterns of use marking the hours of the day or seasons of the year. (Heschong 1982) These thermal nodes of warmth or "coolth" can be designed and shaped in our current architectural landscape just as light spaces are designed. If we pay attention, we can sense their location, volume, intensity, and boundaries. Who has not experienced the sphere of warmth around a campfire and felt the edge of this warmth as it dissolves into the surrounding night air?



**Figure 3:** Pike Place Market in Seattle provides a sequence of smell and sound spaces

### 7.0 Olfactory Space

Olfactory spaces can represent the collective memory of a culture – the smell of a bread shop in Paris, spices in a Middle Eastern souk, fresh mown hay in the countryside. Often one smell evolves to another as a person moves through a neighborhood or space. The rhythm of smells may become a signature line for a particular city, neighborhood or season. Pike Place Market in Seattle, for example, is experienced as a modulation of smells and sounds (Fig. 3). Visitors move from the seaside smell and raucous sounds of the fish market to the delicate aroma and relative calm of the flower market. A blindfolded person could sense moving in and out of these distinct nodes as if they were separate rooms within the Market. Each of them would be diminished if their wares and sensory cues were intermixed.

### 8.0 Multi-Sensory Examples

Just as we can understand these sensory spaces of light, temperature and smell, so we can call to mind and design inhabitable volumes of sound, texture and touch, color and pattern – each of them independently located in space and time. Computer simulation programs can even render the shape of these spaces, noting how they overlap with a building's geometric space or the landscape of an urban neighborhood. As these rich sensory nodes take shape, they define sub-spaces that people are drawn to either alone or in a group. While the window seat might call out a private refuge for a solitary afternoon of reading; the inglenook draws a more social gathering.

The inglenook's strength as a social node is heightened by its intense overlap of multiple sensory zones. This small confined space adjacent to the larger space of the room is reinforced by the warm thermal space of the fire, the flickering orange light space of the flames, the crackling sound space and the smoky olfactory space. Over time, its habitual use on chilly winter evenings makes it also a cozy communal space shaped by the stories and laughter that have been shared within it. These perceived personal and cultural/spiritual shaped spaces are easily identified by the people who ritually use them, but they may be indiscernible to those who have not shared the experience and may not even recognize the spatial boundaries. A late night group of men gathered around an open charcoal fire in a metal drum may appear menacing to a visitor in unfamiliar territory but be experienced as a cozy neighborhood social node to those within the culture.

Crafting these multisensory spaces requires a truly integrated design approach that can no longer tolerate a handoff of responsibility from the designer, to the engineer, to the occupant, but rather requires all parties to work together at the design table and speak a shared language. The resulting multisensory designs may consist of intentional nodes of overlap among three or four sensory volumes that intensify the overall experience and ritualize its use as a cultural space. Alternately they may contrast individual sensory space experiences to create mystery and illusion. They can provide variety to allow occupants to choose their preference of warmth, light level, sound or quiet. These sensory designs can make spaces come alive with the rhythms and rituals of sensation and movement, privacy and community to enliven our homes, offices, public buildings and urban neighborhoods.

Two recent architectural examples illustrate the impact that multisensory design can have. In Seattle's Chapel of St Ignatius, Stephen Holl used the concept of seven bottles of light in a stone box to generate the form, clearly delineating light spaces separate from their geometric space container. Each of the seven bottles of light is a differently colored volume experienced sequentially in the building. (Holl) Perhaps the most compelling sensory space in the chapel is the Chapel of the Blessed Sacrament, whose walls are dripped with bee's wax. Stepping into this space, the visitor enters an olfactory volume of sweet smell that also radiates with the warmth and amber glow from a concealed skylight.

In his personal residence in Venice, California, artist Doug Aitken experiments with a variety of sensory dimensions. "The goal was to create a warm, organic modernism that's also perceptual and hallucinatory," he said of the design. (Yablonsky 2012) Aitken both combines sensory spaces to create intense sensory environments and contrasts them to create illusions. "The ground-floor walls and curtains have been silk-screened to simulate the hedges growing outside the windows, the sky-lighted staircase is lined with angled mirrors that turn the passage into a dazzling kaleidoscope ... at certain times of day, the living room windows appear to melt away, dissolving the painted walls into the greenery beyond them." (Yablonsky 2012) Even the stairwell is an active sound space "played" by the rhythm of footsteps ascending and descending.

The attention to sensory design is not separate from, but in many ways arises from passive and sustainable design approaches. Daylighting design, for example, frequently results in distinct zones of light and dark. Although this modulation of light level can be evened out across a space where desired, the glow of direct sunlight is frequently used to call out significant nodes and gathering spaces. In addition, the basic premise behind task lighting or heating (well recognized sustainability practices) is the creation of subspaces of sensory intensity. Rather than conditioning an entire space, the design may provide a localized "tent" of light under which more demanding tasks can be performed or an alcove of warmth or "coolth" where people can gather to be refreshed. The passively designed cool-tower at Zion National Park's visitor center creates an alcove of cool air at its base for visitors to gather in and refresh themselves. This reduces the need to condition the entire space to a level that may be experienced as chilly to people entering the space from the overheated desert environment. Similarly, displacement ventilation systems provide fresh air (olfactory and thermal space) just in the first 8 feet above floor level, basically creating a truncated volume of sensory conditioned space where the occupants reside.

## 9.0 The Future of Full Sensory Design

To move contemporary design practice toward a full multisensory approach the following changes need to occur:

- The first crucial step is to recapture an understanding and appreciation of the sensescape and its impact on the emotional and physical health of occupants. Research into the mechanisms of human perception for individual sensory modes, the sensory responses of individuals and cultures, and the exploration of the ambiance of place is essential to a more complete understanding of this field. This work is gaining momentum with the research, projects and publications of many new advocates in this field and with seminal conferences like the International Congress on Ambiances under the aegis of the International Ambiances Network. Since much sensory design research focuses on an individual sense mode, this platform for cross-modal sharing of information is critical for integrating and reconciling the directions of this emerging work. In addition to architecture and engineering, this work engages the fields of psychology/physiology to understand the underlying mechanics of sensory perception, sociology/anthropology to explore the cultural implications, and art and creative writing to celebrate the depth of sensory experience. Development of a comprehensive list of contemporary and historic building/urban precedents is needed to further assist students and designers in experiencing multi-layered sensory impacts first-hand.

- Equally important is the development of a shared language and design framework to envision, and communicate sensory design. Sensory fluency is rapidly developing with the pioneering work noted above. Design frameworks like the one proposed in this paper are beginning to emerge to facilitate communication of the sensory design intent to the design team, client and stakeholders. Future work in these frameworks needs to also systematically characterize the physical attributes of each sensory mode. For example, how does one describe and control the boundary condition for the sense space or its intensity or the pleasant/unpleasant quality of its impact?
  
- Lasting change will require integrating this sensory design knowledge into traditional educational coursework to train tomorrow's designers in a multisensory approach. To achieve this, many parts of the design curriculum must evolve, including:
  - *History and Theory*: Introduction of the concepts of sensory design and the influence of the sensescape throughout history.
  - *Building Science/Engineering*: Reinforcement of the concepts of the experience of sensory space and the technical expertise to use passive and active design mechanisms to shape sensory space across multiple sensory modes. Integration of sensory principles with sustainable design curricula.
  - *Architecture Design Studio*: Use of sensory design criteria to envision and evaluate the ambiance of studio projects. Involvement of associated disciplines (building science, anthropology, physiology, etc.) in an integrated studio atmosphere to collaborate in envisioning and creating the sensory space.
  - *Design Computing*: Provision of programs/platforms to calculate and render shaped sensory spaces overlaid on three dimensional computer models.
  - *Urban Planning*: Exploration of the impact of the urban sensescape in identifying or creating urban ambiance and its attendant cultural implications. Involvement of associated disciplines (engineering, anthropology, physiology, etc.) in an integrated studio atmosphere to collaborate in envisioning and creating the sensory space.
  - *Landscape Design*: Exploration of the impact of the sensescape in identifying or creating a landscape ambiance and its attendant cultural implications. Involvement of associated disciplines (geography, civil engineering, etc.) in an integrated studio atmosphere to collaborate in envisioning and creating the sensory space.
  
- Sensory design will necessitate an evolution of professional practice into a fully integrated design process. This process must leverage the current sustainability emphasis on integrated project teams to involve all team members in the co-design of the full sensory experience.
  
- Tool Development: Although currently available design tools can render individual sensory spaces, a common platform is needed to visualize and juxtapose these diverse sensory environments. The expanding body of virtual reality research must also be leveraged to simulate the experiential impact of innovative new sensory designs.

By engaging a full sensory design process, we can make the places we spend time and move through in our daily lives more humane and interesting. These multi-sensory spaces will use



the earth's precious resources well to create magical, memorable experiences. No longer shuffling between anonymous universal spaces, we will savor our environments and dwell in the true sense of that word – to live or stay as a permanent resident, to linger over. And we'll imbue our man-made realm with the sensory variety and vitality that we are drawn to in the world of nature.

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# Narrative Thinking in Architectural Education

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**ABSTRACT:** Recent research indicates that mainstream architectural practice is in a general state of denial about participation and client/user involvement. Within this paper we argue that this general denial is already acquired during architectural education. Given the fact that architects are influenced by this 'academic experience' to such an extent that it influences their professional careers, we argue that it is acceptable to look to education for the root cause and potential alleviation of the problem. Framed within phenomenological thinking (Ricoeur) and pragmatic theory (Dewey), we develop *narrative thinking* as a basic design attitude which combines user based research and moral imagination. We implement narratives in the design studio to (re)connect designer and client/user. Our main objective is to stress the importance of narratives as a sustainable starting point for a real participatory process. Methodologically we link narrative thinking and research by design. More specifically, we develop a design assignment on multigenerational dwelling at our school of architecture. We challenge our students to find 'real' client/users, to report about their narratives on the desired use of the multigenerational dwelling and to use these narratives during the entire design process. Most important outcome of our study is growing empathy and enthusiasm among our students towards their client/users. Narrative thinking initiates a participatory design process which brings about positive change and a more daring and less predictable design project in favor of all participants.

**KEYWORDS:** Architectural education, narrative, moral imagination, user/client, multigenerational housing

## INTRODUCTION

Several observational studies have been made of how designers work (e.g. Lawson 2006). A general finding is that designers solve problems which are ill-defined, ill-structured or 'wicked' (Cross 2006). These problems are not susceptible to exhaustive analysis, and there can never be a guarantee that 'correct' solutions can be found for them. However, designers use a pattern language, or codes to control the design process. Designerly ways of knowing are embodied in these 'codes', which guide the process towards a final design product (Cross 2006). Of course there is no correct 'method of designing', nor one route through the process. Nonetheless, we observe that most design process models, especially within the field of architecture, tend to exclude the client/user from the design process (Parnell 2003). In most cases their role is limited to the provision of basic constraints. Consequently, it may be argued that collaborations between architectural designers and client/users tend to be nothing more than pseudo-participation (Till 2005). In fact, mainstream architectural culture is in state of denial about real participation, a denial that is tantamount to rejection but without a real need to be explicit about it.

Within this paper we argue that the basis for a general denial of the user/client by architects is already formed during education. In particular, the development of empathy and cooperation among students of architecture is recognized as most lacking in the traditional model of their education (Parnell 2003). Bearing in mind that architects are influenced by this 'academic experience' to such an extent that it influences their professional lives, we state that it is justifiable to look to education for the root cause and hence potential alleviation of the problem. According to Sara (2000), the involvement of clients/users in the design studio and the education process currently challenges the traditional model which generally tends to exclude these people.

Framed within phenomenological thinking (Ricoeur) and pragmatic theory (Dewey), we develop a narrative design method which sustains the involvement of the final users during the design process. This method breaks through professional codes by dissociating itself from the belief that the architect should be the one who is telling the story. To make this clear we explore narrative thinking as a process of collaborative design thinking, or - inspired by the ideas of pragmatist Dewey – as a process of moral imagination and joint inquiry. Motivated by this pragmatic perspective we develop an assignment on narrative thinking in the design studio. More specifically, we send out eighty architecture students to find possible client/users for an extensive design assignment on multigenerational housing. We question, what it means to occupy a structure; to use it. What does it mean to rearrange the activities within a building, to imagine its life over 20 years instead of just the two years of a construction period? By doing so we promote early user involvement and an iterative approach involving research, design and critical evaluation. Moreover, we challenge our students to invest their 'professional architectural competences' in a realistic and democratic environment.

### 1.0. EDUCATING FOR COLLABORATIVE EDUCATION

Collaboration and communication skills are not, apparently, strengths of the architecture profession (Parnell 2003). But, perhaps of greatest concern is that architects are described as arrogant, poor listeners, and their education is seen to be to blame (Sara, 2000). However, lack of communication brings a lack of understanding, and where there is a lack of understanding, relationships tend to break down. From this perspective, one can see how easily a non-professional might arrive at a negative impression of the professional designer.

According to Parnell (2003), a lack of communication skills, and the basis for a general denial of the client/user by architects, is already formed during their education. In particular, the development of cooperation and an empathic attitude among architecture students is recognized as lacking in the traditional model of their education. Recently, Steele, director of the AA School in London, remarked that 'the key project of the architectural school today is the making of audiences, not architects' (2013, 90). Parnell therefore urges to introduce the client/user into the design studio. Hence, despite the considerable differences in the process of educating future architects around the world, there is one remarkable similarity – the overriding primacy given to the design studio as the main forum for creative exploration, interaction and assimilation: 'The design studio is the kiln where the future architects are modeled' (Salama 1995, 1). In this respect, Parnell (2003) states, that studying people and communicating with client/users from day one in the design studio, would help architecture students to see their perspective on design and architecture and learn to respect their viewpoint. 'While they will necessarily develop their own professional position and inevitably become socialized into profession's culture, they will still be able to communicate with and understand non-professional culture' (Parnell 2003, 68). This should breed respect and ultimately avoid the public view of architects as arrogant and out of touch with reality. Of course, Parnell (2003) remarks, the involvement of client/user in the design studio and the education process immediately challenges the traditional model which mostly excludes these people. 'In so doing it challenges the implicit value position of the traditional design studio and communicates an alternative to students' (Parnell 2003, 68).

Undeniably, the empowerment of client/users demands that they not only play a role in the process, but that this role affects the final design in a real and sustainable way. By encouraging students to develop and use participatory methods, they are effectively being asked to reject a paternalistic model of practicing architecture and instead design *with* people. If this were to happen in architecture school, Parnell (2003) argues, it would clearly communicate to students that the school of architecture valued people within the design process. 'The skills and attitudes developed in students as a result of this interaction with client/users would potentially improve relations greatly' (Parnell 2003, 68).

Undeniably, Parnell's proposal for an alternative pedagogy in architectural education points towards the development of a listing approach. 'Characteristics such as empathy and co-operation and activities such as brief development, client/user involvement and client/user

understanding, demand that the student architect learns to listen' (Parnell, 2003: 69). This is not just a skill, but also an attitude. Listening to find value in what other are saying is the only true listening process. In order to achieve this, Till argues, that it is necessary to look for a new model of communication, and 'the key lies in recognizing the power and validity of ordinary conversations as a starting point for the participatory process' (2005, 17).

## 2.0. NARRATIVE THINKING

In our view, the quest for real participation (in education) is appropriate. In line with Parnell (2003), we argue, that listening to the client/user is something that should be thought and practiced in the design studio. Yet, we want to stress the importance to (re)connect the act of listening to the act of narrating. By doing so we aspire that the act of listening does not degrade into a formal procedure without content and some kind of 'pseudo-listening'. To clarify this we introduce phenomenological thinker Ricoeur's narrative theory.

In *Life in Quest of Narrative* (1991) Ricoeur develops narratives as a structural and anthropological phenomenon. Without narratives it is impossible for individuals to live as human beings. In this sense Ricoeur takes a critical look both at the common-sense linking of life and narrative, and at the equally common distinction between real life and fiction. Ricoeur seeks to rework the Socratic claim that the unexamined life is not worth living (Wood 1991). To bridge the unmistakable gap between narrative and life, what we need to do is to rework our sense or meaning of each term. Narratives are not just configurations out there; they are completed only in the act of listening or reading. Moreover life is not only a biological phenomenon but symbolically mediated. And Ricoeur (1991) argues, that human experience is already riddled with stories in a way that suggests a demand for narrative immanent to experience itself. 'Indeed, psychoanalysis suggests that we might think of lives in terms of untold or virtual stories; recounting a life would merely be articulating these, rather than imposing them on an alien content' (Wood 1991, 11). Ricoeur (1991) suggests we think of the examined life as a narrated life, characterized by a struggle between concordance and discordance, the aim of which is to develop, not to impose on oneself, a narrative identity.

In his philosophical contribution, Ricoeur (1991) demonstrates that narratives manifest themselves in stories. At first sight these stories are fictions which have nothing to do with reality. It's as simple as that. Ricoeur points to the way in which these stories are perceived by readers or listeners. He states that 'it is in this way that we learn to become the *narrator* and the hero of *our own story*, without actually becoming the *author of our own life*' (1991, 32). By doing so, the narrative identity of the listening subject arises. According to Ricoeur (1991), this narrative identity plays an indispensable role in the formation of the subject, because 'the subject is never given at the start' (1991, 33). Without narratives the *subject* is in danger of being reduced to its narcissistic and egoistic ego. Ricoeur clarifies that narratives help the *subject* to build up its own identity. 'And these narratives give us a unity which is not substantial but narrative (Ricoeur 1991, 33)'.

From our point of view, this vision on the narrative identity of the subject is relevant for designers. Indeed, in modernism the architect's considered as an autonomous subject and in line with this: architecture as an autonomous discipline (e.g. Van der Rohe). This, however, leads to solipsism and narcissism of the architect. With Ricoeur we learn that architects, and designers in general, cannot 'work' autonomously. In this regard, the implications for the design process are pretty clear. Indeed, what happens in design can be understood as a process of *abduction* – a term introduced by pragmatist Peirce, which refers to a type of reasoning that is different from *deduction* or *induction*. In contrast with *deduction*, which proves that something must be and *induction*, which shows that something actually is operative; *abduction* suggest that something may be (Cross 1995). In abduction (open problem solving) one starts with a desired outcome (result) and develops both an object (what) and a working principle (how). The latter however is an approach of iteratively and creatively moving between 'result', 'how', and 'what' during the design process (Steen 2013). We believe that this creatively moving creates openings to involve the client/user throughout the entire design process. Knowing that a design process involves finding as well as solving problems (Lawson 2006), we state that it is justifiable to involve the client/user (and generator of the design

problem) throughout the whole design process. In our view the client/user does not necessarily become a 'co-designer' (e.g. Steen 2013) but a narrator, narrating about the future use of the desired object or building. Whenever narrator and designer meet, the possibilities arise for what we call 'narrative thinking'. In this regard, narrative thinking becomes a general design attitude, an anchor throughout the design process and a cure for pseudo-participation.

### 3.0. JOINT INQUIRY AND MORAL IMAGINATION

Following on from our belief that architects should be educated for collaborative practice, we argue that narrative thinking as a general design attitude should be implemented in the design studio. Before doing so, we introduce pragmatic thinker Dewey in the next section of our paper. With him we hope to refine Ricoeur's narrative theory. Our main argument is that narrative thinking can be understood (and organized) as a process of *collaborative narrative thinking and designing*, or – drawing from the ideas of pragmatist philosopher Dewey – as a process of *joint inquiry and moral imagination*.

From our point of view Dewey's interpretation of joint inquiry elucidates narrative thinking as a necessary attitude in architectural design and education. In fact narrative thinking implies joint inquiry as well as user based research. After all, narrative thinking is jointly organized inquiry, which aims to find solutions for a more or less clearly formulated problem. Additionally, Fesmire (2003) adds, inquiry is story structured. 'In Paul Ricoeur's terms, it has a narrative structure' (Fesmire 2003, 51). Nonetheless, a process of joint inquiry consist of five phases which are intimately related and addressed in an iterative process (Dewey 1938). The first two phases exemplified by Dewey include the indeterminate situation and the institution of the problem. Central to these phases is exploring and defining the problem. 'The way in which the problem is conceived decides what specific suggestions are entertained and which are dismissed' (Dewey 1938, 108). In the case of narrative thinking, we learn that defining a problem is drawn from the ability of both, designer and client/user, to express and share certain experiences, as well as to empathize with other people (e.g., engaging in narrating). During the third phase, problem(s) and imaginable solutions are simultaneously exposed and further defined throughout an iterative process. Dewey proposed that problems are best explored and defined using perception—one's capacities to see, hear, touch, smell, and taste current situations (what is)—and that solutions are best explored and developed using conception—one's capacities to imagine and envision alternative situations (what could be) (Steen, 2013). Of course, this combination of perception and conception (moral imagination) reunites designer and client/user. Indeed, client/user narratives stimulate the designer in designing several possible solutions for a jointly formulated problem. Finally, during the last two phases, these solutions are tested and critically evaluated. Of course this part requests cooperation among client/users and designer. Again, narrative thinking becomes a general design attitude which enables an iterative and participatory approach.

Apparently, imagination is key throughout the process outlined. Fesmire (2003) discussed two roles of imagination. Firstly, imagination as an 'empathic projection', as an opportunity to respond directly and empathically to others and their feelings and thoughts; and secondly, imagination as an opportunity to escape from current patterns and imagine alternatives. Imagination is, then, 'a capacity to engage the present with an eye to what is not immediately at hand' (Fesmire 2003, 67).

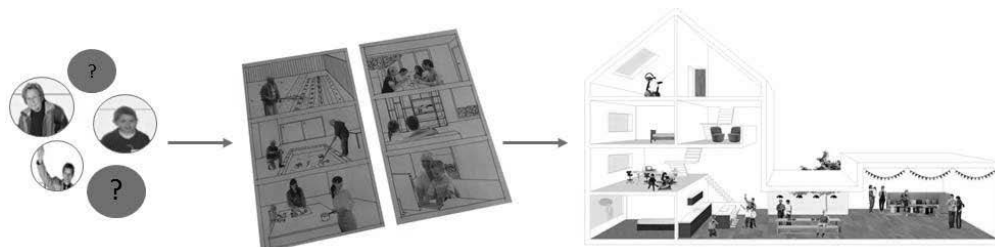
All in all, we can understand narrative thinking as a process of joint inquiry and moral imagination—as 'a reflective activity in which existing tools and materials (both of which may be either tangible or conceptual) are brought together in novel and creative arrangements in order to produce something new' (Hickman 1998 cited in Steen 2013, 24). In such a process, people use moral imagination as a capacity to see the actual in light of the possible (Fesmire 2003). 'Imagination expands our focus beyond a confused and dizzying present so that we can reflect and act in ways that may eventually bring about more desirable conditions' (Fesmire 2003, 146).

#### 4.0. NARRATIVE THINKING IN THE DESIGN STUDIO

Narrative thinking is a design attitude. It supplements the 'traditional' design process by enabling designers to imagine different perspectives. In this sense it is ideally suited to communicating change, stimulating innovation and realizing client/user involvement. In line with Parnell (2003) we assume that it is necessary to implement narrative thinking during education. Dewey's pragmatic 'moral imagination' helps us to translate Ricoeur's narrative theory into a general methodology applicable in the design studio and architectural education. To illustrate this argument, we discuss a design assignment developed in the design studio of a third grade bachelor at our school of architecture.

In this assignment for about 70 students each designed a multigenerational dwelling. Multigenerational dwelling indicates that this housing concept does not refer to standard single-family housing or apartments. It is a dwelling in which at least three generations live together. The residents do not necessarily belong to one family, but they are expected to know each other. Initially our assignment is an attempt to prepare architecture students to a future characterized by a new need for alternative housing concepts (De Bleeckere & Gerards 2013). Secondly, and connecting up to this paper, we aim to teach our students to think narratively. By doing so we want to stimulate an empathic attitude towards the final users. Exceptional about our assignment is the fact that these final users were not fictional and determined previously. The only limiting conditions were a minimal amount of five residents representing three generations and a specific location for the final building.

The assignment took six weeks and promoted early user involvement and an iterative approach involving research, design and evaluation. In the following sections we discuss three phases of our assignment and focus on the ways in which students and final users engaged in joint inquiry and moral imagination.



**Figure 1:** Design phases: scenario (1), storyboard (2), final design (3)

The first phase of our assignment included exploring and defining the problem. We asked our students to search and interview at least five possible clients/users (inhabitants) for a multigenerational dwelling. In this sense, they were invited to empathize with real persons, and to take them as the starting point for developing *scenarios*. Based on clear narratives by the chosen client/users about their proper demands towards the multigenerational dwelling, each student started to write a scenario-rapport. This rapport helped them to empathize with the final users and their experiences. Additionally, they learned to more vividly imagine specific problems that multigenerational dwelling as a new housing concept aims to solve.

During the second phase of our design assignment we aimed to perceive the problem and conceive possible solutions. More specifically we questioned our students to transform each scenario into a storyboard. Every storyboard consisted of five to ten drawings. For example, some students took the chance to imagine the opportunities arising from multigenerational dwelling. Based on client/user narratives they were able to demonstrate how different stories by different clients might fit to each other and create an added value for the dwelling of all future inhabitants. Moreover, some students used their storyboards to organize additional

meetings with their client/users. They talked with them about applications as early as possible – before any architectural designs were made. These meetings helped the architecture students to better understand people’s daily lives, their expectation and preferences in relation to multigenerational dwelling. Creating storyboards and discussing them with potential client/users helped combine professional architectural perspectives (ambition to create a building) and user’s perspectives (ambition to help people). It promoted an iterative process in which the young designers were able to discuss different narratives and solutions in the context of the overall goal of the assignment; to design a multigenerational dwelling.

In the third and final phase of our assignment, different solutions were tested and critically evaluated. Most students designed several possible multigenerational dwellings. They placed particular emphasis on interweaving the previously developed storyboards and conceivable design solutions. Moreover, these scenario-designs were tried out and evaluated in cooperation with the client/users and possible future inhabitants of the building. In this sense, students and client/users were able to jointly achieve concrete results and, at the same time to critically discuss these results, as well as to learn from this confrontation.

## CONCLUSION

As mentioned in the first lines of our paper, we must admit a general denial of the client/user in current architectural practice. According to Till (2005), mainstream architectural culture is in state of denial about ‘real participation’, a denial that is synonymous to rejection but without a need to be explicit about it. Furthermore, Parnell (2003) demonstrates, that the basis for this general denial of the user/client by architects is already formed during education. Therefore, we think, that it is justifiable to look to education for the root cause and hence potential alleviation of the problem.

From our point of view, narratives might help to reconnect designer and client/user. Narrative thinking is a design attitude which stimulates the involvement of the final user of a certain building. It implies to deal with stories, told by client/users about past, present and future actions. In this respect, narrative thinking realizes joint inquiry and moral imagination about the desired use of a certain design. Through thinking narratively we encourage a critical, empathic and democratic attitude. In this way, it prevents architects from mutating into narcissistic subjects.

Our implementation of narrative thinking in the design studio demonstrates that narrative thinking can be facilitated through Dewey’s concepts of ‘joint inquiry’ and ‘moral imagination’. Surely what we need is a focus on people’s practice and experiences, rather than on abstract theories. Narrative thinking should be understood as a process of collaborative design thinking: a process of joint inquiry and imagination in which diverse actors (student designer and client/user) jointly explore and define a problem and jointly develop and evaluate more daring and less predictable solutions. It is a process in which all participants are able to express and share their experiences, to discuss and negotiate their roles and interests, and jointly realize positive change.

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# The “engineer” on the magic mountain: Integrating building performance with design

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**ABSTRACT:** There is a widespread misperception in architectural schools that anyone, student or teacher, interested in evaluating building performance likely lacks well-developed design skills; that perhaps the two mindsets are fundamentally incompatible. However, this paper presents the argument that the design process that leads to compelling spaces can, and optimally will be, the same process that leads to valid, versus smoke-and-mirrors, building analyses. The linking of technical prowess with design skills is a constant and worthwhile endeavor for architectural faculty and their students, particularly in this renaissance of age of sustainability when the effects of the built environment on the ecosystem can no longer reasonably be ignored.

This paper gives pedagogical examples of means by which students in an environmental building systems course taught by the author are encouraged to understand buildings' behavior at an elemental level by engaging simple calculation methods, rules of thumb, and quick modeling techniques in their current or recent design projects. In these classes, analysis is brought out of the realm of the purely scientific, where it is often perceived by students as both unapproachable and unassailable, and brought back to the drawing board. Both failures and successes resulting from student engagement with these exercises are shared and examined, student perceptions of this approach are cited, and recommendations for refinement of these strategies are made.

**KEYWORDS:** Architectural design, building performance, sustainability, pedagogy

## INTRODUCTION

Architecture faculty who teach courses related to the environmental performance of buildings often feel a bit like Hans Castorp, the hero of Thomas Mann's novel *The Magic Mountain*. Hans Castorp leaves his bourgeois life as an engineer to visit a sick cousin for a few weeks and winds up, thanks to a suspicious spot in his lung, persisting in the rarefied environment of a Swiss sanatorium for seven years. Because of the topics they engage, building science educators are often regarded as “engineers” with just a little “moist spot” of consideration for the sublime and mysterious in architecture. But usually the reverse is the case; many are first and foremost architects who happen to have a particular penchant for building physics and passion for acknowledging its importance in the built environment.

In defining the educational aspects of the discipline of architecture, a strong dichotomy has often been drawn between a belief that architecture is implicit and learned by emulating a process of design, and a belief that it is, or should be, explicit and rationally described using a scientific model. A discussion of this theme can be found in the now-classic collection of essays entitled *The Discipline of Architecture* (Piotrowski and Robinson 2001). In “Disciplining Knowledge: Architecture between Cube and Frame”, Michael Stanton paints a picture of professional degree programs in architecture where formalistic design processes are taught with little regard to rigorous intellectual inquiry. This practice “paradoxically advances an intuitive paradigm that is in fact a form of antiknowledge” (2001, 17). Stanton states that design is approached as a game, a series of self-referential riddles to be solved using one's own internal creative capacity without resorting to the crutch of reference to other works, disciplines, or ideas. This approach, born with the modern movement, is characterized by an anti-intellectualism that Stanton feels is outmoded in today's world. Sharon Egretta Sutton, in

“Reinventing Professional Privilege as Inclusivity: A Proposal for an Enriched Mission of Architecture”, cites James S. Polshek’s view of architectural pedagogy:

Architectural principles...have been transmitted from one generation of architects to another for thousands of years....Despite the logic inherent in these ordering systems, the manner of their transmission...has been more akin to folk art than to the studied and systematic teaching of science (2001, 191).

Julia Williams Robinson, in her essay “The Form and Structure of Architectural Knowledge: From Practice to Discipline”, echoes this dichotomous view of architectural knowledge which she defines as:

(1) the intellectual, or explicit knowledge disseminated primarily in academia, and (2) the knowing embedded in the process of making architecture that is essential to design, what Polanyi calls tacit knowledge that is learned by doing and that cannot be critical” (2001, 66).

This break, which Robinson says traditionally separated the scientific disciplines in the first case from the guild-like profession of architecture in the second, has since the 1960s been manifested within the discipline of architecture itself. The result is that architects as form-givers are viewed as central to the discipline, while researchers who delve into the sociopolitical, cultural and scientific impacts of architectural forms are considered marginal or external to the discipline. Robinson calls for a new view of architectural education in a paradigm that integrates the subdisciplines, thereby framing “architecture as a cultural medium, deriving from the design question ‘what ought architecture to be’”(2001, 78)?

To exclude from the discipline of architecture that which is not considered purely “architectural” rejects the richness of scientific inquiry, the complexity of cultural and environmental repercussions, and alternative methods of knowledge transmission. This leads to a deeper question of the role of the discipline of architecture in society. In “Environment and Architecture”, Donald Watson states that architecture has a capacity as an ethical apparatus, capable not only of improving the global environment in our own time, but also of addressing the needs of the earth’s future inhabitants through dedicated environmental stewardship (2001, 172). The challenge, then, for teachers of both the design lab and the “support” courses, who may be and often are the same people, is to find ways of integrating questions of building performance into the rhythm of the design project.

A host of architects and engineers have begun to both explicitly engage this question in the profession and explain their rationale. In the realm of structural engineering, Jennifer Kabat in a *Metropolis* article explains that Cecil Balmond is attempting to introduce structural questions at the outset of design rather than as a refining process. Considering Balmond’s work, she writes:

Form for its own sake isn’t good enough for him—nor is creating a new shape without rethinking the underlying structure. His solutions inevitably have an enormous impact on buildings, but it’s not as if he wants them to look like “feats of engineering.” Instead they appear so integral to each project that you can’t tell the engineering from the architecture (2007, 101).

In the realm of environmental building systems, a growing number of renowned architects including Renzo Piano, Nicholas Grimshaw, Thom Mayne and Glenn Murcutt refer explicitly to the centrality of questions of solar geometry and wind forces in the design of their buildings. In a quote from his essay “On the Teaching of Architecture”, Murcutt relates his strategy for teaching students the criticality of response to climate in architecture:

I’d take the students into various sorts of spaces and leave them to understand why a room feels a bit too cold, or a bit too humid—and why they’d like to open a window to get a bit of air in....When you know what you want, you can find a way of achieving it. When I want the sun to come in during wintertime, but not in

the summertime, or if I want to catch the north-east breeze and pass it through the building, there are many ways of achieving it—ways that respond in a beautiful way to the climatic variations (2008, 17-18).

## **1.0 BACKGROUND**

### **1.1. The structure of the Environmental Building Systems II course**

The Environmental Building Systems II course (EBS II) taught by the author is the second in a two-semester series of required survey courses exploring concepts of architectural form, climate, and human response, ordinarily taken in the third year of a five-year Bachelor of Architecture sequence alongside a required six-credit design laboratory. Through a series of lectures, readings, assignments and exercises, students are exposed to strategies for minimizing the environmental impact of buildings through informed planning and design of passive and active building systems. The enrollment is typically between 90 and 100 students. Half of the assessment is through multiple-choice tests, and the other half is through the completion of pass-fail in-class exercises and, more prominently, three assignments of longer duration. The first of these is weighted less heavily and involves the preparation of a small graphical board presenting a building material or system that contributes to the thermal performance of a built project of the students' choice. This is considered a warm-up exercise to prepare students for the two thermal comfort exercises that follow, which are discussed in this paper.

In the in-class exercises, students are asked to differentiate between appropriate architectural responses to hot-arid and hot-humid climates, to navigate the psychrometric chart, to calculate thermal resistance of the building enclosure and heat loss and heat gain for a small model building, to design a passive solar direct gain space, to size a photovoltaic array, and to consider the advantages of different means of heat distribution. These exercises are designed to be completed in one class period so that they can be related directly to architectural examples in the course.

The course previously included an assignment engaging energy modeling software, but difficulty with partitioning hard drives and other technical problems associated with running the software quickly consumed disproportionate amounts of time for both students and faculty and compromised any learning resulting from the tool. Even the simplest of these programs assumes a base level of building science and systems knowledge that the majority of the students do not yet possess, so the result is that the software becomes a black box with many unfounded assumptions made to generate the necessary input values. This is a common issue; at the 2013 Association of Collegiate Schools of Architecture (ACSA) Fall Conference, Brad Deal (2013) reflected on similar initial challenges in teaching an elective seminar on building energy modeling at Louisiana Tech University.

Improving architecture students' facility with energy modeling is a laudable and arguably necessary goal in the architectural profession if architects are to claim control over building performance. However, the most recent EBS II course focused instead on the fundamentals of climate and thermal comfort, and how these interact with building enclosures. This said, the students, of their own accord, overwhelmingly chose to use basic, self-taught design tools such as Climate Consultant to analyze their sites for the assignments explained below.

## **2.0 METHODOLOGY**

### **2.1. Thermal comfort assignments**

Students in EBS II were given two assignments requiring them to consider thermal comfort in the context of their design work. The first of these assignments asked the students to describe how issues of thermal comfort were addressed in a current or past studio project through the following: a graphic depiction of the climate and microclimate at the site; a graphic representation of the project in the form of architectural drawings, renderings, and photographs with a particular focus on describing the thermal envelope; a diagrammatic representation of

the thermal comfort strategies or systems being developed in the project; and a brief abstract to establish what they proposed, why they proposed it, and how they planned to develop and defend it. Students were reminded, as is emphasized liberally in Norbert Lechner's *Heating, Cooling, Lighting: Sustainable Design Methods for Architects* (2009), the core text for the course, that basic building design should be considered before passive and active systems are developed. All of these elements were summarized and presented on an 11-by-17-inch board. The second such assignment built on the first, and asked for corrections to and development of the previous proposal. It encouraged the use of texts, in-class exercises, reference to precedents and other resources to determine the size and geometry of designed systems or elements. In both of these assignments, students were expected to explain in some detail how thermal performance influenced the building design rather than to give a list of generic strategies. The diagrams and the writing in particular quickly revealed the degree to which students actually understood the building science behind the strategies discussed in class, and individual comments were given to each student to help remedy any misunderstandings. Most importantly, the thermal comfort assignments gave students the agency to explore those elements of thermal comfort that interested them most.

## **2.2. Questionnaire**

The survey instrument discussed here consisted of questions designed to collect data for the larger goal of improving the author's EBS II course. The specific questions presented in this paper were intended to probe the students' perceptions of the relationship between the EBS II course, with an enrollment of 90, and a concurrent Architecture III course co-taught by the author, with an enrollment of 13, in the 2013 spring semester. The intersection of students enrolled in these two classes was a cohort of ten students, representing a range of performance levels in both courses. Targeting this population allowed for discovery of linkages between the two courses and excluded the possible confounding variable of the different approaches taken by other third-faculty teaching architecture laboratory to students within the EBS II course. With such a small sample size, this study may be viewed as a pilot which will require repetition in subsequent years to strengthen its findings.

A questionnaire was developed and approved by Virginia Tech's Institutional Review board, and delivered to the students via an anonymous web-based survey instrument on June 27, 2013. Six of the ten students responded between June 27 and July 20, 2013. The students took the survey after their obligations to the course and the instructor had ended; however, there is some possibility that the more engaged students in the group responded to the survey due to their inherently stronger sense of duty or loyalty to the instructor.

## **3.0 RESULTS**

### **3.1. Thermal comfort assignments**

Figures 1 and 2 show an example of one student's submission for the first and second thermal comfort assignments, respectively, as described in Section 2.1. Comments given to the student on the first submission included a suggestion to think about how the glazing needed for the Trombe wall would change the appearance of the facade, and to actually size the area of glass and mass needed. It was also suggested that the student do the same for the direct gain space to check assumptions about its appropriateness. Finally, details about the thermal resistance of the opaque walls were requested.

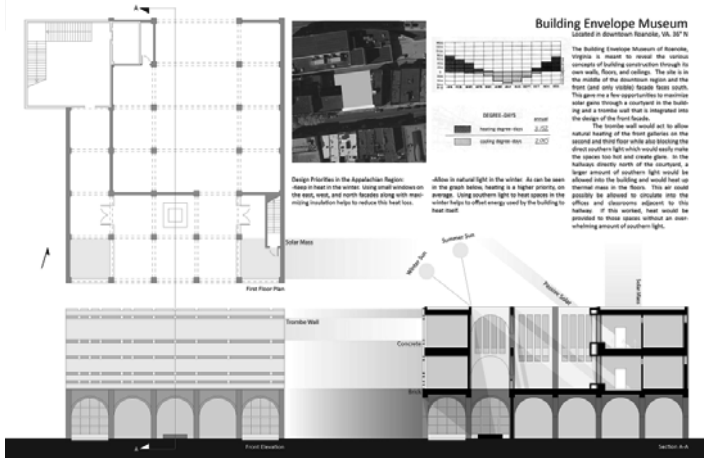


Figure 1: A student's submission for the first thermal comfort assignment in EBS II

The student followed up on these suggestions, likely referring back to an in-class exercise embedded in a lecture regarding passive solar design. The exercise in question was drawn from Norbert Lechner's *Heating Cooling Lighting, Sustainable Design Methods for Architects* (2009). Students were asked to quickly apply the method shown for the design of a direct gain space to their own projects.

The student's resulting final board, shown in Figure 2, includes simple calculations showing the student's use of the rules of thumb presented in class. While addressing insulation, though insufficiently, in the exterior walls, the student failed to realize that the Trombe wall section should not be insulated, because this insulation would limit the desired flow of stored heat energy inward to the conditioned space. The student also viewed the required thermal mass area as a maximum rather than a minimum in his direct gain space. Despite these errors, the student did alter the façade and more specifically consider the materiality of floors and walls as a result of this exercise.

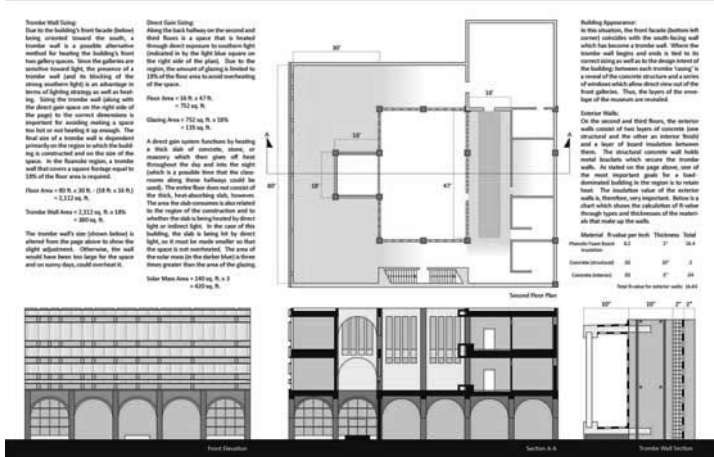


Figure 2: A student's submission for the second thermal comfort assignment in EBS II

### 3.2. Questionnaire

In an anonymous web-based survey administered as described in Section 2.2, students were asked to respond to the following statement (#1), "I used a methodology presented in the lectures or in-class exercises to design or evaluate my own building or an element of my building as follows (describe briefly)".

The following responses were garnered from the five students who responded to this statement (see Table 1).

**Table 1:** Responses to statement #1 "I used a methodology presented in the lectures...to design or evaluate my own building..."

#	Response
1	For the second and third class assignments, I took a studio project which I had completed in the fall semester and improved it from a "green design" perspective. I used what I had learned in class to size a Trombe wall for part of the building and also sized a space for heating through sunlight and thermal mass in the floor. Both systems worked well for my building's site and worked well with my existing design.
2	To me, it was very useful to draw information from EBS II and apply it to the studio projects I was working on. It helps to have a better understanding of the realities of construction and the building/design process as a whole.
3	Would it be appropriate for the climate and did it make use of the resources of that climate (wind, solar, etc.)?
5	I integrated my final studio project with the third exercise, in order to add a geothermal heat sink that effectively took over half the cooling load of the project.
6	The information I learned in EBS II was important to my design process. The first step I take is to examine the climate. Where the building will be sited and how it will respond is of the utmost importance.

The next item asked students to respond to the following statement (#2), "I applied the methodology discussed in the last question to my own design" with one of the following responses: "As part of one of the assignments for EBS II"; "As part of my design process in Architecture III, but not for an EBS II assignment"; "For both of these purposes simultaneously" or "Other". All five of the five students responding to this question chose the option "For both of these purposes simultaneously".

Following this was statement #3, "I was able to integrate information learned in EBS II with my design process in Architecture III". Students selected from the following responses: "5 Strongly Agree"; "4 Agree"; "3 Neutral or Undecided"; "2 Disagree"; or "1 Strongly Disagree". Two of the students responded with "Strongly Agree" and four responded with "Agree".

The final statement (#4) of the questionnaire asked students to complete the sentence, "The interrelation of EBS II and Architecture III could be improved by:" to which two students responded as shown in Table 2.

**Table 2:** Responses to statement (#4) "The interrelation of EBS II and Architecture III could be improved by:"

#	Response
5	Having an architectural studio project when the EBS II assignment require[s] integration with a studio project.
6	Making EBS requirements expected in all studio work.

### 3.0. DISCUSSION

The thermal comfort assignments were successful to the degree to which each student followed through on explaining strategies used to achieve thermal comfort. In many cases, they were required to become much more explicit about the nature of the building enclosure, and more realistic about the amount of glazing appropriate for passive solar strategies. Similar refinements and realizations were made in the arena of natural ventilation when students

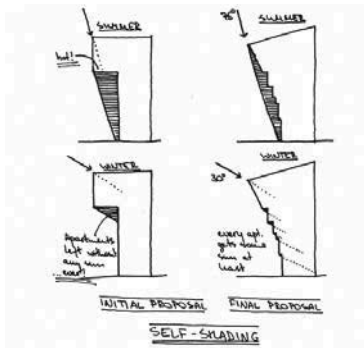
accepted its limitations and the need for intelligent placement and sizing of inlets and outlets to achieve the desired effect. Future investigation might include evaluation of students' design work before and after the EBS II course, to determine the course's impact on their design processes.

In the questionnaire, Respondent #5's response to statement #4 points to an unfortunate scheduling issue that arose during the beginning of the spring semester whereby students worked on several smaller competitions before beginning their main studio assignment of the term. This timing meant that many of the students retroactively applied ideas learned in EBS II to past, rather than current, studio projects for the first thermal comfort assignment. This particular student, respondent #5, subsequently did relate a concept learned in EBS II to his or her current studio project as seen in the response to statement #1.

**CONCLUSION**

Both the outcome of student exercises and students' observations regarding the relationship between the two courses suggest the limitations of and the possibilities for the integration of EBS II with the design laboratory. Because there are typically six third-year undergraduate design laboratories taught by faculty with differing approaches and project schedules, perfect coordination of the design exercises in EBS II with design exercises in the laboratories is unrealistic. Often students do not feel ready to introduce newly learned concepts into current design processes even when scheduling allows, and this time-lag effect between the laboratory and the work appearing in EBS II has been evidenced in the assignments submitted for the EBS II class over the past several years.

This situation is not always a negative one, as the rethinking of past work can be instructive when students take more time to analyze certain aspects of their projects. However, the ideal situation would be that they would be enabled by this process to internalize these lessons and incorporate them during the initial stages of design in the future. Figure 3 shows an example of the work of a graduate student enrolled in the EBS II course in 2011, who used the simple idea of winter and summer sun angles to modify the south-facing façade of his proposal during the design process, rather than after the fact.



**Figure 3:** A student incorporates concepts taught in the EBS II course to modify a building façade.

This adaptation calls to mind Glenn Murcutt's simultaneously poetic and precise description of his design of the roof-windows at the Marie Short house, which was introduced in an EBS II lecture:

I opened up the interior to the sky, through roof-windows which face the northern sun, but I realised that the important thing is to control the heat entering the house through the glass. So, I covered the roof-windows with external louvers that are fixed at the mid-winter sun angle and overlapped at the equinox angle of 55 degrees. The sunlight that comes through tells you what time in the

year it is. The thinner the shadow of the louvers at mid-day, the closer you are to mid-winter. As the shadow gets thicker and thicker you get closer to the summer equinox. It's a diary (2008, 18-19).

As this snapshot of Murcutt's thinking demonstrates, the architect remains chiefly responsible for the performance of the building. The increasing fragmentation and specialization of the complex process of building design should not give architects license to disregard, or delegate, decisions about siting, thermal envelope, energy balance, and other concerns generally grouped under the umbrella of sustainability to consulting engineers or other practitioners. Sophisticated performance analysis cannot and should not replace the judgment of the architect, who needs to internalize these basic concepts at the earliest stages of design, when they make the most difference. Simple analytical exercises reinforce the veracity of certain assumptions and help the designer make choices between alternatives. They check the naive suppositions of the inexperienced architect (and some experienced ones as well) and should be viewed as information to be filtered through the design process, like any other. At their best, they offer a range of possible scenarios that give designers a fluid feel for the consequences of their judgments regarding orientation, geometry, solid and void, materiality, and proportion. Educators in the realms of design and building science have an obligation to teach their students to employ these strategies within the context of the design project.

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# Changing mindsets: A passive-first artificial sky

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**ABSTRACT:** Architectural design that meets the goals of Architecture 2030 or results in zero net-energy performance is most elegantly achieved when employing effective passive strategies before adding high-technology components. With this ideal in mind, I posed a research question to a graduate seminar in natural lighting, “Can an artificial sky for testing daylighting models be designed that uses only daylight, rather than electric lamps, as its light source?” My threefold motivation for the question was: (1) matching—use a passive device to test a passive system (daylighting), (2) quality—use high-quality daylight to test daylighting systems, and (3) energy—use a low-energy system for testing models of low-energy designs. Currently, all artificial skies use an array of fluorescent lamps to simulate sky conditions. These skies are solely mechanical systems, have color rendering capabilities far inferior to daylight, and consume thousands of kilowatt-hours of electricity. The seminar students were up to the task and developed and tested successful scale models of two basic types—mirror-box and conical. We chose to build the conical prototype because its geometry is unlike that of any existing skies. To further encourage a sustainability-sensitive mindset, we designed the sky to be made of modular, bolted segments for non-destructive deconstruction and easy reconstruction. The building phase of the project was completed by the end of Spring 2013, and testing commenced in Fall 2013. This paper reports on the actions necessary to make the prototype a viable tool for learning about daylighting from prototype construction, calibration, and adjustment to test equipment set-up; to a users’ manual describing how to employ useful test methods.

In summary, the project not only focused on the design, fabrication, and testing of the sky, but is also about the change in mindset—valuing the efficient and elegant use of resources—required for a sustainable future stressing: (1) employing appropriate technologies for the task at hand (passive systems), (2) using high-quality resources (daylight), and (3) saving energy (100% lighting energy savings). The daylighted artificial sky serves as a hands-on exemplar, which has involved the collaboration of teams of students over a four-year span to design, develop, and test the artificial sky. To date about 30 students have participated in the project by answering the design question, writing and presenting research papers, designing and building the full-scale prototype, testing its performance, and, finally, testing their daylighting design proposals in the sky. Aspirationally, this shift in mindset will translate into the students’ future work in the design professions.

**KEYWORDS:** Daylighting, Artificial Sky, HDR Photography, Daylight Models

## INTRODUCTION

One of the most viable strategies for reducing energy use in buildings is to use natural daylight to replace electric lighting during daytime hours. Successful daylighting reduces both electrical and cooling loads. To achieve satisfactory results, daylighting schemes must be tested for light levels, light distribution, sunlight penetration, glare, and overall spatial quality before the actual building is built. Physical scale models of daylighted spaces offer a reliable means of testing daylighting options. This type of testing is also valuable in architectural education where students propose designs of buildings that most likely won’t be built; yet require verification of the fitness of their designs. The design and testing also builds practical skills for their professional careers.

When testing physical scale models of architectural spaces, useful parametric comparisons of design options can be achieved only under reliably consistent sky conditions. The natural sky poses a problem: natural skies are dynamically variable in brightness and distribution of light,

not only from day-to-day, but from minute-to-minute, defeating the principle of consistency required for accurate comparisons. This problem has led lighting designers to create electrically lighted artificial skies for testing daylighting models. These artificial skies must be able to simulate a standard uniform overcast sky condition where the zenith is about three times brighter than the horizon with gradual darkening from zenith to horizon. It is not necessary that the artificial sky match the luminance (brightness) of a real overcast sky: it's only necessary that the distribution of light in the sky meets the criteria for a CIE standard uniform overcast sky—a 3:1 brightness ratio from zenith to horizon. In theory, it's most critical that the artificial sky provide the proper and consistent distribution of light rather than the proper intensity of light (Haglund, 2011).

While electrically-lighted artificial skies are adequate for model testing, there are three reasons why they are not optimal: philosophical, qualitative, and environmental.

*Philosophical:* Daylighting, like all passive design strategies, requires sensitivity to context, yet today's artificial skies are machines for testing daylighting models independent of natural sky conditions. They offer the convenience of being able to conduct model testing at any time, including nighttime, no matter what outdoor sky conditions occur. Passive design requires a mindset that places natural processes in the forefront, relegating mechanical devices to backup status. Is there a passive tool that could encourage this mindset while accurately testing daylighting models?

*Qualitative:* The spectral distribution of daylight is dissimilar to that of any electrical lighting source, though many aspire to replicate daylight. Therefore, viewing daylight models under electrically lighted artificial skies that provide accurate distribution of light does not capture the aesthetic essence of light. Could natural light be used for model testing?

*Environmental:* From an energy-conservation standpoint, the irony of using high-energy artificial skies for designing low-energy buildings is palpable. Currently, a mirror-box artificial sky uses twenty-two 59-watt fluorescent lamps (1.3 kw total), while an 8-meter diameter sky consists of 640 CFL luminaires (12.8 kw total)<sup>1</sup> and a smaller sky (5.2-meter diameter) has 270 CFLs (5.4 kw total).<sup>2</sup> Is there a zero-energy alternative?

## 1.0 PROTOTYPE DESIGN AND CONSTRUCTION

### 1.1. Design Phase

Four teams of five students in the Fall 2011 Natural Lighting seminar were given four flawed prototype scale models of the proposed first-ever daylighted artificial sky. They were tasked with testing and modifying these models to the point that they could simulate a standard overcast sky under any exterior daylight condition. The students tested their model iterations under the natural sky using a circular fisheye lens pointed upward through the model base to record the lighting conditions and *Culplite*<sup>3</sup> to analyze their results. The resultant successful models were of two basic types—mirror-box and matte white conical (Haglund et al, 2012). We used these research results to successfully apply for a modest university seed grant of \$12,000 to fund the design, building, and instrumentation of a full-scale prototype. We chose to build the conical prototype because its geometry is unlike that of any existing skies (our mirror-box prototypes mimic electrically lighted mirror-boxes) and showed greater potential to meet the performance goals elegantly.

### 1.2. Lost in Translation?

Going from the successful scale model skies to the full-sized prototype was not without challenges. Upon obtaining the seed grant we proposed two options for the full-size prototype—an outbuilding that could be built near the architecture building or a device that could be built inside the architecture building. We favored the indoor version because the outbuilding posed several problems—the need for a weather-resistant envelope (expensive), for wintertime heating (problematic), for electrical service (expensive), and for easy access for students and their models (not easy). Thankfully, the architecture faculty supported our indoor option for the project by designating a space for the sky proximate to the fourth-year and

graduate studios so it could be easily accessed by students for testing their design studio projects' daylighting schemes. We also had to obtain university approval to install a skylight for the sky in the roof of our historic building. Amazingly, permission was granted. Once all these hurdles were cleared we were able to convince a manufacturer<sup>4</sup> to donate a high-efficiency skylight to the project.

The ideal form for the sky is a perfect cone. However, we chose to approximate the cone with a ten-sided form constructed of lumber and plywood segments bolted together for non-destructive deconstruction and easy reconstruction, which is also in accord with a sustainability-sensitive mindset.

### 1.3. Construction Phase

The construction phase of the project began during Fall 2012, after the award of the internal seed grant and approval by the faculty and the university. The first item to be dealt with was installation of the high-performance, commercial skylight in the pitched roof of the historic Art and Architecture building. We strategically chose an installation site near the top of a north-facing hip—receiving full access to the sky dome while being sheltered from prevailing SW winds and high enough to avoid snow loads. Getting the project approved and bringing the sub-contractors to the site to install the skylight consumed the entire semester. Meanwhile, we were generating construction drawings in *Sketch-Up*, which allowed us to accurately cut the compound angles in the plywood and lumber that the ten-sided form required. The exact configuration of the skylight installation geometry became an emerging issue, we weren't sure of the exact location of the skylight on the roof or of the depth of penetration of the extension tube and diffuser into the space below. This uncertainty stalled finalizing the construction drawings and initializing actual construction of the prototype sky structure until after skylight installation was complete (Fig. 1)—Spring semester 2013. We wanted to leave a gap between the top of the prototype and the bottom of the skylight to allow stack ventilation of solar and internal gains in the sky. Once we determined the floor-to-diffuser height, we were able to finalize the construction drawings for the prototype and begin actual construction. The brunt of the work was completed by the end of Spring 2013, and finish work and testing commenced Fall 2013. The donated skylight allowed the project to come in about \$2,000 under budget, so the seed grant funding was extended to May 2014 to cover new materials, equipment, and travel expenses. Hopefully, we will be able to report on both design and performance testing phases in February 2014.



Figure 1: Skylight mounting details, interior and exterior.

### 2.0. HDR PHOTOGRAPHY FOR CALIBRATION

In order to ascertain that the artificial sky is performing as expected, we need to be able to accurately evaluate the luminance of the surfaces of the cone. To do this, photographs are taken using a camera with a 180 degree, circular fisheye lens placed in the center of the artificial sky at the height of its horizon and pointed toward its zenith.

Because the characteristics of daylight are constantly changing, it is important that data collection within the artificial sky be done instantaneously. A digital camera with a fisheye lens

fulfills this requirement by collecting data from all points within the space at high resolution, which can be evaluated with per-pixel accuracy if desired (Inanici and Jim, 2004).

## 2.1. Camera Calibration

All photos exhibit a phenomenon known as light fall-off, or vignetting, where the amount of light entering a lens is diminished at the edge, causing reduced brightness at the periphery of the image compared to the center. When evaluating the performance of the artificial sky or architectural models this light reduction must be corrected before analysis can take place.

To evaluate the color response of the camera sensor a color response curve was generated by taking a series of photos with a fixed aperture size of f/4.0 and varying the shutter speed from 1/4000s to 2s at one stop intervals. These photos were processed in a program called *Photosphere* to get an accurate color response for the camera's sensor.

The amount of light fall-off caused by a lens is determined by the geometry of the lens and the aperture size of the lens (Inanici, 2006). This light fall-off can be expressed as a quartic expression, and will change as aperture size is increased or decreased. A fixed aperture size of f/4.0 was chosen for the calibration and testing because of its appropriateness for balanced exposure with a shorter exposure time in indoor light levels.

To determine the light fall-off of the lens a series of photos were taken in a room with controlled, constant light levels. An area of focus, with even lighting, was chosen and measured to be five degrees of the lens' view. A photo was taken from a tri-pod mounted camera, and then the camera was rotated five degrees before taking the next photo. This procedure was continued from zero to ninety degrees to move the area of focus from the center of the lens to the edge. The area of focus of each image was then analyzed for its brightness using *Grasshopper* for *Rhino* and the relative brightness was used to create a quartic expression representing the light fall-off caused by the lens.

A filter was created from this quartic expression which was combined with calibration photos to increase the brightness of the individual pixels at the correct rate from the center of the image to the edge, giving a fully corrected photo that can be used for the analysis of the artificial sky or for architectural models.

## 2.2. Sky Calibration

Using the procedure listed above, calibrated photos represent an accurate data set for relative luminosity within the artificial sky. The photos can be analyzed using a *Grasshopper* script in *Rhino*. Using this method, the artificial sky will be tested to see if it achieves a 3:1 brightness ratio from the zenith to the horizon with a linear reduction in brightness.

After initial tests are completed, modifications will be made to the sky to get as close as possible to the 3:1 CIE standard brightness ratio. These modifications may include adding a shroud to the top of the cone, to capture some light that is escaping through the gap between the diffuser and the top of the cone, or adding materials between the skylight and the cone to modify the distribution of light.

## 3.0. DATA ACQUISITION SCHEMES

Physical architectural scale models can be tested for satisfactory daylighted schemes within the artificial sky prototype in two different ways: Data Acquisition System (DAQ) and Fisheye Lens.

Data Acquisition Systems allow for a sampling of signals that measure real world physical conditions (such as daylighting) and converting the resulting samples (taken using photometric sensors) into digital numeric values that can be manipulated by a computer. There are three main components of a DAQ setup: Sensors, Hardware, and Software. The sensors measure the daylight illuminance, and are connected to the hardware<sup>6</sup>: an analog-digital converter. The hardware is also connected to the computer via a USB port and its data stream is analyzed using specific software<sup>9</sup> (usually paired with the hardware when purchased).

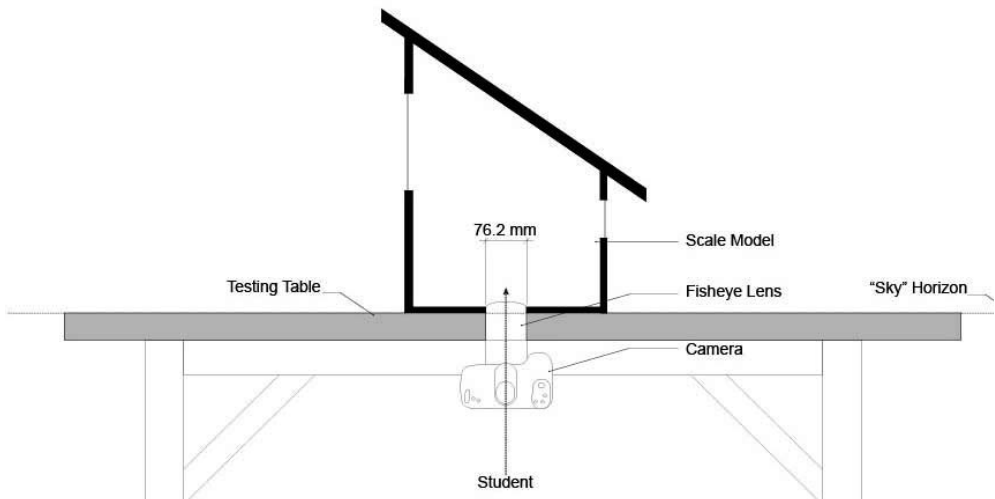
### 3.1. Data Acquisition System

Because our sky uses the constantly changing natural sky as its light source, it is important to collect the data from the five probes simultaneously. While the brightness of the sky constantly changes, the design of the prototype ensures that the lighting distribution- under all outdoor sky conditions remains constant.

We will use five photometric sensors<sup>5</sup>, specifically located within the prototype and connected to a DAQ system<sup>6</sup>, to gather the most accurate results. One photometric sensor will be placed externally, outside the scale model with full exposure to the “sky” and without blocking any of the model’s apertures to test outdoor sky conditions funneled in through the skylight. The other four sensors will be placed internally at different points within the model to test for interior light distribution, which will then be used to calculate the daylight factor at each of the interior points. In order to properly connect the photometric sensors to the DAQ system, millivolt adapters<sup>7</sup> are required.

### 3.2. Fisheye Lens

This is another successful method for testing the effectiveness of student’s designs for daylighting schemes. Scale models made with a 76.2 mm (3 in) diameter hole at the base allow enough space for our circular fisheye lens (of that size) to be placed and pointed upward through the model. In conjunction, the model will be placed on a testing table, whose surface is level with the artificial sky’s horizon, which also has a same size hole to allow the student to photograph from underneath the table and capture an image of all surfaces in the scale model. (Fig. 2)



**Figure 2:** Fisheye lens set-up for model photography.

Using a fisheye lens is beneficial for evaluating daylight distribution because it allows the student to physically examine interior conditions and see how much light gets through the apertures to the point where the camera is located. Through HDR photography captured through the lens, the brightness of the room’s surfaces can be measured and the contrast in the space can be visually inspected. Other possibilities for analyzing the data through the use of a fisheye lens include using outside software such as *Culplite*<sup>3</sup> to evaluate glare or using the Fisheye Projections and Dot Diagrams method and superimposing it on an image to calculate the daylight factor (Tergenzer and Wilson, 2011).

The prototype is meant to be used throughout the design process as a resource to influence architectural designs through passive daylight strategies. Both methods for testing daylighting schemes: Data Acquisition System and Fisheye Lens will provide student’s a means for

parametric testing, where the acquired results can be used to alter student's designs and re-test as needed.

#### 4.0. USERS' MANUAL

It is often the case something that is more obvious to the developer is less obvious to the user. Concepts that are second nature to an experienced user may be totally foreign for a novice user. When students need to employ an unfamiliar product, the user's manual can provide a gentle and efficient way to bring them up to speed. Due to the uniqueness and complexity of our prototype and physical daylight modeling in general, it is essential to provide coherent step-by-step guidance through the procedures of placing the sensors, using the fisheye lens, and operating the DAQ's *Omega*<sup>o</sup> software. We will write a users' manual that will be a valuable resource for future students and designers.

Users will refer to the manual for comprehensive detailed explanations of menu use, settings, preparations, and general information about the prototype and daylight modeling. The user's manual will categorize in detail the two different testing methods—data acquisition system and fisheye lens.

The Users' Manual will consist of:

Introduction

Preparations

- Getting Started
- Testing
- Daylight Model Basics
- Basic Operation of the Camera
- Computer Programs and Sensors

Photography

- Taking HDR Photos
- Diagrams

Data Acquisition

- Terminals on the Devices
- Saving your Information
- Sensor Placement

General Information

- Accessories
- Product Codes
- Specifications, Index

With extensive instructions and illustrations, we will provide a positive experience for students to learn and discover the effects of daylighting in their architectural designs.

#### CONCLUSION

An overarching goal of this project has been to involve graduate students in on-going research. This paper's co-authors are only three of the thirty-odd students who have taken the project from an odd-ball idea to a practical reality. The student researchers have performed hands-on research tasks from design inquiry to fabrication, to contributing to writing and presenting four conference papers. They have acted as agents of change, instilling their understanding and enthusiasm for the project in their classmates and visiting prospective students and their parents. Having the artificial sky proximate to the upper level design studios will help extend its success in setting a passive-first mindset in future architectural design classes.

We have also aimed to make all of our research freely available to architecture schools and others worldwide. Our plans and findings can help others construct, test, and instrument similar low-cost daylighted artificial skies in their schools and offices. We've also discovered that even electrically lighted mirror-box skies can be converted (easily) to passive, daylighted skies (Haglund et al, 2012).

## ACKNOWLEDGEMENTS

A huge thanks to the cadres of students who have contributed to this project. *Solatube* donated a high-efficiency skylight that powers the project and allowed funding to extend for an additional year, which allows us to cope with emergency expenses in completing it. Thanks also to the architecture faculty, who allowed the project to become well-integrated into the program's physical space, and to the architecture program for providing the digital SLR camera and circular fisheye lens.

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## ENDNOTES

- 1 The University of Cardiff School of Architecture Skydome is described at: <http://www.cardiff.ac.uk/archi/skydome.php> [7 April 2012].
- 2 The Bartlett School of Architecture artificial sky, is described at <http://www.bartlett.ucl.ac.uk/research/consult/sky/sim01.htm> [7 April 2012].
- 3 *Culplite* is available from Jeff Culp, Center for Energy Research/Education/Service, Ball State University.
4. Solatube donated a Solatube 750 DS-O 530 mm (21 in.) skylight.
5. The Photometric Sensors (LI-210SA) are available through Li-Core and is described at: <http://www.fondriest.com/li-cor-li-210-photometric-sensor.htm> [10 October 2013].
6. The Data Acquisition software and hardware (OMB-DAQ-55) is available through Omega and is described at: <http://www.omega.com/pptst/omb-daq55.html> [10 October 2013].
7. The Millivolt Adapters (2290) are available through Li-Cor and is described at: <http://www.licor.com/env/newsline/2007/07/interfacing-li-cor-radiation-sensors-with-campbell-scientific-dataloggers/>.

# Diagrammatic thinking – complexity handled between knowing and feeling

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**ABSTRACT:** This paper explores a dual position of the diagram through Deleuzian theory and the theories of Frederik Stjernfelt and C.S. Peirce. I will try to demonstrate how diagrammatic drawing can take an intermediate position between knowing and feeling. For architects and designers, thought is continuously formed by drawings in an intuitive and sometimes unpredictable, but nonetheless intentional, manner. Such a thought process I have termed *diagrammatic thinking*. Through a deeper understanding of diagrammatic thought, tactics with which to approach architectural development can be articulated and thus in the end taught or exchanged. In this paper the tactic of abstraction is investigated and presented through the drawings of architecture students at Department 6 of the Danish Royal Academy, Architecture School. My findings are based on studies I have made of the drawing praxis at the department in 2011. Department 6 has an approach to architecture that does not only deal with environments that are to some extent already built upon, but also with elements that are not traditionally architectural, but connected to alternative organizations of urban flows, thoughts and memories. I present the notion of the fictive diagram as a model to understanding how this very aesthetic diagram praxis works.

**KEYWORDS:** Diagram, architectural drawing, iconicity, diagrammatology, Stjernfelt

## INTRODUCTION

Architecture has perhaps always been a syncretic profession, but it certainly is becoming increasingly more complex with a growing number of disciplinary connections. This complexity has an impact on how we approach architecture as a discipline itself, but it also affects the teaching of drawing in architecture. Drawing is not simply putting onto paper an already formed thought. Architectural thinking is formed and informed by drawings or models in an intuitive and sometimes unpredictable, but nonetheless intentional, manner. My research work centers on the formation of knowledge through drawing, and to be more specific, how you as an aspiring architect create experience through drawing. This thought process I have termed *diagrammatic thinking*.

My findings are based on studies I made in 2011<sup>1</sup> of the praxis at Department 6 of the Danish Royal Academy, Architecture School. The theoretical work that I will here put forth is a sense-making model of the drawing praxis I found at the department and is aimed at giving a better understanding of the students' design process. Why and how is it you can learn something about a building or a place by drawing it? The diagrammatic drawing praxis found at Department 6 is interesting because it crosses between intuitive and intellectual design strategies. Theoretically I therefore position myself between the Deleuzian notion of diagram, mainly as found in "*Francis Bacon – The Logic of Sensation*" and the diagram of C.S. Peirce that I explore through the Danish researcher Frederik Stjernfelt's work "*Diagrammatology*".

Firstly I would like to present to you briefly some background knowledge about Department 6 and the Danish architecture schools and the key findings of the small study. Then I will demonstrate how the drawing praxis functions in the instance of it that I have called a mapping tactic and finally present my model for *diagrammatic thinking*. The case study of Department 6 is a case study of a particular and rather distinct praxis and the findings cannot therefore immediately be generalized or seen as applicable for all architecture students, but I hope that you will recognize potential in the theoretical framework put forth and in the material see connections and similarities to common and well-known situations.



## 1.0 Diagram Praxis at Department 6 – a study

The two Danish architecture schools (Copenhagen and Aarhus) both have a strong artistic tradition and are both built on an academy practice rather than a polytechnical one or affiliated with a university. This has fostered an emphasis on artistic qualities that is reflected in teaching approaches and student output equally. It results in design and teaching practices that from the very beginning of a student's studies aim higher than already formalized knowledge or 'best practice'. The Copenhagen school, KARCH, in 2011 had 9 study departments with different profiles and 4 institutes (design and communication, building culture, technology and planning). The departments all had different profiles and focus, but they all qualify for the same degree as architect after five years of successfully completed studies. After their admission to KARCH, students choose which department they want to be connected to. The department of choice is hereafter responsible for the daily education and training of the student, who spends the majority of his or her education at the department engaged in project based studio-type learning. The institutes are responsible for lectures and a few mandatory courses.

Department 6 is profiled as the department for 'space and form', which on a more concrete level has developed into an abstract and expressive form of drawing with a strong emphasis on experimental topology and morphology. The kind of architecture taught and drawn at Department 6 seems to grow organically out of a certain place and not only does it deal with environments that to some extent are already built upon, but also with elements that are not traditionally architectural: alternative organizations of urban flows, thoughts and memories. It is to a certain extent the urban complexity that the department aims to tackle in their approach to project development and teaching, where the drawing takes center stage.

The high artistic and creative ambition of the studio work does, however, have complications with regards to formation into an actual design methodology. Perhaps exactly because of these artistic ambitions, discussions of methodology are often shunned or passed on to students through rather vague or very complex theoretical reflections. The 2011 project focused on collecting and putting into words the knowledge and approaches that the students in Department 6 exhibited and then structuring and focusing this to make theory and practice comparable.

The data gathering consisted of semi-structured interviews with a range of students from all levels and two teachers as well as observations and the collection of a diagram archive. The interviews were of approximately an hour's length and based on 20 questions, which especially targeted generative and creative phases. Interviews were tape recorded, anonymized, transcribed and thematically coded where after they were made available to the department faculty as a resource. My interest in the drawing praxis of Department 6 stemmed from my time there as a student and my view was thus a critical and inquisitive one from the inside rather than that of an outsider. It was my assessment that this position facilitated the interviews both because of my knowledge of the terminology, but also because the students seemed eager to volunteer information to someone whom they trusted would understand the way they worked without passing judgment on their drawings.

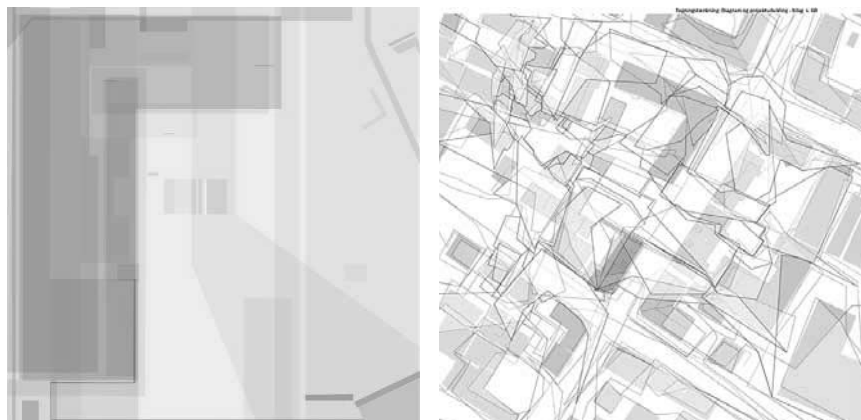
Students were asked both how they perceived their own drawing practice as well as to talk about a couple of drawings of their own choice. The diagram archive consists almost purely of digital diagrams, which wasn't the initial intention. The collection method chosen was to let the students select the diagrammatic drawings. This was done to not force my own notion of diagram on them and remain open to their definitions. The difference between analogue and digital diagramming was addressed in all of the interviews but is beyond the scope of this paper. Suffice it to say that I observed that the students utilized the digital diagramming's capability of copy/paste and undo/redo tactically in their work. Although most of the interviewees worked digitally they all also drew by hand and some even spoke of changing between the analogue and the digital as a way of avoiding creative impasses.

## 1.1. Observations

The two key observations of the study were:

- The diagram as a drawing tactic was crucial in their project development. The diagram was used as a tool and its defining characteristic is therefore that it is operative.
- The students describe their work as a constant change between two phases in the drawing process - reflection and creation. In the creative phases uncontrolled developments occur in the drawings.

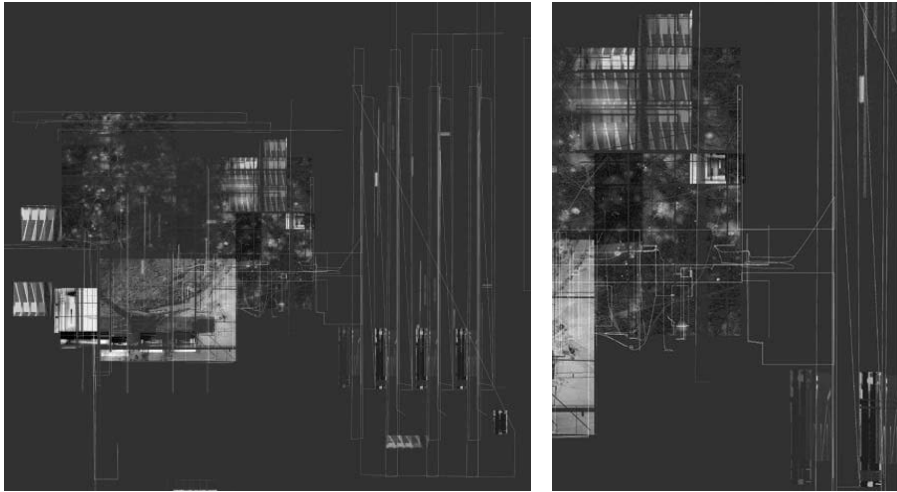
## 2.0 DRAWING TACTICS: ABSTRACTION



**Figure 1:** Left: 2nd year student drawing. Right: 3rd year student drawing"

The study uncovered five diagrammatic tactics, but in this paper I shall focus on only one: abstraction, which is inseparable from all diagrammatic drawing. The abstraction tactic most frequently takes form as a mapping. All of the students in the study, barring one first year student, made use of this tactic. The mapping was though, carried out in varying ways. Compare for instance figure 1 left and right and figure 2. Where the diagram in figure 1 left maps an interpretation of a place through transparent overlapping layers, without any visible sub layer, the diagram in figure 1 right is an expressive sketching of perceived relations in lines that at times break from the underlying drawn up conventional map only to relate to the map in other points. The diagram in figure 2 also performs a mapping, but here the mapping consists of a montage of aerial photographs, reproduced multiple times with the effect of layering in the drawing.

Despite the diverse methods of carrying out the mapping, the abstraction/mapping tactic has the common feature that it is "drawing over something"; adding a new layer to an existing sub layer. The sub layer is not necessarily a conventional map, although the most frequent use of the tactic is in contextualized diagrams. Even more importantly the diagramming process in this drawing practice is not simply a mapping, but form generation. To capture this difference in diagrams I differentiate between referential diagrams, abstract diagrams and fictive diagrams, as will be described later. The fictive diagram is where the mapping goes hand in hand with the emergence of new structures. Let us first though examine more closely what a diagram is.



**Figure 2:** This small scale reproduction hardly does the complex drawing by the hand of a 4th year student justice, but shows an interesting hybrid technique using both lines and aerial photography. Left: Detail of same drawing.

### 3.0 THE LOGIC OF THE DIAGRAM

In Diagrammatology, Frederk Stjernfelt, who is a Danish scholar working within the field of semiotics, explores the diagram theory of C.S. Peirce and although he does not approach it from an architectural viewpoint, his reflections are still applicable to the present investigation. The diagram in Peircean semiotic theory is part of the system of signs – more precisely it is an icon. For brevity I will not lay out here the entire Peircean semiotic system, but skip right to the characteristics of an icon. Icons are similar to their objects in a way that does not rest on them *seeming alike* but *behaving similarly*.

"it does not matter whether sign and object for a first (or second) glance seems or are experienced as similar; the decisive test for iconicity rests in whether it is possible to manipulate the sign so that new information as to its object appears." (Stjernfelt 2008, 90)

A diagram and its object do not necessarily look alike but they *act/react in a comparable way*. This points to that their similarity shouldn't be seen as a core around which changes occur, but rather as a pattern or structure, that change similarly under similar transformation rules. Because of this *operational likeness*, which can only be grasped through deduction and not through experience, for Stjernfelt the icon and thereby also the diagram are closely connected to reasoning (Stjernfelt 2008, 102). The similarity simply only occurs through deduction and therefore the relations that a diagram produces are understood through reasoning. The diagrammatic reasoning is a softening of deduction, however, because it is also dependent on observation. Stjernfelt uses the following model for diagrammatic reasoning:



**Figure 3:** Model for Diagrammatic reasoning (Stjernfelt 2008, 104)

The model shows how a construction, which is first observed and thereafter manipulated, results in a new construction or an observation and so forth in a process that continually moves through construction, observation, and manipulation until a conclusion is finally

reached. The model in this way closely reflects the thought process respondents at Department 6 described in their drawing process. It is experience formation that happens through drawing and the interchange of observing and constructing it.

### 3.1. Diagram, experience and imagination

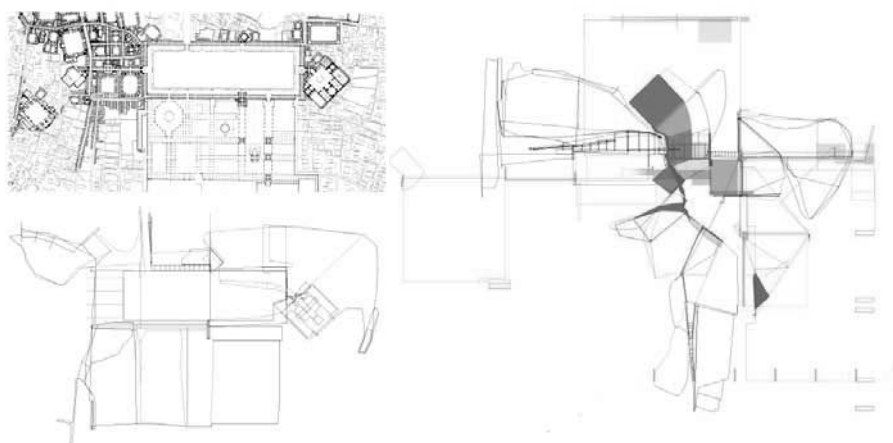
The special ability of the diagram is that it with real tangibility demonstrates an outcome of a scenario:

"It is, therefore, a very extraordinary feature of Diagrams that they *show*, - as literally *show* as a Percept shows the Perceptual Judgement to be true, - that a consequence does follow, and more marvelous yet, that it *would* follow under all varieties of circumstances accompanying the premises."(Stjernfelt 2008, 93)

In the above quote from Peirce it is evident that you in the diagram can literally see the similarity with the object. To return to the diagrammatic drawings; it is in other words of not important whether elements in the drawing look like the reality to which they point, but that they behave in similar ways – the diagram is operational and not representational. All diagrams are in this way abstractions, which do not seek a mimetic relation to their object but rather to sketch structural elements. In this we find a general legitimization of drawing as an experiential tool.

The reason that architecture drawing is important in the training of architects is because the students gain experiences from the drawings that they transfer not only to other drawings, but also in the end to buildings. Here we can, as Stjernfelt does, lean on Husserl's idea that we through ideation can intuit pure essences in an adequate way; we can gain experience even through free fantasy (Stjernfelt 2008, 185).

It is a sort of basic premise for drawing that the experiences made through the diagram are similar to those one could get from the object of the diagram. For architecture this type of ideational experience is particularly necessary as it would be practically impossible to get the same experiences from the objects of the diagram. It would not be possible to build and rebuild entire cities or even houses merely to acquire experience or observe changes. Architects both in training and in practice rely heavily on the experiences they can acquire through diagrammatic thought. But the model as yet presented does seem to lack a good description of how the creative act is performed.



**Figure 4:** 4<sup>th</sup> year student drawing: Left: The Square in Esfahan, Iran. Right: Hierarchies in the square and detail

### 3.2. Sensual logic: The Deleuzian Diagram

If we return to the student diagrams using the abstraction tactic the problem with the Stjernfeldian notion of diagram will become apparent. The diagrams of the Square in Esfahan demonstrate with all desired clarity how through the diagram the student at the same time both maps and generates. At the top of figure 4 left is a conventional map of the square. It is in its own right a diagram – the kind of diagram that I have called an empirical diagram, because it relates in a direct way to physical reality. Underneath a sort of plan drawing of the square becomes the first loosely abstract analytic drawing. But in figure 4 right the diagram has freed itself from the ties of any empirical origin, and, although one recognizes many of the previous elements and proportions from the other two drawings, other elements are also introduced in the drawing material. From what do these elements develop?

The problem is the genesis of form. If you want to go beyond “form follows function” and “form follows style” paradigms, how does form take shape? Both in drawings like this one and in the drawing process described by other respondents there seemed to be developments not described through the very rational logic of the Peircean diagram. For Deleuze a diagram is basically showing relations between forces – that is the definition he gives in his book on Foucault. The drawing of “forces” and “relations” correspond well with the abstraction that the diagram has in Stjernfelt’s work. The diagram is though much more than just abstraction to Deleuze. In *The Logic of Sense* he describes the paintings of Francis Bacon as a particular form of diagram between abstraction and abstract expressionism; code and sensation. The diagram that emerges is a catastrophe – irrational free and involuntary, says Deleuze (Deleuze 2003). But at the same time in Bacon’s diagram the sensation is checked by the coded dimensions – they challenge and inform each other.

In the students’ diagrams you find precisely such constructs; not only physical and factual structures, what we could call an intellectual coding of a place, but other elements added to the abstraction. The diagram in figure 4 right – the student explained – was constructed according to the hierarchies that dominate around the square (Christensen-Dalsgaard 2011, 25). They are though also marked by an imaginary act, as these hierarchies are interpreted through sensual drawing elements, e.g. the red shapes in the diagram. These elements are ideas that meet empirical elements and are shaped in the drawing. The diagram holds a double in-between position, between the real and the imaginary but also between the known and the felt.

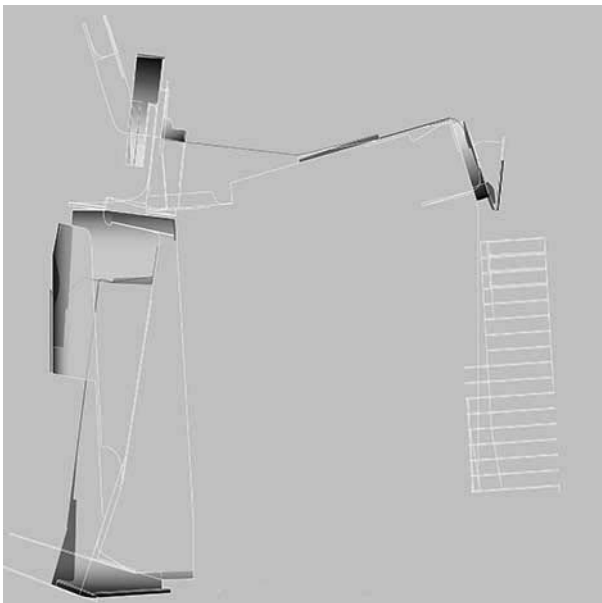


Figure 5: 5<sup>th</sup> year student diagram

### 3.3. A synthesis of oppositions

What I propose as a model for the fictive diagram is in many ways a synthesis of the diagrams of the Stjernfelt tradition and Deleuze tradition, which are two theoretic traditions in open opposition. Stjernfelt attacks irrational vitalism and wild intuition (Stjernfelt 2008) whereas Deleuze and Guattari write that semiotization – i.e. the diagram as a sign, which is the core of Stjernfelts argument – isn't really a diagram, because it precludes the creativity of the diagram (Deleuze and Guattari 2004, 159). Still the diagram as we find it in Stjernfelt is not hermetically closed for creative developments. Stjernfelt does approach diagram theory from a logic tradition, but he distances himself evenly from vitalism and reductionist logic. Stjernfelt writes that "Logic is in itself basically iconical" (Stjernfelt 2008, 110), which suggests that there is a need to interpret logic and in such an interpretation of course there is also an opening for different interpretations.

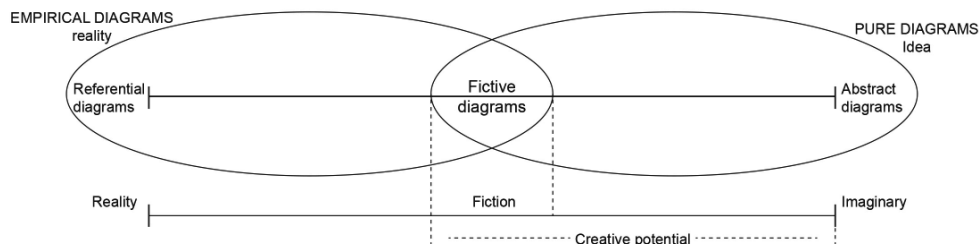
Diagrammatic reasoning is a pragmatization of deduction because it portrays how the deduction consists of a series of observations of change in a material. In other words it is a logic experimental process that has to be open to intuition as the background for doing certain manipulations, the result of which only being clear after the manipulation has set an effect in the material. It does also not seem to be an impossibility to have sections governed by cerebral code in a Deleuzian diagram – in the Bacon readings it is exactly the balance between code and sensation that renders the pictures diagrammatic.

### 4.0 THE FICTIVE DIAGRAM - BETWEEN THE IMAGINARY AND THE REAL

Stjernfelt differentiates between pure diagrams and empirical diagrams (Stjernfelt 2008, 99). Pure diagrams refer to an idea or a concept, whereas empirical diagrams refer to an empirical symbol in an actual or at least possible reality. The common denominator for all of the diagrams using the mapping tactic is that the structure of a place is constructed and in this they are similar to Stjernfelt's empirical diagrams that also have a signifié in reality. There are, however, two kinds of empirical diagrams: those that refer to a material existence that doesn't actually exist (fiction) and those that refer to a material reality. Here we uncover the possibility of fiction in the diagram, midway between reality and the imaginary.

The literature scholar Wolfgang Iser suggests that in literary fiction the fictional is not completely arbitrary, but it points to a reality within itself. The diagrams found in Department 6 can be said to be fictional as well because they map imaginary as well as factual relations. They contain traces of imaginary dimensions at work but are not pure imagination – as we saw with the abstraction/mapping tactic. One can build a house, plan out an area and rearrange in the real world by directions given in drawing, but although the drawing has this characteristic of a "recipe for spacial action" it is not in itself an actualized reality. It holds several possibilities for actualization. The Department 6 diagrams are also both pure and empirical diagrams in Stjernfelt's terminology because they perform a trialectic mapping of reality. The tangible and factual merges with ideas, emotions and dimensions with no tangible or physical reality, such as the perceived hierarchies in the square of Esfahan.

I propose a sort of scale for the diagram that goes from the referential diagram through the fictive diagram to the abstract diagram.



**Figure 6:** The Fictive diagram between the referential and the abstract diagrams or as the overlapping zone between empirical and pure diagrams. Model by (Christensen-Dalsgaard 2011)

All three types of diagram consist of elements that with their relations to each other create a structure. The referential diagram always points to something else in a direct manner as it is intended for reading and communication purposes and not for creative development. The referential diagram is exemplified in the engineer's drawing of machine parts or the map of a metro. The abstract diagram has no signifié in the real world. It is a pure concept and can be exemplified by a triangle or a grid. Between these two we find the fictive diagram – the type of diagram that rises up from a reality but distances itself from the same reality by pointing to a new reality within itself. A fictive diagram embodies its own reality, which doesn't just refer to an outside reality or real objects – and herein lies the difference between the referential diagram and the fictive diagram.

#### 4.1. "Felt logic" of aesthetic decision

It is characteristic that the Department 6 diagrams take a point of departure in empirical data, but that it lifts the empirical elements to a level where they are no longer referring just to a reality, but acquire their own internal laws and regulations. It is what Edward Soja would call a *thirdspace mapping* (Soja 1996) that includes both the subjective and the objective. This is an appealing thought for the architectural drawing as well, because it opens a field between the logically coded and sensation. It holds the power to move as well as inform – to be artful and technical at the same time. The creative potential in the fictive diagram is that it attaches itself to a reality and mutates it. That, however, does not make the diagram a loose or thoughtless operation. It is as demonstrated with Stjernfelt a particular kind of logic; a thought operation in itself that constantly balances control and creation - intellect and intuition.

Diagrammatic work, although seemingly sometimes wildly aesthetic, should not be considered irrational but simply a combination of reason and intuition. The drawers may "feel" rather than deductively reason their way to aesthetic decisions in the drawings, but there is logic in it. Through drawing they explore places in a sensitive way and build up their understanding of a project in a constructed "self-dialogue" which enables them to utilize not only what they know but also what they feel. It is perhaps in many cases an escape from a completely rational and highly technical approach to architecture that favors such an aesthetically driven approach. A goal in my research is to provide a better basis of understanding for the methodology behind such feeling based decisions.

The acceleration in use of diagrammatic drawing in architecture seems to coincide with a paradigmatic change towards an architecture that distinguishes itself from the modernist paradigm. The distinction seems to be brought about by an additive nature - adding to the urban sphere as opposed to tabula rasa constructions - and secondly, being both dynamic and highly complex. The fact is that place and space don't consist of tangible elements alone, and architects need tools where they can engage with the material as well as the immaterial qualities of a place. In fictive diagrams architecture students are given a tool with which they do not just gain experience but also work across a technical and aesthetic divide.

#### 5.0 CONCLUSION

Drawing has a special role in design and architecture education since much of the learning and transfer of knowledge passes through drawing rather than language or alongside the linguistic transfer. Therefore researching how experience is gained through drawing acts is vital for better understanding architectural education. Research of diagrammatic drawing could help bridge the sometimes seemingly insurmountable divide between the technical and the aesthetic skills demanded of an architect. Admittedly, the researched practice at Department 6 seems to tilt heavily towards the aesthetic and I do not believe that the diagrammatic practice at Department 6 fully utilizes the technical and logical potential in the diagram. My research is still at an early stage and the limitation of the theoretical framework presented here is that it has been based on the study of a single studio. The 2011 study is intended though to function as a basis for a broader study on diagrammatic thinking that I am conducting. The model here put forth will thus be challenged by many questions that still remain unanswered: Do less aesthetically oriented students experience and express uncontrolled developments of their material in the same manner? How does the role of the diagram change between different studio practices? And how have diagrammatic drawing practices developed through different drawing paradigms? However, the preliminary findings have convinced me that in

diagrammatic thought there is a potential for a tool that can handle the complexity demanded by architects.

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<sup>i</sup> A note to avoid confusion: the study *The Diagram – Thinking with Drawing in Architectural Education* that I carried out was made under my maiden name Christensen-Dalsgaard.

<sup>ii</sup> All diagrams and models are from (Christensen-Dalsgaard 2011) and reproduced with the permission of the students



# Suitability for Infill Development: A multi-criteria and Spatial Assessment Approach

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**ABSTRACT:** Studies on the capacity of vacant sites for infill development have been limited to the analysis of parcels potential for infill, rather than a systematic measure of the accurate amount of parcels suitable for this type of development. Mostly, central city development has been the locale for potential developable sites, yielding only a very few parcels suitable for infill. Additionally, very limited studies have examined infill development in the context of suburban areas (Wiley, 2009) or small towns. This paper, as part of a broader funded research on unincorporated communities in *Zapata County*, develops a multi-criteria analysis method for parcels' suitability for infill development; this method could further be applied to other areas and regions. A spatial analysis method using Geographic Information Systems (GIS) was utilized to develop the assessment model. Pertaining to the theme of this year's conference, this method extends beyond the institutionalization of the inquiry within the discipline of architecture; it intersects with other disciplines such as urban planning, and housing and land development. The inquiry includes: a review of relevant studies and applications of GIS in sustainable urban planning, the creation of a code system for developable sites through the evaluation of eligible parcels in accordance with eight criteria, and a summing up of parcels' composite scores. A compartmentalization of this final score – using an ordinal scale - is what created each parcel's ranking for suitability. This ranking method, unlike the preceding assessments, retrieved a larger amount of vacant parcels suitable for infill by intertwining GIS with multi-criteria coding. The method is feasible and traceable at both the county and city levels; it creates visual mapping outputs that could easily be adopted by other communities in urbanized and peri-urbanized areas alike. City architects and planners could utilize this method to support future policies for land development, rezoning, and land use that leverage smart growth principles.

**KEYWORDS:** Multi-criteria Assessment, Infill Development, Spatial Analysis, Site Suitability.

## 1.0. SPATIAL ANALYSIS AND SUSTAINABLE URBAN PLANNING

This paper reviews an empirical case study application of GIS tools in the assessment of the suitability of vacant sites for infill, a form of sustainable urban planning. The case study represents an application of North American planning forms that promote sustainability principles and healthy communities in land development. Infill development refers to new development of vacant and underutilized parcels within the built-up areas of existing communities that have in-place infrastructures (Maryland Department of Planning, 2001). As a sustainable and urban form of promoting smart growth principles (Downs 2001; Burchell et al., 2000; Cooper 2004; and Downs 2005), infill development conserves environmental resources, economic investments, and the overall social fabric through a strategy of absorbing growth into existing communities, thereby relieving growth pressures on rural areas. This strategy preserves agricultural and natural areas by eliminating developments that have spread too far from the traditional population centers. More importantly, it is a form of planning that impact the community and its residents by enhancing the overall quality of life in older communities. However, only a limited number of studies have addressed a comprehensive quantitative assessment for sites eligible for infill development.

As a spatial analysis tool, GIS has been noted to be very useful in monitoring, appraising, and updating the indicators and metrics used in the assessment of sites and neighborhoods for the suitability of urban sustainability approaches. It also provides flexibility and efficiency as a platform for planning and decision making (Kamal, 2012; Collins et al., 2001; Malczewski,

2004; and Saleh and Sadoun, 2006) for its aptitude at visual and quantitative analysis. Because of GIS's capability of linking location data with multiple attributes – quantitatively coded - and its ability to perform spatial analyses on large amounts of data, it has successfully been used to depict proper sites for minimizing commuting distance, assessing walkability and proximity to major facilities, and mapping vacant parcels. Obtaining useful information and providing effective support for these examples of urban planning applications is a new and increasingly prevalent challenge. Currently, there are several different technological platforms being used to provide support to planners to complete their specific objectives (Anthony et al., 2006; Ning-rui and Yuan, 2005). Incorporating GIS in suitability assessments involves data manipulation, integration, and analysis, all of which could be used to visualize clustered residential developments, rates of vacant units, availability and suitability of parcels for infill development, and overall neighborhood assessments.

For these types of tasks, GIS is valuable especially for the sophisticated and extensive database management tool it offers, which also displays the capabilities of its tools; it is also recognized as quite user-friendly (Malczewski, 2004; Saleh and Sadoun, 2006). Other GIS benefits include the possibility that an increase in access to location-based data might lead to a greater number of alternative scenarios, and thus a better-informed public debate on the topic (Shiffer, 1995). As a newly applied apparatus in rural and peri-urban communities, GIS also has incited the development of geo-technology tools that support planning processes, particularly those where participation is a key element (Geertman, 2002). These participatory GIS tools have been described by the generic term Planning Support Systems (PSS) (Harris, 1989; Brail and Klosterman, 2001; Geertman and Stillwell, 2002; Geertman, 2002). PSS have been applied to urban-rural planning for the past 20 years, particularly in developed countries with advanced economies, societies and technology, and perfected systems and laws. The main idea proposed by Harris (1989) was to combine information technology with the methodology of urban planning to provide decision making at every step of the planning process (Mao et al., 2008).

### **3.0. THE LOCALE: UNINCORPORATED COMMUNITIES IN ZAPATA COUNTY**

The overwhelming level of economic distress exists in *Zapata* County, TX (Tangum and Kamal, 2013) has triggered a broader-funded project on economic growth and competitiveness. This economic development project was designed to develop solutions to problems related to current land and economic conditions, and to facilitate a long-term economic and land development plan for the county. It also emphasizes strategic, long-term initiatives that deal with some of the underlying causes of underdevelopment in this county.

*Zapata* County is predominantly rural and sparsely populated. Its urban portions make up only a small part of the county's total land area. Moreover, all of its communities are located along a narrow strip of land centered on U.S. Highway 83. This highway runs along the western edge of the county, and with the Rio Grande it forms a natural boundary with Mexico. While the county is relatively dry, the Rio Grande and Falcon Lake/Falcon International Reservoir provide a stable supply of water for residents in the area. However, during prolonged droughts that supply can be compromised as water levels in the reservoir may decline. The interior portion of the county is largely devoid of any population centers. However, that portion of the county has enormous oil and gas deposits. These deposits provide the county with a huge natural resource base for the local economy. Equally important to the county's long-term economic growth is its potential tourism base centered at Falcon Lake, and several historical sites located in the Highway 83 corridor. Its two largest communities – Zapata and San Ygnacio – are also located within this corridor.

As part of this economic development and growth management study, an analysis of the county's vacant residential lots was conducted. The analysis aimed to create (1) a systematic method of reviewing available vacant parcels, and (2) a quantitative system of assessment and ranking those sites to prioritize them for types of residential infill development that would be both adaptable and comprehensive. The assessment method was intended to be driven by the principles of smart growth and healthy living principles, including proximity to services and public facilities.

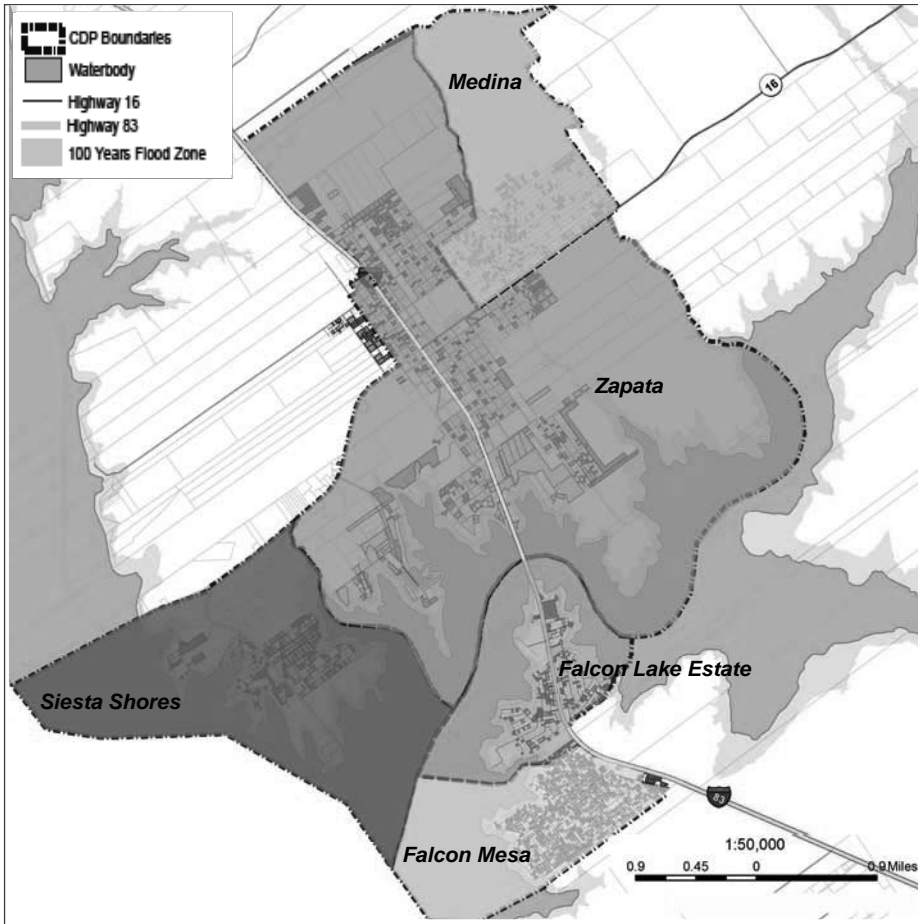
This case study, as part of a broader body of funded research, incorporates a multi-criteria analysis of certain residential vacant parcels. Of the twelve Census Designated Places (CDP) in *Zapata* County, five had a sufficient population and level of economic activity to be explored for potential infill developments. These five communities are: Zapata, Medina, Siesta Shores, Falcon Lake Estates, and Falcon Mesa (see Figure 1).

#### **4.0. INTERDISCIPLINARY METHOD FOR SUITABILITY ASSESSMENT**

##### **4.1. Assessment Criteria and Coding System**

To identify developable sites for infill development in the five qualified communities in *Zapata* County; all vacant parcels located, in whole or in part, in the 100-year floodplain as determined by the U.S. Federal Emergency Management Administration (FEMA) were omitted. The remaining parcels were evaluated. The methods utilized in the evaluation identified those parcels that emerged from an analysis of the degree of each parcel's suitability to satisfy the assessment criteria (Mokarram and Aminzadeh, 2010). This method entailed developing a spatial model using GIS mapping and incorporating a binary coding system to establish the degree of each parcel's suitability for infill, based on eight assessment criteria. The eight criteria were identified in collaboration with the sponsor organization of this research, and by identifying the available mapped data considered to be significant components of smart growth principles. The assessment of whether or not each parcel met the eight criteria was conducted by utilizing different types of data sets:

- 1) Land use parcel shapefiles, generated by researchers at the Center for Urban and Regional Planning Research (CURPR) in the College of Architecture, University of Texas at San Antonio. Land use maps were generated from a raw parcel data file obtained through the sponsor organization.
- 2) Thoroughfare layers and natural environment attributes were obtained from the ArcMap USA libraries available via ArcMap 10.0 (Environmental Science Research Institute [ESRI], 2010).
- 3) Each community's boundary file was downloaded from the US Census TIGER Files (US. Census, 2010).
- 4) Field notes and mapping shapefiles for all services and public facilities. These maps were generated by the GIS unit in the sponsor's organization in *Zapata* County.
- 5) Verification of building coordinates (longitude and latitude), as well as the street addresses obtained as mapped field notes from the GIS unit of the sponsor's organization.



**Figure 1:** Parcels' suitability for residential infill development in Zapata County. Source (Tangum and Kamal, 2013)

Each parcel was evaluated and coded based on a score system assigned for each parcel, according to the following criteria (see Table 1). The binary code was inserted into the tabulation of the multi-layered County parcel's file using ArcMap on ArcGIS for Desktop (ESRI, 2010).

- **Criterion #1:** Vacant parcels in predominantly residential areas were assigned a score of "1," indicating significant potential for infill; all other vacant parcels were assigned a score of "0," indicating little or no potential for infill.
- **Criterion #2:** Distance from major highways. Parcels used for residential developments needed to be located a sufficient distance from the highway due to the noise, pollution, and high traffic volume that accompanies such high-traffic roadways. Desired locations, however, could not be too far away from the highway, either. Parcels located within a range of 0.2 to 2.0 miles from US Highway 83 or within a range of 0.1 to 2.0 miles from Texas Highway 16 were considered appropriate for infill, and thus scored a "1." Parcels satisfying proximity conditions for both highways scored a "2." All other parcels scored a "0."
- **Criterion #3:** Ratio of Improvement Value (RIV) to the Total Market Value (TMV). This ratio is considered a good measure for the potential for development of vacant


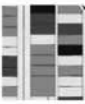





parcels. A parcel with a RIV of 100% means that it has the maximum potential for development. Conversely, a parcel with zero improvement value would have a ratio of 0%, and thus would have no potential for development. All residential vacant parcels were grouped into four categories: 1) parcels with an RIV of 100%; 2) parcels with an RIV between 50.01% and 99.99%; 3) parcels with an RIV between 0.1% and 50%; and 4) parcels with an RIV of 0%. Categories 1 and 2 scored a “1” because they showed a high priority for infill; categories 3 and 4 scored a “0” because they indicated a low priority for infill.

- *Criterion #4:* Proximity to school. Homes closer to schools are more desirable than homes further away. Vacant parcels were grouped into three categories. Parcels in categories 1 and 2 scored a “1” because they were considered a high priority for infill, while parcels in category 3 scored a “0” as they indicated a low priority for infill. Categories were determined by distance: category 1: up to 0.5 miles, category 2: between 0.6 and 2.0 miles, and category 3: over 2.0 miles.
- *Criterion #5:* Distance from injection wells. These wells have negative environmental impacts on most nearby land uses. Parcels closer to such wells have less value, and are least desirable for potential infill developments due to their relatively lower market values. The parcels' proximity to injection wells were classified into three categories: category 1: up to 0.25 miles, category 2: between 0.26 and 0.5 miles, and category 3: over 0.5 miles. Categories 1 and 2 scored a “0” as they were low priority for infill, while parcels in category 3 scored a “1” as they were a high priority for infill.
- *Criterion #6:* Proximity to utility lines. Vacant parcels closer to existing gas lines are economically more efficient than those further away. Vacant parcels were classified into two categories: 1) parcels immediately adjacent to gas lines scored a “1” as they were of a high priority for infill, and 2) parcels not adjacent to gas lines scored a “0” as they were of a low priority for infill.
- *Criterion #7:* Proximity to commercial land use. A considerable impact on the land value and potential revenue is associated with proximity to commercial land use. In addition to increasing the parcel's potential for mixed-use development, this proximity has a significant impact on a vacant parcel's potential for infill. Vacant parcels were grouped into the following categories. Parcels located within a 0.25 mile distance from commercial land use scored a “1” as they were of a high priority for infill, while all other parcels scored “0” as they were considered a low priority for infill.
- *Criterion #8:* Neighborhood's real estate stability. Neighborhood stability was indicated by city blocks with comparatively high ratios of owner-occupied housing that were also free and clear of mortgage. To identify the neighborhood stability of the vacant parcels, a map of the blocks (each containing a number of parcels) was overlaid with a map of the vacant parcels. Vacant parcels were grouped into two categories. Category 1 included blocks with over 50% of the parcels owner-occupied and free and clear of mortgage. These blocks scored a “1” as they were considered to be of a high priority for infill. Category 2 included all other blocks, which were scored with a “0” as they were considered to be of a low priority for infill.

#### **4.2. A Parcel's Composite Score and Rank**

ArcMap (ESRI 2010) was utilized to code an equal-weight score of identified criteria to each parcel. The incorporated score system permits a high score of nine because certain parcels could gain two points for the proximity to both highways. Nevertheless, the maximum score any parcel achieved was eight. The feasibility of estimating each parcel's composite score was made possible by inserting the coding systems for eligible parcels on the ArcMap tabulation (ESRI, 2010) using a separate layer for each criterion. A final table was then generated on a spreadsheet to calculate the composite score.

**Table 1:** Criteria and Coding System for assessing A Parcel's Infill Suitability (Kamal, 2013)

Criterion	Coding System	Symbol
1 Location of vacant	1: predominantly residential areas 0: other vacant parcels	
2 Distance from major Highways	2: 0.2 to 2.0 miles from US highway 83, and 0.1 to 2.0 miles from Texas highway 16 1: 0.2 to 2.0 miles from US highway 83, or 0.1 to 2.0 miles from Texas highway 16 0: all other parcels	
3 Ratio of RIV to TMV	1: parcels with 100% RIV/TMV and parcels with 50.01%-99.99% RIV/TMV between 0: parcels with 0.1%-50% RIV/TMV and parcels with 0% RIV/TMV	
4 Proximity to school	1: 0-0.5* miles and 0.6-2.0** miles 0: over 2.0 miles	
5 Proximity to commercial land use	1: over 0.5 miles 0: up to 0.25*** miles, and 0.26 and 0.5 miles	
6 Proximity to utility lines	1: adjacent to gas lines scored 0: Not adjacent to gas lines scored	
7 Distance from injection wells	1: within a 0.25 mile distance from commercial land use 0: all other parcels	
8 Neighborhood's real estate stability	1: blocks with over 50% of the parcels owner-occupied and free and clear of mortgage 0: all other blocks	
<b>Total possible score</b>	<b>0 (minimum score) - 9 (maximum score)</b>	

**Table Key**

\* 0.5 mile = Ten-minute walk

\*\* 2.0 mile = Minimum distance beyond which a required school bus transportation is mandated (required by law in the state of Texas)

\*\*\* 0.25 mile = Five-minute walk

To assess the overall potential of vacant parcels in the five selected communities, a semantic differential scale to measure suitability of Good, Moderate, or Fair was adopted. The scale allocated a score of six to eight for a parcel of "Good" quality, a score of four to five for a parcel of "Moderate" quality, and a score of zero to three for a parcel of "Fair" quality (see Table 2 and Figure 2). The method used in allocating the scores was limited to the data available in an ArcMap-compliant format at the time the research procedures were performed. Additional attributes could be incorporated in the future, including environmental, transportation, and food desert elements. Data for these attributes are being prepared for further investigation. A weighted-scale for the attributes could then be developed to permit the use of criterion-specific weights to fine tune the preciseness of the scale and its relevance to the magnitude of importance of each criterion.

**Table 2:** Ranking and Areas of Available Parcels for Residential Infill Development (Kamal, 2013)

Code/Score	Rank	Count and Percentage		Area (in acres)		
		#	%	Minimum	Maximum	Average
6-8	Good	592	24	0.03	38.46	0.46
4-5	Moderate	1142	46.4	0.02	36.36	0.4
0-3	Fair	730	29.6	0.02	30.66	0.57
<b>Total</b>		<b>2464</b>	<b>100%</b>			

**5.0. DISCUSSION: ASSESSMENT AND INTERSECTION OF DISCIPLINES**

This method of assessment of a parcel's suitability for infill residential development differs from other forms of analysis of land development in central city development. The incorporation of ArcMap software and the coding system into the exclusion process of parcels unable to meet the eight identified criteria occurred at an early stage of the analysis.



**Figure 2 (a, b, & c):** Parcels' suitability for residential infill development in Zapata County.; **(d):** Sample criteria analysis (Buffers for estimating distance from major Highways). Source (Tangum and Kamal, 2013)

This process retrieved a greater number of available vacant parcels located in primarily residential areas suitable for infill development. By integrating a multi-criteria assessment and through the use of spatial analysis and a binary system of coding, the final scores were feasible for an assessment via the combined tools of ArcMap (ESRI, 2010) and the coding spreadsheet. While no parcels scored nine in the total composite score, thirty parcels received a score of eight. Overall scores and ranks of the eligible vacant parcels were as follows: 592 parcels (24% of the total eligible parcels) received a good suitability score; followed by 1,142 parcels (46.4% of the total eligible parcels) which were regarded as of moderately suitable

quality; and 730 parcels (29.6% of the total eligible parcels) were considered to be fairly suitable for infill. In lieu of a review of similar quantitative methods utilized to assess the potential of developable sites for infill development that have appeared in the literature published in the past ten years, this method offers a comprehensive and synthesizing approach that combines all available attributes in peri-urban communities in South Texas. The methods published in the literature reasonably exclude further numerous sites from their assessments due to their uni-variate approach.

## 6. CONCLUSION

Communities in southern and western Texas, particularly in rural counties, are recognized as outmigration communities; they strive to incorporate sustainable approaches for development, which includes long-term plans for economic and job growth. El Paso, Texas and Odessa, Texas (Andrews, 2013) are examples of local governments working towards healthy community principles through smart growth. Opportunities generated from these efforts not only impact the way we design cities and towns, but the health of both older and younger generations. Adding to this, the benefit of the densification of city centers and urbanized areas in peri-urban communities (i.e., the five communities studied in Zapata County crafts a sense of community that is both sustainable and healthy).

The case study of peri-urban communities in Zapata County presented in this paper address the invaluable use of GIS and quantitative analysis tools for evaluating land development for infill as a sustainable form of smart growth development. The method used of intertwining GIS mapping with a coding and ranking systems for developable sites was the most appropriate method for processing and projecting quantitatively and visually the *big data* necessary for this type of analysis, and for combining this array of location-based attributes with the planning standards of smart growth. It also provided a useful tool that could both be applied to large amounts of parcel data and be used to create visual mapping outputs for other communities and city center developments. This process would not be possible if these tools were not available. Building on other sustainable development studies (Mokarram and Aminzadeh, 2010; Alshuwaikhat and Aina, 2006; and Maryland Department of Planning, 2001), the challenges urban planner would have had without computer technology and GIS mapping would not make it feasible to incorporate all attributes at once in the assessment and coding system. The elimination of ineligible parcels at the early stage of assessment in traditional – manual- or Computer Aided Design [CAD] maps would have been gigantic, leaving only highly eligible parcels (i.e. parcels close to commercial land use, or schools) for the planning team to offer for the developers. The equal-weight codes assigned to each attribute also helped this approach over other traditional approaches; it increased the number of developable sites (those meeting conditions of distance from injection wells, or far from highway noise and pollution). At the same time, it is a point of research that could further be investigated to study the possible allocation of varied-weight system based on each attribute's contribution to smart growth principles.

The tools used, the results of this assessment, and the expertise developed will facilitate the use of this process in the future, and will provide not only valuable assistance to towns, counties, and regions in their planning for smart growth implementation, but for capacity building and assistance for their staff members. The assessment tool created in this study also provides a beneficial input for decision-making planning at the neighborhood and community levels; the processes was previously challengeable for sites located in peri-urban areas where GIS spatial analysis represented a new trend in data manipulation and decision making. The outputs of this assessment method are time and economically efficient outputs that are feasible, quantifiable, and traceable. This method offers flexibility in the periodic updates of parcels and zoning regulations that the researcher or the planning staff using this method could frequently monitor. Local and state policy makers need to identify a code for sites designated as developable for infill, a code that could be monitored and updated according to the future growth of the community. This process could result in a strategy for allocating resources for an incentive program and a priority zones policy, which would encourage area developers to invest in the designated developable sites. The outcomes of the process could also be used to inform the general public and solicit their involvement in the decision making necessary for sustainable planning. These decisions will flourish from regular updates and the



monitoring of the already-established score system which will aid future decisions, assessments, and the allocation of resources. The implementation of this process could also be replicated by creating a score system for other land use policies (i.e., commercial and mixed use development), which in turn could direct further decisions for economic growth and sustainability. The availability of these quantitative attributes and the scoring system to planners, policy makers, and other stakeholders will facilitate their assessment of the long term impacts of decisions regarding real estate equity and the overall condition of neighborhoods, their tracking of population and economic growth, and their re-evaluations of the capacity and amount of infill scores in residential and other forms of development in their communities.

## ACKNOWLEDGMENTS

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# Intersection of understanding: the digital, tactile and physical in fabric architecture

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**ABSTRACT:** The use of tensile fabric in architecture results in structures that can be both ecologically sensitive and delight the eye — but how do we begin to understand this non-traditional method of defining form and shaping space? Various methods of form finding help in understanding the capabilities of tensile fabric structures. Digital modeling, soap bubbles and stretchable fabrics can assist in understanding the inherent properties of fabric and the natural curvatures formed by the interaction of structure and fabric. These methods, however, are plagued by a steep learning curve and time investment that deters designers from utilizing fabric and makes it difficult to intuitively understand the properties of fabric. This paper explores how our group utilized a full-scale fabric installation meant to educate the user about the possibilities of fabric in architecture through an interactive and tactile experience. This study documented the users' initial knowledge and comfort level with fabric in architectural applications as well as their understanding of its material properties and compared this understanding to their understanding after interacting with the installation. The results of this study show how the use of a hybrid methodology of exploring a new material can lead to an increased understanding of how to utilize fabric for architectural applications and form finding.

**KEYWORDS:** Fabric Architecture, Form-finding, Computational Design, Experiential Learning

## INTRODUCTION

From its earliest uses to contemporary applications, the use of fabric in architecture has resulted in delicate evocative forms that have delighted the senses of occupants. Despite a continued interest in thin lightweight structures throughout history, the specialty nature of the design, fabrication and construction of fabric structures has limited widespread implementation of this material type. The potential for enclosing large volumes of space with a minimal amount of material makes the use of tensile fabric in architecture increasingly relevant in this day and age of heightened interest in sustainable design principles (Bechtold 2008). In the Spring 2013 term, an intermediate design studio led by Assistant Professor Mark Donofrio in the Department of Architecture at the University of Oregon explored the potential of using tensile fabric architecture in environmentally sensitive locations. As part of the studio, students were charged with the design and construction of installations to be built around Lawrence Hall, the home of the School of Architecture and Allied Arts at the University of Oregon. The goal of these installations was to provide students with the hands-on experience of designing and constructing a tensile fabric structure with the intention that this experience would help inform design decisions to be made on the large scale projects. This paper outlines one group's approach of designing an installation which was intended to not only increase their own understanding of the potential of fabric in defining space in architecture, but also educate all those who interacted with the installation. Through this development of an interactive installation, the authors set out to expand the understanding of the potential of fabric in architecture beyond just the scope of those involved in the design studio.

## 1.0 FABRIC IN ARCHITECTURE

### 1.1. Historical developments

Fabric is one of the original materials used in architecture with its first known use dating back to more than 40,000 years ago. In the earliest known example of a manmade shelter, remains were found of animal skins draped over sticks at a site called Moldova 1 on the Siberian Steppe (Drew, 1979). Associated with nomadic tribes, the earliest tent structures were loosely woven fabric draped over a support framework. More permanent systems evolved over time, including shading systems for urban applications in hotter climates. Due to their lightweight

and portable nature, tent structures proved useful for military functions, with leather tents being used by the Roman Legions in the 1st century B.C. (Faegre, 1979). Later, “novelty” structures became popular in the twelfth century. These non-utility structures gradually became more ornate through the sixteenth century and were a sign of wealth and royalty. Beginning with the first travelling circus tents in the 1770’s, fabric structures grew up to 50m in diameter. This burgeoning entertainment industry led to an increase in demand and the formation of tentmakers Stromeyer and Company.

In historic applications, these shelters were generally fabricated using traditional methods of handmade ropes and woven fabrics. The basic, generic forms of structure that were developed until this time still persist today due to their utility and function in particular applications. These original pure forms include the cone, hemisphere, cylinder, semi-cylinder, pyramid, and cube, as well as various combinations (Drew 1979). However, by the 1800’s, advancements in rope strength and steel cables as well as suspension structures began to revolutionize long span bridge structures which in turn informed the structural elements of fabric architecture. By the 1950s Frei Otto began investigating the possibilities of this architecture and was supported by the aforementioned Stromeyer and Company tent manufacturers. Stromeyer and Otto collaborated for over 20 years and were instrumental in making pre-stressed fabric structures part of the modern architectural vocabulary (Otto, 2005).

### **1.2. Physical form finding**

Physical modeling of tensile fabric structures seeks to recreate “the complex field of forces in equilibrium” which defines the form of fabric architecture (Berger 1998, 167). Experimenting with forming soap bubbles over proposed structural forms recreates this perfect equilibrium. This method can be used to create temporal forms over limited amount of structure. Frei Otto popularized the use of these studies at his Institute of Lightweight Structures at the University of Stuttgart (Bach et.al. 1988). Another method is draping and tightening elastic string over structure to create naturally curved forms meant to approximate the tension in fabric. The physical modeling method that is “most realistic in [its] structural behavior” utilizes stretchable fabric (Berger 1998, 168). This method is easily approachable, most accurate and results in a permanent model which can be further studied. These various methods of physical modeling have evolved to assist the designer in form finding as well as teach the designer about the properties inherent in tensile fabric structures.

### **1.3. Digital form finding**

Computational modeling and analysis has expanded the realm of possibilities for fabric as a structural building material. What once was physically impossible or financially inconceivable with regards to fabric is now an accessible and desired reality. By utilizing complex algorithms and mathematical equations, computer models allow the user to make quick revisions as well as explore countless variations. This technology is much less time intensive and costly than a physical model approach. Physical modeling may continue to be useful for initial conceptual investigations, but final form finding, load analysis and patterning are now all undertaken using computers for reasons of speed and convenience (Koch et. al. 2004). What is most valuable about digital models for designers is the translation of relationships governed by physics into a visual representation. For example Kangaroo, a plugin for Rhinoceros3D parametric modeling plugin Grasshopper, enables geometric forms to be shaped by material properties and applied forces and interacted with in real time (Piker, 2013). While digitally modeling, the designer is aided by the software’s extensive ability to simulate physical forces which frees them from a complete knowledge of physics. Instead the digital model allows changes to be made much more intuitively based on the other parameters the designer wishes to explore.

### **1.4. Need for a hybrid approach**

While computational modeling is very strong in its ability to approximate the form of a structure being designed, it is less successful in communicating an intuitive understanding of the behavior and internal stresses of the material. Digital tools exist which can produce colored diagrams representing the stress distribution of a structure. While colored plots of structural forces are more useful to a designer than a table of pure numbers, without the proper background knowledge and understanding of how the software is working these tools can provide misleading and even incorrect results. Digital modeling has other disadvantages

including the impossibility of capturing the visceral characteristics of fabric, such as the texture or the movement of the fabric with the changing winds. Some kinds of knowledge are only gained through the tactile hands-on experience of physical form finding. Additionally, computational modeling occurs in a closed box. There is much about the programming of these algorithms that is out of the control and expertise of the designer. Lastly, the level of proficiency in computational modeling exceeds the needs of most designers. One may master software for purposes of form finding, yet the collaboration of others will always be required to complete a detailed load analysis, patterning and construction. It is the designer's role to have a more general understanding of all the disciplines rather than a complete understanding of any one. Alternatively; hands on, physical models may be more beneficial in gaining the desired knowledge of fabric which would supplement digital methods.

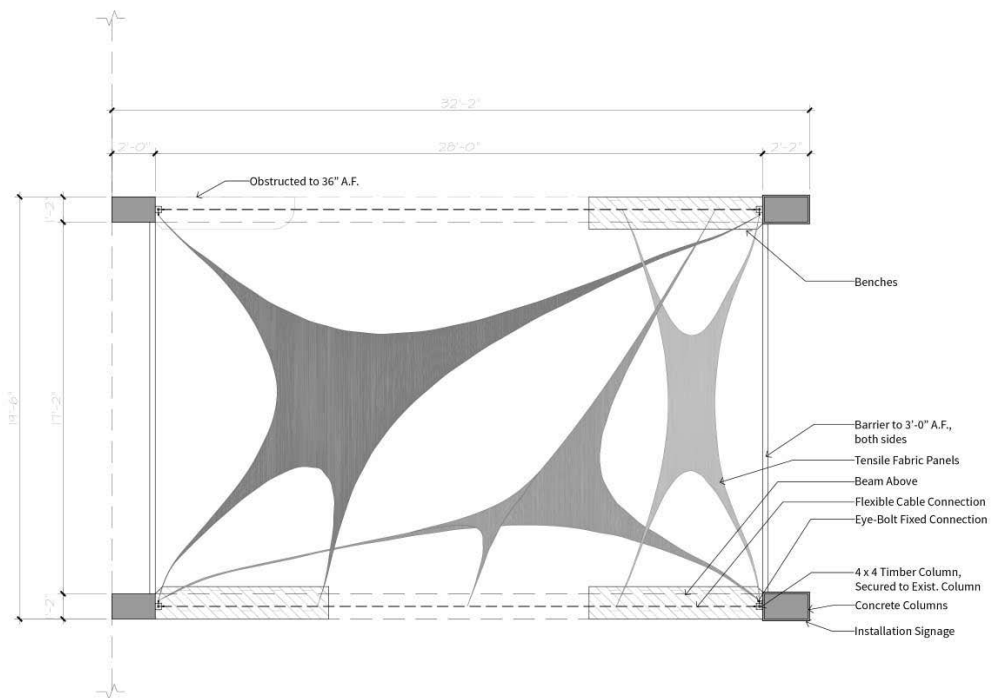
## 2.0 INTERACTIVATED SPACES: INTERSECTION OF UNDERSTANDING



**Figure 1:** Photograph of Interactivated Spaces tensile fabric installation. (Source: Loeliger 2013).

### 2.1. Installation description

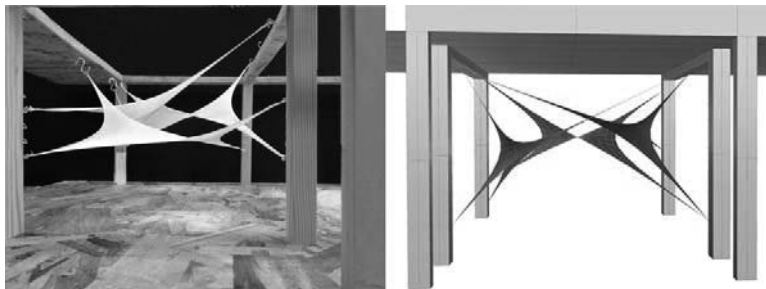
In order to explore the potential of full-scale form finding in synthesizing digital and physical methods, the authors conceived of an installation consisting of fabric panels suspended between connection points located on columns (Fig. 1). The installation takes advantage of four existing columns which create a breezeway between a quadrangle and the courtyard of Lawrence Hall. This is an area of moderate traffic and high visibility. Multiple fixed connection points were located on timber posts strapped to the four existing concrete columns located 17 feet apart in one direction and 28 feet apart in the other (Fig. 3). Eyebolts were placed at 8 inch increments on the timber posts allowing for a variety of support points that can be adjusted up or down by the user to change the forms created by the fabric. A sliding cable connection at the high point of the existing structure was connected to one corner of each fabric panel. Three fabric panels in total were permanently installed at the location; two of the panels had four corners while the third panel had three. Each corner of each fabric panel was equipped with a carabiner for attachment to the eyebolts. The parameters of the installation were optimized to the location in order to provide for the largest range of formal possibilities and the desire to educate the user about how the relationship of connection points, adjustable variables, panel shape and size directly impact the form of a fabric structure.



**Figure 3:** Drawing showing location of installation within existing breezeway columns.

## 2.2. Methodology

Our research consisted of two parts: applying methodologies used in defining the parameters of the installation as well as questionnaires answered by design students exploring their level of material understanding before and after interacting with the installation. During the first stage of research, we used techniques such as digital modeling in Rhinoceros3D software with the Grasshopper, Kangaroo and Weaverbird plug-ins as well as physical modeling, allowing us to establish the design parameters of the installation (Fig. 4). These techniques helped us establish ideal fabric shape, size, connection locations and test which variables should be adjustable by the user. Our time utilizing current methods of formal explorations gave us a thorough knowledge of the shortcoming of current methods and confirmed that a new method of understanding and teaching about fabric in architecture was required.



**Figure 4:** Physical and digital form-finding models utilized to optimize installation configuration and variables.

The second stage of our research utilized questionnaires which sought to establish the users initial knowledge of fabric and its material properties and their understanding once they had interacted with the installation. Our research pool consisted of 21 graduate and 35

undergraduate students engaged in the Bachelor of Architecture and Master of Architecture curriculums at the University of Oregon. These students served as our target audience as they are at once trained designers and curious about the use of new materials and forms in their designs. Before working with the installation, the students responded to a questionnaire asking how familiar they were with how fabric is used in the architectural professional and its material properties, formal capabilities and spatial characteristics. They also were asked how comfortable they were utilizing fabric in their architectural designs and how likely they were to do so. The students then engaged with the installation and documented their interaction through photographs of the form they created. Signage at the installation prompted the user to consider the material characteristics of fabric and its use in the architectural profession. The users were also encouraged to create a configuration with a specific spatial characteristic such as gathering, entrance or transition. After this interaction, the students were asked similar questions about the formal capabilities and possibilities of fabric, its material properties and the effectiveness of the design of the installation. The students were also asked the same qualitative questions about how comfortable they were using fabric in their designs and how likely they were to do so.

### **2.3. Process summary**

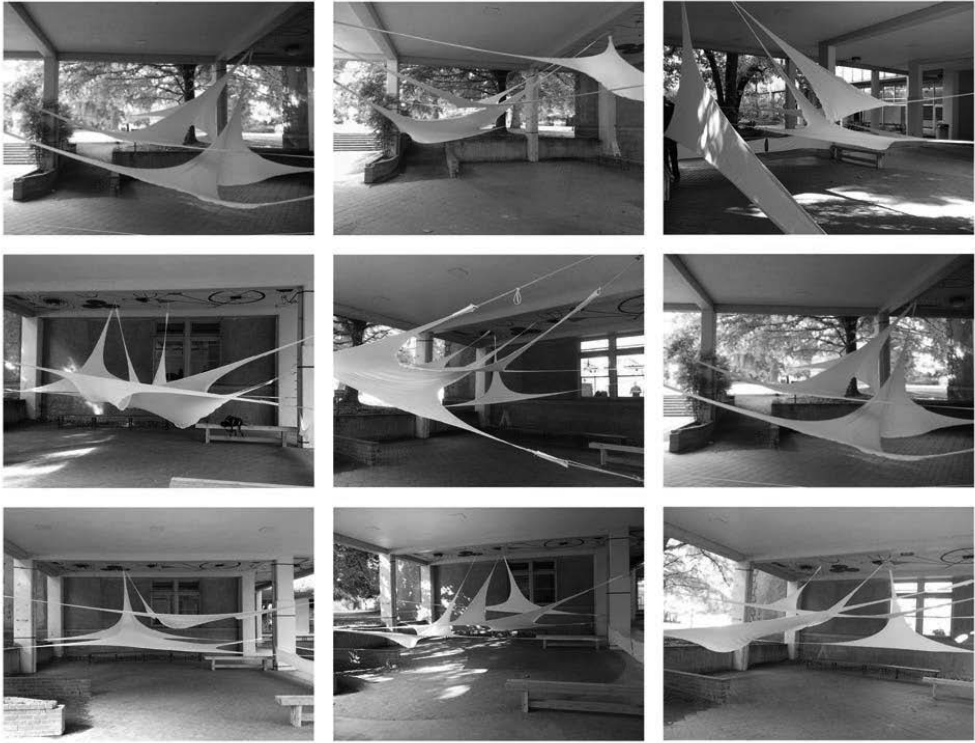
The use of physical form finding models coupled with digital modeling led to an installation that utilized the benefits of each method while also attempting to eliminate the issues and limitations related to each. Our goal was the creation of an installation where designers would be able to focus on the formal possibilities of fabric architecture and not the technicalities of connection points, shape, patterning and be confined by the inherent limitations of different modeling methods. The intention was to devise a tool that bridged the gap between the limitations of small scale physical modeling and digital modeling to the understanding of a full-scale material application through the intuitive process of manually manipulating the material itself. This hybrid method was developed to educate potential users about how the relationship of connection points, adjustable variables, panel shape and size, etc. directly alters the form of a fabric structure through an intuitive tactile experience.

## **3.0. RESULTS**

Analyzing questionnaires taken before and after interacting with the installation shows a general increase in the perceived usefulness of fabric to the architectural profession after utilizing the installation both in terms of form finding and for creating spatial qualities. While before questionnaires illustrated a generally timid use of fabric in temporary structures for shading or roof coverings; after utilizing the installation students saw the potential in using fabric to create permanent structures, for form finding and understood the formal and tensile properties of fabric.

### **3.1. Qualitative results**

While before questionnaires established what existing experience and knowledge students had of fabric in architecture, comparing these to the after questionnaires illustrated what they had directly learned from the installation. Students exhibited a general knowledge of the material characteristics of fabric before interacting with the installation but lacked how to apply those methods to more substantial architectural applications. Typical existing knowledge of fabric utilized in architectural applications included use as awnings, partitions, shading, temporary structures and interior uses. Material characteristics of fabric that the students thought would be most beneficial to architectural applications before using the installation were that it is lightweight, can create adaptable forms and is flexible. After interacting with the installation, suggested uses for fabric tended towards more permanent and substantial architectural spaces such as stadiums, pavilions or public gathering spaces. Students also described material characteristics such as “tensile strength, physical flexibility and tactile qualities” after using the installation.<sup>1</sup> Specifically, before the installation a student would consider fabric for use in “sun shading and rain protection” while after using the installation the use of fabric had graduated to more formal architectural uses “to represent/define space”.<sup>2</sup> This reaction illustrates how the installation helped the user to internalize the important material characteristics of fabric through the tactile process of configuring the installation thereby allowing them to see more formal and structural possibilities for fabric.



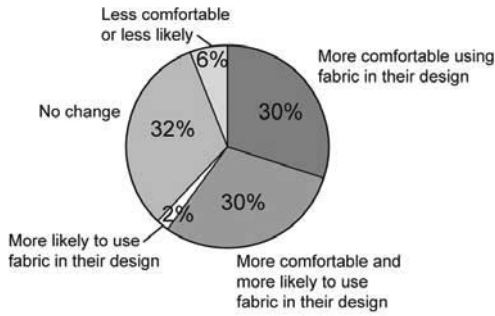
**Figure 5:** Examples of various installation configurations realized by student users.

Fabric itself also took on a more primary role in defining space once the students had manipulated the installation. The architectural uses and material qualities of fabric discussed before the installation were most often ways to ornament a building or provide utilitarian shading. Once the students had experienced the installation, fabric was seen as a tensile and/or structural element that could define the form of the building itself and was talked about with more architectural and spatial vocabulary (Fig.5). A student representative of this trend felt like fabric “is typically used as an additional element to a structure rather than the primary structure” before using the installation. This perspective then shifted to fabrics’ use “as a primary element that can easily be reconfigured for varying uses” after the installation.<sup>3</sup> Another student discussed how fabric “falls naturally” and could “be helpful in determining how loads are distributed” in non-rigid materials which are reliant on tension to create form.<sup>4</sup>

**3.2. Quantitative results**

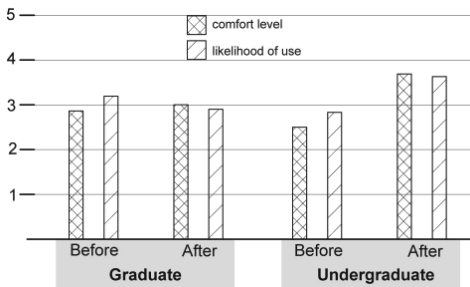
The student questionnaires also included quantitative questions regarding the student’s comfort level using fabric and the likelihood of utilizing fabric in their own designs. The same questions were asked before and after interaction with the installation and were based on a scale from 1 to 5, with 1 being least comfortable and 5 conveying a high level of comfort. Comparing results before using the installation to after, 60% of students became more comfortable with using fabric. Among that percentage, 30% were not only more comfortable with fabric but were also more likely to utilize fabric in their designs (Fig. 6). These increases are attributed to their hands-on exploration with the installation. The tactile and intuitive nature of the installation provided them with an approachable and efficient learning tool.





**Figure 6:** Percentage change in after response.

Answers to numerical questions varied between the undergraduate and graduate populations. Before interacting with the installation, graduate students were 12% more comfortable and more likely to use fabric in their designs. After the installation, the undergraduate students became 25% more comfortable and more likely to use fabric (Fig. 7). This shift possibly speaks to a differing willingness to utilize new materials and different learning styles related to age and life-experience levels. Results from the numerically based questions showed a significant increase in student comfort level and likelihood of using fabric. By eliminating the learning curve and limitations inherent in other form finding tools, the students were able to maximize the learning potential of their time with an installation that synthesized the positive aspects of the current methods.



**Figure 7:** Average before and after survey responses.

## CONCLUSION

The use of fabric in architecture has far reaching potentials, yet the specialty knowledge required for designing with fabric has limited its implementation and further development in contemporary architecture. The utilization of our hands-on installation informs an understanding and intuitive knowledge of fabric in architecture while also conveying the roots of knowledge necessary to design in fabric. It distills knowledge from both digital and physical modeling practices to create a new method of design communication that educates designers on the dynamic relationship of form, material, and structure. The installation removes barriers to understanding new formal possibilities in architecture by utilizing a material with tremendous capabilities and exploiting the curiosity of the user by making experimentation educational. This experimentation thereby provides the user with the opportunity to create new and interesting forms and relationships but also allows them the distinct opportunity to create non-tensile and less successful forms. It represents the need to remove barriers to learning by creating new methods of instruction which synthesize current methods but also create more approachable and efficient learning opportunities. Significant increases in the users comfort level and likelihood of using the material as well as the use of formal architectural language after utilizing the installation illustrates that it was successful in its educational goal. The

installation presents opportunities for further research into why undergraduate students became more likely to utilize a new material after experimenting with it while graduate students became less likely even while both groups show an increased understanding of the material. By creating an installation that was at once defined by the digital, refined through the tactile and experienced in the physical, we were able to create an experience that led to an increased understanding of the formal possibilities of fabric in architecture.

### ACKNOWLEDGEMENTS

The authors would like to thank the School of Architecture and Allied Arts House Committee for approving the installation of the Interactivated Spaces Fabric structure as well as Dean Francis Bronet for the funds to help realize it. We are grateful for the helpful critiques and suggestions of Mar Ricketts of GuildWorks. We appreciate the students and other individuals who took the time to answer surveys and playfully interact with the installation, thereby expanding their understanding of the potential of fabric in the structuring of space.

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### ENDNOTES

<sup>1</sup> Questionnaire Survey response from M.Arch student Ally MacLean

<sup>2</sup> Questionnaire Survey response from B.Arch student William Page

<sup>3</sup> Questionnaire Survey response from B.Arch student Nicole Ghiselli

<sup>4</sup> Questionnaire Survey response from B.Arch student Joanna OConnell

# Zero net energy education: mind the gap

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**ABSTRACT:** Seven years after the American Institute of Architect's adoption of the 2030 Challenge, 233 architecture firms across the nation have committed to reducing energy consumption by 60% (from a baseline national average) before the year 2030. Simultaneously, 86% of A/E firms report difficulty finding employees equipped with the knowledge and skills necessary to achieve this goal. Such a gap between supply and demand begs the question: is architectural education rising to the challenge of effectively communicating energy-efficient design strategies? This paper presents a follow-up study examining the state of zero-net-energy (ZNE) education in accredited architecture schools across North America. Previous work relied upon statistical analysis of 45 syllabi for foundational building science courses; these were self-reported from instructors from 29 accredited institutions. The study showed that these instructors were dedicating approximately 25% of course time to ZNE-related topics through a combination of lecture- and project-based learning. While insightful, the limitations of the statistical methodology and narrow information from the syllabi left many questions unanswered. The study presented herein builds upon the previous work, to first re-examine the syllabi under a different lens and also to look beyond the documents to what the instructors say. Targeted surveys were used to uncover stories that cannot be easily identified through syllabus review and to reveal how "sustainable" design education is [or isn't] being handled. We hypothesized that architectural curricula have tremendous inertia, and we (faculty) are lagging in adequately preparing students for the challenges of the present and future. Survey responses revealed that fundamentals of environmental controls were being taught, but specific ZNE applications were not. Faculty perceived that students were moderately prepared to meet the 2030 Challenge. Institutional demographics revealed that environmental controls are typically taught in the third year for undergraduates and in the first year for graduate students.

**KEYWORDS:** ZNE (zero-net-energy), education, carbon neutral, environmental controls, 2030 Challenge

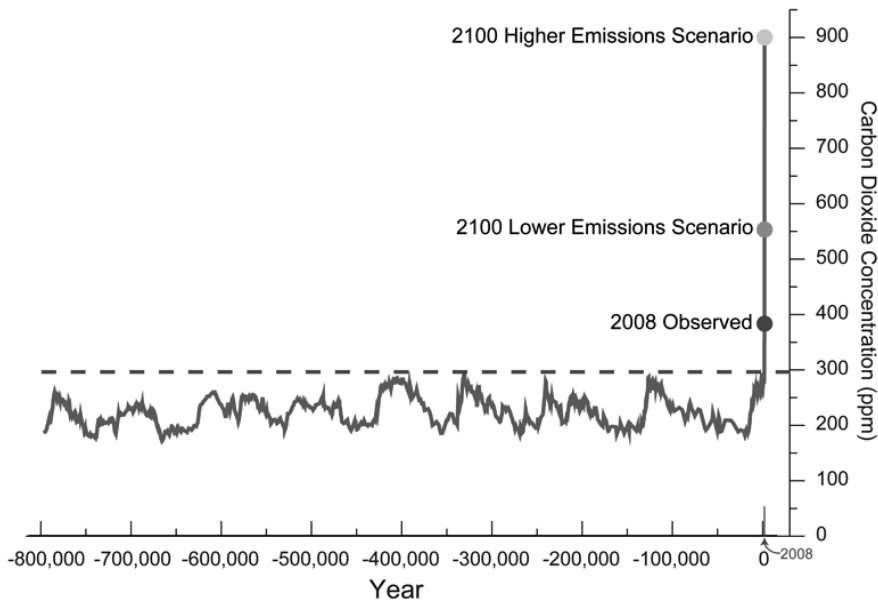
## INTRODUCTION

In the spring of 2103, a very important environmental milestone was passed. Ambient CO<sub>2</sub> levels in the atmosphere reached 400 ppm for the first time in human history. (NASA, 2013). Such concentrations of CO<sub>2</sub> have occurred in the past—but only in the distant geologic past and typically as a result of some cataclysmic event. Figure 1 shows the progression of CO<sub>2</sub> levels since a bit before the time of the Egyptian master builders. Figure 2 shows more recent CO<sub>2</sub> data in greater detail.

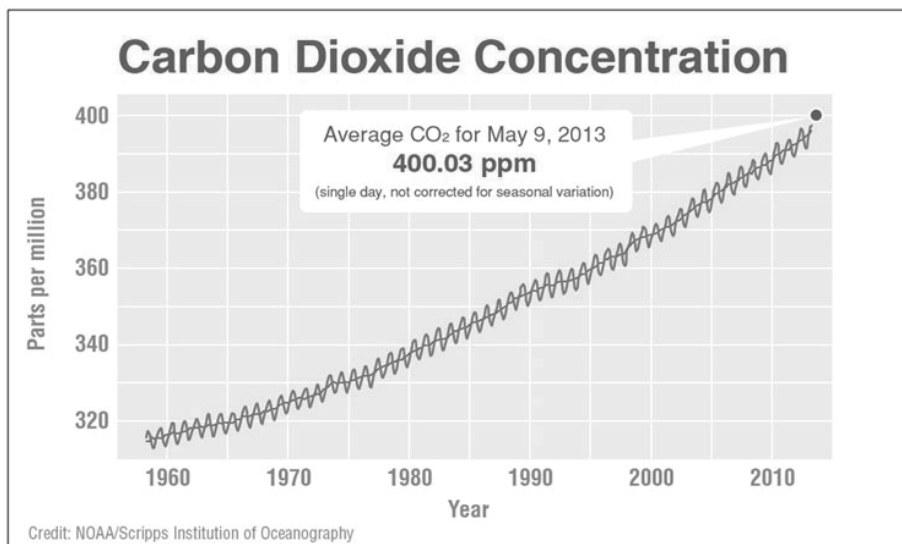
Remarkably, although meriting some mention in the popular press (and more discussion in science circles) the 400 ppm milestone was not an issue of great concern in building design forums. This is especially quirky since buildings, in their design, construction, and operation, contribute mightily to carbon emissions that drive up ambient CO<sub>2</sub> concentrations. Perhaps this is a normal reaction from busy professionals who don't want to admit complicity in what many believe to be an ongoing crime-against-nature spree. This complacency feels very disingenuous, however, as Ed Mazria called us out on this issue in 2003 with the publication of "It's the architecture, stupid." (Mazria, 2003).

Mazria's contention was (and remains) that architectural design decisions affect roughly 50% of national energy consumption and, thus, roughly half of all gaseous carbon emissions. These emissions are changing the global climate (by scientific consensus) with unknown societal

impacts on the horizon. (IPCC, 2013). Buildings are literally altering the global climate in ways that are unpredictable and arguably not net-positive. For building design professionals, ignoring the problem and its root causes is irrational. Pogo was right, “We have met the enemy and he is us.”



**Figure 1:** Atmospheric carbon dioxide concentrations over time. Source: [www.ncdc.noaa.gov](http://www.ncdc.noaa.gov)



**Figure 2:** Recent carbon dioxide concentrations in detail. Source: [climate.nasa.gov](http://climate.nasa.gov)

Intriguingly, the same Mazria who pointed out architecture’s role in climate change has charted a way forward for the building professions. This is the 2030 Challenge promoted by Architecture 2030. (Architecture 2030, 2013). Philosophically the 2030 Challenge represents a

way for design professionals to step forward, take responsibility for climate change, and engage in CO<sub>2</sub> mitigation efforts. Technically, the Challenge provides a set of escalating targets for building energy performance that culminate in 2030 with near-carbon-neutral buildings. In the United States there seems to be a preference for discussing energy efficiency in lieu of carbon neutrality. Since the vast majority of energy consumed by North American buildings is fossil-based, there is a clear and almost direct connection between decreased energy use and reduced carbon emissions. This paper essentially equates energy reductions with carbon reductions.

### 1.1. Background

Seven years after the American Institute of Architect's adoption of the 2030 Challenge, 233 architecture firms across the nation have committed to reducing energy consumption—before the year 2030—by 60 percent from a baseline national average. Simultaneously, 86% of A/E firms report difficulty finding employees equipped with the knowledge and skills necessary to achieve this goal. Such a gap between supply and demand begs the question: is architectural education rising to the challenge of effectively communicating highly-energy-efficient design strategies (which would, as a direct consequence, lead to reduced carbon emissions)? This paper presents a follow-up study examining the state of Zero Net Energy (ZNE) education in accredited architecture schools across North America. Previous work by Anderson relied upon statistical analysis of 45 syllabi for foundational building science courses. These syllabi were self-reported from instructors from 29 NAAB-accredited institutions. The study showed that these instructors were dedicating approximately 25% of course time to ZNE-related topics through a combination of lecture- and project-based learning. While insightful, the limitations of the statistical methodology and the limited information provided by the syllabi left many questions unanswered. The study presented here builds upon the previous work, using qualitative analysis to look beyond what the syllabi say. A survey and several focused interviews were used to uncover stories that cannot be easily described or defined by numbers and to reveal how design education for high-energy-efficiency is [or isn't] being handled.

### 1.2. Objectives

AIA leadership groups recently identified four top priorities (Lazarus, 2013) when asked for perspective on the *most important sustainability priorities and trends* to meet the current and future needs of their clients and communities; these were performance metrics, design and human health, climate change, and energy. These topics were also noted as the top educational program wishes for the membership. Such results suggest a high priority need for designers well-prepared to address building energy/climate performance when they enter the profession.

The objectives of this study are to:

- determine if architectural curricula in North America are providing the students with the proper tools, skills, and resources to address zero net energy design;
- explore perceptions of student understanding of how to reduce or eliminate fossil fuels in design projects (are we properly preparing students to achieve low energy/carbon neutral solutions?)
- examine selected contextual factors surrounding building science education.

### 1.3. Hypotheses

We hypothesize that architectural curricula have tremendous inertia and we (faculty) are lagging in preparing students to viably contribute to reaching the Architecture 2030 targets. We also hypothesize that energy simulation and parametric analysis will be touted as common means of engaging energy efficient building design.

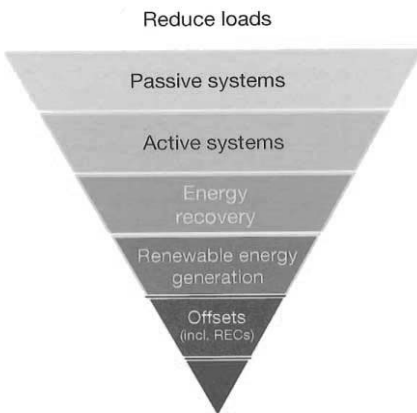
**1.4. Previous work**

A previous study (Anderson et al., 2013) collected syllabi for building science technology courses at schools of architecture, gathered public information from program websites, and reviewed/analyzed the course syllabi and schedules thus obtained. A total of 45 course syllabi and schedules were received from 38 faculty representing 29 schools of architecture (approximately one-quarter of the NAAB accredited schools). Several faculty submitted multiple syllabi (representing different courses). The acronym “ZNE” was used to broadly cover content in four categories: passive systems, active systems, benchmarks and standards, and energy. Results of the analysis suggested that ZNE topics account for approximately 28% of the time devoted to material coverage in the building science (or technology) course schedules reviewed. It was found that the majority of instructors who responded relied on exams as a primary means of student assessment. The kind of experiential activity that students were involved in (if at all) during lab sections was also investigated. Of the 45 courses reviewed in the study, approximately half were lecture-based only, and the others were lecture-lab courses. Most syllabi did not indicate the nature of the activities conducted in lab sections; the ones that did so, however, described activities such as design charrettes, tours, hands-on experiments, use of tools to gather information, games, measurement verification, calculations, and peer-to-peer collaboration. A number of inconsistencies in the data left the study with some unanswered questions at the conclusion of the document (syllabus/schedule) review process.

**1.5. Methods**

**Syllabus Review**

The course syllabi received during the prior study were reviewed through a different lens to verify the results of the Anderson study. A hierarchical approach to net-zero energy [herein designated ZNE] design was proposed by McGregor et al. Shown in Figure 3, the approach first prioritizes reducing loads, follows with the integration of passive systems, then active systems, energy recovery improvements, and concludes with integration of onsite renewable energy sources and energy offsets.



**Figure 3:** Hierarchical approach to achieving net-zero energy in buildings. Source: McGregor et al. 2012.

While it is essential for an architect to be proficient in each of these areas, this framework may suggest a reasonable weighting scheme for building science pedagogy. The expectation is that more time would be spent addressing the topics at the top (wide part) of the pyramid, where performance is most effectively addressed. The 45 building science course syllabi were therefore analyzed through the lens of this framework. 32 different building science topics found in the 45 course schedules were sorted into nine categories, including the six identified by McGregor. Table 1 shows how these topics were sorted. Additional categories, including

“fundamentals,” “water,” and “standards and best practices,” were created to accommodate topics that fell outside of the McGregor framework. Course lecture schedules were used to determine the relative amounts of time dedicated to these different topics and, in turn, these nine categories.

**Table 1.** Building Science Course Syllabus Topic Categories

TOPICS SORTED to MCGREGOR CATEGORIES						OTHER TOPICS	
Load Reduction	Passive Systems	Active Systems	Energy Recovery	Renewable Energy	Offsets	Topics	Standards and Best Practices
Daylighting	Bioclimatic design	Active solar	n/a	Energy sources	n/a	Psychrometrics	ZNE/CND
Heat transfer/flow	Passive cooling	HVAC				Thermal comfort	LEED
Solar radiation	Passive Heating					Fire/smoke	Passive House
Electric lighting	Solar geometry					Electrical systems	Integrated design
Lighting design	Wind					Physics of light	POE
Luminaire design	Site analysis					Vertical transport	
						Acoustics	
						IAQ	
						Case studies	
						Simulation	
						Water/Waste	

**Survey**

Qualtrics survey software was used to administer a fifteen-question online survey. Surveys were distributed via email to adjunct, tenure-track, and tenured faculty teaching building science. Respondents included participants from the previous Anderson study, as well as additional users of the Society of Building Science Educators [SBSE] listserv, the platform through which the survey was distributed.

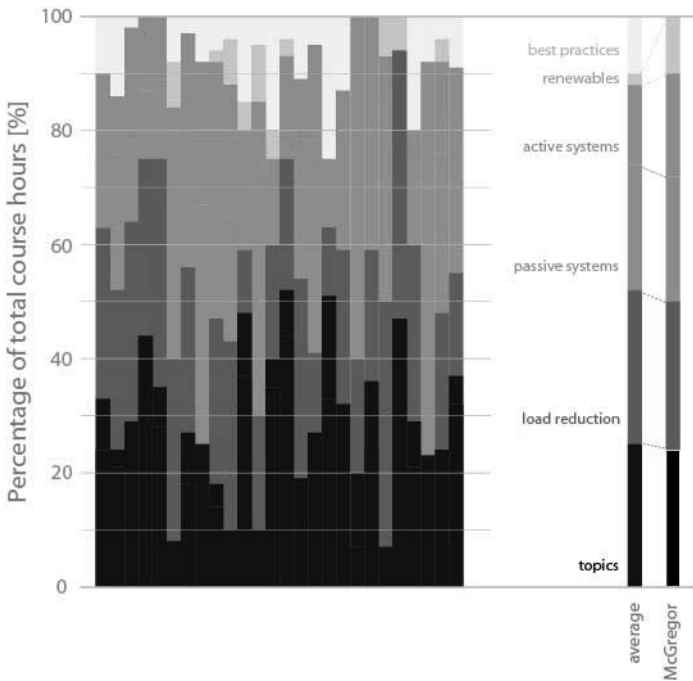
A total of 26 faculty responded to the survey. While the authors recognize that this dataset is in no way comprehensive, we feel that it can be used to qualitatively examine current practices in ZNE education and that it is a useful supplement to the previous syllabus review.

**RESULTS**

Results from the current study are described below. First, results from the follow-up syllabus review are presented, followed by results from the online survey.

**2.1 Follow-up syllabus review**

Figure 4 shows the percentage (by time) that each course—for which schedule information was available— allocated to each of the seven topic categories (from Table 1).

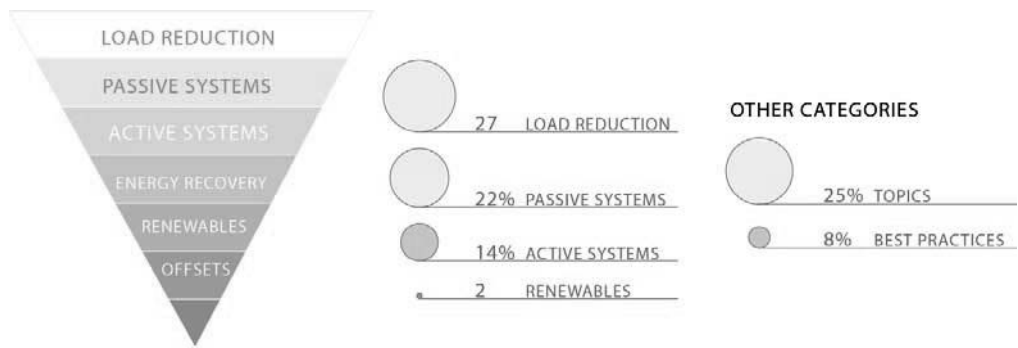


**Figure 4.** Percentages of lecture time dedicated to the topic categories listed in Table 1.

According to the analysis, instructors who provided detailed course schedules dedicate roughly 72% of class time to energy-related topics, of which zero net energy, carbon neutral design, and green building practices represent at least 8%. Interestingly, the graphic demonstrates that course topic prioritization generally aligns with McGregor's hierarchy, particularly for passive and active systems and for load reduction. Such agreement between the relative effectiveness of design moves described by McGregor and current teaching emphases, while professionals report a lack of preparedness for sustainable design, suggests that lecture-class time may be appropriately allocated. Perhaps, however, the connection between fundamental principles and studio-based design thinking and solutions is not being adequately reinforced. In accreditation language, there is apparently acceptable conveyance of “understanding” (all courses in this study are from NAAB-accredited programs) but a gap between understanding and ability to use knowledge or information.

Energy offsets and energy recovery were not directly referenced in any course schedules. This is most likely due to the fact that these are technical (non-architectural) topics generally engaged in the design development phase of a project (which is rarely dealt with in design studio settings). Using lecture time as an indicator of relative priority, Figure 5 compares McGregor's hierarchy to the topic-time averages shown in Figure 4.





**Figure 5.** Comparison of McGregor's prioritized approach to zero net energy to the relative distribution of building science course class time.

## 2.2 Survey results

Building science courses are primarily offered during the third year of undergraduate programs and during the first year of graduate programs. Institutions that offered such courses earlier in the curriculum generally offered more electives related to energy topics. Most institutions provided teaching assistants to support the basic building science courses; on average this involved two teaching assistants (and in some of the larger programs three to five teaching assistants). Half of the building science courses were lecture-based only and the other courses offered lecture and laboratory- or discussion-section-based meetings where more experiential activities occurred.

## DISCUSSION

### 3.1 Course content

The syllabi and schedules alone were unable to sufficiently answer all questions about whether building science courses are providing students with the experiences, skills, and abilities to address the goals of the Architecture 2030 Challenge. The close agreement, however, between the design move emphasis described by McGregor and current teaching practices reveal that class time might well be appropriately allocated, but that integration of fundamental principles and passive strategies may not be reinforced or required in studios.

It is not well reflected in the syllabi/schedules just how students are taught design integration or if these primarily lecture-based courses are even intended to provide the necessary experience to enable integrated design, in studio or once in practice. Respondents provided some comments about using the Leadership in Energy and Environmental Design (LEED) checklist as a course framework, but it is not clear that this is enough to actually provide proper preparation (and retention) of the application and integration of fundamental principles into low-energy/low-carbon building strategies.

### 3.2 Department-level commitment

The study examined a few institutional factors surrounding teaching technical subjects and integrating building science topics and design. A look at the percentage of the total number of faculty who teach technology courses (often considered "technology faculty") revealed that 20% of the faculty teach technical subjects (e.g., 2 out of 10). The term "technology" includes environmental control systems, construction and materials, and structures.

Who teaches these courses, adjuncts or tenure-related faculty? The survey showed that 52% of the technology courses are taught by tenure-related faculty; 12% by adjuncts; and 36% are taught by both adjuncts and tenure-related faculty. Is there a split between faculty that teach design studio versus those that teach technical subjects? Sixty percent of the institutions represented in the survey are in this category and 36% of the institutions have faculty that regularly teach both design studio and technical subjects.

The sampling conducted for the survey may be too narrow to derive conclusive results. Limitations include the sample size and the pool from which respondents were drawn—the Society of Building Science Educators listserv (an already “committed to the cause” group). It also may be problematic to assume that topics not included in course documents are not covered in the course content. For instance, a lecture topic or title may not specifically mention passive design, but the course may still cover such strategies. The syllabus and schedule review provided more accurate and detailed information than the website review, but additional data collection may be necessary for a more nuanced look at course coverage of zero-net-energy design issues. This study did not consider information from complementary documents (such as project requirements, assignments, activities, or exams) which might provide a more qualitative understanding of course content

### **3.3 Student preparedness and enthusiasm**

Faculty were queried on their perceptions of student preparedness for the energy/carbon challenges of the profession on a scale of 1 to 5 (with 5 being well-prepared)—the faculty response averaged 3.1. When asked about perceived student enthusiasm for ZNE topics, the response was slightly more positive at 3.4.

Follow up interviews with several faculty yielded anecdotal stories ranging from frustration with department culture (administrative and collegial support); at not having attention placed on student work in the technical areas. On the other hand, there were reports of courses where students rose to the challenge and ended up in well-known firms. Though the results from these perceptions are interesting, the results are weakened by not having an equivalent survey of student perceptions.

### **3.4 Remaining questions**

During the course of this study, additional questions about related topics and educational vehicles came up to address in future studies:

- how do building science and architecture programs adapt to the world of MOOCs; and what does this mean for ZNE?
- when do we shift to emphasize water and water conservation; materials, health, and IEQ?
- do professors and practitioners value the same knowledge and skillsets; how do we find out; how do we (collectively) align these goals?
- will curricula change in light of the recent proposed changes to NAAB student performance criteria, which essentially remove the current “sustainability” criteria?
- is anyone talking (in their classes) about commissioning and aftercare; do we know that buildings are actually performing as designed?
- most courses have teaching assistants who primarily do administrative tasks; are these human resources underutilized

## **CONCLUSIONS**

From this limited snapshot of syllabi from 29 institutions we found a number of intriguing facts, trends, and relationships. On average, roughly 72% of class time is devoted to energy-related topics, of which ZNE/CND and green building practices represent at least 8%. Topics are taught through lectures and project-based learning and faculty are generally placing emphasis on fundamentals, load reduction, and passive systems.

The courses examined in this review appear to maintain a division between traditional design and integrated design. Since extracting information from building science syllabi and faculty surveys is not an exhaustive way of evaluating content or the uptake of ZNE topics, there is a real need to expand this study to look at coverage of high-energy-efficiency goals in design studios. The syllabi, schedules, and survey were unable to sufficiently answer all questions about whether courses are providing students with the experiences, skills, and design abilities to address the goals of the Architecture 2030 Challenge.

At this point, our first hypothesis appears to be correct (students are not prepared to viably contribute to a low-energy/low-carbon future), but future research should address student impressions of their own abilities and preparedness for low-carbon design challenges. Only one response (by telephone interview) mentioned energy simulation and parametric analysis as the answer to sustainability. In this respect, our second hypothesis was incorrect.

The movement within the profession is toward sustainable design, including zero-net-energy issues. This study was intended to begin a conversation about how building science courses across a number of schools of architecture are preparing students to design buildings that address the very real concerns of global climate change. We expect that additional data collection and analysis methods can be used to build upon this initial exploration and to better reveal the true state of building science education in North America.

### **ACKNOWLEDGEMENTS**

The authors gratefully acknowledge those who provided their course syllabi for review and the online survey respondents. The authors also thank University of Oregon graduate students Melissa Anderson and Thomas Collins for their work on the previous study and paper presented via the American Solar Energy Society.

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# Black boxes and gray spaces: how illegal dwellings find regulatory loopholes

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**ABSTRACT:** In Honolulu, the building permit process has been likened to a black box, synonymous with regulatory barriers and unbearable delays. In response, homeowners cultivate gray spaces: ambiguous accessory spaces such as “Hobby,” “TV” or “Rumpus Rooms” that are issued permits and then frequently converted illegally into an independent dwelling unit. In essence, these Illegal Accessory Dwellings function as non-permitted second units on land zoned for single-family use.

This paper proposes to quantify the number of Illegal Accessory Dwellings in Honolulu, based on the number of residential buildings permits issued for spaces that could be easily converted into a separate rental unit. Using building permit data provides a systematic method to analyze all legally sanctioned building activity, pinpointing only those residential layouts that are highly suspicious of being converted into a separate rental unit. In so doing, this paper makes a key distinction: a structure can be built to code, but its occupancy – how it is used – can still be illegal.

From 2005-2012, this paper found that Illegal Accessory Dwellings comprised a low of 30% up to 46% of all new one and two-family dwellings units created. The highest rate of production was in 2008, during the Great Recession. Thus, this paper suggests that Illegal Accessory Dwellings contribute a substantial number of units to the overall housing supply.

This paper also raises questions such as – How are these units being counted in the official US Census? Are they counted as separate households or as part of the primary residence? Given the significant number of this type of housing, how Illegal Accessory Dwellings are characterized could potentially shift the landscape of where urban growth is occurring.

Research methods include correlational research, GIS mapping and case studies, to explain how homeowners circumvent the rules.

Key Words: Illegal Accessory Dwelling, Regulatory Capture

## INTRODUCTION

*An Illegal Accessory Dwelling (hereafter: IADs)* is a legally constructed room accessory to a primary residence. However, these spaces are frequently illegally occupied as a separate independent dwelling unit (including a bedroom, full kitchen facilities and bathroom), becoming an illegal second dwelling unit on land zoned for single-family use.

A critical distinction made in this study is use vs structure. All Illegal Accessory Dwellings identified in this paper were issued a building permit. Their structure, layout and floor plan are all legal and met local zoning codes. However, it is only when these spaces are occupied by a tenant and used as an independent living unit that these spaces become Illegal Accessory Dwellings.

These types of living arrangements create needed rentals (Reade 2000). This issue is particularly relevant for Honolulu, a city with one of the highest costs of living and the most unaffordable real estate (relative to income) in the nation (Performance Urban Planning 2012). Thus this paper begins with the premise that Illegal Accessory Dwellings actually serve a significant public benefit by adding units to the housing supply, thereby having the net effect of

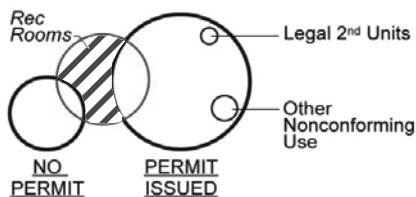
improving housing affordability. IADs highlight an interesting contradiction in housing policy – while they are officially unwanted, they are desperately needed.

To that end, the goal of this paper is 1) to quantify all legally sanctioned building permit activity to create Illegal Accessory Dwellings, and 2) perform a rudimentary spatial analysis to see what, if any, patterns emerge. With this information, policymakers will have a better understanding of where this type of urban growth is occurring and perhaps which portions of the second unit policy should be modified.

To date, illegal dwellings have not been comprehensively quantified in any major metropolitan area. While studies of illegal units in other cities have used visual surveys (Cchaya 2008) or focused on the hypothetical occupancy of the structure (ie. realtor descriptions that describe potential rental income from a basement studio), the methodology used in this paper systematically investigates *all* legally sanctioned building activity, pinpointing only those residential layouts that are highly suspicious for being converted into a separate rental unit.

IADs are difficult to quantify because their immense variety makes it difficult to create a filter to catch them all – and even if they were identified, how the space is used is likely to change over time. While previous studies have relied primarily on surveys of user behavior or visual surveys from a home’s exterior, this paper focusses on the floor plan configuration.

While it is common knowledge that these conversions occur, data has been lacking to quantify this type of housing. Using GIS and basic spatial analysis tools, this paper proposes to show where these IADs are being built and their relationship to other demographic information provided by the US Census.



**Figure 1:** Venn Diagram: Most Rec Rooms are issued permits, but then used/occupied in way that is not permitted.



**Figure 2:** Legal 2<sup>nd</sup> Unit: Ohana Dwelling (down) + Main House (up)



**Figure 3:** Suspicious: Single-family dwelling with an affidavit; one can assume it has a Rec Room.

From the exterior, it is difficult to tell whether a structure contains a Rec Room or not. While accessory residential spaces are often lawfully built with a permit, it is only when a tenant moves in, that the IAD becomes an illegal unit. An IAD’s physical location, dimensions, and configuration is not the issue; it is how the space is occupied that makes it illegal.

Under the land use code, IADs are not intended to be used as a bedroom or an independent living unit. This exuberant gray area is where regulation of planning policy gets messy. Because land use departments cannot effectively monitor or control landlord behavior, the City has great difficulty enforcing occupancy or use provisions, especially on residential zoned land.

## AFFORDABLE RENTAL HOUSING

Organizations such as the AARP, HUD, EPA, the Joint Center for Housing Studies of Harvard University and the SmartCode (AARP 2000) (US 2008) (EPA 2009) (Lawler 2001) (Hurley 2009), specifically name “Accessory Dwelling Units” as a form of supportive housing for seniors and a source of affordable rental housing. Essentially, they are advocating for Rec Rooms that can be legally occupied and rented for income.

Furthermore, secondary units support housing affordability by increasing the number of units available for renters, giving homeowners passive income, thereby supporting neighborhood stability, aging-in-place, (Hare 1991) and long-term community goals such as reducing sprawl and concentrating new development near existing civic infrastructure. But while Honolulu has allowed legal Accessory Dwelling Units since 1982, (City 1984) there seems to be a disconnect between policy intention and urban implementation that encourages otherwise law-abiding homeowners to operate illegal rentals.

### **CASE STUDY**

The demand for homes that are configured to include a secondary unit can also be seen in predesigned home kits. Homeowners who can't afford the services of an architect to customize their home to include a separate rental unit can select from a variety of predesigned home kits that include plans and materials from Honsador Lumber. The Oahu model floor plan is notable for its entry, at the bottom of the stairway. Adding a door at the 1<sup>st</sup> floor Living Room easily converts this home into two separate dwelling units. The 1<sup>st</sup> floor already has a wet bar and its own separate entry off the Family Room.

The fact that homes like these are available for purchase off-the-shelf from suppliers who can supply all materials pre-cut and ready to assemble on site, shows how sophisticated and ubiquitous the Rec Room loophole has become.

As a single-family dwelling, the Oahu model unit would not be required to provide a 1-hour fire-rated separation between units (ie. the floor-ceiling assembly). Consequently, if the initial homeowners added a door at the stairway and sold the home, the physical configuration could easily become a de facto separate, second unit.

### **METHODOLOGY**

The key insight that makes this research possible is that when a building permit is issued for residential property, City Plan Examiners will flag projects that contain layouts they deem suspicious for containing an illegal rental unit. In this writer's experience, living areas that are partitioned separate from the main house and provided with its own exterior entry, bathroom, bedroom and wet bar, would be considered suspicious and thus trigger a requirement for an affidavit and/or restrictive covenant document to be filed as a condition of permit approval.

While the affidavit/covenant document states that the owner of the property promises that the use will not be converted into a separate dwelling unit, in reality, this does little to deter illegal rental activity. However, these data fields provide an excellent way to pinpoint only those permits that contain layouts that are suspicious.

This search criteria is especially useful because many of these permit descriptions do not say "Recreation Room" and of course do not say "Illegal Accessory Dwelling". Using this as the search criteria avoids the necessity of needing to review the actual approved building permit drawings to determine which ones were suspicious; by flagging the permit as needing an affidavit or restrictive covenant, the City Plans Examiners have already made that determination. Even when the building permit description states new "Hobby Room," "Gym," "Sun Room," or simply "Alterations," if the permit required an affidavit or restrictive covenant, one can assume that the layout was suspicious because it could be easily converted into a separate rental unit. Therefore, this research relies on City Residential Plans Examiners to review all permit drawings.

Exceptions to this rule are: Ohana Dwellings, Farm Dwellings, Relocation permits, and Demolition permits. These categories also require either an affidavit or a restrictive covenant, but are not Illegal Accessory Dwellings and were therefore removed from this study's dataset. The permits that remained were assumed to be for Illegal Accessory Dwellings. Spot checking permit descriptions suggests this understanding is consistent with the results.

**FINDINGS**

This paper identified a total of 5,680 Illegal Accessory Dwelling permits were issued in Honolulu between 2005 and 2012. In comparison, 9,726 single-family or two-family dwellings units and 102 Ohana Dwelling units were created in the same period. Thus, during the 8 year period of this study the contribution of each category to the total number of residential dwellings (multifamily dwellings were not counted):

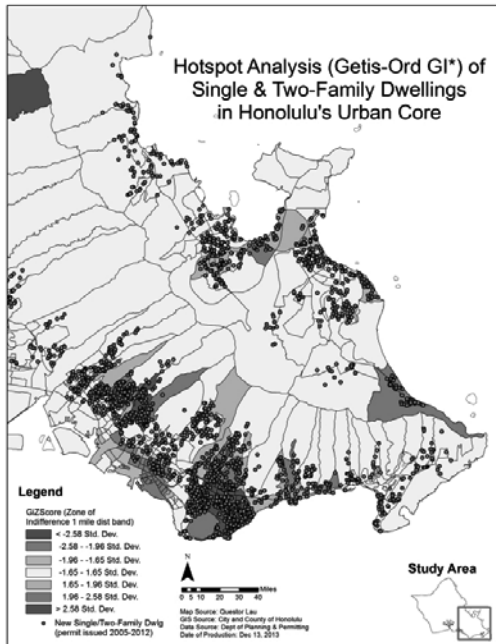
Total	%	Type
5,680	37 %	Illegal Accessory Dwellings
9,726	63 %	Single and Two-Family Dwelling Units
102	1 %	Ohana Dwellings

Year Permit Issued	2005	2006	2007	2008	2009	2010	2011	2012
SFD + TFD[1]	2,111	1,848	1,357	808	876	911	780	1,035
Illegal Accessory Dwellings[2]	911	927	896	695	562	593	594	502
Ohana Unit[1]	11	13	18	11	10	14	12	13
Total Residential	3,033	2,788	2,271	1,514	1,448	1,518	1,386	1,550

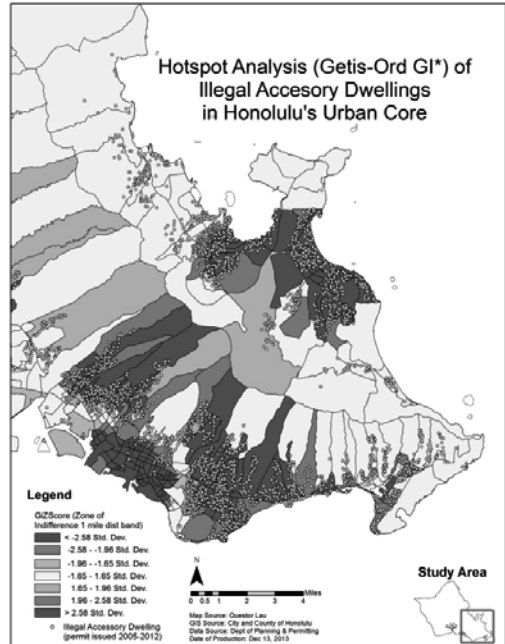
Illegal Accessory Dwellings/Total Res	30%	33%	39%	46%	39%	39%	43%	32%
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**Figure 4:** Annual New Residential Housing Inventory (Honolulu County)

Figure 4 shows that the highest proportion of Illegal Accessory Dwellings was permitted in 2008, the year of the Great Recession in the US. This suggests that in worsening economic conditions, homeowners create above average numbers of Illegal Accessory Dwellings. However, this correlation could be due to other factors. The second highest number of Illegal Accessory Dwellings occurred in 2011 and one wonders if this correlates to a relapse of bad



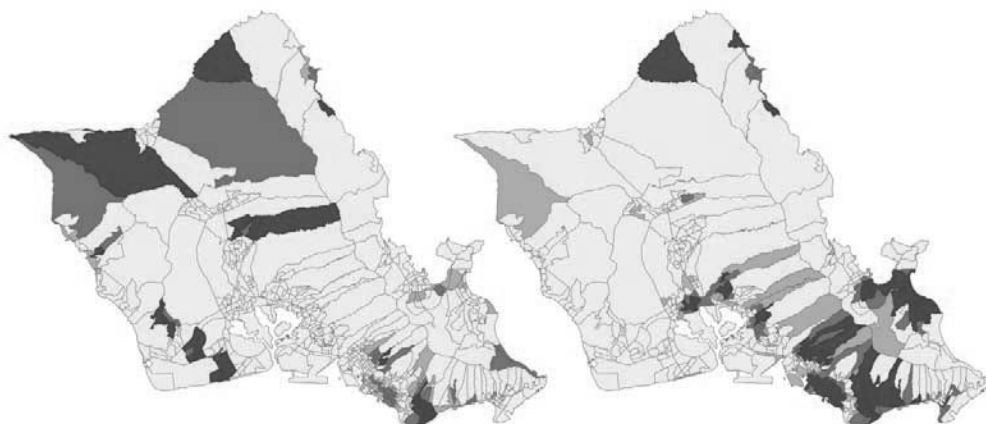
**Figure 5:** Statistical Hotspot Analysis of Single and Two-Family Dwelling distribution



**Figure 6:** Statistical Hotspot Analysis of *Illegal Accessory Dwelling* distribution

economic conditions in Honolulu.

The Department of Planning and Permitting has already designated an Ohana Zone, wherein properties have supposedly already been prescreened for adequate road, water and wastewater infrastructure. However, when Illegal Accessory Dwellings were overlaid over the



Ohana Zone, 69% or 3,804 Illegal Accessory Dwelling permits issued between 2005 to 2012 were not within the Ohana Zone. A little less than a third or 1,700 of the total 5,504 Illegal Accessory Dwellings were located within the Ohana Zone. If it is reasonable to assume that at some point in its lifetime, these Illegal Accessory Dwellings will be occupied as an independent dwelling unit, then this pattern of growth suggests that the City is losing control over where urban growth is occurring.

**Figure 7:** Islandwide Statistical Hotspot Analysis. Left: Single and Two-Family Dwellings; Right: *Illegal Accessory Dwelling*

Figure 7 shows that the distribution of Illegal Accessory Dwellings vs new Single and Two-Family dwellings is different. New legal dwellings are statistically more prevalent in West Oahu, whereas Illegal Accessory Dwellings occur primarily within the urban core. This is a striking difference although not unexpected since real estate prices and vacant land availability are more favorable at the urban fringe, which is more conducive to new development. However, this pattern suggests legal dwellings are contributing to urban sprawl. In comparison, Illegal Accessory Dwellings locations are consistent with Smart Growth principles, that is, they are primarily urban in-fill, occurring in areas with existing civic infrastructure.

One of the major regulatory barriers to Ohana Dwellings – could be eliminated. Using ArcGIS to intersect the bus stop ¼ mile buffer with Illegal Accessory Dwelling centroid locations, revealed that 4,827 out of 5,504 Illegal Accessory Dwellings or 88% of Illegal Accessory Dwellings were within a 5 minute walk of bus stops. This is compelling evidence to support reducing off-street parking requirements for Ohana Units from 2 stalls to 1 or none. This is supported by research from Berkeley shows that tenants of Accessory Dwellings are less likely to own cars than the people who reside in the main house (Chapple 2012).

## DISCUSSION

One strong criticism of this research is that it makes the assumption of guilt – that these building permits may contain layouts that are suspicious for being a separate rental, but that does not guarantee that they will be used that way. This is exactly the point of this methodology. While other studies have focused primarily on the behavior of users, this study examines the physical layout of the structure. How a space is used, frequently changes over time, while the structure itself is less likely to change. Therefore, if we examine the floor plan layout of a home, we can gain some significant insight into how that space will likely be used at some point of its existence. Maybe it is not used as a separate rental unit now, but because it is configured in a way that is easily partitioned from the main house, there is a high likelihood that at some point, someone will be enjoying the space as a separate dwelling unit, independent from the main house.



This research leads to more questions, such as why did homeowners choose an Illegal Accessory Dwelling permit instead of an Ohana Unit (a legal second unit)? The dataset examined for this paper can be drilled down further to gain insights into the underlying property characteristics. For example, did owners who built Illegal Accessory Dwellings have lot sizes that were too small and thus precluded an Ohana Unit? What is the average construction valuation of Illegal Accessory Dwellings as compared to new Ohana Dwellings and single and two-family dwellings? Further correlations between Census Block Group data (ie. owner-occupancy rate, mean household income, number of cars per household, and so on) and areas with the highest number of Illegal Accessory Dwellings might suggest future illegal growth trends if regulations were liberalized. Further statistical analysis of the results could greatly enhance the impact of these findings.

### **BLACK BOXES → GRAY SPACES**

Reports from planning organizations repeatedly show that 1) with or without government approval, secondary units are being created within residential neighborhoods (Wegmann 2011); and 2) these units rent at or below fair market value (Reade 2000) (P. H. Hare 1985).

The widespread pattern of IADs suggests that the traditional command and control approach to regulation is not working. This is especially true for residential properties where public sanctions are least welcomed. However, even if this approach were taken to its logical extreme – and City Inspectors were granted police search and seizure capabilities, like narcotics enforcement – the list of violators and illegal tenants would result in a mass eviction on the scale of a natural disaster, except this would have been completely man-made. Therefore, current regulations exist in a state of limbo – not allowing but needing IADs. Even the current complaint-driven enforcement system is more like posturing than sound policy. What would happen if all IADs uncovered during this research were tendered to the City as a mass complaint? Such mischief only underscores the substantial number of IADs, highlighting its status as a regulatory gray area.

What then is the alternative to regulation? One approach comes from social normativity research. According to legal scholar W.A. Bogart, when it comes to behaviors that are difficult to regulate (he was studying overeating, gambling and smoking, but the same logic can be applied to Illegal Accessory Dwellings) nudging people towards desired behavior: a permit-but-discourage approach, is more effective than legal sanctions alone (Bogart 2011, Introduction). This logic refocuses regulatory efforts on the worst offenders rather than minor ones. Applying this to Illegal Accessory Dwellings means that only those homes that have been converted into multifamily (three or more) units without a permit should be identified and prosecuted since they pose the highest hazard.

For example, the risk of fire is significantly higher for a single-family home that has been converted into a multifamily dwelling (more than three units) without a permit. According to the National Fire Data Center, “Cooking was, by far, the leading cause of all residential building fires and injuries.” (National 2013) If each unit has its own hot-plate or impromptu cooking area, an accident in one unit can spread quickly to all. This is exacerbated when minimum fire-safety elements required by the Building Code, such as: fire alarms (smoke detectors), egress windows, and minimum clearances around cooking areas, are not provided. Multifamily dwellings have additional safety requirements such as fire-rated corridors and fire-sprinklers that are typically not provided in illegal conversions.

This article suggests that the legal field’s interest in social norms, as a potentially more effective mechanism to shape behavior than law, should also be applied to the Building and Zoning Codes, especially in areas where officials find it difficult to enforce. This paper raises and interesting question: If homeowners use a legal loophole to make one Illegal Accessory Dwelling, then why aren’t they making two or more? The answer seems to be because one accessory is the social norm (Lau 2012) but also, because the City will not issue a permit for more than one accessory use per dwelling (Crispin 2004). If a City Inspector discovers multiple IADs in a single-family residence, the City will require alterations to revert the home back to single-family use. The potential massive loss of rental income and added rehab costs seem to be enough to deter such activity (Lau 2012). Such conversions are rare because it runs

against prevailing social norms and because such configurations cannot obtain a building permit. Therefore, Illegal Accessory Dwellings in Honolulu demonstrate that regulations can have greater effectiveness when they reinforce social norms.

## CONCLUSIONS + FURTHER RESEARCH

Considering that *all* of the Illegal Accessory Dwellings identified on the attached maps are not recognized as legal dwelling units, this research helps situate the nuances of the zoning code in the public discourse by providing maps and pictures. Armed with quantifiable information, lawmakers will be better informed to address public concerns and fears about change.

As GIS becomes an increasingly accessible and user friendly tool, it is being used to help understand the factors that drive urban phenomenon such as Illegal Accessory Dwellings. Such data also challenges assumptions of larger development trends in Honolulu and nationally. In Honolulu, the majority of new single and two-family dwellings are being built at the urban fringe. However, the pattern of Illegal Accessory Dwelling development shows that these units are typically built within the urban core that according to the City's Primary Urban Center development plan, is already built-out. This paper challenges that assumption.

As a study of a major metropolitan city<sup>1</sup>, this paper suggests that Illegal Accessory Dwellings are a major contributor of housing, contributing substantially to a shadow supply of housing. On a larger scale, this study draws into question the accuracy of the US Census. Are Illegal Accessory Dwellings being counted in the Census? This paper paves the way for a systematic method of counting Illegal Accessory Dwellings that can be compared against official housing production numbers.

It should be noted that while none of the Rec Rooms included using these search criteria have been verified as containing an illegal rental, it stands to reason that the physical configuration of the spaces are so conducive to its use as a separate rental unit, that at some point of the life of the structure, there is a high likelihood that it will illegally occupied. It should also be noted that some Rec Rooms do not have direct access to an exterior exit and are well integrated into the floor plan of their unit. It is this writer's experience that although such instances are rare, there are indeed homeowners that design the layout of their Rec Room in an integrated way, so that circulation ingress and egress paths overlap. As these integrated Rec Rooms are much harder to segregate and rent separately from the main house, they are not suspicious and thus not counted in this study.

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<sup>1</sup> Honolulu is currently just under 1 million residents and consequently has been excluded from studies comparing major cities in the US and the world. In a few years, this will change as Honolulu will soon surpass the 1 million population benchmark number in a few years.

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# State of the Art Methodology to Assess Energy Facade Retrofits (EFR)

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**ABSTRACT:** This paper summarizes findings from existing literature and proposes a methodology to assess facade retrofits. Literature review indicates that research on energy-based retrofits isolates limited factors and does not address the holistic benefits associated with facade retrofits. Many cases of energy upgrades in practice that included facade retrofit describe energy savings, but without any quantification of the facade contribution to those savings. In addition, current practice considers the facade as a last step in the process of energy upgrades, confined to being part of a 'deep' or 'comprehensive' intervention. This is primarily due to the higher initial costs of facade replacement or renovation. An extended understanding of facade retrofit from the perspective of related fields would help to establish a more comprehensive evaluation of its benefits. A proposed methodology to perform life cycle assessment of facade retrofits that are initiated with an energy-based systems retrofit is described in this paper. It recognizes the building skin as the key system in the total building performance. Total performance refers to energy, human and financial parameters. The different perspectives considered in the methodology include Building Science, Human Comfort, and Real Estate fields. Building Science is used to evaluate several energy retrofit alternatives and resulting energy reductions are obtained from energy simulations. A sensitivity analysis assists in evaluating and selecting the most beneficial input facade parameters. Human Comfort responses to environmental factors influenced by the facade are analyzed from existing literature and findings are used as reference. Real estate gains and losses are evaluated based on current market trends to appreciate the influence of facade improvements. A holistic methodology to evaluate overall building performance enhancements of facade retrofit could provide a paradigm shift in the importance of facade retrofit on our existing building stock.

**KEYWORDS:** Facade, Retrofit, Energy, Human factors, Costs.

## INTRODUCTION

Facades were a priority in the design of traditional architecture. They played an important role in the overall building performance prior to forced air and electric lighting. With the advent of economical energy use and the introduction of new building materials, facade designs transformed to aesthetic expressions with less concern about performance. With increased awareness due to an energy crisis in the 1970s, the facade once again was conceptualized as the building skin, becoming a key building system for environmental control. Adapted to specific climatic conditions, it acted as a filter for maximizing the use of free energy and human comfort (Fitch and Bobenhausen 1999). Paradoxically, during the same period, buildings were designed with facades that did not respond to that priority. Sealed glass boxes were developed everywhere under principles of modernity and progress and corporate symbolism. These buildings were inherited in our cities in the 21<sup>st</sup> century, and now a major target for energy reduction. Most of these buildings possess inefficient envelopes as major contributors to building energy waste. In our current scenario with uncertain energy prices, most of the energy challenges for the upcoming decades relies in the capacity of transforming existing inefficient buildings into high-performance ones.

Energy building retrofit is an emerging area of research. Within this area, very little is known about the development of high-performance facade retrofits from inefficient old ones. Even for new projects, technical references for assisting the design of high performance are scarce (Straube 2012, 2). A preconceived design is settled early in the process without tools to consider the full range of impacts on other performances, and systems are still often design sequentially instead of fully integrated. Consequently, facade interventions are usually based

on professional experience or relying on rules of thumb. Measurement and verification is infrequent, and if done, these results are not shared as public knowledge, (Warburton and Kostura 2007, Benson et al. 2011) limiting current and future informed decision making. Moreover, the energy retrofit market works in a 3-5 year payback period (Benson et al. 2011, 1), which makes HVAC and lighting systems the preferred replacements. Due to lower implementation costs than facade retrofits, quick savings on utility bills give more tangible and controlled risk. However, improvements on the energy efficiency of internal mechanical equipment do not reduce the energy flow through an inefficient skin. The owner sees a smaller energy bill but does not realize further energy reductions and other performance benefits of retrofitting the facade.

Facade retrofit is understood as any intervention (modification, addition) in the building facade with the goal of improving energy performance and/or indoor quality in an existing building. Facade retrofit can range from small repairs (weathering) to a total replacement of the original facade for a new system. Generally, the facade is included in what is known as a 'deep energy retrofit', which analyzes the building as a whole with the goal of achieving over 50% energy reduction (The American Institute of Architects and Rocky Mountain Institute 2013, 6).

## **1.0 EXISTING EVALUATION METHODS FOR FACADE RETROFITS**

A growing interest in energy performance has been centered on understanding existing buildings from a life-cycle perspective. Some studies have approached the topic from a global point of view of the challenges and opportunities of building energy upgrades, whereas others have focused on specific aspects. For example, research has centered on embodied or operational energy, costs of these interventions, or impact in several aspects of sustainability. Many studies in the area of energy building retrofit have focused on a variety of energy conservation measures (ECMs), such as lighting, Heating, Ventilation and Air Conditioning (HVAC) equipment replacement, incorporation of building controls, and changes in operations or energy generation. Some cases of facade retrofit have been included as just another alternative among these strategies.

Yet, studies focusing on the retrofit of the building envelope are limited. Qualitative studies have looked to map the challenges and opportunities that facade retrofit offers in practice (Patterson et al. 2012). Others investigate the appropriateness of strategies of facade intervention for specific building type or context (Brunoro 2008). Typologies of facade retrofits have been explored according to the magnitude of the intervention in the building. These range from repairs of the original facade to the full replacement (Sanguinetti 2012, 8-9, Patterson and Vaglio 2011). From a broad perspective of sustainability, studies have examined facade retrofit using life cycle assessment (LCA) (Ebbert 2010). Some of these studies include operational energy but many have explored other aspects, such as economic, urban, equity, ecological or social impacts.

### **1.1. Deterministic methods for evaluation of facade retrofits**

In deterministic methods, the results obtained in a model are directly defined by their initial input. In energy analysis, a common practice is to use engineering calculations for predicting future behavior based on physics. Some deterministic methods describe energy flow through the envelope statically (no time variation). Those steady-state calculations are performed for a selected set of rooms on the building with critical conditions, which are assessed under standard design conditions.

More advanced deterministic methods use dynamic simulation models to assist the evaluation of any prediction of the building performance based on spatial-temporal variations. Simulations are considered an important paradigm shift in the assistance of design processes for a faster and cheaper performance prediction before construction (Clarke 2001). Nowadays, hundreds of simulation tools are available with multiple capabilities. Some of them allow whole building analysis and consider load calculations, renewable energy, indoor air quality, ventilation, code compliance and more (US Department of Energy 2013). However, assessments using these tools are not routine in practice yet, not even for new design. If project budgets allow for them, the assessments may be incorporated later in the process, frequently when design decisions

have been made already (de Wilde 2004). In addition, fewer of these tools are dedicated to the study of the facade itself, so its analysis is embedded in whole energy analysis.

As part of the use of simulation, facade retrofits have been explored using calibrated energy models. They are extensive, since the goal is to obtain a closer representation of the behavior of the building under study. Because it is a complex procedure, calibration is addressed by some standards such as ASHRAE Guideline 14, International Performance Measurement and Verification Protocol (IPMVP), or the Federal Energy Management Program (FEMP). Some studies such as the one carried out by Güçyeter and Günaydın (2012) integrate envelope retrofit strategies (insulation) with renewable energy technology and climate control using a calibrated simulation model (EDSL software). That model is fed by data from one year of energy monitoring to analyze environmental parameters and annual energy of a campus building in Turkey (Güçyeter and Günaydın 2012). Martinez et al (2012) evaluates single and cumulative effects of facade retrofits on energy consumption using whole-building calibrated energy models (eQuest and Design Builder) for a commercial office building in Los Angeles (Martinez et al. 2012). Singh evaluates facade retrofit strategies among several ECMs intended to bring a building to zero net-energy status (Singh 2012).

Other studies have looked to existing energy simulation tools to evaluate different retrofit packages. NREL modified an existing energy simulation tool (BEopt) for evaluating retrofits of residential buildings from a life-cycle perspective (Polly et al. 2011). The study includes wall insulation and air seal among the alternatives. Ebbert (2010) explores facade retrofits in European office buildings using energy models (ESP-n) integrated in life cycle analysis (LCA). Rosenfeld et al (1999) proposes a computerized semi-automatic tool to assist decision-support for renovation projects (Rosenfeld and Shohet 1999).

### **1.2. Stochastic methods for evaluation of facade retrofits**

As an alternative to deterministic methods, some studies have assessed energy retrofit decisions incorporating stochastic models. In those approaches, random component selections represent the behavior of building performance. As is characteristic of stochastic models, multiple simulations using uncertain inputs and processes defined by appropriate probability distributions develop a range of probable outcomes. Asadi et al (2012) develops a simulation-based multi-objective optimization scheme (TRNSIS, GenOpt, Matlab) to include facade retrofit strategies for a residential building in Portugal (Asadi et al. 2012). Sanguinetti (2012) uses a statistical model to compare a series of energy retrofits with a traditional energy simulation for a residential building. With three performance parameters (environmental, delivery process and financial), she evaluates different combinations of new layers and infiltration control (Sanguinetti 2012).

Even though the facade is not considered within the strategies, Heo (2011) proposes a scalable and adaptable framework for analysis of building retrofits under uncertainty. The study covers physical properties, equipment performance, and costs. In a scalable method (individual building or portfolio), a normative model is calibrated using Bayesian theory and probabilistic analysis. This model assesses feasible ECMs to select the optimal mix of retrofit technologies in a modeling process described as transparent and easy to use (Heo 2011).

### **1.3. Financial evaluations of facade retrofits**

Several studies have indicated insufficient data and methods to assess investments on retrofits. Consequently, one of the many myths regarding sustainability is that any action for greening an existing building is not a worthwhile investment (Kubba 2012, 2). Investments in energy retrofits that do occur are commonly measured by single payback calculations. The payback method emphasizes initial costs of implementation, and only accounts for future energy savings as returns on the investment. It fails to integrate indirect benefits derived from improved facade performance. In addition, these calculations do not incorporate other factors such as interest rate, inflation, energy price fluctuation, happening overtime. To consider the facade as part of an energy retrofit, studies need to be framed on a period adequate for financial evaluation longer than the typically 3-5 year payback owners expect for retrofits that only upgrade internal systems. Many complexities appear with systems in the building that have different life spans. Studies have estimated those life spans: the structure could last the

whole life of a building, while equipment would be updated every 8-15 years (Kats 2003, 10). Some facade components need to be replaced every 20 years to maintain a longer overall lifespan for the facade system (Giebeler et al. 2005).

Life Cycle Cost (LCC) method has been used to serve decision analysis. It considers initial cost, actual initial savings, and persistence of savings over time. Some of these studies have included facade in the retrofit strategies have used different time periods for analysis: 20 years (Gilligan 2009, Sanguinetti 2012); 30 years (Kats 2003, 10, Polly et al. 2011); 50 years (Maleki 2009);. A recent modification of the California Energy Commission extended the evaluation time period of analysis from 25 to 30 years (California Energy Commission 2011). Financial analysis models should not only consider that facade retrofits extend the life of buildings, but also a series of other benefits.

Among other financial benefits of green buildings are higher rental and building values. A study found rental rates in green-certified buildings are roughly 3% higher per sq. ft. than otherwise identical buildings, and selling prices are about 16% higher (Eichholtz, Kok, and Quigley 2009), whereas a study also reports rents about 35% higher than other local properties (Northwest Energy Efficiency Alliance and National Buildings Institute 2011, 2). Another study found that certified buildings reported between 31-35% higher sales prices (Kubba 2012, 31-32). A survey in Seattle by the Building Owners and Managers Association (BOMA) reported that 61% of real estate owners believe green buildings enhance their corporate image and many of them believe that 'green' buildings will be a factor in the selection of a lease space in the short term (Kubba 2012, 3). A survey reported that green buildings have better financial performance compared to other similar buildings including higher building values, higher asking rents, higher return on investment and higher occupancy rates (Turner Construction 2010). A report analyzing LEED buildings suggests that the greener the buildings, the longer their lifespans are compared to conventional buildings (conventional Certified building: 40 yrs; Silver: 60 yrs; Gold: 80 yrs; Platinum: 100 yrs ) (Kubba 2012).

#### **1.4. Integrating human value**

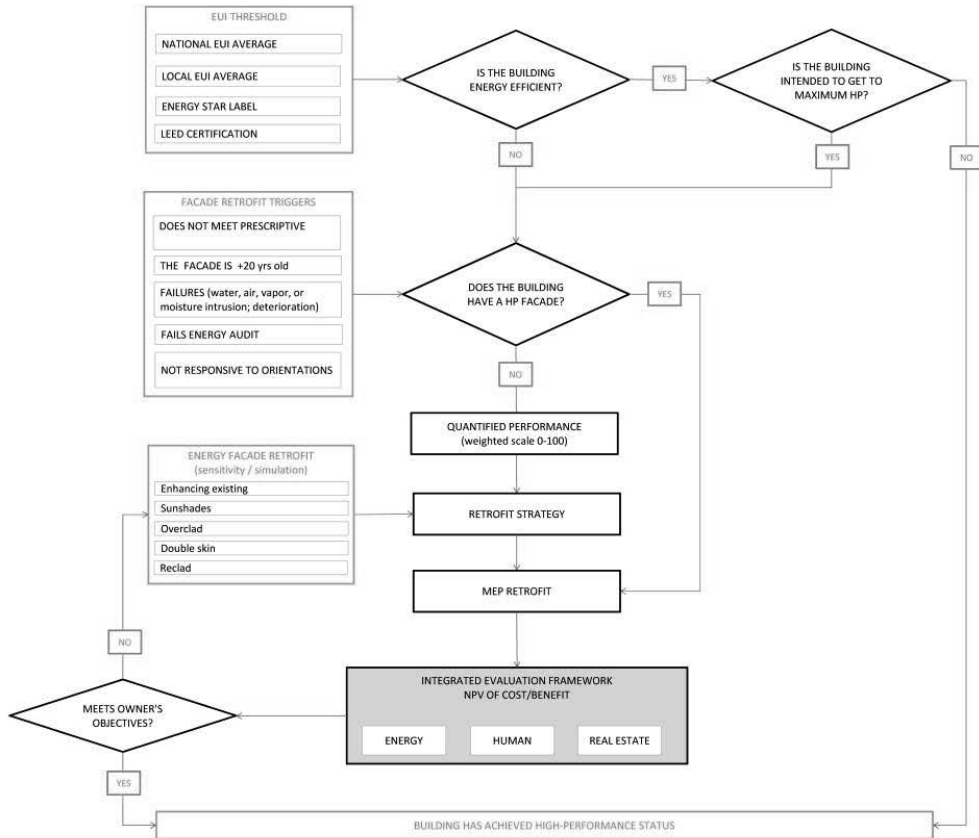
Over the last few years, the importance of the connection of human comfort to the concept of sustainability has been brought to the foreground. Americans spend 80-90% of their time indoors (US Department of Labor 2013). Concepts such as the Sick Building Syndrome (SBS), Building Related Illness (BRI), and Multiple Chemical Sensitivity (MCS) are consequences of poor indoor quality, generally detected in enclosed, mechanically-conditioned spaces. As a direct influence on indoor environmental quality, a proposed facade intervention must evaluate restoring ventilation and lighting levels that will favour human comfort. However, considering human parameters for evaluation under quantifiable criteria is a complex task. The nature of thermal comfort derives from subjective evaluations (Carlucci 2013, v). Several other human factors are influenced by facade retrofit- noise, glare, daylight availability, visual contact with the outside environment and other factors can all be influenced by facade in working environments. Not only listed as one of the reasons by doing retrofits, the cost of people is highlighted by several studies. Analysis focusing on office building costs shows that the cost of employees is 72 times the cost of energy (Zobec, Colombari, and Kragh 2001); or the costs of California's State employees as 10 times the cost of property (Kats 2003, 54). Current research recognizes that strategies to maximize occupants wellbeing would quickly offset the costs of implementing well-done energy retrofits (Zobec, Colombari, and Kragh 2001, citing Romm and Browning 1998).

## **2.0. A PROPOSED METHODOLOGY**

An integrated approach, rather than energy-based evaluation that is commonly done with simple payback, would allow visualizing a range of usually hidden benefits. This method is intended to demonstrate that implementing a facade retrofit could yield a net gain that a single payback approach accounting only for energy savings does not assess. Even though energy and economic performances have been integrated in life cycle context, the integration of so called 'soft benefits' is less explored. These benefits are usually described qualitatively, since they are highly complex to quantify and lack empirical data. Some of these benefits are improved human comfort, urban regeneration, improved corporate image, enhanced historical value, and increase curb appeal. This paper recognizes that facades have a direct



relation with indoor quality and real estate, and uses previous researcher's estimations in these areas.



**Figure 1.** Methodology for assessing energy facade retrofits

The general framework is described in Figure 1. The methodology starts with the evaluation of benchmarking the building Energy Use Intensity (EUI) to some of the commonly used thresholds in practice. Facade evaluation is assessed when the building does not meet these energy performance levels, or the building is intended to achieve a higher performance status. In this methodology, a high performance facade is understood as one that at least achieves high levels of adaptation to climate, orientation, durability (related to age and maintenance) and code compliance. Buildings with deficient facades then follow a quantification of that performance that would determine an appropriate level of retrofit, which could be assisted by energy simulation. Once the best strategy of retrofit is predicted, it must study the synergies with internal systems such as HVAC and lighting.

The evaluation is based on cost-benefit analysis, which accounts for positive and negative consequences of a facade retrofit in monetary terms (Figure 2). Benefits are classified as direct, indirect and intangible (CDC 2013). Direct benefits are evaluated in terms of savings on operational energy. For example, daylighting strategies reduce artificial light when coupled with photo sensors; as including passive strategies, the need for mechanical systems for internal conditioning is reduced. Indirect benefits are gains related to employee costs, such as reduced absenteeism and turnover that are a result of better indoor environment quality. Indirect benefits related to real estate include the increased value on rents or in the value of the building due to the improved status of the building performance.

A timeframe is needed to identify the occurrence of different money flows at different times. A high initial cost is considered in the implementation phase. The operational phase is representative of the life cycle of the renovated facade. This duration will depend on the type of retrofit being evaluated (film in windows have a shorter lifespan than a total new facade).

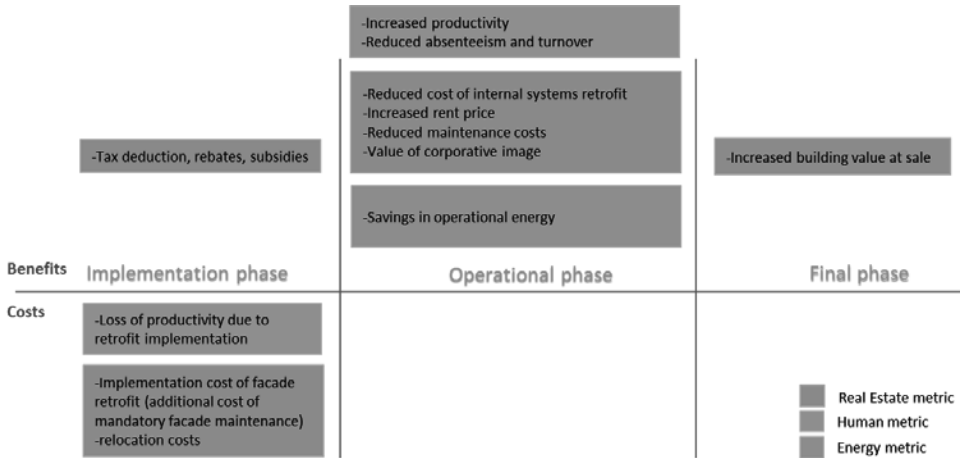


Figure 2. Cost and Benefit diagram and performance metrics

### 3.0. EXAMPLE-TESTING METHOD

The proposed methodology is tested in two existing office buildings in L.A. and compared with the common practiced payback period. Building-1 has received only maintenance, while Building-2 had a total facade retrofit in 2009. These buildings allow a comparison of predicted energy performance with real measured results for facade retrofits. The measured data in the first case is used to build the baseline for simulations.

**Case Building-1 (simulated facade retrofit):** Built in 1972, the building is 18,506m<sup>2</sup> (199,199ft<sup>2</sup>) over 12 stories. The building maintains its original curtain wall facade, with vertical bands of 6.35mm (¼”) single pane glass (clear glass in vision areas and tinted in spandrel) mounted in black neoprene in a non-thermal broken aluminum frame that are engaged in painted steel columns. Drawings show 25mm (1”) insulation with no specification of the material. At some point in the past, a reflective solar film was added to the glass. The Window Wall Ratio (WWR) is less than 30%. The building obtained EnergyStar status in 2009. The building housed 531 office employees in 2010.

**Case Building-2 (real facade retrofit):** Built in 1973, the 9,964m<sup>2</sup> (108,300ft<sup>2</sup>), 6-story building, received a total facade renovation in 2009. The building was gutted to its structural frame and mechanical system. The single tinted paned curtain wall facade was replaced for low-E insulated glass. The new facade is a good solution responding to orientation and integrating interior sunshades. Interior finishing and lighting renovation were done at the time of the facade. In addition, the building grew 93 m<sup>2</sup> (1,000 ft<sup>2</sup>) in the renovation due to extensions of the concrete slabs that also provide some solar shading. The facade retrofit was reported to have a cost of \$1450/m<sup>2</sup> (\$135/ft<sup>2</sup>).

Average energy consumption for large office buildings (>= 2787m<sup>2</sup> (30,000ft<sup>2</sup>)) in Los Angeles area is 262KWh/m2yr (82.3KBtu/ft<sup>2</sup>yr) (California Energy Commission 2006, 8). Both building perform better than average; Building-1 with a EUI of 150KWh/m2yr and a predicted energy reduction of 19% based on energy simulation. Building-2 has a EUI of 222KWh/m2yr and 30% energy reduction (assumed a typical energy use before the facade retrofit).

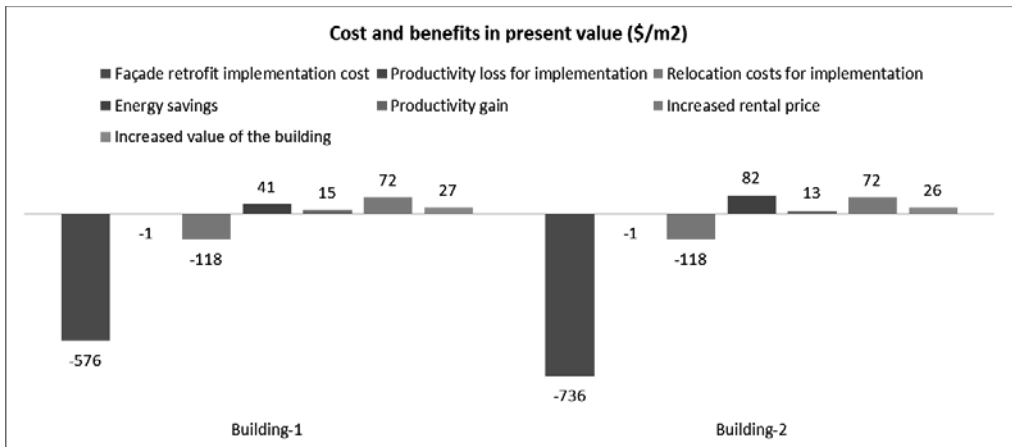
**3.1. Parameters and assumptions**

Existing literature and average values for the Los Angeles area serve as a basis for the method in data that has not been obtained by measurement or existing documentation. Parameters and conservative assumptions for the calculation of the costs and benefits for both buildings are detailed by performance area (Table 1). The period used to estimate future benefits and cost is 20 years

**Table 1:** Parameters and assumptions

<i>Item</i>		<i>Value used analysis</i>
<i>Period of analysis</i>		20yrs
<i>Discount rate</i>		10%
<i>Cap rate</i>		7%
<i>Implementation time</i>		5 months
<i>Energy</i>		
<i>Total Energy savings after retrofit</i>	<i>Building-1 predicted (energy simulation)</i>	19%
	<i>Building-2 reported (monthly bills)</i>	31%
<i>Energy prices (no escalation)</i>	<i>(US Bureau of Labor Statistics 2013a)Electricity</i>	0.203 \$/KWh
	<i>(US Bureau of Labor Statistics 2013a)Nat. gas</i>	1.23 \$/therm
<i>Human</i>		
<i>Salaries(weekly)</i>	<i>(US Bureau of Labor Statistics 2013b)</i>	\$1,185
<i>Productivity gain / loss</i>	<i>15% increase to work dedication (Figueiro 2002)</i>	5%
	<i>Up to 15% in offices (Loftness et al. 2003)</i>	
<i>Real estate</i>		
<i>Implementation cost of EFR</i>	<i>Bldg-1 estimated</i>	\$100 / m2
	<i>Bldg-2 reported cost</i>	\$135 / m2
<i>Rent price</i>	<i>(Loopnet Inc 2013)</i>	283
<i>Increased rent price</i>	<i>3% higher (Eichholtz, Kok, and Quigley 2009)</i>	3%
	<i>35%higher(NEEA +NBI 2011)</i>	
<i>NOI</i>	<i>Increased rents (-)energy use (+)energy savings</i>	---
<i>Building increased value</i>	<i>31-35% higher sales prices(Kubba 2012)</i>	5%
	<i>16% higher (Eichholtz, Kok, and Quigley 2009)</i>	
<i>Building gained area</i>	<i>Reported for Building-2</i>	92.9m2(1000sf)

The value of the building at sale is estimated on year 20 and calculated based on the Net Operative Income/ cap rate. An increased on 5% is estimated over that value due only to the facade improvement.



**Figure 3.** Comparative and benefits in present value (dollars/m<sup>2</sup>)

**Table 2:** Comparison between single payback and proposed method.

Stakeholder	Building-1	Building-2
<b>Traditional single pay-back</b>	<b>120 yrs</b>	<b>76 yrs</b>
	\$5	\$10
	\$576	\$736
<b>Proposed method</b>		
<u>Owner (leased building)</u>	<b>5.8 yrs</b>	<b>7.5 yrs</b>
benefit: (increased rent + building add value)	\$99	\$98
cost: (implementation EFR)	\$576	\$736
<u>Tenant</u>	<b>1.3 yrs</b>	<b>0.8 yrs</b>
benefit:(productivity gains + energy savings)	\$56	\$95
cost:(increased rent price + productivity loss)	\$73	\$73
<u>Owner (occupied by owner)</u>	<b>8.4 yrs</b>	<b>7.1 yrs</b>
benefit:(energy savings +productivity gains +building add value)	\$83	\$121
cost:(implementation FR +relocation +productivity loss)	\$695	\$855

From an owner's perspective, there is an estimate of at least 10 times between the traditional payback and the proposed method for both buildings. Considering more than energy in the evaluation allows an increased awareness and understanding of why these are valid benefits to include in a financial analysis when considering the initial investment of retrofitting the facade. Even though this method requires more research and quantification, the range of the adjusted payback years in these studies shows that different stakeholders might consider investing in façade retrofit. Further research needs to find the best ways to quantify all the soft benefits considered here from previous references.

## CONCLUSION

This paper proposes an integrated methodology for facade retrofit evaluation, recognizing adjacent fields to architecture. The synergetic approach includes areas that contemplate human and real estate performance criteria in addition to energy performance. The associated research summarized in this paper helps to understand and appreciate the complex interactions in facade retrofit decisions.

The method described in this paper evaluates the costs and benefits of the facade retrofit including areas that are not usually visualized to define the convenience over a limited method used in practice. The method keeps the decision making process open to the richness of interactions, avoiding premature concentration only on initial costs, and allows quantitative consideration of non-energy impacts (such as occupants or building increased value) earlier in

the decision process. It incorporates the costs of people under conservative assumptions for increased productivity and the value of the building as extended benefits of energy savings. Extending the period of analysis to 20 years allows these future benefits to be compared to present values. This analysis resulted with an adjusted payback period of less than 5 years when considering all the benefits for both cases than resulted with paybacks of 120 and 76 years using the simple payback method.

This paper recognizes the urgent need for more shared data about building performance to gain a better understanding of the real impacts of facade retrofit. Future work needs to test this methodology with real data for all the performance measures mentioned. Even though actual data is collected (commissioning of new systems, utility bills, sick days, etc.), it is hardly accessible due to the proprietary nature of retrofit designs. Further sources such as post occupancy data from existing retrofitted buildings could help in the foundation of a platform of knowledge for future existing buildings energy interventions. A great opportunity exists in exploring how a facade retrofit affects the building value and how that affects the depreciation of the building. Moreover, optimum facade retrofit solutions and opportunity costs could be determined to help building owners make more informed decisions about energy reductions.

## ACKNOWLEDGEMENTS

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# 490: Modular Housing in Hawai'i

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**ABSTRACT:** This paper is jointly presented by a faculty member, a practicing architect, and selected students enrolled in a Spring 2013 undergraduate professional practice elective course to examine learning results of professional practice design processes coupled with academic research.

In Hawai'i, fair market rent for a two bedroom apartment is \$1,671—the highest in the nation. To afford this level of rent (without paying more than 30% of income on housing—the threshold for “affordable” housing), a household must earn \$66,853 annually.

Statistics such as the above cited by Hawaii Appleseed Center for Law and Economic Justice in their paper “Barriers to Affordable Housing and New Models” inspired students to research modular housing options applicable to their own age group.

The collaborative teaching sought to provide a genuine understanding of how architecture can affect each student's lifestyle and future job viability while also instilling the realization that architecture students can provide creative proposals for real life solutions. Student learning activities included

- Team investigation and reporting
- Regularly scheduled discussions with a practicing architect
- RFQ/RFP document development
- Case study research on modular housing
- Interaction with invited reviewers, panelists and lecturers, a development company engineer, the Building Industry Association of Hawai'i president, a housing construction Real Estate Consultant, Hawaiian Home Lands representative, local architects and interns.

The debate will include assessment of student learning successes relative to the emphasis on superior performance and goals to exceed the imagination and relevancy of normal architecture education through interaction with community leaders.

A highlight of the discussion will be one student team's modular unit design. The ultimate goal is to discover how academic design research that includes interdisciplinary collaborations beyond traditional architecture practice education modes can result in inspired student proposals for innovative paradigms that respond effectively to changing societal needs.

**KEYWORDS:** Methods, Changing Paradigm, Interdisciplinary Collaboration

## INTRODUCTION

Collaborative partnerships between students and professionals were made possible through an elective seminar course. Professional participants were primarily board members of Housing Hawaii, a non-profit corporation created “to advocate for affordable rental and for sale housing in Hawai'i.” The group, founded in 2005, includes representatives from the non-profit development community, private developers, government officials, housing and homeless service providers, self-help housing developers, labor and business leaders. Since then Housing Hawai'i has sponsored several conferences to increase public awareness of the housing crisis which resulted in formation of an Affordable Housing Regulatory Barriers Task Force” to identify barriers that lead to increasing costs of developing housing in Hawai'i.

Architecture 490 students were tasked with researching and presenting alternative modular housing designs in search of a new paradigm to reduce housing development costs. This paper includes one team's design described in detail in section 2.0.

### **1.0. The Hawaii Affordable Housing Crisis: The Architect's Reflections**

Lack of available affordable housing significantly impacts students and others in their income level negatively. The average median home price in Hawaii is \$600,000. This places the majority of homes out of reach of the entry level salaries in the architectural profession. Per Hawaii Appleseed Center for Law and Economic Justice, "Additional symptoms of a crisis for lower income residents include:

- 73% of extremely low income people (under 30% of area median income) pay more than half of their income in shelter costs.
- Hawaii has the highest rate of homelessness among the states, with almost 14,000 people receiving homeless services annually.
- We need 13,000 units by 2016 for households earning less than 50% of the area median income. "

This shortage of affordable homes for students contributes to young professionals moving away from Hawai'i causing a "Brain Drain" condition in Hawai'i.

For those young professionals choosing to remain, it is extremely difficult to sustain a good quality of life. They typically spend more than half of their income on housing rental costs and must share their living space with others with the same dilemma. This condition can be an opportunity for architects to use their creative minds to offer a new approach for housing design.

#### **1.0.1. Arch 490 Modular Housing**

The design and planning initiative for this class was to research how innovative modular construction technology used for housing can become a partial solution to lowering housing construction costs thereby lowering housing costs.

#### **1.0.2. Agents of Change Approach**

Architects are trained to be problem solvers. This aspect of creative design should be maximized in architecture curricula and utilized as a tool to shift the paradigm of minimum housing standards to one of efficient space/materials use. In addition, effective civic leadership skills are critical aspects that the profession should utilize to impact perceptions of space needs for the community at large. Civic leadership is currently not taught in architecture programs. Students should be inspired to become "agents of change" who consistently push the boundaries of design creativity as leaders to achieve affordable housing innovations by educating the public and producing innovative housing designs.

#### **1.0.3. A Collaborative Teaching Process**

Students were exposed to practice methods and resources to expand student awareness of the realities of professional practice. Responsibilities emphasized were: 1) Architecture Can Affect Lifestyle, 2) Architecture Can Affect Future Job Viability, 3) Architecture Students Can Provide Creative Real Life Solutions.

#### **1.0.4. Research and the Case Study Method**

Research via web, library, and periodical searches was essential to explore existing examples of modular construction used in the development of housing. Case studies of modular designs were prepared by student teams to provide detailed understanding of the realities of housing design cost including real-life design challenges and viewpoints of housing industry experts and client expectations. Examples of the research include:



- 1.0.4.1 Portland SRO Housing: "Freedom Center Project" (Portland) 150 units; and "Apodments" (Seattle) 60 units: examples of small studio and 1 bedroom units that average between 100 to 230 SF. While built as market housing these units offer a shift to micro units that include modular construction at lower construction costs. Both Pacific Northwest projects are located in the urban core.
- 1.0.4.2 Container Housing: (20 ft. x 40 ft. modules) reuses normal shipping containers as the basic module to construct multi-family structures. These have been marketed as effective examples of adaptive re-use to create small multi-family housing buildings that can be stacked and retrofitted with housing finishes and fixtures. While in Hawai'i containers are commonly used as temporary construction field offices or classrooms they can be expanded easily as options for inexpensive housing. The design challenge is the livability of the housing to minimize the industrial character of the modules.
- 1.0.4.3 *My Micro NY*, a housing project by design firm *n ARCHITECTS*, was the winning program of New York Mayor Bloomberg's New Housing Marketplace Plan competition, adAPT NYC. The design of *n ARCHITECTS* followed many of the objectives that one team's project aimed to fulfill, providing a marketable and desirable residence that would also meet affordable housing needs. As requested in the RFP by the New York City Department of Housing Preservation and Development (HPD), the apartment is a mixed-use building that provides innovative design that "facilitates the development of functional and affordable Micro-units." The NYC project is built with prefabricated building modules, each unit only 270 to 350 square feet. The space is broken down into two elements – the "toolbox" and the "canvas". The "toolbox" contains a tenant's needs for living, including a kitchen, bathroom, and storage. The "canvas" provides the resident an open space for personalization. The apartment building also included a 1,200 square feet "flexible creative space" on the ground floor as an outlet for residents to be used for rehearsals, performances, or cultural activities. The space activated the pedestrian street" to create a connection with the local community.
- My Micro NY* is an example of an affordable housing micro-unit development that could be integrated into a dense living environment. Concurrently, the case study also is a model of an architectural *program* rather than an architectural project. Issues of community development, creative flexibility, and affordable living became the foundation for one team's investigation into the role and influence of affordable housing.

### 1.0.5 Networking

Perhaps the most valued activity for the students was the opportunity to network and learn from relevant private industry experts in housing development. Subject matter experts were invited every two weeks to conduct lectures and provide feedback on the modular affordable housing strategies pursued by the student teams. Housing Industry Experts included but were not limited to:

- 1.0.5.1 Real Estate Consultant who provided market advice of how the consumers would view market level modular housing. The discussion with the Consultant included advice on the key housing features that are deemed most desirable by potential homeowners.
- 1.0.5.2 Affordable and Rental Housing Developers provided background information on the challenges the housing industry faces with reduced subsidies for affordable units. In addition sharing the economic funding complexity of development of affordable housing projects gave students insights into the reality of regulatory restrictions and funding aspects not available through textbook assignments.
- 1.0.5.3 Hawaiian Homelands Representative and Architects with the School of Architecture provided their approach to a modular housing development prototype that achieves a sustainable modular home. The intent of the project design to provide a culturally relevant home for a local market while maximizing modular structural components provided a "real time" example for students.

### 1.0.6. Expert Critics

A culmination for the class was the opportunity to present their case study findings and design proposals to a panel of the industry experts who were involved throughout the semester. Summary comments and learning highlights Included

- 1.0.6.1 Initial steps toward identifying opportunities for Hawai'i to implement the innovative modular housing design ideas as a means to reduce housing costs.
- 1.0.6.2 Students' expressed some knowledge of and fresh appreciation for the challenges of the regulatory barriers obstructing housing development,
- 1.0.6.3 Students' changing views regarding negative perception of affordable housing, high construction cost and high cost land development.
- 1.0.6.4 The students gained valuable personal perspective on the real problem of the housing crisis in Hawaii in addition to gaining a perspective of the challenges for affordable housing developments.

### 2.0. One Student Team's Proposal

Shipping containers, or *inter-model steel building units (ISBU)*, were chosen as the core construction material for Team *690 builds'* housing project. Traditionally used as storage units, ISBUs are made of Corten steel, a weathered material highly resistant to atmospheric corrosion, making it ideal for Hawai'i living conditions. Once their value has been exhausted as storage units, they can be reused for housing. A predominant trait of ISBUs is their prefabrication. Since containers are already built, the construction of residential units is completed quickly with fewer materials and savings in labor costs. Containers are also adaptive and can reflect the needs of residences due to their dimension proportions making new additions to existing housing complexes simple. In the case that building height restrictions change due to edits made to zoning codes, containers may be easily added to a building to create more stories. Containers are designed with a simple skeleton-and-skin system to make modification effortless.

One of the challenges addressed was the marketability of shipping containers due to their relative newness to the residential market. Developers express concerns regarding aesthetics and comfort. Customization and contemporary aesthetics proved to be quick solutions to these concerns but challenges with image remain.

When does housing become more than just housing? *690 build* became our rhetorical architecture proposal to meet affordable housing needs as well as acting as an economic catalyst for Hawai'i. Paralleling the intentions of the New York City HPD, *690 build* was designed to tackle *affordability, marketability, and social activism*.

Parameters for the modular design project were established early on:

- High land values in Hawai'i equate to high housing costs.
- Units are not restricted to residential use only. Versatility in modular units would allow options for private and public use.
- Connectors used to attach units should follow a similar modular design to keep production time and costs low.
- Units should be transportable if components are to be prefabricated.
- Redundancy in unit design needs to be addressed to keep project desirable to prospective tenants.

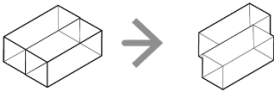


Figure 1: Offset

Each unit of *690 build* is intended to be flexible in program - as a residential unit, an office, a bicycle storage facility, or an event space – in order to fit the needs of the developer and the community. A single unit is constructed out of two prefabricated ISBUs that are offset in order to provide additional living space and compensate for furring of interior walls (Figure 1). All exterior surfaces are exposed and left untouched for additions, such as green walls or retractable partitions. The skeletal steel framing of each container replaces any need for support posts and beams due to its short width and offset design.

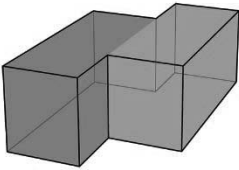


Figure 2: Residential unit

The residential unit is a two-part program: living/dining and bathroom/kitchen (Figure 2). The living/dining area includes sleeping quarters and entertainment space. The bathroom/kitchen area contains plumbing infrastructure. Units are to be organized in order to optimize outdoor spaces in order to compensate for small interiors (Figure 4). Figure 5 shows an example of what *690 build* could look like.

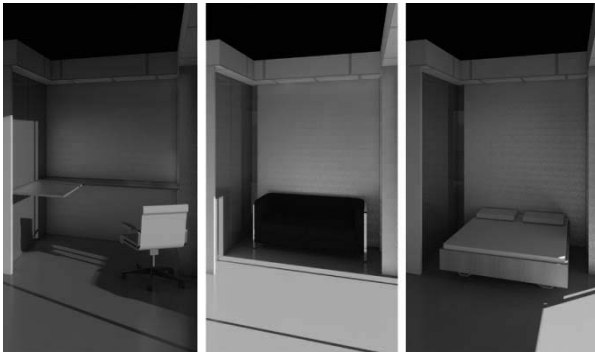


Figure 3: Modular furniture

The challenge of micro-housing designs is the utilization of small spaces. Furniture proposed for these units will be modular, multi-purposed, and built-in, in order to make the most of interior spaces. Figure 3 shows how one space can contain a bed, a sofa, and a desk.

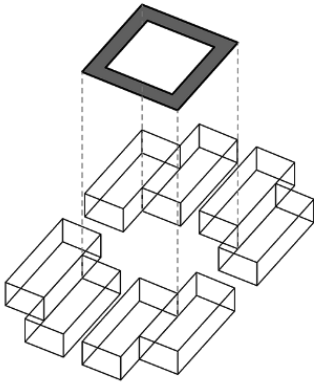


Figure 4: Courtyard



Figure 5: Concept rendering

Units are organized to optimize outdoor spaces which compensate for small interiors (Figure 4). Figure 5 shows an example of what *690 build* could look like.

### 2.0.2. Affordability

With every opportunity for a new paradigm comes expected responsibility. The current construction field is simmering with a lackluster job market for builders and architects. *690 build* provides an opportunity for work, directly and indirectly. The student team's goal is to have their proposal become a catalyst for various project types beyond residences. Aside from the accessibility of materials and smart use of technology and construction methods, *690 build* could be new paradigm for architecture practice.

### 2.0.3. Marketability

Affordable housing has traditionally been associated with construction projects that have never been attractive or welcoming, in areas that were not necessarily places that encouraged community. Housing creates a synergetic relationship between its users and the immediate areas – community reflects housing and housing reflects community. If *690 build* is able to transform the way “affordable housing” is perceived to the public this type of housing program can be a model for creative housing projects and fill the critical need for housing in Hawai'i.

### 2.0.4. Social Activism

A residence cannot exist without a community. The people living in these homes are not just consumers, they are citizens with jobs, families, and goals. When is housing more than housing? *690 build* provides opportunities for its residences to meet and connect, and also to give back to their community. When an individual becomes responsible for things beyond their home, a sense of pride is attained and pride can last beyond the lifespan of a residence.

### 2.0.5 Policies

Alongside the *690 Build* project was a proposal for policies to be implemented in residential projects. These policies have been produced in an effort to (1) keep costs consistent, (2) create a socially resilient class of residents, and (3) keep communality a priority.

### 2.0.5.1 Residential Eligibility

Eligibility requirements are intended to keep housing affordable. *690 build* is intended to be short-term housing and provide professional opportunity for residences. Prospective residents must meet the following requirements:

- a. Be 20 - 40 years old.
- b. Be currently employed (self-employment allowed).
- c. Fall into a salary bracket of less than \$50,000 annually.
- d. Work within a 5 mile radius of housing site.

### 2.0.5.2 Types of Units

*690 build* is comprised of one unit type with a flexible interior that can be customized to create a personalized home or a business space that meets its owner's needs. The interior will consist of modular units available to the owner. Units used for "business" will be restricted to availability. One business unit will be available for every three residential units.

### 2.0.5.3 Pricing

In an effort to keep housing costs low, they will be subsidized by the leasing of business units. Residences of the *690 build* community will have priority rights for these units but they will not cost the same as the residential units. Keeping these leasing costs high allows for internal community cash flow to keep housing prices low.

The costs of these units will be targeted specifically for local residences. Prices are to be lowered by 30% for *690 build* residences. Other businesses whose owners do not live in the *690 build* community will be required to pay full price.

### 2.0.5.4 Co-operative Living

A co-operative living program is to be implemented and enforced by federal aid. Residents of the *690 build* community are to join small co-operative groups that contribute to the housing development. For example, within the *690 build* community, there will be a bicycle storage facility available, free for residences. Residences who are a part of the bicycle co-op will be responsible for maintaining the bicycle facilities, a requirement for all residents.

## 2.0.6. Student Reflections on the Course

Modular housing as a solution to rising living costs and dwindling housing options surpasses aesthetic innovation and requires a comprehensive understanding of Hawai'i's socio-economic community with an interdisciplinary approach. As opposed to a traditional architectural design course, the organization of *490 Modular Housing* helped decipher the complicated process required to produce a successful housing program as a response to said concerns. Case studies, construction systems, material research, Request for Proposal (RFP)/Request for Qualifications (RFQ) writing, business strategy and marketing/branding, housing policy, and land-use were topics included in the development of an affordable housing program. These categories contribute to a complicated network of architectural problem solving that mimics a real-life scenario. Student practice and production in the course extended into the professional realm and provided opportunity for personal growth in skills such as presentation, speaking, and writing.

The weekly class was divided into sessions where every couple of weeks, students would present their RFP/RFQ and housing program to a new panel of professionals. This weekly reiteration was an opportunity to practice skills in presentation and make necessary edits as needed, identified by the professionals. As students of architecture, the project began with a formal design approach to solving housing concerns. By exposing the project to people of multiple disciplinary fields of work, the housing proposal was able to develop in a manner that could tackle problems that may have been originally overlooked. Reviews helped mold the housing program as a solution for affordable housing and exposed students to realistic complications associated with the project.

As the course progressed and more professionals reviewed the project, the data and research conducted became tangible and probable. The statistics found regarding housing availability and average incomes for young adults was, realistically, a reflection of students' future and the housing situation they would soon encounter. It no longer became a study of housing availability, but rather, a case of Hawai'i's real estate market, job economy, and community values.

### **2.0.7. Role of the Student and the Professional**

The 490 Modular Housing course provided what many other courses normally are unable to offer: exposure. The interaction between students and professionals provided exposure to new perspectives of a design challenge. Our role as students provide us the liberty of distancing ourselves from the difficulties of construction and related legalities; and in doing so, an architectural project can be transformed into an innovative reconfiguration of social and societal needs. Working with interdisciplinary professionals from different fields provided insight into the varying facets of the design project that eventually transformed what the project originally intended to be. It was no longer a post-and-lintel project but rather a public program.

Students are able to provide insight into urban solutions because they are able to dismiss context. In the case of 490 Modular Housing, the course began with an open-ended proposal in an effort to resolve housing concerns without restriction or expectation, other than it being a form of modular design in Hawai'i. Early project designs, evidently, began as unfeasible and premature but were new and innovative. The advice and review of professionals acted as guidelines to narrow down these design solutions that otherwise may have strayed away from conceivable application. With the help of these professionals, students were able to take big ideas and turn them into plausible solutions. It became important not only for the students to produce appropriate, detailed background research into the housing market and other related topics, but that they also develop a camaraderie with said professionals to fully utilize their expertise and improve communicative relationships during the little time shared between both parties.

### **3.0. SUMMARY**

The Arch 490 Modular Housing course is one of a series of professional practice courses specifically developed to provide students with out of the box learning opportunities by challenging them to apply innovative thinking to real world problems. Positive discoveries are encouraged by professionals who are leaders in their fields eager to interact with and nurture young minds.

Key to the success of such interaction is the relationship between the practicing professional and the teaching faculty which is founded on multiple amenities such as:

- The culture of collaboration instilled as a responsibility to serve family, community, and environment with aloha
- The UHM School of Architecture as the only architecture school in the region is **the** source of design knowledge dissemination attracting students from the Asia Pacific region
- The culture and climate of Hawai'i appealing to a majority of the graduates to practice within the islands
- The University of Hawai'i at Mānoa's aspirations and commitment to provide global leadership

The resultant network strength and diversity of partnerships within all sectors-business, professional, and government makes courses such as Arch 490 not only possible but essential to provide exceptional design solutions for challenges like the affordable housing crisis. The largest resultant costs are the multiple volunteer hours provided by the professional participants and the jeopardy that the energy expended by all will be filed away, never to be pursued as credible solutions. It is the architect-educator's responsibility to seek funding to implement the creative ideas uncovered.

## ACKNOWLEDGEMENTS

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# Hand to Mouse: Integrated Technology Laboratory in Undergraduate Architectural Education

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**ABSTRACT:** The undergraduate building technology sequence (uBTS) seeks to impart a broad understanding of environmental systems through a variety of research and simulation techniques including direct observation, traditional calculations and scientific method, and advanced modeling and evaluation software. The integration of the uBTS sequence with studio project work and engagement with the larger inter-institutional research efforts encourages strong student engagement and early mastery of advanced skills. This paper will discuss the above general themes through specific laboratory case studies which are tied to key points in the three year uBTS.

**KEYWORDS:** digital analysis, design integration, engagement, building performance simulation, building technology education

## INTRODUCTION

The undergraduate building technology sequence (uBTS) seeks to impart a broad understanding of environmental systems through a variety of research and simulation techniques including direct observation, traditional hand calculations and scientific method, and increasingly through advanced modeling and evaluation software. The integration of the uBTS sequence with studio project work and engagement with larger inter-institutional research efforts encourages strong student engagement and early mastery of advanced skills. This paper will discuss the above general themes through specific laboratory case studies which are tied to key points in the three year uBTS.

### 1.0 CASE 1: MULTI-INSTITUTIONAL RESEARCH WITH BEGINNING DESIGN STUDENTS

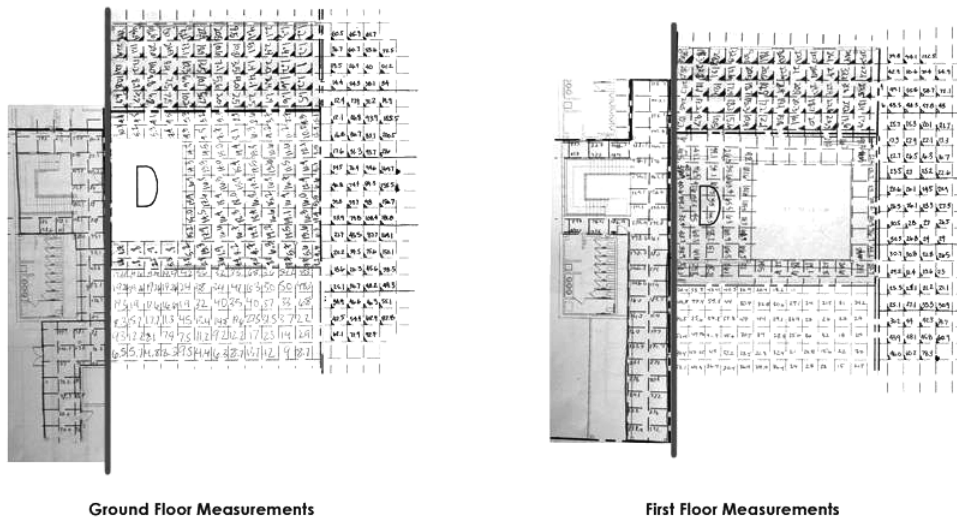
The building systems faculty members were invited to participate in LORAX, a multi-institution research project, to improve the DIVA plug-in to the Rhinoceros modeling program (Reinhart, 2012). Participation in the project involved several stages, some of which were specifically targeted towards beginning design students. The student participation for this project was completed during a one hour laboratory section when the students were in their first five weeks of a Bachelors of Architecture program. The course was the students' first exposure to quantitative research, and the tools used in architectural building science.



**Figure 1:** Student assessment of daylit areas for ground floor and first floor. Source: (Liu, 2012)



Students' initial tasks required them to make qualitative observations of daylight for a large, open classroom building and record those in a hand drawn plan drawing. These observations were followed by the gathering of quantitative measurements with light meters. Measurements were taken in foot candles at 30" above the floor in a precise five foot grid. The measurements were taken for the entire two story, 22,000 square foot studio spaces and hand-recorded on grid-lined plans provided by the faculty. Due to the size of the spaces and the time limitations of the course, students worked in groups to take measurements for one zone. Following the class period, students collaborated with other groups to combine the measurements from their zones with the other zones to create full plans for both floors. Students then compared their initial qualitative observations with the quantitative maps and analyzed both to find any areas of inconsistency. An additional request added to the lab by faculty members requested that the students propose design solutions to modify the existing building to improve daylighting in areas that were underserved according to the measurements gathered in the laboratory.



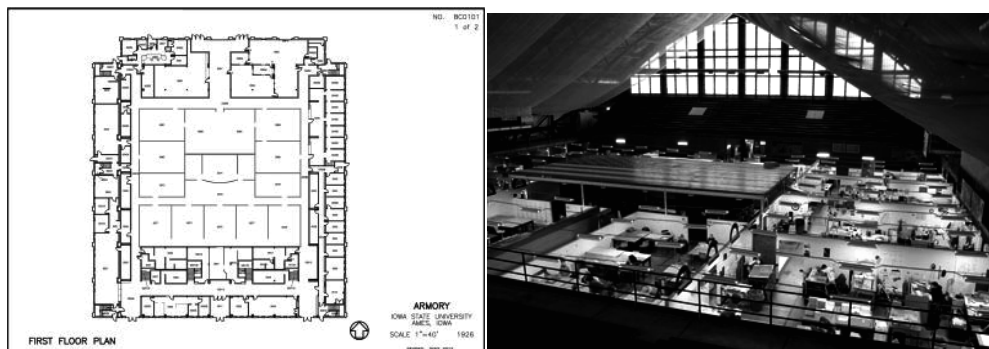
**Figure 2:** Student measurements in foot candles for ground floor and first floor. Source: (Romero, 2012)

The format and content of the study increased student interest in a few distinct ways. The students' portion of the work was used in conjunction with similar efforts by numerous universities in North America, Europe, South America, and Australia. Beginning student exercises typically focus on skill-building with a very limited potential impact in the larger context of the profession; the high profile of this project encouraged students to be diligent in their work and precise in their measurements. This was furthered by the knowledge that their work would represent the architecture program, the College and the University in an international effort, which was a unique experience usually reserved for upper level undergraduate students or graduate students. Secondly, working with a prominent software platform also intrigued the students. The University uses a peer-to-peer formal mentoring system in the initial year of the program. The mentoring program matches beginning students with students in later stages of the program. The relationships established in this early phase of the students' academic careers often endure through the entire program and even into practice. The beginning students frequently ask the mentors about current software preferences and strive to engage the digital tools as early as possible. The popularity of the Rhinoceros modeling software, and the increasing integration of Grasshopper, DIVA and other plug-in programs made the younger students feel that they were contributing to the refinement of a digital tool that was valued by their mentors and would be valuable to the students themselves in the future.

Participation in the project did not detract from the traditional module objectives. This section typically uses a portion of the same building to note areas of inadequate daylighting, and propose design adjustments to remedy the affected areas. The work for the study imparted the basic skills included in the laboratory from previous semesters: judging daylight within a space intuitively, using light meters to take precise measurements, recording data graphically, and comparing the qualitative outcomes to the initial judgments. The final element of proposing a design solution to address the shortcomings of the building was easily added to the base project work. In short, the benefits of working in an international context, and knowledge that the work would contribute to the improvement of an advanced digital tool dramatically increased student interest. The authors suggest that increasing opportunities for beginning student involvement in high profile research projects would benefit both students and professors, and should be considered as an underserved area within the academic realm.

## 2.0 CASE 2: PROBLEM SOLVING ALIGNED WITH STUDENT SELF-INTERESTS

The second case study involves a laboratory project working with third year Bachelors of Architecture students to investigate well-known acoustical issues within their studios and review spaces. This project was created with the input of the students and in conjunction with a second course in the College (Horwitz, 2012). During a preliminary lecture on acoustics, the students noted that their primary work spaces had serious acoustical issues which made it difficult to hear professors within the studio and review spaces. Previous acoustic laboratories had focused on precedent projects or a problem in a non-existent space. While these projects allowed students to investigate issues of acoustic geometry, absorption and reflection, and reverberation, the exercises were disembodied from firsthand experience. The opportunity to address problems within their own built environment motivated the students to deeply investigate the problem and propose a creative design solution.



**Figure 3:** Armory first floor plan and interior perspective. Source: (FPMS, 2013)

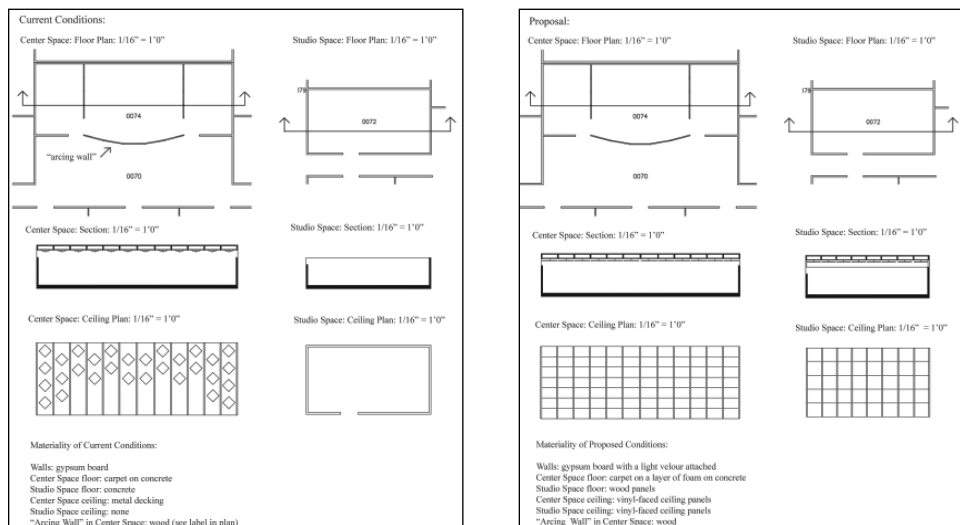
The current space used by the third year students is a 90,000 square foot, triple-height barrel-vaulted armory built in 1924. The space originally was used for sporting events, and second story bleacher seating remains in balconies running the full length of the building at the arched ends. The studio spaces are located on the main floor and shared between students in landscape architecture, architecture, and industrial design. The studios are arranged in a ring around a large review pavilion in the center of the space. The review pavilion is the only space with an immediate ceiling condition; all other spaces are open to the barrel vaulted structure above. The pavilion has partial height walls for displaying work, leaving large gaps between the tops of the walls and open webbed joists and metal deck ceiling structure. The sheer number of students in the space, along with the variety of activities from the different courses, causes ongoing conflict. Studios in review are disturbed by other studios using power tools to build models, or adjacent instructors speaking very loudly, by necessity, to be heard by their students. Within the studios themselves, it is hard for students to hear and understand announcements, leading to frequent work stoppages to gather students into a small area. Any group discussion requires reservation of alternate space, limiting the types and numbers of interactions possible within the studio.

Faculty delivered two 45 minute lectures on basic acoustic principals and methods of evaluation. These lectures were followed by a laboratory, which culminated in student proposals to improve their studio and review spaces. The initial steps of the project involved making intuitive judgments regarding the nature of the acoustical problem – did the problem derive from the geometry of the space, from the materials within the space, or from the openings between the spaces? Many students identified the large volume above the studio spaces as an issue; many also noted the openings between spaces with non-complimentary uses as a concern. Still others noted prevalence of reflective materials, and the absence of absorptive materials in the studios as problematic.

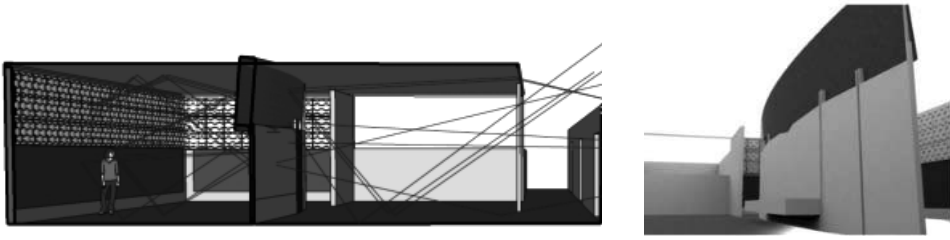
**Table 2:** Student responses regarding major deficiencies in the Armory. Source: (Author, 2013)

<i>Response</i>	<i>Number of Responses</i>
Excessive Reverberation Time	7
Geometry of the Space	14
Materials in the Space	31
Lack of Ceilings	28
Adjacent Spaces not Isolated	5

The students then engaged in formal calculations involving the volume of the space, and the types and amount of each material in the space (Stein, 2010). This phase allowed students to more closely identify the true problems in the spaces. As an example, many students initially felt that the openings between the walls and ceiling would be the primary problem in the review pavilion, but calculations revealed that the major issue was the reverberation time. These openings were allowing desirable sound from speech within the space to escape, but this was not the major issue. The excessive reverberation time was allowing sound to linger in the space and mask speech (the primary function for the pavilion.) Students correctly predicted that the open top of the studio spaces was the primary problem in this case. Many students proposed interesting tensile acoustic solutions, which incorporated absorption to counteract the predominantly reflective surfaces within the studio spaces. Other solutions proposed hard ceiling panels, and softer acoustic panels on the walls and carpet or similar absorptive surfaces on the concrete floor. These solutions were primarily designed using hand calculations. However, students in the third year are beginning to engage more complex studio projects, and the desire to incorporate more sophisticated digital analysis is present in the more advanced students. This lab incorporated an extra credit portion to allow students to verify their hand calculated results by building and testing a simple model in Autodesk Ecotect, version 2011.



**Figure 4:** Existing and revised proposals. Source: (Wamples, 2012)



**Figure 5:** Autodesk Ecotect acoustical analysis. Source: (Khesroh, 2012)

The authors proposed that incorporating student self-interest into the building technology laboratory, both by incentivizing the opportunity to learn advanced digital analysis tools and to propose improvements to a notably flawed daily environment encouraged greater student engagement with this project. The most sophisticated solutions were packaged for presentation to College administration to show several unique options to improve the learning environment.

**3.0 CASE 3: STUDIO INTEGRATION AND ITERATIVE DIGITAL ANALYSIS**

The final case study involves a laboratory project which integrated the uBTS with advanced students in the pre-comprehensive studio project located in Columbus, Indiana. The studio program requests a 40,000 square foot museum to house innovative industrial design objects, and documents and models from the architectural archive for the numerous notable architectural projects in the community. This project is completed in the first semester of the fourth year of the Bachelors of Architecture program, and tied into the studio project at the beginning of the building massing phase. At this point in the semester, students were making major decisions about the form of the building, which specifically affected the daylighting strategies for the gallery components.

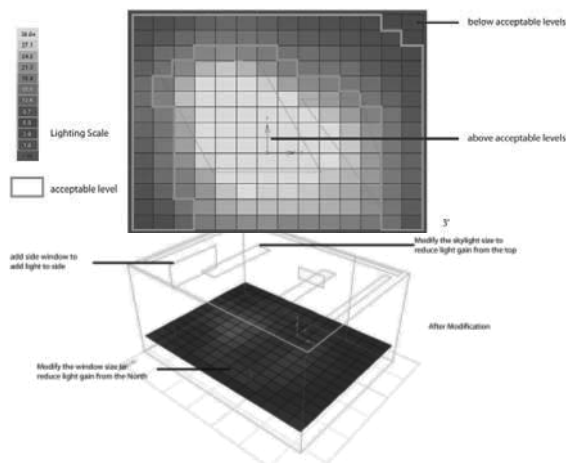
Faculty members delivered two 45 minute lectures regarding daylighting opportunities and limitations in museums. The lectures featured methods to hand calculate foot candle and daylight factor values, and showed numerous contemporary precedents. Allowable levels of light exposure for various media and materials were also discussed, which formed the basis for the laboratory assignment. Daylighting was presented as a potential opportunity, widely viewed by curators as the ideal light source for a gallery; but also as a potential source of permanent damage for many fragile works on paper, or composed of delicate natural materials such as fur, feathers or cloth. Baselines for material classes were presented as design parameters, which heavily influence building form and materiality.

**Table 1:** Light exposure levels recommended for museum objects. Source: (PMA, 2013)

Light level	Material
200 lux (20 footcandles)	ceramics, glass, and metals
150-200 lux (15-20 footcandles)	oil and tempera paintings, leather, lacquer, wood, horn, bone, ivory, stone
50 lux (5 footcandles) or less	watercolor paintings, dyes, manuscripts, prints, drawings, textiles, photographs

The initial laboratory task required students to create a three-dimensional digital model of a proposed gallery space. Many students utilized existing digital models from their studios which were created in Autodesk Revit or Google SketchUp. These models were simplified, eliminating voids and excessively detailed geometry and imported into Autodesk Ecotect. The daylight analysis tool was used with an analysis grid to evaluate the amount of natural light in the student design proposals. The resulting daylight levels were combined with the types of artifacts displayed and compared to the baselines from the lectures. Nearly all of the students determined that their initial proposals allowed daylight to be admitted to the galleries in an

uncontrolled manner, which resulted in foot candle levels that far exceeded the baselines established in the lectures.



**Figure 6:** Initial results (left) and modified proposal (right). Source: (Zhao, 2012)

The second task involved using digital analysis, in conjunction with design revisions to improve performance through controlling and reducing the footcandles admitted to the display zones within the gallery. This required students to use the analysis in an iterative process, which was documented at each major proposed revision. Students found that successful strategies were possible utilizing top lighting or side lighting, however, most proposals found that layered diffusing elements or multiple reflectors were necessary to adequately control the daylight admitted to the gallery. Integrating the lab in the middle of concept design allowed students to avoid development of proposals that were infeasible from a building performance perspective, and to focus on solutions more suited to a typology driven by display and preservation of valuable objects. Students were required to revisit the process at the conclusion of the semester, when the final exam for the module required digital analysis grids showing the daylight levels for their completed museum proposal.

Student feedback noted that the process, although demanding, resulted in gallery geometry that was materially engaging, provided high-quality diffused daylighting, and protected valuable objects from damage. The learning curve for the software proved slightly frustrating for many students, but the powerful information yielded from the process overcame many initial reservations. The work was well received by professional guests visiting for final reviews, and the integration efforts in the course were noted as especially successful by the NAAB accreditation committee when top projects were presented in the following semester. The authors propose that integrating highly technical, digital analysis software into advanced building technology courses allows students to make more informed design decisions and respond intelligently to environmental factors which must necessarily shape design in demanding project typologies. Furthermore, these skill sets are particularly valuable for upper level students, trying to differentiate themselves from many similar students seeking positions in graduate schools or in professional employment.

## CONCLUSION

The uBTS endeavors to inculcate the necessary design processes of careful data gathering and diligent analysis through a variety of project opportunities. The examples listed in this paper attempted to generate greater student enthusiasm for learning objectives by aligning the uBTS project goals with elements outside of the course which are highly valued by students. These elements range from perceived prestige through association with numerous respected Universities and valued visualization software, through improvement of one's own environment, to gaining the ability to use advanced digital analysis tools to demonstrate

technical skills valued in academia and in the profession. The subject matter is approached from a variety of perspectives to allow students to gain a level of comfort with different approaches across disciplines and practice environments, apply multiple methods to cross-check personal work, and to develop hybrid approaches as a complex world demands. The methods are sequentially layered in a way that is designed to reinforce learning from previous semesters, while pressing for the integration of more advanced concepts and analysis tools in the development of complex thinking and proposals. This mixture of methodologies effectively engages each level of the undergraduate architecture program in the challenging task of comprehending the invisible forces in architecture through perception, measurement, simulation, and the synthesis of environmental factors as key components of successful and sophisticated spaces.

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## FIGURES

Figure 1 C Lui, student worksheets from ARCH 245 assignment

Figure 2 F Romero, student assembled floorplan from ARCH 245 assignment

Figure 3 "Armory First Floor Plan," FPMS, accessed October 31, 2013, [http://www.fpm.iastate.edu/maps/buildings/docs/ARMORY/plats/pdf/First\\_Floor.pdf](http://www.fpm.iastate.edu/maps/buildings/docs/ARMORY/plats/pdf/First_Floor.pdf).

Figure 4 S Wamples and C Widlowski, student work from ARCH 342 assignment

Figure 5 M Khesroh, T Gonzalez and J Bassett, student work from ARCH 342 assignment

Figure 6 C Zhao, student work from ARCH 445 assignment

## TABLES

Table 1 "Light exposure levels recommended for museum objects, Philadelphia Museum of Art, accessed November 2, 2013, <http://www.philamuseum.org/conservation/10.html?page=2>

Table 2 Author, Student responses from Arch 342 assignment

# Use of augmented-reality in teaching energy efficiency: prototype development and testing

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**ABSTRACT:** Passive solar and energy efficiency concepts are usually taught through lectures, textbooks, or hands-on experimentation, but the relationship between these concepts is typically not effectively visualized. To address this, this paper reports on the design, development and preliminary testing of a prototype Augmented Reality (AR) application for residential energy use education. This tablet-based AR application simulates the impact of different residential building design characteristics on both indoor temperature (for passive heating/cooling) and annual energy use and cost (for mechanical HVAC). The application was developed by an interdisciplinary team of researchers/educators from three related fields: architecture, interdisciplinary education, and computer science. AR consists of additional information that is visible through a technology interface, shown on top of the images of the real world under study within a digital 3D space. The interdisciplinary model presented in this paper integrates three distinct lenses: 1) passive design and energy efficiency education 2) AR as an interactive modality and 3) a computationally complex building performance simulation model. In particular, the paper reports on the results of an experiment in which junior-level university students in a school of architecture used the prototype. Results from the pre and post knowledge surveys conducted within the experiment show consistent and high improvement in the students' confidence in their knowledge of the topics following the use of the prototype. Student feedback was also generally positive but some issues were identified which may indicate that this prototype would be more effective at the freshmen level. Plans for future development phases for this project include focusing on this new population. The project described in this paper also illustrates the considerable potential that interdisciplinary collaboration offers for architectural research through enabling architectural researchers to tackle more complex issues and developing a better understanding of the research approaches and expectations in other disciplines.

**KEYWORDS:** Augmented Reality, Energy Efficiency, Passive Design, Education, Performance Simulation

## INTRODUCTION

Architecture is a field of knowledge which draws from multiple other disciplines and as such offers strong potential for interdisciplinary work. The case for the important role played by both the human sciences and the physical sciences in architecture has been clearly established in the literature. This paper discusses a project which builds on this interdisciplinary potential and addresses an issue which is gaining considerable importance in architecture and other built environment disciplines: improving the environmental performance of buildings. The growing significance of environmental performance has increased the role of environmental technology, and technology in general, in architecture and architectural education (i.e., Abel, 2000; Kolarevic & Malkawi, 2005; Steele, 2005). While the recognition of the need for better integration of environmental performance criteria in architectural education and the search for means of effectively achieving this is far from being a new concept, recent increases in concern for the environment have given this area of research a renewed sense of urgency. Effectively introducing new generations of architects, in the formative years of their architectural education, to the basic principles and concepts of passive solar design and energy efficiency can have both a direct impact on the students' understanding of the basic principles and relationships involved, as well as an indirect impact on increasing their awareness of the significance of these issues. This can also have a positive impact on their subsequent professional careers. Several approaches for teaching these concepts in

architecture curricula can be identified in the literature. Examples of these include introducing them in textbooks, lecture classes, technically-focused design studios, or through hands-on experimentation (e.g. Heliodons). While each of these approaches offers some potential, none of them provide an effective means of visualizing the relationship between the concepts involved.

Augmented reality (AR) consists of additional information that is visible through a technology interface, shown on top of the images of the real world under study within a digital 3D space. To date, few research publications report on the impact of AR-supported collaborative learning spaces. Studies (e.g., Pemberton and Winter, 2009; Van, 2009; and Shelton and Hedley, 2002) show that the use of AR improved students' motivation and engagement, and can significantly improve understanding of scientific principles through providing a unique combination of visual and sensory information that results in a powerful learning experience. Studies also show that AR and game-based learning are likely to gain widespread usage in the near future.

Taking advantage of this innovative technology, this paper reports on the design, development and preliminary testing of a prototype AR application for residential passive design and energy efficiency education. This tablet-based AR application simulates the impact of different residential building design characteristics on both indoor temperature (for passive heating/cooling) and annual energy use and cost (for mechanical HVAC). The application was developed by an interdisciplinary team of researchers/educators from three related fields: architecture, interdisciplinary education, and computer science. The interdisciplinary model presented integrates three distinct lenses: 1) STEM Education 2) AR as an interactive modality and 3) a computationally complex building performance simulation model. The paper will report on the process used to develop the AR application, the components of the developed prototype, and the validation and usability testing conducted for it so far. In particular, the paper will report preliminary results from an experiment in which the prototype was used by undergraduate architecture students from a large public university based the results from pre-post surveys. The paper will also discuss future work planned within this ongoing project and its potential within architectural education programs.

## 1.0 LITERATURE REVIEW

### 1.1. Passive design and energy efficiency in architectural education

Discussion of the need to better integrate environmental performance issues, principles, and concepts in architectural education can be traced back to Meunier (1980) who argues for the necessity of introducing performance, measured in non-visual ways, into architectural education through the application of simple scientific principles and the use of multiple testable models, both physical and mathematical. Brown (1980) further argues that "mechanical electrical building design must be integrated with a synthetic building design process so as to combine programmatic elements in a way that is responsive to physical, social and political context." Principles of passive design and energy efficiency are typically introduced into architectural curricula using one or more of the approaches discussed next. The first approach is through the use of *textbooks*. Numerous textbooks have been developed to assist architecture students in understanding the principles of passive design and taking environmental performance criteria into consideration within their design process. Prominent examples include "Inside Out" (Brown and Reynolds 1982), "Sun, Wind, and Light" (Brown and Dekay, 2000), "Mechanical and Electrical Equipment for Buildings" (Grondzik et al. 2010) and "The Green Studio Handbook" (Kwok and Grondzik, 2011). Another approach involves the use of *performance simulation software*, which offer students the potential and ability to experiment with greater complexity in a shorter time frame. The Carbon Neutral Studio Initiative (SBSE 2009) documented several examples of the use of these tools in both lecture classes and studios. While offering considerable potential, many of the available simulation tools require time to acquire the technical skill level needed to take full advantage of their capabilities and potential. A third approach to introducing architectural students to the principles of passive design and energy efficiency involves the use of *hands-on experiments and activities*. The Agents of Change Project (2005) provided training sessions for faculty and teaching assistants in several areas including developing exercises to implement at their home



institutions and many of those exercises involved hands-on experiments and activities. A classic example of this approach is the use of Heliodons in introducing students to the principles of solar geometry and passive design. Several versions of the Heliodon can be found ranging from highly sophisticated commercial models to smaller models which can easily be constructed in an architecture school's shop. While being easy to use and very effective in introducing students to the basic principles involved, the time and resource requirements of hands-on experiments make it difficult to use them to understand more complex scenarios. The approach used in developing the prototype discussed in this paper combines the latter two approaches, use of simulation software and hands-on experimentation, and places them in the context of the new and very promising potential offered by AR technology as discussed in the coming sections.

## **1.2. Use of technology in education**

Technology has regularly been used in classrooms and learning environments. Through tools such as the internet, videos, software, games and simulations, our learning experience can be enhanced with real world scenarios (Kirkley & Kirkley, 2005). As real world problems and scenarios grow more complex, newer technology, like simulation and AR, is capable of providing more complex and authentic experiences. Klopfer and Squire (2008) suggest that as AR is established further into handheld devices, there are unique opportunities for uses in education. They point out that handheld devices allow for the collection of real-time data and support collaboration, yet allow for individual exploration. Although there are few studies on learning environment impacts, research by Shelton and Hedley (2002) found AR media was useful in "teaching subject matter students could not possibly experience first-hand in the real world". Regarding simulation, the visual representation of calculated simulation results has the potential to greatly impact the user's ability to understand their implications and identify any relationships and trends they may indicate. McDonald (2010) argues that simulation results must convey meaning and their effects on the performance of the building should be highlighted. Interface design plays a major role in efficient educational technology, unusual computer navigation or unfamiliar actions that obscure the overall experience are common.

## **1.3. Augmented reality (AR)**

AR experiences help one understand spatial relationships (Kerawalla, et al., 2006). They provide a physical interaction that brings a new perspective and understanding (Rosenbaum, et al., 2007). Early AR systems have been used in maintenance and repair projects for Boeing, and Columbia University's KARMA (Knowledge AR for Maintenance Assistance) helped explain maintenance and repair tasks. Mobile systems have been tested that could be used for travel, history recreation and touring as well as for U.S. Coast Guard navigation systems. AR has also been used in the medical field guiding doctors performing biopsies (Kirkley & Kirkley, 2005). Publications discussing AR-supported collaborative learning spaces include Pemberton and Winter (2009), who report on a platform that supports remote collaboration. They found that the use of AR improved students' motivation and engagement. Shelton and Hedley (2002) created an AR-based simulation focused conceptually on "rotation/revolution, solstice/equinox, and seasonal variation of light/temperature" (p. 1). They showed that participants significantly improved understanding of the science, and indicated that understanding new concepts had the potential to be fundamentally changed "through a unique combination of visual and sensory information that results in a powerful learning experience" (p. 7).

## **1.4. AR in education**

Billinghurst & Duenser (2012) argue that there are recognized advantages for using AR in education including the increased retention of learned content due to the interactive nature of the technology especially compared to passively learning from textbooks. They further argue that AR can be an effective means of adding meaning to the student's learning experience and can support deep content learning. In general, AR has been shown to have positive educational benefits, but there are usability concerns that potentially threaten motivation and learning benefits. Discussing the use of AR in higher education, Liarokapis and Anderson (2010) presented ways of effectively incorporating AR with existing multimedia materials and identified several usability issues. Moreover, they found that different populations of higher education students may have different preferences for system and interaction design. With

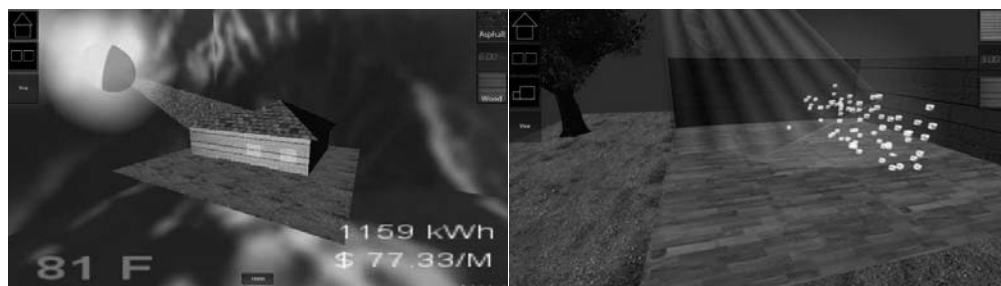
regard to architectural education, Webster et al. (1996) developed an early prototype of an AR system for architectural construction, inspection, and renovation which used an optical see-through display to afford users something akin to 'x-ray vision' of the internal structures of buildings. Wang et al. (2008) compiled an extensive review of using mixed reality (i.e. AR) in architectural design and construction, and showed that AR can be used to enable new types of interactions that enhance the design process. Behzadan et al. (2007) also developed a hardware and software framework for visualization of construction processes, thus showing the potential the technology offers for built environment disciplines.

## 2.0 PROTOTYPE DEVELOPMENT

As discussed previously, this paper reports on the work of an interdisciplinary team of researchers to design, develop, and test a comprehensive project-based and technology-mediated learning environment that combines computationally complex simulations, real time simulations, graphical user interface (GUI), tangible interaction, and visualizations. The vision of the proposed prototype is that effectively combining such new modalities, through supporting deep content learning, transforming inquiry-oriented behaviours into habits-of-mind, and refining appropriate communication skills, will result in an improved learning experience for the students. The proposed prototype aims to teach: 1) the scientific principles behind passive design and energy efficiency, and 2) the practical implication of integrating these principles in the design of single family homes. Through the use of the prototype, students can understand the relationships between architectural design parameters (e.g., building size, form, orientation, material choices, window size and placement, etc.) and the underlying science (e.g., passive solar energy, energy transfer and conversion). Although the prototype discussed here focuses on single-family residential buildings, the concept behind the prototype is applicable to other residential and non-residential building typologies. The following sections describe each of the three major components of the prototype in more detail.

### 2.1. Real-time simulation and visualization

The first component of the AR prototype combines a visualization of solar simulation and Brownian motion with a combination of 2D GUI and tangible AR interfaces. The tangible AR interface will be discussed more in section 2.3. The GUI works in two modes: 1) the passive mode: which assumes that the house is not air-conditioned and in which users manipulate the design characteristics of the house (e.g., size, form, orientation, material choices, window size and placement, shading size, etc.) in order to achieve internal human thermal comfort conditions, 2) the active mode: which assumes the house is mechanically air-conditioned and in which users can modify the same characteristics and get feedback about the annual energy use and utility costs. Users look through a tablet at markers and see a visualization of the house on the screen. Inside the visualization of the house is another visualization of energy transfer and conversion at the atomic level. Users can change the design characteristics of the house using the tangible interface (see section 3.3) resulting in immediate feedback to the user regarding either internal temperature (the passive mode) or annual energy use and costs (the active mode). Figure 1 shows two screen shots from the AR GUI, one showing the visualization of the sun's position and the other showing the visualization of the Brownian motion.

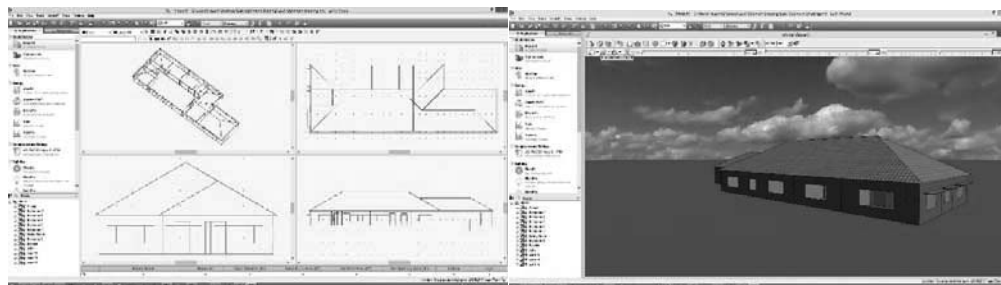


**Figure 2:** The AR graphical user interface.

## 2.2. Computationally-complex performance simulation

Internal temperature, annual energy use, and annual utilities costs data used in the prototype were pre-calculated using the performance simulation package IES-VE Pro. This process included developing a baseline model for a typical residential building in a major US city and simulating its performance in both passive and active modes. Nine baseline models were developed and simulated representing three different single-family house (SFH) sizes and form proportions. These included a small SFH (1,800 ft<sup>2</sup>), an average SFH (2,160 ft<sup>2</sup>), and a large SFH (2,450 ft<sup>2</sup>). Each of these three sizes was simulated in three different proportions: 1:1, 1:2, and 1:3, maintaining the floor area and volume of the house in each case. This aimed to capture the considerable impact that building form and proportion have on both passive performance and cooling/heating energy use. The characteristics of the base models were developed based on census data and data from the Residential Energy Consumption Survey (RECS), and aimed to represent as much as possible the typical characteristics of single family homes in the project location. Characteristics not available in census data and RECS were based on NREL's Building America House Simulation Protocol (Hendron & Engebrecht, 2010).

All nine base-models were calibrated using the Building America House Simulation Protocol. This process aimed to insure that the results of the simulation closely matched actual conditions and that results of future parametric simulations reflects as much as possible the actual impact of each of the variables tested on the house performance (both in the passive and air-conditioned modes). A parametric analysis was then conducted, which included changing the values of selected building characteristics and repeating the simulation in both the active and passive modes to evaluate the impact of those changes on the performance metrics mentioned above. Building characteristics modified included: glazing size and orientation, existence and size of shading devices, glazing type, wall/room thermal resistance (R-values), and wall/roof exterior finish materials. In all, 45 scenarios were simulated. Figure 2 shows screen shorts of one of the simulated scenarios including both a wireframe and rendered view.



**Figure 1:** Screenshots from one of the IES-VE models used in the simulation.

## 2.3. Tangible AR interface: use of the Heliodon

The final component of the prototype included a physical model of the SFH mounted on a simplified Heliodon that allowed the user to change the orientation, time of day and year, and latitude of the house. The model and Heliodon were instrumented with a series of sensors, which are tracked by the AR interface. Users are able to physically change house characteristics (e.g. house size, proportions, glazing types, shading, surface properties) and based on their selections, the AR interface would show a visualization of the selected set of characteristics as well as the resulting performance of the house (either energy use and utility cost for the active mode, or internal temperature for the passive mode). Performance data were pulled by the AR interface from the previously simulated scenarios. Users can also change the time of day and year using the Heliodon although this would only impact the passive mode (i.e. internal temperature). Figure 3 shows one of the two usability pilot studies conducted for the prototype.



**Figure 3:** The full prototype in one of the cycles of usability testing.

### 3.0 MODEL TESTING AND VALIDATION

#### 3.1. Preliminary usability testing

Two pilot studies with nine teachers and thirteen high school students were conducted to evaluate the usability and acceptability of the prototype. In particular, user feedback was collected through surveys and interviews and that data, as well as the observations made by the research team, were used to further develop the prototype and address issues identified through the testing (Ferrer et al., 2013).

#### 3.2. Prototype testing in architectural curricula

While the initial development and testing of the prototype was primarily aimed at the high school context, the research team recognized that a potential exists for using the prototype in undergraduate education and in particular in architectural education. To investigate this potential, an experiment was conducted in which junior-level architecture students in a large public university directly interacted with the prototype. The experiment was conducted as part of the lab component of an environmental control systems course. While the experiment was conducted as part of the class activity, several measures were put in place to eliminate the potential of bias in the results. First, participation in the experiment was made optional and an equivalent activity was made available for students unwilling to participate. Second, the faculty member, who is also a member of the research team, was not involved in conducting the experiment and was not informed of the names of participating students. Finally, collection of information from the students regarding the experiment was done completely anonymously and no records linking responses to student names were maintained. In total, 118 students participated in the experiment. The design of the experiment consisted of three major activities described as follows:

- 1) Two weeks prior to being exposed to the prototype, all students were asked to answer an anonymous knowledge survey (Nuhfer, 2003) consisting of nine questions about passive solar design and energy efficiency principles. Students were asked to indicate their level of confidence in knowing the answer to these questions on a scale of one to five, with one meaning the student had no confidence in being able to answer the question and five meaning the student was very confident of the answer. In total, 118 students responded to the pre survey.
- 2) Students were divided into teams and each team was exposed to the prototype in two consecutive rounds of lab sessions. In the first round of lab sessions, students were introduced to the prototype and its functionality and then they were invited to independently explore its use in both the passive and active modes. Students were also asked to investigate the impact of each of a number of building design characteristics on the model performance.
- 3) Prior to the second round of lab sessions, the prototypes were set to the characteristics resulting in the worst possible performance. In the sessions, students were asked to use the prototype to identify a set of characteristics that will result in achieving specific levels of performance improvements (a reduction in energy use of 10%, 20%, and 30% for the active mode; and a comparable reduction in internal temperature for the passive mode).
- 4) Following the second lab sessions, all students were asked to answer the same knowledge survey, also anonymously. Students were also asked to provide comments on

their experiences using the prototype. In total, 100 students responded to the post surveys and provided written comments. Both lab sessions were also video recorded.

#### 4.0 EXPERIMENT RESULTS

The results of the experiment reported in this paper include both quantitative results (based on a comparison between the pre and post survey responses) as well as qualitative results (based on student comments, video recordings, and research team observations). With regard to the survey responses, comparing the pre and post surveys showed a notable increase in the students' confidence in their ability to answer all the survey questions following the two lab sessions. In the pre survey, student confidence levels ranged between 2.74 and 3.52 (on a 1-5 scale) indicating an average confidence level in all questions. The average response was 3.19 and the standard deviation was 0.29. Students showed the lowest level of confidence (2.74) in the question addressing their ability to optimize design characteristics in order to improve performance. In comparison, responses to the post survey ranged between 4.27 and 4.44 with an average of 4.41 and a standard deviation of 0.09. The percentage of increase in students' confidence for individual questions ranged from 25% to 57% with an average increase of 39% and a standard deviation of 11%. The highest percentage of improvement, 57%, was found in the optimization question, which showed the least level of confidence in the pre-survey, while the lowest percentages of improvement were found in the questions relating to the impact of window size and shading on performance. Students answering "very confident" for the optimization question increased from 7 to 39 (6% to 39%). Figure 4 shows the average response for each of the survey questions in both the pre and post surveys.

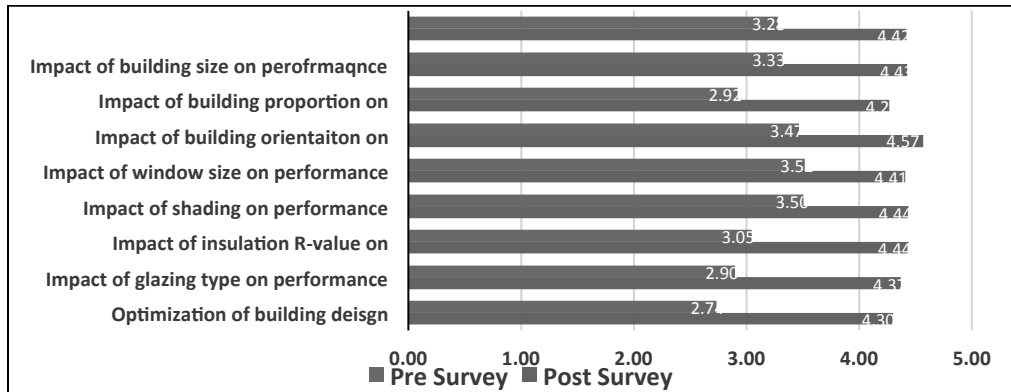


Figure 4: Comparison between student responses to pre and post survey questions.

The student comments and feedback collected after the two lab sessions were categorized into four major sections: *potential*, *content*, *function and usability*, and *passive design*. With regard to *potential*, the comments were overwhelmingly positive although in some cases the comments were qualified by references to some usability issues discussed later. Representative examples include: "offers potential and a great idea", and "great potential and visual representation". With regard to *content*, the comments were generally positive and indicated that the students managed to clearly understand the content through the use of the prototype. On the other hand, some students commented that the variables they could manipulate were limited and/or simplified and recommended increasing the complexity of the prototype as well as the scope of buildings it can deal with. Example comments include: "Clear representation of passive and active functions within the building", and "Would like to see more building material options". With regard to *function and usability* most comments stated that the GUI was intuitive, user friendly, and easy to understand and navigate. On the other hand, several minor technical usability issues were identified in the comments relating to some of the tablets not functioning occasionally, not recognizing some of the sensors, or freezing and needing to be restarted. Examples of comments include: "dummy proof", "fairly user friendly", "fun and entertaining", "good and cool way to learn but bugs were a hassle", "worked at the beginning but then stopped". Finally, with regard to *passive design* the comments were again overwhelmingly positive and indicated an appreciation of the potential

the prototype offered in this area. Example comments include: “*If it were developed further it would be a great tool for designers*”, “*Great way to explore the basic principles of passive design and solar efficiency*”. Observation of the video recordings generally showed that students were engaged with the prototype and that it was successful in provoking discussions and collaborative activities. The usability issues stated in the comments were also visible and frequent and in some cases led to the students appearing frustrated. Those usability issues make the positive outcome of the knowledge survey even more significant as it indicates that the results could have potentially been even better if those technical issues were resolved.

## CONCLUSIONS

This paper reported on the process of designing, developing and conducting preliminary usability and effectiveness testing for an innovative prototype AR application for residential passive design and energy efficiency education. The prototype was developed by an interdisciplinary team of researchers from computer science, education, and architecture. The prototype combines computationally complex simulations, real time simulations, graphical user interface (GUI), tangible interaction, and visualizations. Through taking advantage of the considerable potential offered by AR and combining these modalities, the prototype aims to create a learning environment that supports deep content learning, transforms inquiry-oriented behaviors into habits-of-mind, and refines appropriate communication skills. While the prototype offers potential for several educational levels, this paper focused on the potential it offers for architectural education specifically in relation to the teaching of passive design and energy efficiency principles. Through the use of this prototype, students can develop a better understanding of the scientific principles involved as well as of the impact of a variety of building design characteristics on the performance of the building in both active and passive modes.

The results of the experiment described in this paper indicate a strong potential for the use of the proposed prototype in architectural programs. Comparison between students' confidence in their knowledge of the topics addressed before and after using the prototype shows consistent and high levels of improvement in all aspects measured by the survey, with the highest improvement being in their confidence in their ability to address complex tasks such as the optimization of multiple design characteristics, which are typically the most difficult issues to tackle at this level. Student feedback also indicated a generally positive response to the prototype and an appreciation of the potential it offers. This positive response is particularly interesting as it came in spite of the experiment being affected by several minor usability and functionality issues which would typically have a negative impact on the results. We believe this to indicate that the prototype can have an even more positive impact once fully developed and tested. On the other hand, student feedback from the experiment showed that the current prototype may be too limited in offering the variety of variables and level of complexity expected by, and perhaps needed for, students at the junior level (the population of the study). While the current plans for developing the prototype do include increasing its level of complexity by adding additional variables and scenarios as well as including other residential and potentially non-residential building typologies, the results indicate that the prototype may be more effective at the freshmen level where it could be used to introduce students, potentially for the first time, to the principles and concepts of solar geometry, passive design, and energy efficiency. Plans for future development phases for this project include focusing on this new population as well as expanding the experiments to undergraduate freshmen students in other disciplines such as science, engineering, education, etc. Planned expansions also involve the use of control groups and more detailed statistical analysis to increase the reliability of the results. Other potential future directions for the project include focusing on user behavior issues, expanding the prototype to the urban scale, and expanding the performance metrics covered beyond temperature, energy and cost. Even though the preliminary results of this experiment were positive, more testing is needed to determine the effectiveness of the proposed prototype as well the best approaches of integrating its use in architectural curricula.

The project described in this paper also illustrates the considerable potential that interdisciplinary collaboration offers for architectural research. While certainly not unique, the composition of the interdisciplinary team working in this study is not typical in architectural research. Working in such a diverse interdisciplinary team, while presenting its own set of

challenges, enabled the research team to develop a project that offers considerable long term potential in each of the three disciplines involved, and through the collaboration enhanced their own personal knowledge of the other two disciplines. The project also provided a unique opportunity for several architectural graduate research assistants to be exposed to more structured forms of research, which they were not accustomed to. Working in such a diverse interdisciplinary team also presented some challenges. These included the need for the researchers to develop a common language and an appreciation of the differences in approaches and expectations of research in each of the three disciplines involved. Having an effective means of communication played a major role in developing this common ground. Over the course of the project, there were also some minor logistical and administrative challenges that the team dealt with. These issues were, in general, relatively easy to resolve especially given the diverse nature of the academic and administrative units that the researchers belong to.

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# The Digital change. Reasons and meanings of a new architectural expressivity

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**ABSTRACT:** The entry of computing in architectural has produced a real revolution in architectural scenario, changing the designer's arsenals and producing new expressive trends. However, up to now it is unclear how designers have actually taken advantage of the use of software to develop new styles, it is unclear what is the relationship between programs, operations and tools provided by them, and the formal configuration of new architecture. Moreover, the only element to identify digital influence on design seems to be only what designers or critics say-so. Then, the goal of the research was to actually identify these digital influences on architectural designs by developing a framework for identifying and classifying architectural design elements that should be attributed to the methods and techniques of design computing. This framework was developed in terms of a database where to collect and classify sixty case-studies, which are prominent recent buildings and acknowledged products of digital means. The goals of this are, firstly, to verify the applicability of the descriptive framework and, secondly, to identify combinations of elements that characterize different approaches or types in current architecture. The results suggest that the use of digital tools in architecture is ubiquitous, where the conceptual starting point of designers and the improvement of the original idea are expressed in the digital domain, taking advantage of the augmented representation skills to control and manipulate form. Furthermore, it seems evident that the current digital architecture is dominated by new figurative trends, which we will identify and examine in depth, showing also common aspects and eventual criticisms.

**KEYWORDS:** digital design thinking; contemporary architecture; design process; digital trends.

## INTRODUCTION

The introduction of computer in designer's scenario have produced a revolution in architecture. Since the commercialization of the first CAAD (Computer Architectural Aided Design) programs in the '80s, initially born to *aid* the production of *drawings*, software has progressively begun part of designer's tools. Despite at first the undoubted advantage resided in the representation power, especially the control of three-dimensional shapes, after some years of experimentation it was clear that software aided the expression of designer's creativity. Several vanguard architects were enthusiastic about the possibilities guaranteed by programs and, among them, Greg Lynn has publicly declared his favour.

Despite the fact that calculus is more than three hundred years old, the advent of the computer allows us to be among the first architects and designers to work intuitively with a new class of shapes that are calculus-based - that is, built out of interconnected and interacting variables (Lynn 2003).

After about fifteen years of experimentation, everyone agrees that digital tools are currently used in architectural professions and that the effect of their use is rather evident on the formal and aesthetic configuration of some buildings. Hence, the aim of this research has been to identify digital influences in real architectures and, above all, to understand the several digital trends existing in our profession, also by analysing possible issues and criticisms. To reach this goal, we need a well-defined theoretical framework, in order to examine the current phenomenon with consistency and objectivity.

## 1.0 IDENTIFYING DIGITAL INFLUENCE IN CURRENT ARCHITECTURE

Even though an architect uses computers in a significant manner is primarily a matter of declaration and reputation, everybody can state that digital influences in a design are often easy to perceive in the overall form, as well as in some critical parts such as the building

envelope. They may indicate use of digital means to solve specific problems, e.g. represent complex geometries, or design actions constrained by the use of digital tools, e.g. frequent use of particular geometric primitives or operations. In many cases, the computer is used to facilitate representational and design actions, e.g. model complex surfaces that tend to be hard to specify by hand and may require more information than what is available in conventional orthographic projections. However, the choices and effects of digital means are presumably discernible in the design, but, upon closer inspection, it becomes evident that the main reason for recognizing digital elements in a design is the designers' or some critic's say-so.



**Figure 1:** Cité de la Mode et du Design, Jakob+MacFarlane, Paris, 2005-2008. Photo by Alessia Riccobono.

### 1.1. Research methodology: a bottom-up approach

Identifying the above digital influences in a single design is quite useful for the refinement of the framework, i.e. the definition of the repertoires and the clarification of the specific forms their members may assume in a design. This can be done in either top down or bottom up fashion. Top down means the production of an extensive, possibly exhaustive series of examples for each digital element and use the results, properly classified and clustered, as templates for identification. Such a series can be produced by observing designs, collecting relevant occurrences and probably augmenting the results with plausible, possible and probable variations. Instead, we have opted for the bottom-up approach: identifying instances of the digital elements in existing designs, without attempting to complete the spectrum with additional instances. This agrees with the critique by Dorst (2008), who has denounced a certain absence of consistency and logic in researches on digital design, a lack of scientific methodology, and, at the same time, he has suggested to apply the scheme *observation-description-explanation* also to this field of knowledge.

Consequently, in the first part of the research we have observed and studied a lot of digital designs, trying to understand common and interesting features, then we have developed a framework of analysis to guarantee consistency; finally we have analysed several case-studies according with this framework. To develop the analytical framework, in order to search for digital influences in a design, we have based our investigation on formal and representational repertoires offered by digital means, grouped under two main categories, *general characteristics*, that do not refer strictly to the use of computer, but put attention on other important points, and *local features*. The former contain two groups: the *overall geometry* of a design, which can be either rectilinear or curvilinear; and its general morphological tendency, which can vary from geometric and biomorphic to anthropomorphic and zoomorphic.

Local features have a wider scope, especially as new digital methods and techniques continuously add to them. They comprise three complementary groups, the first of which contains the *geometric primitives* and *models* used in a design: cones, cubes, cylinders,

freeform solids, NURBS surfaces etc. In this group the dual role of digital means becomes quite evident: at least some of these primitives are not bounded by computational environments; it is simply their definition and manipulation that becomes significantly easier and more reliable with digital means. Other geometrical models are inconceivable outside computational environments either because they emerged in relation to computation or because they are mathematically or geometrically hard to implement and control (Tab 1).

**Table 1:** The classification of case-studies, with respect to geometrical features. (Riccobono, Koutamanis, and Pellitteri 2013)

Category	Parameters (underlined words indicate the parameters related to the digital domain)
Geometry	Rectilinear, Curvilinear, Hybrid
Morphology	Anthropomorphic, Biomorphic, Geometrical, Zoomorphic
Geometrical primitives and models (1st and 2nd order)	Cone, Cube, Cylinder, Ellipsoid, <u>Free-form solid</u> , Helix, <u>NURBS Surfaces</u> , Parallelepiped, Prism, Pyramid, <u>Solid of extrusion</u> , Solid of revolution, Sphere, Tetrahedra, Torus, Wedge, None

The other two groups of local features refer to relationships and manipulations in a representation comprising such primitives. *Formal concepts* cover local, general, bilateral and multilateral relationships such as *alignment*, *axiality*, *horizontality*, *symmetry*, *verticality* etc. These underlie the arrangement of primitives in a design but are not limited by them: they are discernible as patterns and coordinating devices that may be quite indifferent as to the elements they apply to (Arredi 2006). In digital representations such formal concepts are often expressed as constraints.

Finally, *operations* like *Boolean*, *folding*, *revolution*, *rotation* and *repetition* serve two related purposes: firstly, the implementation of formal concepts, e.g. as in the use of reflections and translations to create symmetric forms; secondly, the transformation of primitives so as to produce generally more complex forms (Di Mari and Yoo 2012). The effects of these operations arguably determine most of the cues that allow us to recognize digital influences in a design, e.g. a Boolean combination or the adaptation of a mesh (Tab. 2).

While these repertoires were initially compiled in a bottom-up manner by observing designs and correlating their features to the capabilities of digital design environments, there is also substantial support from literature, especially in some studies about the theoretical conception in architectural design, conducted through the observation and analysis of morphological features related to digital instruments (Evans 1995, Liu and Lim 2006, Oxman 2008, Wong 2010). The overall structure of the repertoires and the definition of their members derives from the *Getty Art & Architecture Thesaurus* (Getty), in an attempt to add lexicographic consistency to the description of digital designs.

**Table 2:** The classification of case-studies, with respect to compositional issues. (Riccobono, Koutamanis, and Pellitteri 2013)

Category	Parameters (underlined words indicate the parameters related to the digital domain)
Form and compositional concepts	Alignment, Articulation, Asymmetry, Axiality, Balance, Complexity, Contrast, Disproportion, Frontality, Gesture, Harmony, Horizontality, Linearity, Monumentality, Obliquity, Plasticity, Proportion, Rythm, Scale, <u>Simmetry</u> , <u>Simplicity</u> , <u>Unity</u> , <u>Verticality</u>
Compositional Operations	Align, <u>Boolean</u> , Break, <u>Bulging</u> , Copy, Divide, <u>Extrusion</u> , <u>Folding</u> , Interrupt, <u>Loft</u> , <u>Mesh</u> , Move, <u>Offset</u> , <u>Overturning</u> , Repeat, Retract, Revolution, Rotation, Scale, Slicing, Sliding, <u>Smooth</u> , <u>Stretch</u> , <u>Sweep</u> , Taper, Tilt, Translation

The analysis of designs concerning these repertoires can be done in two complementary ways, *syntagmatically* and *paradigmatically* (Van Sommers 1984). Syntagmatic analysis refers to the sequence of actions by which different primitives, concepts and operations are entered in the design. Syntagmatic aspects can be of great value in computational and algorithmic studies (e.g. in shape grammars) but they are also difficult to detect in the final design and in many cases only loosely related to design thinking, as there can be various sequences of actions by which we arrive at the same results. Consequently, syntagmatic analyses tend to reveal more about contextual factors, including a designer's understanding of digital means. Paradigmatic analysis focuses on the elements of the design, in our case primitives, concepts and operations, their existence and interrelationships without reference to temporal precedence or such mental hierarchy. This allows us to identify traces and effects of digital means in design representations, with the obvious exception of prescriptive algorithmic techniques like shape grammars. The economy and effectiveness of paradigmatic aspects made this analysis a safe starting point for this research.

## 1.2. Case-studies analysis and classification

The analyses were conducted in a uniform, objective manner and collected in a feature-based structured database that allows a wide variety of queries on the identified features, where each building is described by a number of predefined parameters. The use of a database has several advantages: firstly it gives us the possibility to apply a combinatorial approach, which allows us to figure out relationships among several elements in a building's description, to visualize them and to interpret the results; secondly, organizing information in a database forces us to think in a concrete way, less vague than textual discourses, according to a rigorous logical scheme, where several aspects and their interrelationships can be made explicit. The first part of data collection concerns the description of each building, through fields such as *Building Name* and *Designer(s)*, identified as primary keys, *Location (city)*, *Country*, *Date from and to*, *Client*, *Type* and *Context* (Fig. 2).

ID	Building_name	Location	Designers	Country	Date_from	Date_to
1	Acoustic Barrier / Cockpit	Utrecht	ONL (Oosterhuis-Lénard)	Netherlands	2006	2009
2	Allianz Arena	Munich	Herzog & de Meuron	Germany	2001	2005
3	ARCAM (Architecture Centre Amsterdam)	Amsterdam	René van Zuik	Netherlands	1999	2003
4	Arnhem Station	Arnhem	URStudio	Netherlands	1995	2013
53	Auditorium Parco della Musica	Rome	Renzo Piano	Italy	1994	2004
16	Block 16	Amere	René van Zuik	Netherlands	2002	2004
5	BMW Welt	Munich	Coop Hammelb/jau	Germany	2001	2008
6	Bus Station	Hoofddorp	NIO Architects	Netherlands	1999	2003
44	Casa da Musica	Porto	OMA Rem Koolhaas	Portugal	1999	2005
7	City Hall	London	Foster & Partners	UK	2000	2002
8	City of Culture	Santiago de Compostela	Peter Eisenman	Spain	2000	2011
9	Cooper Union Building	New York	Morphosis	USA	2004	2009
10	Design Museum	Holon	Ron Arad	Israel	2008	2010
11	Docks en Seine	Paris	Jakob+MacFarlane	France	2005	2008
13	Eden Project	Cornwall	Grimshaw Architects	UK	1998	2001
14	Elicium Amsterdam RAI	Amsterdam	Bentham Crowe	Netherlands	2004	2009
56	EYE Film Museum	Amsterdam	Delugan Mevssi	Netherlands	2009	2012
57	Ferrari Museum	Modena	Shiro Studio, FutureSystems	Italy	2004	2012
15	Fiera Milano	Milan	Massimiliano Fuksas	Italy	2002	2005

Figure 2: The main interface of the database.

The analytical part is split up in two parts *general characteristics* and *local features*, as we previously discussed in the paragraph 1.1. Furthermore, given that, despite some projects could seem affine by looking at their formal configuration, materials and overall style, their concepts could often start from very different point of view, we have defined a vocabulary of the recurrent *Design Strategies* derived by the use of digital technologies, describing and explaining each category in all specific aspects (Pellicteri and Riccobono 2012). Then we have classified each project according with these concepts on the basis of design process.

## 2.0 EMERGING PATTERNS. CONCEPTS AND OVERALL TRENDS IN THE DIGITAL AGE

After collecting all data, classifying architectures by settling up all parameters for each case-study, we used the database to obtain results through its combinatorial possibilities. Hence, the main operation was the setting out of several queries, through which questioning the software in order to quickly visualize the results and combinations in form of graphs, tables, reports, etc.

Analysing the result, we can note the strong predominance of curvilinear spatial configurations and the always increasing use of digital media, evident at level of geometrical primitives used

as *conceptual starting point*, where there is a strong prevalence of *Digital* ones (61%), but also at level of compositional operations used to modify and refine the initial shape, where, in general, *Folding* appears the most used (32,4%). This suggests that the design phase actually begins in the computational space: design thinking and conception are becoming more and more identified by a pervasive use of digital technology and by the geometrical and mathematical operations offered by commercial software. Looking at the formal concepts detected among the cases, in general the most represented are plasticity (11,5%), unity (9,3%) and complexity (11,2%).

Finally we focus on *Design Strategies*, linking the results that we have previously obtained about morphological features and composition with designer's conception and methodology. The goal is to be able to understand the existing relationship between form, composition and, above all, design ideas, expression of current times and then related with the digital era at level of form, cultural soul and connection to information technology. Comparing this results with what we have already obtained by the analysis of digital operations and primitives with respect to our trends, we can identify some transverse movements in which we could subdivide our digital-influenced architectures.

**2.1. Digital Expressionism**

**Table 3:** The main features of *Digital Expressionism*

<i>Geometry</i>	<i>Operations</i>	<i>Concepts</i>	<i>Design Strategies</i>
Curvilinear	Digital Domain	Plasticity, Unity	Complexity, Artistic Fact, Blob, Flows, Fluidity, Folded Surfaces

This trend gathers architectures with a strong morphological approach, where building envelope, often with curvilinear configuration, is treated as an art work, refining, folding and shaping surfaces (Tab. 3). This appears linked to the main change caused by digitization of architecture, related to advances in representation field and its consequences. Indeed the easy three-dimensional control guaranteed by software has meant a change in the ways of exploration and conception of architectural space. Nowadays it seems that morphological approach to architectural design takes over and the architectural design starts often from the curvilinear manipulation of shape through several different techniques, that could be both algorithms to generate shape or simply operations allowed by commercial software, pushing to the limit the potential of software to search for often unusual spatial configurations (Fig. 3). Patrik Schumacher, director at Zaha Hadid Architects and theorist of architecture, has understood that this new approach has lead us towards a new style:

We are confronted with a new style rather than just with a new set of techniques. [...] Avant-garde styles might be interpreted and evaluated in analogy to new scientific paradigms, affording a new conceptual framework, and formulating new aims, methods and values. (Schumacher 2009)



**Figure 3:** The Admirant Entrance Building in Eindhoven, The Netherlands, Massimiliano and Doriana Fuksas Architects. Photo by Alessia Riccobono.

**2.2. Hi-Tech Evolution**

Within this category, we have inserted those buildings where the generation of the shape is digitally derived from the optimization of one or several parameters, e.g. environmental, procedural, structural, and so on (Tab. 4). The main protagonists of this tendency are some architects of Hi-Tech tendency with a strong technological approach, who have adapted their design methodology to new software when digital media appeared in professional practice (Fig. 4). The building shape can arise both from the creation of autonomous forms by starting from the optimization of different parameters, or, instead, due to the modification of a primitive, by starting e.g. from a sphere, a cube, a parallelepiped and progressively modifying it, deforming it by following approximations, until it reaches the best possible configuration. Norman Foster, one of the main characters of this approach, in an interesting intervention on DLD Conference in 2007 spoke about the possibilities of digital technology and on the necessity to solve building problems through it.

As an architect you design for the present, with an awareness of the past, for a future which is essentially unknown. [...] I think that digital revolution now is coming to the point where, as the virtual world, which brings so many people together here, finally connects with the physical world, there is the reality that has become humanized, so that digital world has all the friendliness, all the immediacy, the orientation of the analog world. Probably summed up in a way by the stylish or alternative available here and again, inspired by the incredible sort of sensual feel. A very, very beautiful object. So, something which in the '50s, '60s was very exclusive has now become, interestingly, quite inclusive. [...] And I think it's very tempting to, in a way, seduce ourselves -- as architects, or anybody involved with the design process -- that the answer to our problems lies with buildings. Norman Foster (2007)

**Table 4:** The main features of *Hi-Tech Evolution*

<i>Geometry</i>	<i>Operations</i>	<i>Concepts</i>	<i>Design Strategies</i>
Curvilinear	Digital Domain	Complexity, Articulation, Plasticity	Performance optimization, Mathematical Derivation



**Figure 4:** Eden Project in St Austell, Cornwall, England, Grimshaw Architects, 2001. Photo by Jürgen Matern (Creative Commons, CC-BY-SA).

**2.3. Diagram Architecture**

The diagram architecture is not born with digital revolution, but it has assumed new meanings and new procedural ways after the comparison of computers in professional practice. We reported a definition of what a diagram is, made by Ben van Berkel and Caroline Bos, founders of UNStudio, an pioneers in the use of IT in architecture and digital diagrams (Tab. 5).

The diagram is not a metaphor or paradigm, but an 'abstract machine' that is both content and expression. This distinguishes diagrams from indexes, icons and symbols. [...] Diagrammatic practice delays the relentless intrusion of signs, thereby allowing architecture to articulate an alternative to a representational design technique. A representational technique implies that we converge on

reality from a conceptual position and in that way fix the relationship between idea and form, between content and structure. When form and content are superimposed in this way, a type emerges. (Van Berkel, Bos, and UNStudio 1999)

Digital diagrams, often integrated in some software or add-ons, have become an operational concept tools. Indeed, it often happens that what was initially mapped as diagram, e.g. for users movement, in the final phase of project become the base of formal configuration. This way to work with diagrams is shared by several architects, as, we reported before, UN Studio, but also Rem Koolhaas, Delugan Meissl (Fig. 5) and, above all, Peter Eisenman, whose diagrammatic approach is more related to digital deformation of grids.

**Table 5:** The main features of *Diagram Architecture*

<i>Geometry</i>	<i>Operations</i>	<i>Concepts</i>	<i>Design Strategies</i>
Curvilinear (50%) Rectilinear (50%)	Digital Domain	Complexity, Articulation,	Diagram, Grid



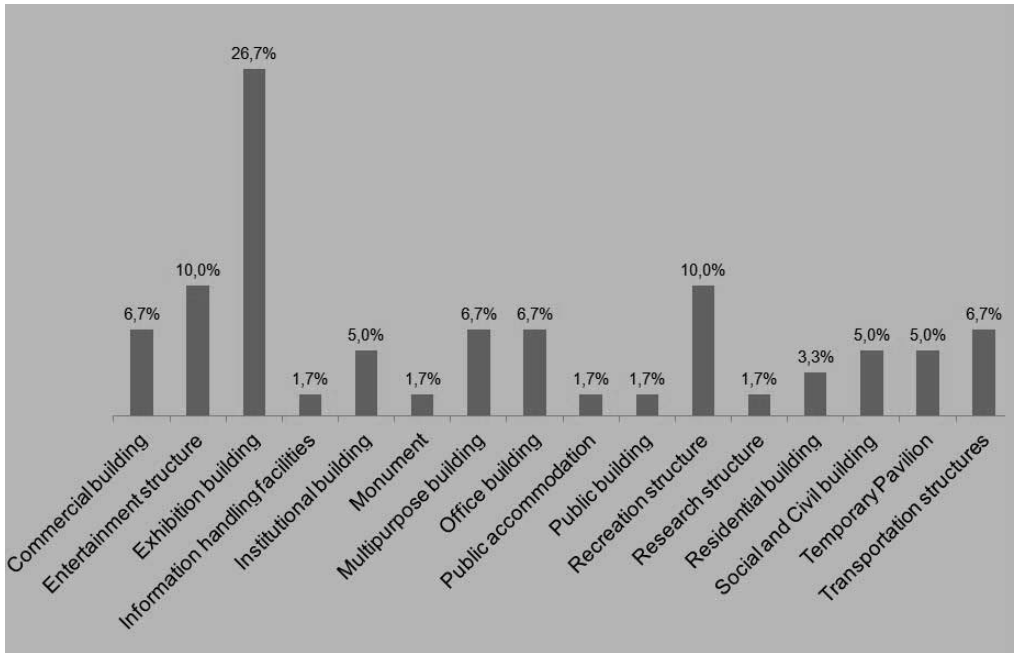
**Figure 5:** EYE Film Museum in Amsterdam, The Netherlands, Delugan Meissl Associated Architects. Photo by Alessia Riccobono.

### 3.0 DESIGNING IN A DIGITAL WORLD

Following the identification of the main digital trends, we would linger on some general issues, recognizable in all our tendencies, that have affected current digital-influenced architecture.

#### 3.2 Museums as new iconic buildings

By analysing our cases, it is surprising to see the great quantity of Exhibition buildings (27%), that comprise both museums and centres where the main scope is the dissemination of information, through the exhibition, such as trade fairs, temporary pavilion, etc. Other prevalent categories are *entertainment*, *transportation*, *multipurpose* and *recreation*, in total 33,9% (Graphs 1). Filtering these types recognized through the variable of geometry, we can observe a very high presence of buildings with curvilinear configuration.



**Graph 1:** Absolute prevalence in the category *type* and *context*.

This datum appears very significant in order to understand our contemporary culture and society. In fact, while in architectures such as offices the formal experimentation remains more limited by the function - and we should also report the absence of digital influenced buildings in the categories commercial buildings, industrial, public accommodation, etc. - the digital expressiveness gains the upper hand. Architects have the freedom to fully play with morphology in relation to museums, stations, multipurpose buildings, architectures featured by more flexible spaces, where functions are sometimes not well distinguished, by often impressive dimensions and, above all, buildings with a great cultural value for the community and the cities, where there are often required elements of novelty, iconoclasm, non-conformism, majesty.

What is surprising about digital influenced architectures is that the majority of them are referred to functions connected to sharing information and communicating culture and belonging. Buildings where people can identify and admire the *mise-en-scene* of own passions, i.e. in the cases of automotive museums (BMW, Porsche, Mercedes, Ferrari), in an atmosphere of grandiosity and celebration (Fig. 6).

Without fear of making mistake, we can assert that museums are the new *Icons*: as in the Past, at least until the Industrial Revolution, the major role to propose new representative buildings, *avant-gardes* in the upcoming architectural language and style, was covered by sacred institutions or governments, in the current times it seems this role belongs to who wants to share culture, both in public and private sector.





**Figure 6:** BMW Welt in Munich, Germany, Coop Himmelb(l)au. Photo by Alessia Riccobono.

### 3.3 Same expressivity, different contexts

Our analysis reveals that architects maintain the same approach with respect to diverse physical context - it seems that is indifferent if we are in an old city, inner city or rural area, etc. - with percentages more or less balanced. Also the geographical area seems to be indifferent and this is the evidence that we are dealing with a global tendency. Then, architectures are often treated as *objects* rather than *buildings*, positioning these "friendly aliens", as Peter Cook (2004) defined his Kunsthaus design in Graz, with the scope to attract people who want to admire - or criticize - their art work. As we have already discussed about museums and type, everyone competes to acquire an architecture that express the latest innovations in terms of style, materials and overall image. For this reason we can explain and justify the tendency to acquire new fashion architectures, particularly evident in those countries where the economy is in growing - Middle East, China and Orient in general. The buildings are statements to have become part of the capitalist system and, then, have to express a certain sense of belonging. Moreover in these countries there is still less attention to the urban context with respect to what happens in Europe, where, as far as possible, it was tried to preserve the historical and cultural roots.

### CONCLUSION

The use of real-world, prominent designs of our casuistry shows these digital influences in critical, high-risk situations where designers tend to pay more attention to project success, client requirements and overall appeal than to any computational principles and approaches or to the context, which is almost always ignored. As a result, we consider that our sample verifies the claim that digital means have become a ubiquitous part of architectural design tools and that their current common use has caused the birth of new figurative trends. Moreover, with the increasing number of younger architects who have had an early exposure to the computer and have an high level of practical skills in design computing, the use of digital design methodology will keep increasing.

One of the main issue of digital-influenced architecture resides in the fact that this new *style* is formally based on free expressions, without a *canon* or a *style*. We think that this recognized digital trends, driven by international firms, introduces new degrees of complexity in profession. Indeed, during the development of a project, it could happen that practitioners will tend to keep merely the style or the formal configuration of some fashion designs, forgetting and not considering other aspects related to design conception, such as cultural references and contextual choices. For this reason, projects as those reported in this research, where the taxonomic values are strong and where the designers tend to develop their own style, could conduct to a simple reproduction of *beautiful forms*. Up to now, just by giving a superficial look at architectural websites like Archdaily.com or Europaconcorsi.com, where practitioners can upload their own projects, we can note strong similarities in some professional projects with international firms designs. Hence, we would conclude this treatise with a series of open questions. Will architectural scenario become analogue to Fashion or Industrial Design? Will we choose our future style as we normally choose a clothes? Probably only the time can give us the right replies, but now it seems fundamental that architecture will begin to question about that.

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# Visible and invisible infrastructures: alternative futures in resiliency, failure and design pedagogy

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**ABSTRACT:** This paper explores the pedagogic and community initiative sponsored by a multi-year interdisciplinary (M.Arch and MLA) design studio project entitled "Design Duluth." Motivated in part by catastrophic flooding in the city of Duluth, Minnesota in June of 2012, this research investigates - through the structure and pedagogic programming of the semester - how complex infrastructures are networked (or not), constructed (or fragmented), dynamic (or static) within the a complex city landscape. The project is rooted in developing, critical and creative topical to issues of resiliency and failure in and across architectural, ecological and urban systems. The studio explores how we can seed and implement innovative methods of interdisciplinary studio teaching and research and perhaps most importantly, how we can help students have agency in a blurry world of shifting pedagogy and practice.

**KEYWORDS:** Resiliency, Pedagogy, Duluth, Architecture, Landscape

## INTRODUCTION

The contexts in which design projects are situated are more complex and difficult than ever. In particular, recent events "from extreme weather...such as epochal hurricanes and floods, geologic disruptions epitomized by the Indian Ocean and Sendai earthquakes and tsunamis, to the 9/11 Terror Attacks, ongoing wars in Iraq and Afghanistan, ethnic genocide in Darfur, popular uprisings in several Arab countries during 2011, and the global economic recessions of 2008 and 2011" (Stokols, Lejano, and Hipp 2013, 1) have diminished the capacity of design as a responsive and responsible act. Daniel Stokols states that "[r]eflecting on the succession of calamitous events that have occurred in recent years, scholars and policy makers from a variety of fields have begun to question whether humans' capacity for protecting the near-term resilience and longer-term sustainability of the earth's fragile ecosystems has been inexorably surpassed by converging environmental and societal perturbations that are now beyond our control" (Stokols, Lejano, and Hipp 2013, 1).

If the ability to manage and protect resources in the short-term, and to plan for sustainability in the long-term is beyond our control, how does design (as a conscious act of reordering systems and space) respond to this challenge? What new tools and methods must be developed to move beyond the typical short-term responses?

### 1.0 Resiliency

The term resilience was introduced into the English language in the early 17th Century from the Latin verb *resilire*, meaning to rebound or recoil (Concise Oxford Dictionary 1999). In 1858, Robert Mallet used the concept of resilience to compare the strength of materials used in the construction of ships. Mallet developed a measure, the modulus of resilience which he defined as the force required to rupture a material. The modulus was used to assess the ability of materials to survive severe conditions. The modulus is still part of the design codes for structural, civil, and mechanical engineers, and naval architects.

Mallet defines resilience as the ability of objects or systems to retain certain characteristics or performance within a tightly bounded zone of disturbance. Modern definitions of resilience have trended towards a dynamics of identity (under what conditions is the thing still the thing, or even a thing). The fundamental concepts of modern resiliency are derived from C.S.

Holling's research into ecological change. Areas of expertise that now use or employ resiliency thinking, strategies, or concepts include economics, security disaster planning, psychology, and ecology.

Ecologist C.S. Holling first posited resiliency as an ecological concept in 1973. Holling defined resilience as the ability of an ecosystem to absorb change and still exist (Holling 1973). Holling contrasted ecological resilience against a mechanistic view (coherence/identity until failure) where ecosystem stability, resistance to disturbance, and speed of return to any stable state were the main indicators of resilience. As many ecosystems are profoundly affected by external changes, the immediacy and constancy of ecosystem behavior is less important than adaptability. "Ecological resilience is a measure of the amount of change or disruption that is required to transform a system from being maintained by one set of mutually reinforcing processes and structures to a different set of processes and structures" (Gunderson, Allen, and Holling 1998, 177). Holling posited that a resilient ecological system had many possible stable states, and that these states shift in accordance with external and internal changes to the ecosystem. Ecologist Richard Klein has taken Holling's concept even further and shown that ecosystems may have no stable states and may be in constant flux. In a study of the Dutch coastline, Klein defined resilience as "the self organizing capacity...to preserve actual and potential functions under constantly changing circumstances" (Klein, Nicholls, and Thomalla 2004, 40).

Resilience is a dynamic property of a system, and managing it requires a dynamic and adaptive approach. Through the course of studio, we attempted to present and explore the many different definitions and contexts of resiliency and employ design strategies derived from principles of resiliency. Students were (and are) expected to develop their own definition and design frameworks of resiliency as the basis for their work. In light of the original and emerging definitions of resiliency, we asked students to reflect on the following baseline characteristics of what may constitute a resilient infrastructure:

1. The systems we are dealing with are self-organizing.
2. There are limits to a system's self-organizing capacity.
3. These systems have linked social, economic, and biophysical domains.
4. Self-organizing systems move through adaptive cycles.
5. Linked adaptive cycles function across multiple scales.
6. There are three related dimensions to resilience: specified resilience, general resilience, and transformability.
7. Working with resilience involves both adapting and transforming.
8. Maintaining or building resilience comes at a cost.
9. Resilience is not about knowing everything.
10. Resilience is not about not changing.

## **2.0 All about Duluth, or, Also, the lake**

Emerging from an 18th and 19th century amalgam of opportunity and enterprise colliding with Archean and Proterozoic geologies, Duluth is bounded by the ferric landscapes of the Iron Range and the liquid bodies of the Great lakes. Human industry and an extraction-based economy has given Duluth its history and set the stage for its alternative and desired urban future. At the end of the 19th century, Duluth was home to more millionaires per capita than any other city in the world. The city's port was the largest in the United States, surpassing both New York and Chicago in gross tonnage handled. To take advantage of the iron ore extraction in the Mesabi Range, US Steel constructed a \$5 million plant south of the city. Steel production did not begin until 1915, and many predicted (hoped) that Duluth would be the next Pittsburgh.

Duluth's fortunes shifted radically in the 1950s as the high-grade iron ore. Low-grade ore (taconite) shipments continued, but substantially decreased due to global fluctuations in steel demand. As the shipping center for a number of extraction industries in the past and present, Duluth had been subject to the boom-bust nature of these industries. From the early lumber industry to iron ore mining, and now taconite production, the unstable economics of extraction

has been difficult for the residents of the city and the region. Forced dependencies on large manufacturing further destabilized the future of the city — the closure of the US Steel plant in 1981 also forced the closure of the cement plant as it was dependent on the steel plant for raw materials (limestone slag). The economic (and social) downturn continued, and in the 1990s more large employers left the city, including shipbuilding, heavy machinery, and an Air Force base. By the end of the 2000, unemployment was over 15 percent.

Plateaued at an approximate population of 86,000 since the 1990s (from a steady decline since the 1960s),<sup>i</sup> present day Duluth wrestles a history that distorts the memory and dampens the desire to move beyond the “rose-colored view of a return to the hey-day of industrial manufacturing” towards new industries (aerospace + health-care) and new foci (art and culture, recreational tourism). This history — cultural, industrial, and urban — must also contend with the geography of the city itself and its infrastructural systems, its disparate neighborhoods, the presence of the Duluth-Superior Port and its implications as a waterway to the Great Lakes, the St. Lawrence, and the Atlantic. All of this exists in a context of the reality of new and varying capital models and the strong pull of historical and cultural memory, of shifting (and potentially drastic shifts) populations and demographics (locals, insiders, students).

The geography — both cultural and physical — is deeply embedded with and connected to the regional traditions and reality of the Iron Range — to manufacturing, extraction, ideas of place and belonging, of national and international history, of drastic turns of fortune, and of the contemporary need to address new economic, cultural, and physical manifestations of Duluth. While Duluth, Minnesota enjoyed its industrial hey-day in the early 20th century (“Philadelphia’s Western Suburb!” “More Millionaires per capita than anywhere else in the US!”), it is today one of the most challenged (yet simultaneously hopeful and beautiful) cities in Minnesota. One third of Duluth’s population lives in poverty or are considered working-poor (double the poverty rate of Minnesota)<sup>ii</sup> and 67% of the African American population and 56% of the Native American community are at or below poverty level.<sup>iii</sup> The population has now stabilized with a demographic that is younger, more outdoor oriented, and less affluent. Mayor Ness’s 90/20 Initiative — to grow Duluth to a population of 90,000 and to become the new Boulder or Burlington by the year 2020 is a major benchmark. This conscious shift (as policy, physical intervention, and marketing bravado) away from the legacy of industry/extraction is one, which in his words will require significant risk (and pain for some).

### 3.0 The New Normal

Duluth is located on Lake Superior, the largest of lake in the world by surface area, and third-largest by water volume. The lake is part of the Great Lakes system, which combined holds 31 percent of the world’s surface fresh water. The Great Lakes are subject to local, county, state, national, and international jurisdictions, with states often overriding (or attempting to) international policy and treaties. The International Joint Commission, a US-Canada advisory body assists in the enforcement of the 1909 Boundary Waters Treaty and management of Great Lakes resources.

The lake tempers Duluth’s weather in the summer, and exacerbates snowfalls (with lake effects snow) in the winter. Today, Duluth is a 27 mile long city, with over a 700-foot elevation difference from crest to the shores of Lake Superior, formed by glacial and volcanic rocks at the Mid-continental divide, with a geologic section that has bedrock at times, no more than 100 feet below streets and buildings. Recent weather-driven events, including the first tornado sighting and damaging rainstorms make Duluth an ideal study area to test climate resilient strategies. Researchers believe that changing weather patterns and warming of (the usually frigid) Lake Superior may make torrential storms a regular part of the normal weather pattern. Changing lake temperatures (slow warming) may also be responsible for new weather patterns, and increased rainfall and large storm events.

This new normal has severe consequences for the city: “The general consensus is that much of the older infrastructure is undersized based on current weather trend.... The weather is

clearly different in last 15 years or more. According to analyses of existing data, there is an increased frequency of big, intense storms” (Vogel 2012). Despite reducing the percentage of impervious surface from 1990 to 2000 and passage of a new unified development code in 2010 that restricted the creation of new impervious surfaces, Duluth saw record damage from the June 2012 storm.<sup>iv</sup> Estimated at well over \$100 million, the city saw destruction of city streets, bridges, and the storm and sewer infrastructure, as well as the washout of the many hiking trails and disturbance to many stream habitats including protected trout streams (Fig 1).



**Figure 1: Duluth Storms**

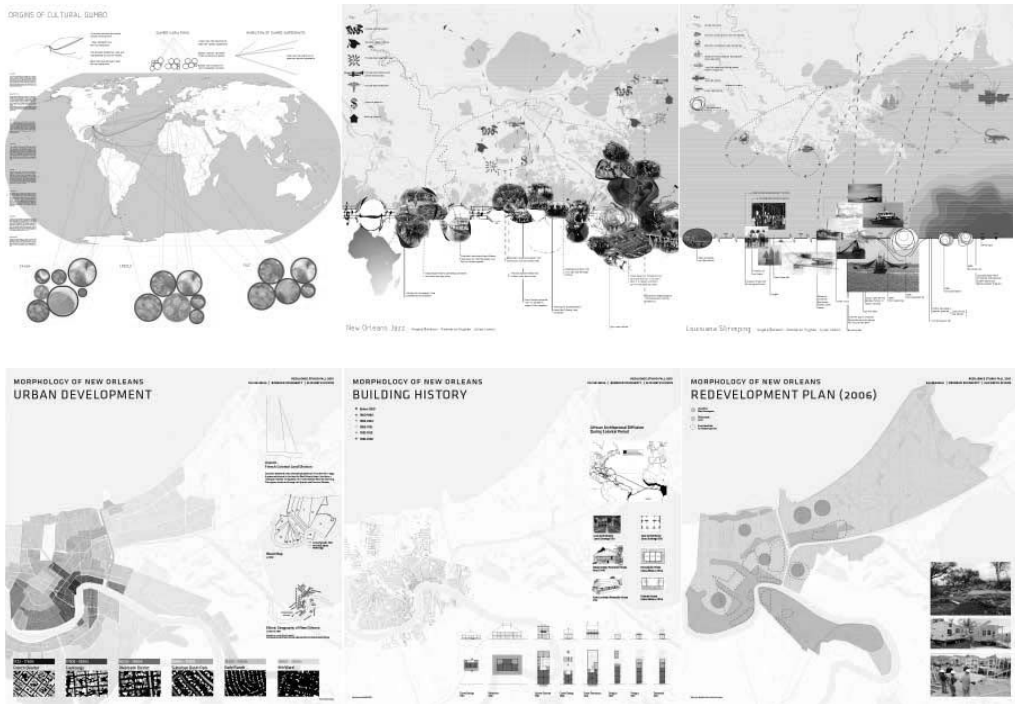
#### **4.0 Year One: The 2012 Design Studio**

Our initial pedagogical objectives were to research, analyze, and map interwoven and cross-scalar social, economic, and environmental systems; and to do this in ways that revealed underlying relationships and (dis)connections necessary to construct resiliency and to anticipate (or design for) future (graceful) failure. Mapping across scale, time, and within nested systems (site, city, region) challenged traditional analysis and cartographic techniques. We needed to rethink methods of data collection, analysis (type and process), and modes of graphic representation. Collecting data across both scale and time generates potentially crippling amounts of information. The challenge was to sift, edit, and transform this material into analysis as a tool for developing well informed, grounded, and projective designs. Strategies employed in the semester projects included explicit requirements for the students to work across multiple systems and scales, for projects to address long time frames (programs and designs had to be projected over 50+ years), the adaptation and co-option of existing systems, and an emphasis on the design of hybrids (that encompassed soft and hard infrastructures as well as policy).

#### **4.1 Projects**

##### **Group Project 1: Pre- and Post- in the Not-So-Big Easy — Mapping Time and Systems in New Orleans**

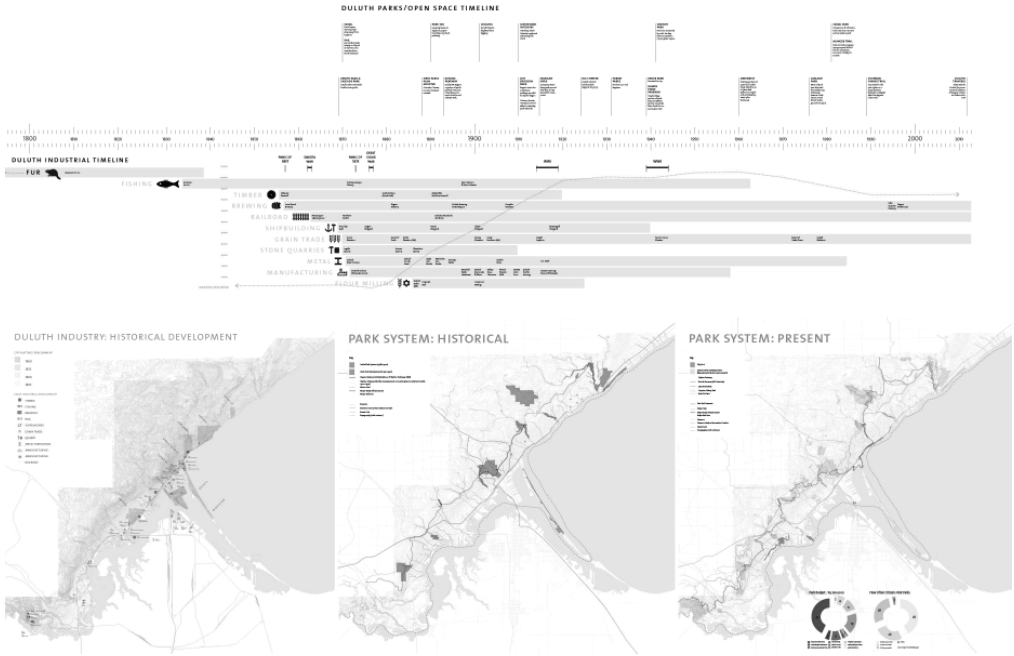
Students were given the city of New Orleans as a case study to quantify and analyze a set of cultural, environmental, or economic systems with a focus on their historic and current relevance, physical attributes, and implications (Figures 2,3). Beginning with Hurricane Katrina as the inflection point in these systems, we hypothesized that the students would have an easier time tracking modes of resilience and failure across a large-scale catastrophic event, and would therefore build the capacity to analyze nuanced and less obvious instances when working in Duluth. During this process of research, mapping was introduced as a subjective and political act that required making decisions about where and how to gather and synthesize data. Final maps were printed on vellum and were overlaid to find new points of contestation or congruence, as well as systemic connections and disconnects.<sup>v</sup>



**Figures 2,3:** Mapping New Orleans

**Group Project 2: The Untold Delights of Duluth or Making the City Visible**

Students turned to Duluth to conduct another case study, which increased the complexity of observation and analysis by requiring the study of interactions (or lack of interactions) between multiple systems at multiple scales. They analyzed the overlaps and incongruences and the physical and conceptual convergences of systems in the city and surrounding region. As the connections or disconnections were altered or aligned in different ways at different scales, students were required to produce two sets of models and diagrams; the first at a scale of their choice and the second inverted from the first (scaled up or down). This scale shift towards a smaller or larger area of focus area generated different congruencies and circumstances of interaction(Fig 4).



**Figure 4:** Mapping overlapping systems in Duluth

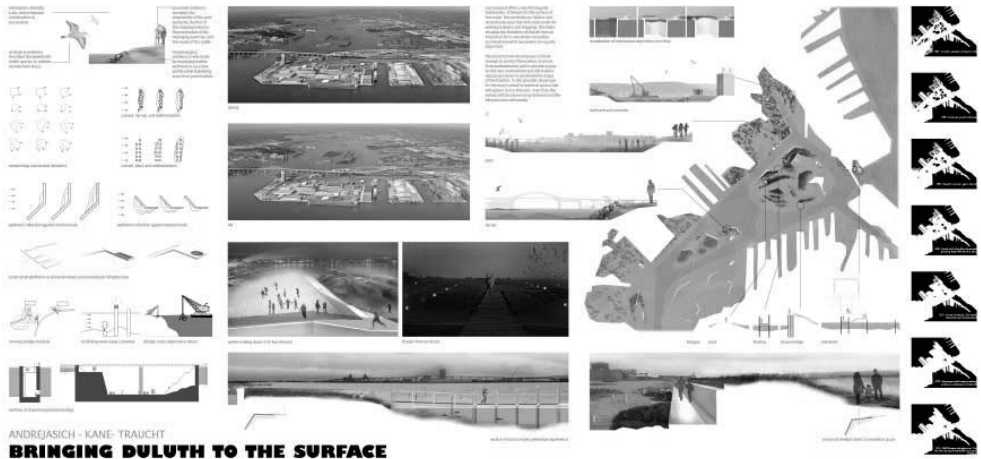
**Group Project 3: Lost in Transliteration**

One of the challenges of research-based design that spans scale, time, and discipline is the critical distillation of abundant data sets into analysis and designs. The fourth project, a week-long charrette, developed schematic iterations of potential futures for Duluth. This exercise set the foundation for the final project by having students work in small groups to generate a shared collection of program and design options for sites throughout the city. Students developed design scenarios grounded in an understanding of historic and current systems that might be influential in future resilient designs for Duluth.

**Group Project 4: Proposals for New Urban Futures**

Project 5 was the creative synthesis of the studio, using the shared work generated in previous projects to craft proposals for a selected site in Duluth. With dozens of models, hundreds of diagrams, drawings, and photographs as contextual material, the students established a rationale and framework for the development of a specific site, program, and assemblage. This framework established the scope and scale of their design proposal. During this project the students developed relationships with specialists from the city, state, and federal governmental agencies, consulting firms, and NGOs. These experts provided a technical and political context for specific issues students were addressing, timelines of historical action (and in-action), and anticipated future goals for the projects. The relationships established during this time signaled a fundamental shift in the studio — from singular effort project to a larger (in time, scale, and commitment) collaboration (Figures 5,6).





**Figures 5(Top) and 6(Bottom):** Alternative Urban Futures for Duluth

**5.0 Year Two: The 2013 Design Studio, or, Where we’re at**

We’ve attempted this year to more rigorously ground the studio with a more robust conceptual framework, to better pace the structure of the studio and to get students on the ground much more quickly. We limited the number of projects (all of them concentrate on Duluth), and all of them require students to work in multidisciplinary teams.

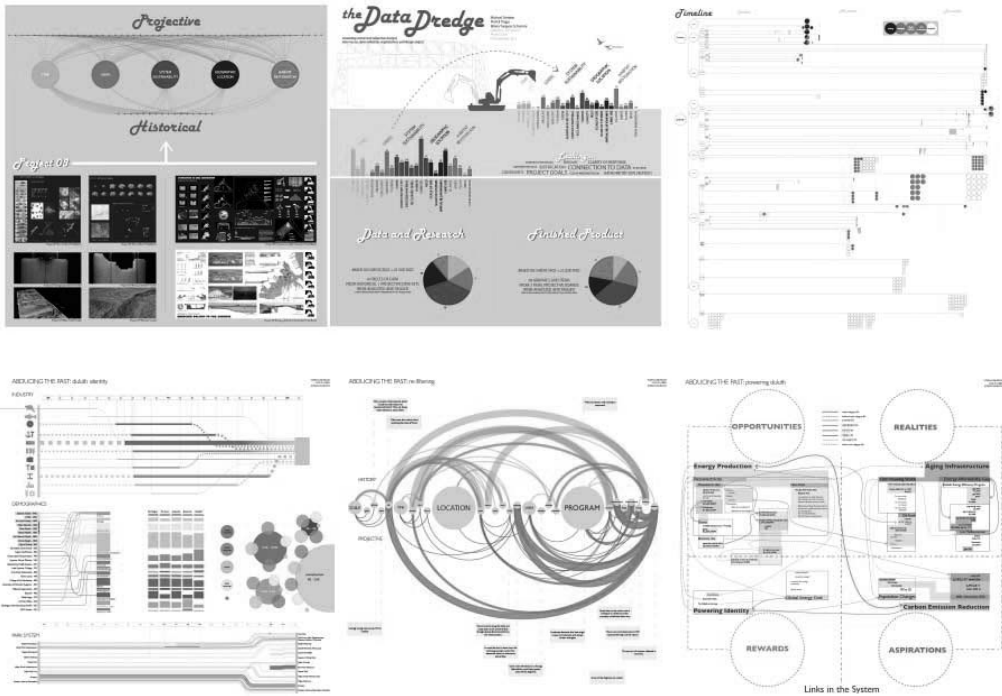
This year we’ve also introduced a related seminar that we’ve connected to the studio via macro and micro content lectures and workshops. As a way to encourage students to remain flexible and adaptable at ALL scales, some lecturers speak to large scale, theoretical issues of resiliency or risk, while others deal with very focused, particular and granular issues.

**5.1 Project One: Abducting the Past**

This first project of the Design Duluth studio focused on critical analysis, processes, organization, and hierarchy. Information overload, first used by Alvin Toffler in the 1970 publication *Future Shock*, is a now commonly used phrase (rehashed as “linkbait” ad nauseum) that refers to surfeit of virtual and real “stuff” that flows through our daily lives. Clay Shirky notes that historically information have been mediated and filtered by a third-party —publishers of books, movie studios, art museums and galleries, etc. have controlled production and distribution. With the advent of the internet, the costs of production have dropped precipitously

and modes of distribution have also multiplied. The responsibility of filtering (or the faddish curating) has moved to other parties, including the user/consumer.

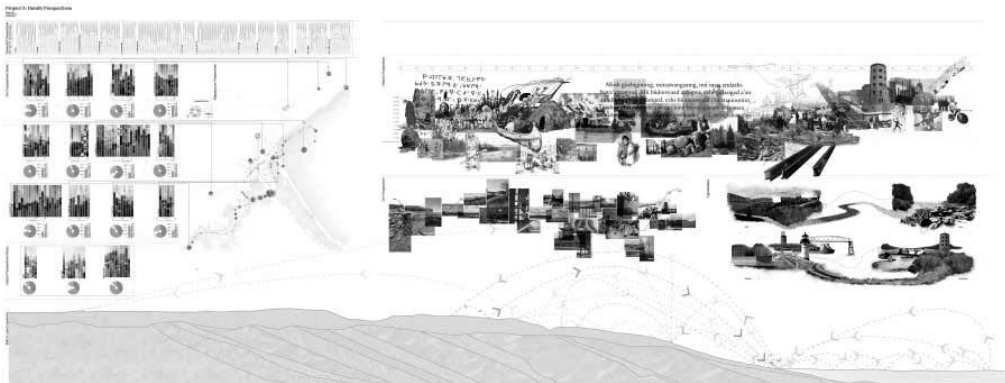
We now collect (as well as re-source and re-mix) concepts, ideas, frameworks, and details from many sources. These virtual and material bits of data are (usually) collected unconsciously and obsessively, poorly documented, and rarely cited. For all its problems, current remix culture mimics, through the action of critical re-appropriation, historical modes of creation in design and the arts — though this studio proposes to “academic up” the remix by focusing/obsessing on processes and by requiring attribution of all contributory material. Why? We are trying to embed resilience in studio processes. Thinking through resiliency requires explicit definition of systems, systems bounds, thresholds, and failure points. Design and the boundaries of that system (all the stuff we do, consume, and produce while producing) will be — in this studio at least — recorded, analyzed, filtered, and represented to make explicit the decisions and materials that are part of the product and product rhetoric. Working in these interdisciplinary teams, students were asked to reverse engineer/perform a forensic analysis on the logic and design decisions of last year’s given landscape and architecture projects through the evidence provided by the assigned datasets (Figs 7,8)



Figures 7(Top) and 8(Bottom): Reverse engineering 2012 Projects

**5.2 Project Two: Gaps and Fills**

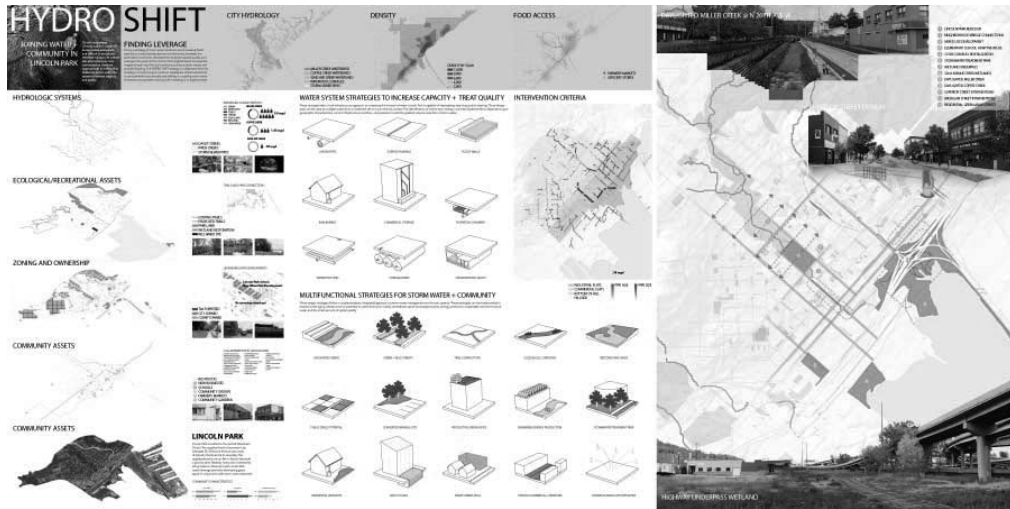
As an isolated inquiry, each group analysis of the datasets from Project 1 indicated/suggested the interests/obsessions of a subset of last year’s studio. This inquiry leads directly to Project 2 — the transfer/translation of abstracted knowledge to the world. Project 2 requires that each group transfer and translate the abstract knowledge gained of Duluth to the physical city — and to search for site-specific circumstances of found/recorded overlaps, redundancies, specific and non-specific indicators, potential gaps, missing information, missing programs, etc. For this project, students were asked to generate responses to site-specific instances of overlap/gap/etc(Fig 9).



**Figure 9:** Gaps and Fills

### 5.3 Project 3: Systems/Systems/Systems

For this project, students were asked to prepare a system-based scenario condition for Duluth, to analyze and interpret it through analytical, conceptual and design lenses, to cast-back and challenge initial assumptions and to further develop the crafted scenario. They were given an introduction to futurist strategies for scenario development (“The Long View,” “Think from the Outside-in,” “Embrace Multiple Perspectives”) and to be clear about the nature of their scenarios (renamed as “inflection points” in order to dispense with the sometimes accumulated “preciousness” of particular scenarios). They were asked to clearly orient, explore, synthesize and act (Fig 10).



**Figure 10:** Potential Duluth scenarios

### 6.0 What we learned

As part of the post-studio evaluation from 2012 (Fig 11), we wanted to reassess what we had done in terms of pedagogy, studio direction, and community engagement. This reassessment is the foundation for another 6 years of studio teaching. The first run of the studio biased data over place and, most importantly people. The network of assets cultivated for Project 5 (over 24 organizations) became both engine and fuel for the studio. Getting connected — on the ground — faster is key to more informed data gathering, analysis, and the generation of

transformational and projective data sets. Mapping within this grounded context is less abstract and less disconnected.

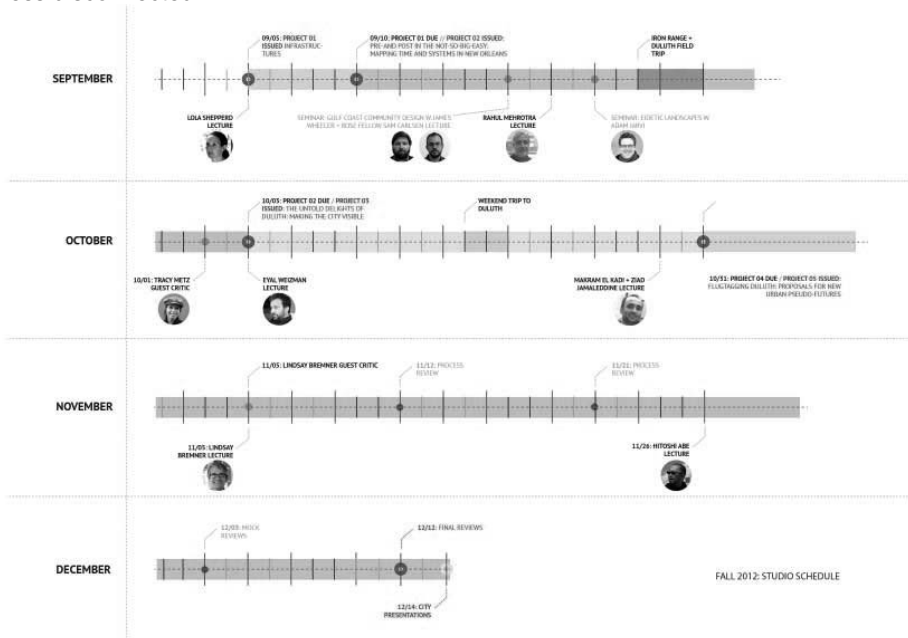


Figure 11: 2012 Studio Structure

Assigning five projects over 15 weeks was overwhelming. Large scale systems need time and productive gestation to be understood and to become useful — overlapping systems are less daunting when they are critically contextualized. We will, in the future, prioritize this across the design studio semester.

The output generated by students needs to be understood, contextualized, analyzed, transformed, and re-represented. And then reprocessed once again. Process, as a system for the organization and processing of data is critical to the studio. Complex systems defy first passes; they themselves contain processes and relationships that are not easily distilled. Process in future studios (as a technical standard and working method) will be embedded in project briefs and structures of work (Fig 12). Students will be asked to turn data into tools, and will be required to develop a system to manage systems.

- **Designers must be system thinkers.** Design Duluth is premised on the fact that only by engaging with complex and multiple systems (economic, housing-stock, transportation, water, food-systems, socio-cultural, socio-political) across a variety of scales (site to region) can we leverage interdisciplinarity as a transformative urban agent.
- **Studio projects must be grounded in community and in connection to the people who live there.** Grounding the studio in the City of Duluth brings forth vibrant projects that stem from the community. Work must deal with “the messy everyday” and generate grounded responses to difficult issues.
- **Every design studio should be (in part) an innovation hub — to cluster talent, resources, information, and tools.** The work of the studio relies on a network of individuals and organizations: community members, professionals, and academics that provide local and specialized expertise and to serve as resources (and educators) for a networked learning experience that happens within and outside the bounds of the University. In order to respond sensitively to the city context and

develop innovative future scenarios, we seek out local expertise and knowledge as resources for design and as a forum for community engagement. Duluth benefits from the development of new networks through the collaboration of experts and community members in new forums for engagement.

- **Resilient design is grounded in building tight information feedback loops.** The Design Duluth studio is an informational free-for-all that not only encouraged open data exchange policies – it fundamentally requires it. This allows for a deeper and more nuanced exploration of complex systems and the minimization of research redundancy.
- **Mandate adaptation to site, context, and studio successes and failures.** Built into the Design Duluth collaboration is a strategic flexibility that allows for fluidity (of processes, strategies, and actions) and a fixedness (of values, long-term goals, and purpose). By collecting and systematizing as many types of information possible (the city's goals, current and long term projects, student process and design, points of contact and information sourcing) we will increase our ability to contextualize changes in understanding the needs of the city (and the students) and respond to these shifts over time.
- **Develop pedagogical design process and project prototypes (and products).** For Design Duluth, we are interested in developing prototypes of design processes with the potential of delivering projects and policies that propose lateral solutions to difficult and complex problems. We hope that the design processes and their products become a method for the city to visualize existing and potential opportunities for a resilient future. Resilient design that addresses risk management by mapping systemic fragilities and thresholds is a driver for developing new technologies that helps communities decouple from ecological scarcity and uncertainty.
- **Create and Build Capacity.** The current Design Duluth studio now has 5 faculty members with a variety of time commitments (2 full-time and 3 adjunct/part-time) and has secured over \$50,000 in funding for academic and further community engagement. We are committed to the development of a long-term vision for Design Duluth and the building of capacity through teaching, community engagement, and the delivery of speculative projects. Design Duluth now cycles through a process of idea and design generation (the fall to winter design studio); reassessment, refinement, and synthesis (winter to spring); and restructuring and reframing of the studio process and theoretical and pragmatic approaches (summer). This annual cycle has an embedded responsiveness to new knowledge, relationships, and funding, and generates a feedback loop/cycle that both informs and transforms our methods of teaching, structuring community relationships, and delivering projects. Building on past projects, each subsequent studio will have the ability to analyze and (hopefully) develop more nuanced and complex projects. This is an important methodological shift in teaching environmental objectives — they are too complex and susceptible to change over time to not rely on interdisciplinary collaboration, data sharing, and a foundational knowledge of the historic, current, and projective future of the city.

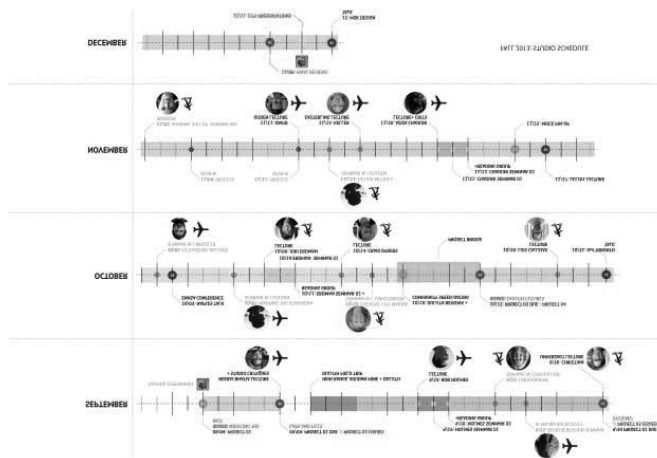


Figure 12: 2012 Studio Structure  
FIGURE CREDITS

- 01: Photographs by Derek Montgomery  
(<http://minnesota.publicradio.org/features/2013/06/duluth-flood-before-after-gallery/>)
- 02: Angela Bateson, Kammeron Hughes, Julian Lemon (Design Duluth Studio, 2012)
- 03: Brendan Dougherty, Kai Salmela, Elizabeth Hickson (Design Duluth Studio, 2012)
- 04: Brendan Dougherty, Kai Salmela, Elizabeth Hickson (Design Duluth Studio, 2012)
- 05: Alec Sands, Chris Wingate (Design Duluth Studio, 2012)
- 06: Matthew Traucht, Jessica Andrejasich, Danica Kane (Design Duluth Studio, 2012)
- 07: Brianna Lauren Turgeon-Schramm, Patrick Triggs, Michael Schiebe  
(Design Duluth Studio, 2013)
- 08: Jordan Barlow, Kaylyn Kirby, Stephanie Erwin (Design Duluth Studio, 2013)
- 09: Jordan Barlow, Kaylyn Kirby, Stephanie Erwin (Design Duluth Studio, 2013)
- 10: Amber Hill, Elissa Brown, Yong-Sam Kim (Design Duluth Studio, 2013)
- 11: Fall 2012 Design Duluth Studio Schedule (Ozayr Saloojee, Vince DeBritto)
- 11: Fall 2013 Design Duluth Studio Schedule (Ozayr Saloojee, Vince DeBritto)

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## ENDNOTES

- i The 2000 Census set the population of Duluth at 86,918, a small increase from 1990 Census population of 85,493. This slight population increase ended a 30-year decrease in population from the population peak of 106,000 people in the 1960 Census year. The 2012 Census estimates the current population to be 86,211 (<http://quickfacts.census.gov/qfd/states/27/2717000.html>, accessed 12 August 2013).
- ii The Minnesota poverty rate is 11%. Household income for family of three living in poverty is \$17,374 while the median household income in Minnesota is \$58,476 (<http://quickfacts.census.gov/qfd/states/27/2717000.html>).
- iii 17% of whites also live in poverty ([http://unfaircampaign.org/wp-content/uploads/2011/09/Racial\\_Disparities\\_and\\_Poverty1.pdf](http://unfaircampaign.org/wp-content/uploads/2011/09/Racial_Disparities_and_Poverty1.pdf), 2010 Census).
- iv An estimated 17.5cm of rain fell over a 24-hour period. ([http://www.crh.noaa.gov/images/dlh/StormSummaries/2012/June19\\_flood/Records.pdf](http://www.crh.noaa.gov/images/dlh/StormSummaries/2012/June19_flood/Records.pdf)).
- v Ironically, this overlay method was pioneered by Warren Manning and Charles Eliot while working in the Olmsted office in the 1890s (see Neckar, Lance. 1989. Developing landscape architecture for the twentieth century: The career of Warren H. Manning. *Landscape Journal* 8: 79–91). In Duluth, the past is a dimension of present and future. This looking back (both in process and context) is a core component of the studio. David Gissen observed that “But the idea of the future always implies a present and a past-and we need to think about what the role of the historical might be within some near or immediate concept of the future.” David Gissen, interview with Geoff Manaugh in *Geoff Manaugh, 2013. Landscape Futures: Instruments, Devices and Achitectoral Inventions*. New York, NY: Actar Press.

# Translating ecological systems models into generative, real-time, form-based visualizations

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**ABSTRACT:** This paper outlines a new methodology for generating and representing site driven biogeochemical forces as dynamic formmakers utilizing Grasshopper 3DM, and its plugin Kangaroo, as translators of ecological systems models (ESM's) into parametric modeling protocols. It also discusses the critical nature of communicating the impacts of these dynamic forces in human cone-of-vision perspectival visualizations that are legible to designers, scientists, and the general public so that they may be utilized as part of larger planning decision making processes.

Within today's context of anthropogenically driven climate change architects cannot ignore the increasingly dynamic environmental conditions on our sites, and those forces extending out from our sites that produce effects at scales from local to global. ESM's are highly useful tools that communicate relationships between stocks and flows of energy and materials through time. Multi-scalar, complex ecologies have been successfully modeled and quantified utilizing this methodology since the 1950's resulting in a new discipline within ecology and critical new understandings of the pathways through which resources organize, flow, and ultimately generate and maintain systems. This understanding of how systems are structured and function (Archer 1994) often determines their form; however, ESM's are not spatially explicit, rendering them problematic tools to incorporate into our spatially explicit processes and products. Because Grasshopper 3DM's programming language syntax has reciprocity with the syntax of ESM's, these models can be translated relatively straightforwardly by partitioning natural and anthropogenic processes into operational strata. This strata structure establishes a framework into which systems models from various disciplines and of various scales can be translated including: ecology, hydrology, oceanography, geology, biochemistry, landscape architecture and architecture, while simultaneously facilitating communication between the disciplines necessary for successful generation and calibration of the model, and ultimately the designed site intervention itself.

**KEYWORDS:** Ecological systems models, parametric modeling, visualization of dynamic landscapes

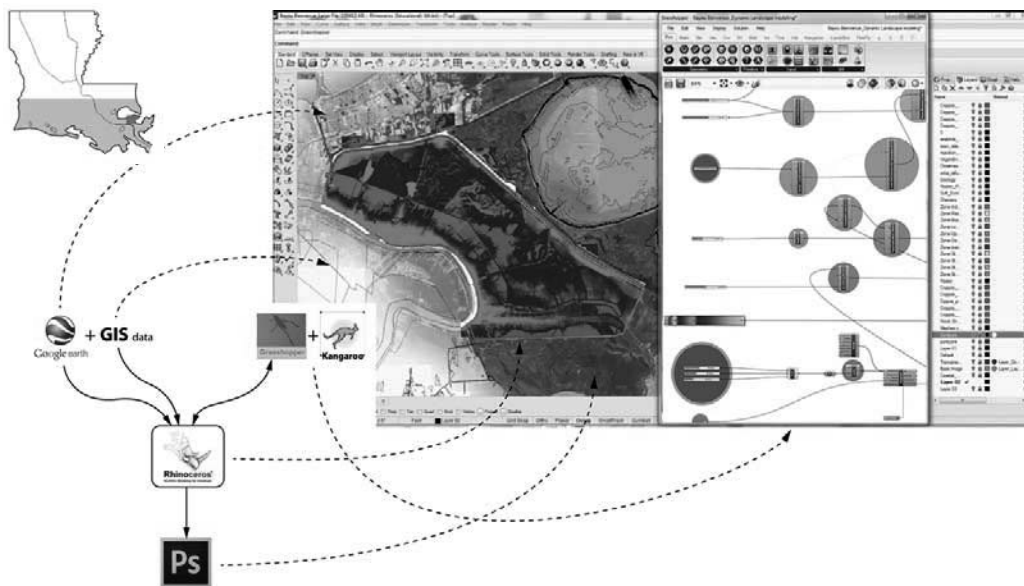
## INTRODUCTION

### 1.0. The Built Environment in the Dynamic Landscape

In places such as the Southern Louisiana Delta, where landscape change previously experienced at a geologic pace is now experienced in a generation, architects can no longer conceive of sites as static conditions on which to place buildings that primarily deal with gravitational and envelope loads. Because built and natural systems behave as one system across the surface of the lithosphere, both the natural and manmade factors that influence coastal development must be considered in tandem as critical components of planning decision-making processes. Coastal development in the Gulf is subject to powerful natural forces that are largely beyond human control, so an understanding of the potential behaviors of these forces can facilitate more accurate projections; hence, design that is sympathetic to the weathering of anthropocentrically re-structured environments. Therefore, we must find new methodologies for understanding, representing, and designing with diversified yet site specific dynamic forces that effect how the built environment mitigates, adapts to, and modifies today's increasingly dynamic environmental loads.



Coastal Louisiana's current land loss crisis is a result of the interaction between human resource extraction, human settlement patterns, and dynamic natural forces, many of which are largely invisible within planning scales of space and time. Recently, in response to dire future predictions, communities have started to question the sustainability of their long-term planning strategies, to challenge their understanding of habitation on fast changing wetland ground, and to explore more resilient options. An understanding of how ecological systems are structured and function (Archer 1994) often determines natural form, and the weathering of the built environments within them; hence, it behooves us to increasingly incorporate them as critical components of the design processes of buildings and infrastructures sited within dynamic geographies. Critical to the re-disciplining of architectural practice, this has led us to develop a new methodology for representing and calibrating site driven biogeochemical forces as dynamic formmakers utilizing Google Earth, Rhino, Grasshopper 3DM, Kangaroo, and Photoshop.



**Figure 1:** depicts the methodology workflow which utilizes data from Google Earth and GIS to construct base topographies in Rhino that are then subjected to dynamic forces and quantification through Grasshopper 3DM and, its plug-in Kangaroo. Still images from the model may be brought into Photoshop for post-processing, in order to generate photorealistic renderings that incorporate existing site conditions and communicate look and feel within the modelled landscape, which can be viewed in plan, section, axon or perspective. Above, the Grasshopper 3DM definition is manipulating and displaying water levels in the Central Wetlands Unit in New Orleans, Louisiana. Source: (Rodriguez 2013)

### 1.1. Modelling Environments of Ecologies

Grasshopper 3DM's programming language syntax has reciprocity with the syntax of ESM's in that Grasshopper's dynamic programming definitions are comprised of parameters, components, and connections which are structured similarly to the symbols and flows of the *Energese Generic Systems Symbols* language developed by Howard Odum in the 1950's (Odum et al. 2000). Grasshopper 3DM's interface requires that parameters and components, which are similar to Energese symbols, are created on a blank canvas and connected by workflow connectors, which are similar to Energese flow arrows. A series of Grasshopper 3DM definitions appear strikingly similar to ESM's in terms of their visual structure and organization. This syntactical reciprocity facilitates a more straightforward translation of existing ESM content and structure into Grasshopper 3DM's language, particularly for designers who are visually acute.

The next step is to translate ESM's into parametric definitions that drive Grasshopper 3DM's outputs. We have found that through the translation of existing ESM's, via functional regrouping and partitioning operations, into natural and anthropogenic processes (we have identified five operational strata specifically), at a range of scales from intra-ecosystem, inter-ecosystem, to whole biosphere functional levels, the accurate translation of the ESM is possible. The five operational strata developed are: astrodynamic (planet-scale), terradynamic (biogeochemical landshaft function), anthrodynamic (human influences), hydrodynamic (biogeochemical hydrological function), and aerodynamic (biogeochemical atmospheric function). This strata structure establishes a framework into which ESM's from various disciplines and of various scales can be effectively reorganized for input into Grasshopper 3DM.

This paper details the preliminary model building methodology developed over a summer at Louisiana State University. By imputing existing topographic and 2012 Master Plan data from the Central Wetlands Unit in New Orleans, Louisiana as a baseline, and utilizing it to generate performative meshes that evolve in response to physics and agent-based commands such as charges, pulls, and fields we can manipulate the output form parametrically. Model calibration is facilitated by natural system parameter ranges of inputs that are derived from measured behaviors (from scientific data), and quantified and controlled primarily by toggles, sliders, and gradients within the Grasshopper 3DM/Kangaroo/Rhino interface. Through the manipulation of these toggles and sliders, landscape form is modified in real-time renderings which facilitate predictive modeling across continuums of time. Research has shown that visualizations which combine GIS data, sketching/rendering, and photorealistic depictions of planning scenarios are more effective at facilitating a "...common language to which all participants technical and nontechnical can relate..." (Al-Kodmany 1999, 38) thereby resulting in the building of consensus, more access to local knowledge, and ultimately a more informed and appropriate design and planning process. This dynamic four-dimensional visualization and design tool is so critically needed today because designers and communities must be empowered to make increasingly complicated planning decisions in the face the dramatic and unpredictable circumstances driven by climate change and land loss.

## 1.0. LEVERAGING THE AGENCY OF ECOLOGICAL SYSTEMS MODELS

Over the last 70 years, the earth sciences have fragmented into two philosophical camps. The reductionists trended toward an increasingly disciplinary pursuit of knowledge which has resulted in the generation of numerous specific models and platforms corresponding to the specific expertise and discourse of each discipline, which track specific behaviors within larger ecosystems. These models are quantitative and often not output visually. This has resulted in a fragmented body of Earth Science knowledge that can prove somewhat illegible, even to other earth scientists in related fields, let alone designers and the lay people who inhabit the environments being modeled. Simultaneously, integrative, multi-scalar, complex ecologies have been successfully modeled and quantified utilizing ESM's, resulting in a new discipline within ecology and critical new understandings of the pathways through which resources organize, flow, and ultimately generate and maintain systems. The father of the discipline of ecological systems modeling, Howard T. Odum, developed and describes optimal organizations of whole systems, and the interactions of their components, as systems diagrams. These diagrams organize complexity via a language that

...should follow naturally from verbal thinking while showing system structure, processes, and flows. A systems diagram should help the mind visualize relationships and infer system behavior from the configurations...[of] energy or material flows. (Odum 2007, 25).

ESM's assist in the understanding of conditions that affect the physical environment, and are excellent tools for testing relationships between system structure, function, and the resulting evolving behaviors. They often inherently link scales from local to global which can prove difficult in design, facilitating the study of complex ecosystems which "by definition...cannot be understood by study at one scale." (Odum 2007, 167) This type of understanding is critical for sustainable and resilient design processes.

The other critical ecological understanding for designers is the disturbance regime. Disturbance regimes, which can be dramatic events like storms, or slow steady processes such as land loss, can stress stable ecosystems, and often render human habitation challenging. While these regimes may have predictable patterns, in recent years scientists have recorded increasingly unpredictable behaviors now attributed to global climate change. Walker et al. identify and describe catalysts of uncertainty, as:

“1. Key drivers, such as climate and technological change [that] are unpredictable. Many change nonlinearly, 2. Human action in response to forecasts is reflexive. If important ecological or economic predictions are taken seriously, people will react in ways that will change the future, and perhaps cause the predictions to be incorrect, 3. The system may change faster than the forecasting models can be recalibrated, particularly during turbulent periods of transition, so forecasts are most unreliable in precisely the situations where they are most wanted.” (Walker et al. 2002, 14)

Because of the variability associated with uncertainty, scenario building becomes a critical tool for ecologists to conceptualize coupled human-natural systems, which can also be employed by planners in the forecasting of future environmental conditions (Peterson et al. 2003). Details of the relationship between planning and scenario building will be discussed in more detail in the “VISUALIZATION FOR PLANNING” and “CONCLUSION” sections. Here it is critical to note that ecology and ESM’s facilitate the inclusion of uncertainty in addition to the behaviors of flows of energy (in particular) and materials through time.

While very effective at taking snapshots of a whole system through time, ESM’s are not necessarily spatially explicit, in that they do not accurately represent adjacencies, distances, and scales, which can make them difficult to incorporate into the design process. Nonetheless, they are an important tool to facilitate communication between designers, planners and natural scientists, because they reveal relationships between energy and material flows visually, relationships that designers often do not consider.

## 2.0. MODELING METHODOLOGY

For us, in order to model the physical behaviors that drive dynamic forces in spatial and temporal continuity, it was first necessary to investigate the behaviors of natural dynamic forces and their resulting processes, which was greatly facilitated by studying ESM’s of our test geography: the Central Wetlands Unit in New Orleans, Louisiana. Despite the fact that ESM’s are designed to facilitate communication, we found we needed to develop a framework to facilitate the translation of the models into a more intuitive understanding of ESM’s for designers, who may not have a comfort level working with their structures, functions, and the scientific nomenclature developed to notate these relationships.

### 2.1.1. Operational Strata Modelling Framework

We have created a programming protocol of organizing guilds (functionally related constituents) and pathways. Pathways connect individual units or whole guilds, together via transfers of energy which may contain or not contain materials. (Odum 2007, 15). Ecological Guilds are defined as a “...group of species that exploit the same resources, often in related ways.” (Simberloff and Dayan 1991, 115) We are not using Guilds in their strict ecological definition, but adapting this system of grouping related units that perform as a whole, which we have defined as five *operational strata*: astrodynamics, terradynamics, anthrodynamics, hydrodynamics, and aerodynamics. This strata structure establishes a framework into which systems models from various disciplines and of various scales can be translated spatially including: ecology, hydrology, oceanography, geology, biochemistry, landscape architecture and architecture, but also facilitates communication between the disciplines necessary for successful generation and calibration of the model. In this way, we facilitate ease of programming of natural processes by designers, who may not have extensive prior knowledge of these systems, i.e.: designers can locate pre-existing ESM’s for specific ecologies, and plug them into our modeling protocol.

### **2.1.2. Astrodynamics (planet-scale)**

Astrodynamics facilitate the programming of forces that affect a site that exist at the planetary scale such as the sun's relationship to the surface of the earth (sun angles/solar radiation/seasonal change), the moon's relationship to large water bodies (tides), etc. Astrodynamics are critical for the modelling of change through time and primary production (plant growth).

### **2.1.3. Terradynamics (biogeochemical landshaft function)**

Terradynamics facilitate the programming of land-based processes such as geology, soil formation, subsidence, pollution, etc. Terradynamics are the formmaking processes that determine the shape of land through time.

### **2.1.4. Hydrodynamic (biogeochemical hydrological function)**

Hydrodynamics facilitate the programming of water-based processes such as wave action, erosion, deposition, pollution, etc. Hydrodynamics are critical for the creation of the complex configuration and behaviours of confined (protected areas behind levees) and unconfined (wetland) hydrological units, and land-formmaking processes as the land-water interface.

### **2.1.5. Aerodynamic (biogeochemical atmospheric function)**

Aerodynamics facilitate the programming of atmospheric processes such as wind, weather, pollution, etc. Aerodynamics influence the programming of storm surge, precipitation, pollution, etc.

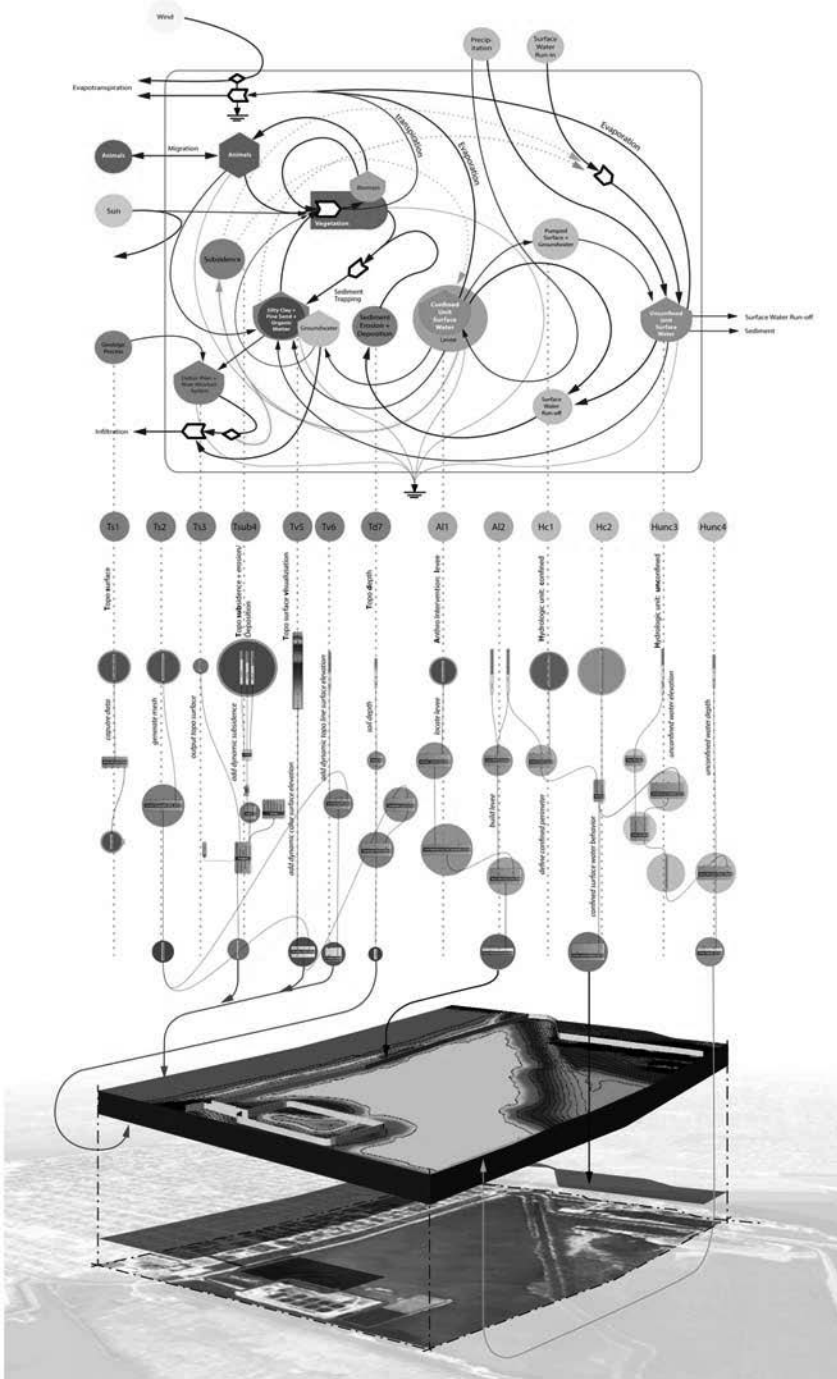
### **2.1.6. Anthrodynamic (human drivers)**

Anthrodynamics facilitate the programming of human driven factors that affect the environment such as settlement patterns, resource extraction, waste disposal, etc. In our test geography, Anthrodynamics are critical for the programming of levee building and other hardscape modifications to Terradynamics and Hydrodynamics that influence land-formmaking through time.

## **2.2. Modelling Software Workflow**

Through the utilization of the State of Louisiana 2012 Coastal Master Plan Project List, site visits, and Google Earth, our test geography was scoped and defined. Once relevant ESM models were identified, they were translated through the operational strata in order to extract their prevalent structural and functional characteristics. This determined not only that three of the five Operational Strata would be deployed (terradyamics, hydrodynamics, and anthrodynamics) to organize the Central Wetlands Unit at the meta-scale, but also the necessary data to be captured from Google Earth, GIS, and scientific papers. This data was then translated into a Rhino base topographical surface projection of the areas being studied (terradyamics). This base layer evolved through the construction and application of topo-surfaces (meshes), subsidence/erosion/deposition, surface visualization layers, and soil depth, and became the 3-D space on which functions of time and natural forces (including gravitational forces, etc.) were then applied via programmed Grasshopper 3DM parametric modeling protocols and definitions and the plugin Kangaroo physics. Kangaroo is a Live Physics engine for interactive simulation, optimization, and form-finding that allowed us to generate geometries that change through time, according to the physical behaviors of the material properties of the ecosystem and the human interventions within it. The visualization produced by Kangaroo allowed us to modify inputs based on actual parameters and feedbacks, and automatically calibrated the behaviors of the forces to produce animated visualizations of the resulting changes in the landscape.

On top of the terradyamics, we overlaid anthrodynamics which included levee building and built hardscape modifications. On top of the more solid hybrid system of terra-anthrodynamics, hydrodynamics were overlaid, which included the creation of confined (protected areas inside levees) and unconfined (wetland) hydrological units, and formmaking processes at the land-water interface (see figure 2).



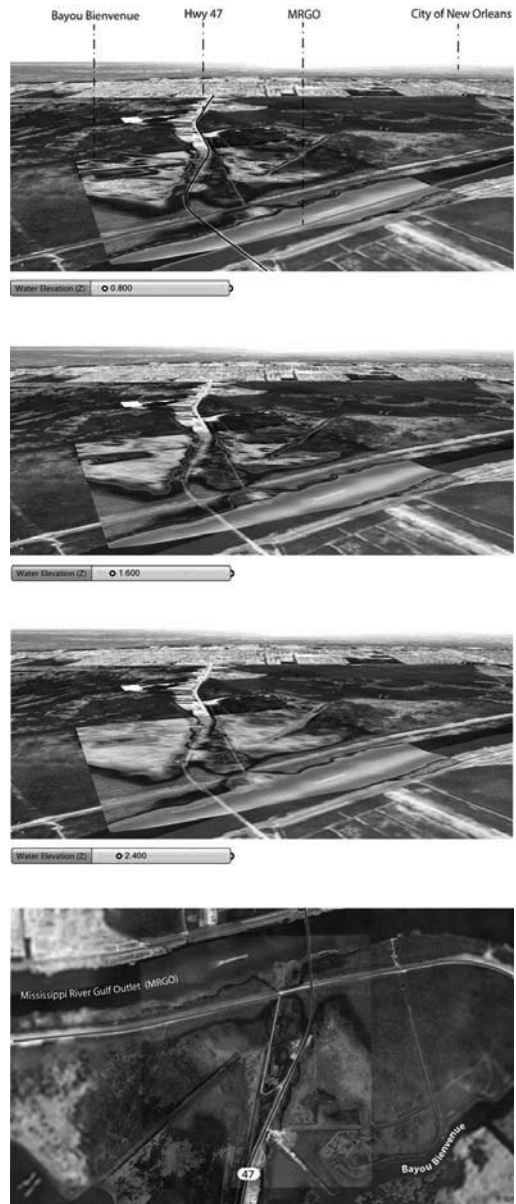
**Figure 2:** the construction of site through the synthesis of coupled human-natural systems. Working from the top down, first is the ESM, which is translated next to the modelling script. Below that are the Grasshopper 3DM definitions, which create the visualized dynamic landscape at the bottom. Central Wetlands Unit and Bayou Bienvenue, New Orleans with terradynamic, hydrodynamic, and anthrodynamic forms mapped. Source: (Rodriguez 2013)

### 3.0. RESULTS

Our preliminary results show that it is possible to successfully model coupled human-natural components of larger ecological systems according to the methodology described above. In addition, through a second round of “streamlining” modeling we were able to strategically manipulate the code to increase efficiency and workability as we learned about tool limitations. We found scalar linking and bracketing to be difficult in the translation of ESM’s into landscape forms at varieties of scales. Ultimately, we had two different models of the Central Wetlands Unit, one smaller and at a finer resolution than the other in order to calibrate file sizes with computing power limitations. In the end, we found that multiple models of the same geography at different scales assisted model calibration.

We were heavily reliant on plugins for Grasshopper 3DM, primarily Kangaroo, to successfully model many of the more sophisticated physical processes that require gravity, etc. We found that some forces/behaviours are significantly more straightforward to model than others. We are still working to resolve the successful modeling of aerodynamics, water velocity, suspended sediment deposition, and other ecological drivers governed by fluid dynamics. At this time there is not an effective fluid dynamics plugin.

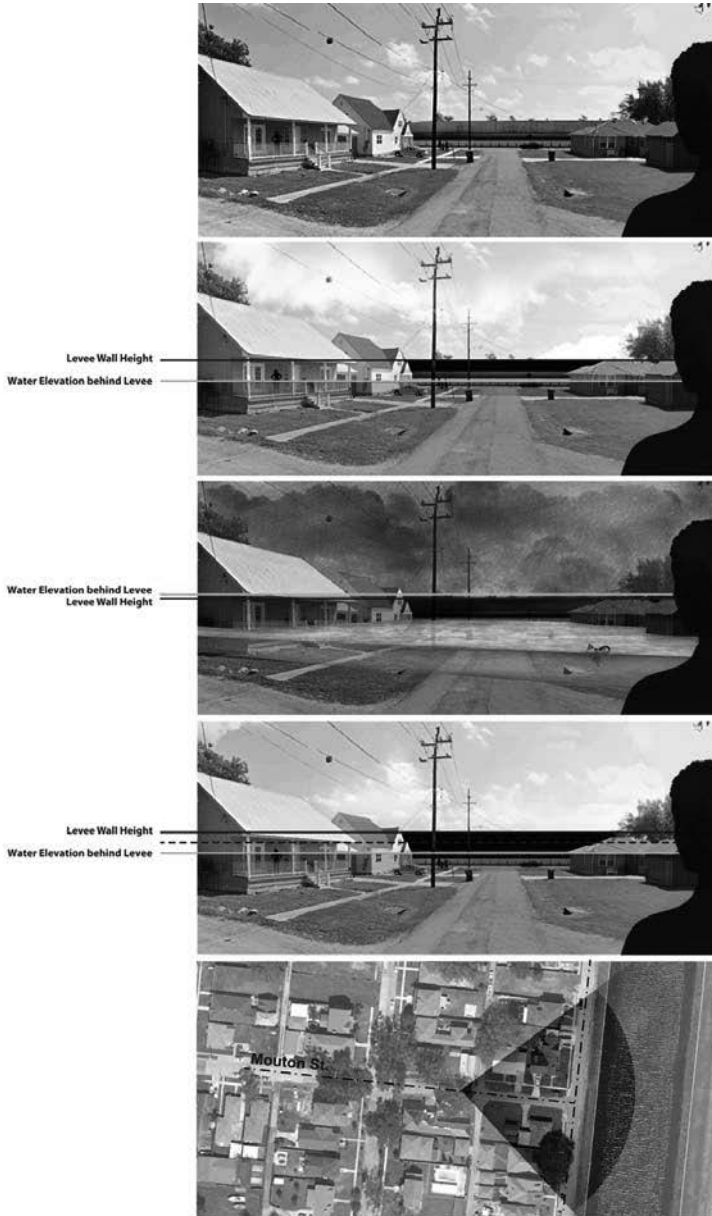
Ultimately, the 3-D quality of the model allowed us to explore the results in different scales, views and cuts, including plan, section, axonometric, and perspective. We also have the ability to represent data with multiple graphic conventions, according to the type of data, scale, and other visualization opportunities including: color, gradient, lineweight, etc. Such a variety of view outputs are not possible outputs in most scientific modeling packages today.



**Figure 3:** The effects of 8” interval water level change on land and plant growth potential. Central Wetlands Unit and Bayou Bienvenue, New Orleans. Source: (Rodriguez 2013)

4.0. VISUALIZATION FOR PLANNING

“Traditional planning is frequently based upon the belief that the application of professional expertise to achieve well-defined goals will ensure efficient and effective management. However, such plans often fail to consider the variety of local conditions or the propensity for novel situations to create extraordinary surprises (Scott 1998). This blindness to variety and surprise, which is often accompanied by a false certainty about the efficacy of management, can lead to costly failures (Holling & Meffe 1996).” (Peterson et al. 2003, 359)



**Figure 4:** A perspectival view depicting the water level on the opposite side of a residential neighborhood levee, and the process of overtopping. Source: (Rodriguez 2013)

In 2005, during Hurricane Katrina, the levee that separated the 9<sup>th</sup> Ward in New Orleans from the Central Wetlands Unit / Bayou Bienvenue failed, sending tons of high velocity water into a residential neighborhood, at the expense of lives and property. That levee failure is dramatic evidence of the costly false certainty cited above. We hypothesize that risk is more clearly understood when it is visualized. Only then does it have the potential to operate as a critical informational tool in design and communication necessary for our evolving understanding of the effects anthropogenic interventions into dynamic environments subject to increasing rates of climate change.

These visualizations are particularly critical in facilitating more effective and integrated public planning processes, particularly those that team specialists from diverse disciplines with local residents. The ability to depict the impacts of largely invisible yet incredibly dynamic forces through human cone-of-vision perspectival images is particularly critical. By placing the human eye into the viewport of the image, perspectives mimic how we perceive and navigate the world daily, and are hence more legible to designers, scientists, and particularly the general public. Historically, much planning work is done utilizing plan drawings, which are often read abstractly by policy makers and community members. We believe that perspectival images, which can be generated by Rhino models, may be utilized more effectively as part of larger planning decision making processes.

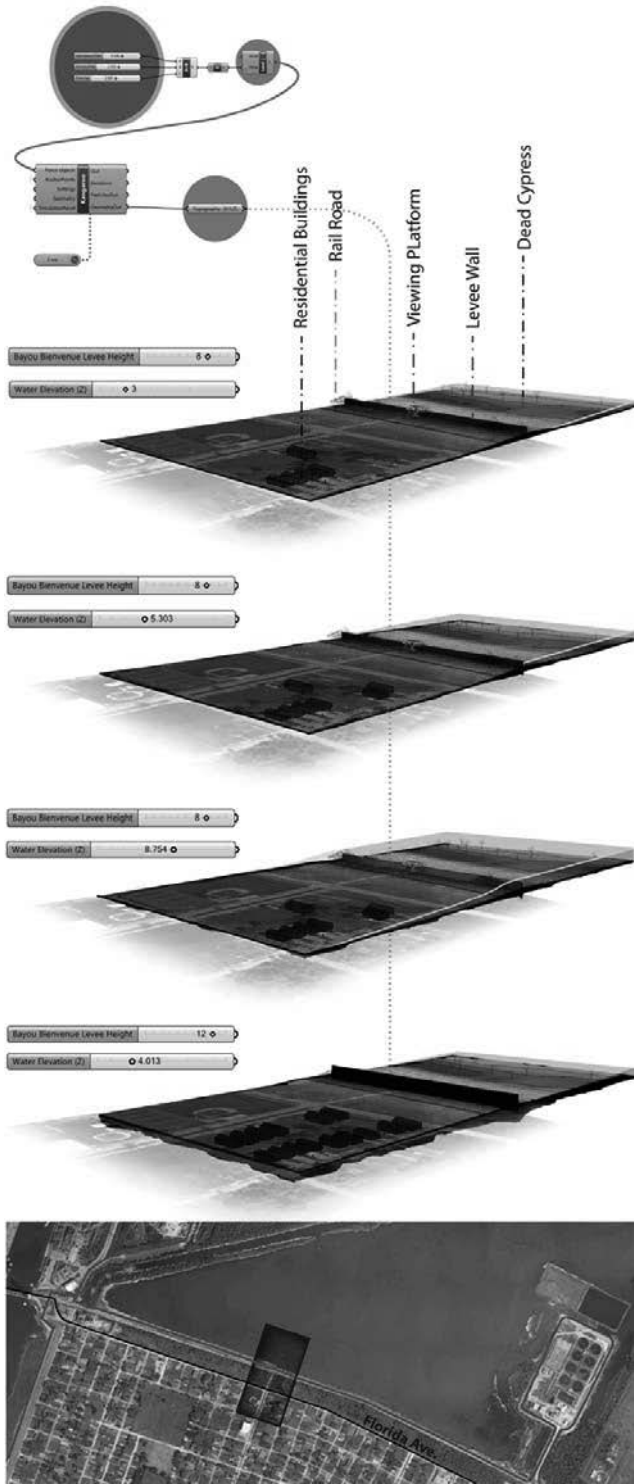
## CONCLUSION

### 5.0. Architectural Implications of the Operational Strata and Methodology Deployment

In architecture, nested scalar relationships and the fourth dimension have historically proven difficult to incorporate into visualizations, and therefore, ultimately the design process. The five Operational Strata facilitate the programming of biogeochemical ecological systems into dynamic forms. They also structure spatial-scalar hierarchy, and facilitate a seamless continuum between past, present, and possible future site conditions through the synthesis of coupled anthropogenic-natural forces in a manner more congruous to their operation across the surface of planet. Through the visualization and communication of a myriad of forces previously less legible to designers, architectures and infrastructures have the capacity to be designed and tested against site forces in new and innovative ways that are more native to the designer. Again, through the multiple scenario modelling and visualization process, weak links between constructed environments and the dynamic forces that play upon them become evident and available topics for further architectural research.

Currently, the role of risk mitigation, in the form of designing and sizing architectural and infrastructural components for pre-determined acceptable levels of risk, is typically relegated to engineers. As architects, we can increasingly take back this scope of services, through a deeper understanding of site forces facilitated by the methodology, we have an increased potential to successfully design softer and more integrated approaches to risk management. Hence, we have the potential to further influence sustainable design strategies and assessment frameworks that currently tout their effectiveness primarily through the *reduction* of material and energetic environmental inputs without satisfactorily linking those reductions to ultimate global environmental performance. Through the integration of multiple sets of disciplinary knowledge, the Operational Strata have the potential to frame a more sophisticated understanding of sustainable and resilient performance of hybrid human-nature environments through time and at multiple scales which is so critical to the synchronization of the built environment with natural environmental forces.





**Figure 5:** Depiction of the dynamic behaviors of settlement patterns, sea level rise, storm surge and subsidence at the levee which separates the 9<sup>th</sup> Ward from the Central Wetlands Unit/Bayou Bienvenue, New Orleans. Source: (Rodriguez 2013)

Ecologically responsive architectures that result in built environments that respond to natural forces, rather than resist them, in the end will prove to be the most resilient and sustainable solutions. Perhaps the significance of this modeling methodology's potential is stated most succinctly and poetically by Master Po in Season 1 of the 1970's television series Kung Fu: to paraphrase,

In a heart that is one with nature, though the (building) body contends, there is no violence. And in the heart that is not one with nature, though the (building) body be at rest, there is always violence.

(Master Po to Kwai Chang Caine (otherwise known as Grasshopper!) in Kung Fu TV show Season 1, 1972)

### **5.1. Applications to Scientific Research**

In addition to visualization for design and planning purposes, our methodology may also further scientific research through the facilitation of communication between diverse scientific disciplines and the visualization of multiple scenarios:

Some paths of domestication will result in improved ecosystems both for people and for other species; other paths of domestication will result in ecosystems that are clearly better for humans but not for other species; and some paths of domestication will result in ecosystems that are too degraded to benefit people or other species. The key scientific goals for the study of domesticated nature are to understand what tradeoffs exist between the promotion or selection of different ecosystem services and to determine to what extent we can change a negative tradeoff to a positive one by altering the details of our domestication process (see Fig. 3). With this understanding will come a science of nature domestication that might guide human activities to minimize the negative aspects and accentuate the human benefits...A second possibility would entail an examination of tradeoffs, perhaps even switches to alternative ecosystem states after some threshold is crossed. Tradeoffs are most likely to create problems when they occur as an abrupt change, with little warning. Because managers and researchers have tended to focus on impacts rather than tradeoffs, there has been no systematic examination of tradeoffs in a way that leads to a useful theory. Without a solid understanding of tradeoffs among ecosystem services, we can expect conservationists to rely on protecting nature from people as the primary form of stewardship. (Kareiva 2007, 1869).

### **5.2. Applications to Sustainable Development Planning Processes**

As previously mentioned, the methodology's greatest impact may be through the facilitation of sustainable development planning processes. By merging interdisciplinary knowledge through the modelling and communication tool of the ESM, and visualizing the resultant forms, multiple scenarios can be effectively vetted by all planning process constituents thereby revolutionizing the community-based planning process. Peterson et al. have identified six interacting stages of planning that can be explored through series of workshops / charrettes:

1. Identification of a Focal Issue,
2. Assessment,
3. Identification of Alternatives,
4. Building Scenarios,
5. Testing Scenarios, and
6. Policy Screening (Peterson et al. 2003, 360-2)

Our methodology seamlessly facilitates these first 5 stages in order to ease transitions toward more performative environments that enhance human welfare in the face of climate change. Sustainable development in the delta relies on striking an integrated balance between natural systems, human needs (resources), technological advancement, and scientific knowledge. As we continue to adapt and create more functional systems for risk reduction and restoration for sustainable coastal development we advance and refine methodologies, including this new methodology of visualization, which may be integral to the development of better planning and design strategies. Our visualizations may facilitate a better understanding of human relationships to the environment's dynamic processes in as society that is eager to explore sustainability and resiliency. By defining a better methodology for the visualization and

communication of Louisiana's dynamic landscape, and the anthropogenic processes that are so integral to this managed environment, we further our understanding, challenge the way we visualize the future impacts of our actions, and plan for a more sustainable future.

## ACKNOWLEDGEMENTS

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# Change: Exploring Psychological & Sociological Constructs in the Quest for Agile Architecture & Environmental Design

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**ABSTRACT:** Architecture and environmental design in our modern world proves intensely complex, driven in part through remarkable advancements in technology, in part through escalating regulatory demands, and in part by dramatic shifts in demographics, expectations and needs. Designers and developers of projects, across a range of scales, struggle to ensure relevancy, viability, potency and sustainability. To achieve such ends the exploration and application of Open Building theories and practices proves increasingly important. In reaction to static and immutable conventional environments (e.g., interiors, buildings, landscapes, etc.) Open Building and Agile Architecture methods foster a milieu of flexibility, modularity, prefabrication, adaptability and change. The critical notion of change has many dimensions, including key qualities that take account of the technological and material ethos. While the vast majority of research efforts have focused on scientific, technical and quantitative characteristics of Open Building, this paper argues that human aspects, and qualitative features, and particularly those social and psychological, are equally essential.

In order for Agile Architecture to be more fully accepted, embraced and executed it is imperative that scientific/quantitative and human/qualitative facets of projects be examined, promoted and addressed in concert. A building deemed green through a checklist may fail if it is not enjoyed and accepted by users. In a similar vein, a project that embraces mutability and affords flexibility on a technical level may fail if users and stakeholders are incapable of acting, unwilling to consider, or disinterested in realizing change. Cognitive dissonance and psychological barriers, for example, may hamper a user's readiness to transform space. NIMBYism and cynicism, for example and in the sense of the surrounding community, can likewise limit realization of more agile buildings. For Open Building and Agile Architecture to progress, there must be intense focus on a broader array of variables that, at the end of the day, prove essential to heightened acceptance, advancement and deployment. Psychology and sociology are key factors in the equation for appropriate, potent and sustainable environments. Technology matters. Above all, however, people matter.

*Keywords: Open Building; Agile Architecture; Change; Psychology; Sociology*

## **BUSINESS AS USUAL AND PARALYSIS IN THE STATUS QUO**

*A concern for greater flexibility in buildings arose in the 1950s as a reaction against the excesses of 'form-follows-function', which argued that all parts of a building should be determined by, and destined for, specific uses. In practice, however, even if these uses could be determined, no allowance was made for new developments over time, yet alone the changes of use that happen in many buildings.*

*Richard Weston (2011)*

Despite the pioneering image of architectural practice being highly progressive and forward thinking, in reality the vast majority of buildings designed and constructed in the past have been relatively conservative, arguably conventional and, in the end, hugely difficult to modify. Most buildings are constructed for single purpose use – for example an office, a hospital, a school, a residence, etc. Architectural programs for such structures are usually tightly delineated in terms of spaces, areas, arrangements and qualities. The nature of the construction process, and especially in North America, is best defined as incremental, fragmented, and even inefficient. A wealth of agents and players, from architects, developers,

and financiers to general contractors, sub-trades and manufacturers, all struggle to find their place, posturing and timing within an overly complicated, perplexing and long-established milieu. Factors such as access to materials, availability of trades, market pricing on structural systems, policies & codes, and, of course, approval by regulatory authorities all contribute to a daunting *modus operandi* regarding the design and delivery of Architecture.

While historically design and construction processes and products have been quite routine, predictable and wasteful (e.g., massive contributions to landfills via the building industry), recent concerns about the state of the planet, the degradation of our environments, and the significant damage inflicted through erecting and operating the built fabric of cities, have raised more than a few flags. The rapid ascent of 'green' and the strong subscription to 'sustainability' have put designers and builders under intense scrutiny with regard to ethics, values and responsibilities. The world is now more urban than rural. Populations in many nations continue to burgeon. Our building stock is aging with pressures to retrofit existing buildings, and requirements to construct new ones, simply remarkable. Construction and demolition advance at staggering levels. For example, the UKGBC ([www.ukgbc.org/content/waste](http://www.ukgbc.org/content/waste)) underscored in 2013 that the "construction and demolition sector is the largest contributor of waste in the UK, responsible for generating 120 million tonnes of waste each year – around one third of all waste in the UK." While many new materials, innovative constructional approaches and energy saving systems are emerging, they tend to build upon commonly accepted ways of seeing, thinking and acting – that is, despite emerging technologies and novel tools, adherence to the status quo remains severe. In light of the urgency around climate change, resource limits and widespread pollution (e.g., air, water, ground, light, noise, etc.), it seems imperative to transcend the status quo. We need to escape the paralysis that increasingly defines 'business as usual'. In fact, considering the plethora of variables in flux, including changing demographics, shifting needs, intensity of churn, etc. it is undeniable that the design and construction sectors must undergo critical and substantive transformations, including a total reconsideration of means & ends around human habitation + city building.

While serious attempts are underway, and often good progress realized, around green building mantras, methods and metrics (e.g., Leading in Energy + Environmental Design), even they fall into quite predictable realms of creating & operating. Certainly such systems call for, and even reward, innovation and ingenuity. Some systems move beyond rather prescribed schemes to promote and pursue regenerative buildings and smart communities. A key aspect that is missing, however, from the authors' perspective, is considerable and meaningful adoption of agility in architecture. As long as buildings remain slow to respond to technological possibilities, stuck in the confines of convention, and staid in their ability to accommodate shifting needs, our buildings will remain a major part of the problem rather than arising as prime players in a more sustainable world.

## **SEEKING HEIGHTENED ADAPTABILITY AND GREATER RESPONSIVITY**

*Technology is the answer but what was the question? Cedric Price (2003)*

The 1960's were a significant period within the annals of modern architecture, with many theoreticians and practitioners filled with enthusiasm of the modern age, equipped with new materials & technologies, and ripe with ideas on how to construct cities of the future that would usher in harmony, happiness and utopian lifestyles. The Japanese Metabolists, for example, led by bold and brilliant thinkers like Kisho Kurokawa, imagined cities where the parts were in synergy, where the systems intertwined, and where the lifelessness and the static was swapped with the living and the dynamic. Leading figures such as Cedric Price, Yona Friedman, Gordon Pask and Constant Nieuwenhuys denied the shackles of the past and sought environments that were fluid, flexible and responsive. Price's Fun Palace, for example, proposed interiors that could be reconfigured based on needs and redeployed, by users, as demands shifted. It was an era that considered the fantastical opportunities for buildings to accommodate the needs of users, versus the more typical (and certainly so today) arrangements whereby people are shoehorned into spaces (where they must struggle to feel comfortable physically, thermally, psychologically, etc.). The vision of the day was spectacular – that is, to create cities, buildings and spaces that reacted to needs in real time, that altered

composition based on conditions, and that pushed + pulled according to expectations. While the concepts were advanced and inspiring, the main challenge was the serious lag in technology. Simply put, the science and systems of the day were not sophisticated enough to rise to the occasion. Only now, in our present times, has science and technology progressed to the point where the thoughts & theories of these architectural pioneers might be realized in built form.

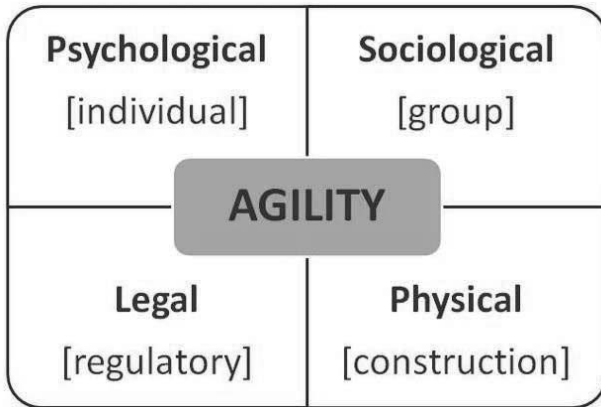
A relatively recent movement worth exploring is Open Building. Open Building (OB) is defined (Kendall - <http://www.open-building.org/gloss/openb.html>) as an “international movement based on organizing buildings and their technical and decision-making processes according to levels. Open Building, as an evolving architectural methodology, allows our buildings, similar to ecological systems, to shift and adjust over time. Embedded flexibility enables such buildings to adapt to different circumstances and be mutable in terms of systems upgrades and ongoing maintenance (Kendall & Teicher, 2000) – hence, in the larger picture, they prove more resilient and less wasteful. The adaptability in OB has become possible through separating the structure or ‘support’ from the interior or ‘infill’ -- in essence ensuring that the systems in a building are independent yet inter-related. This innovative approach challenges the typical ‘entangled’ systems in conventional buildings and provides much greater degrees of flexibility. John Habraken (1994) introduced ‘support’ and ‘infill’ as new categories among existing levels in his theory of “decision-making levels in the built field”. In this theory, Habraken divides the built environment into different aspects that have varying lifespans and across which the decision-making and control is delegated to different parties. In these various ‘environmental’ levels, users have the ultimate control over the ‘flexible’ interior or infill level to adapt it to their own needs and desires. In this system, ‘support’ is the continuation of urban fabric in the third dimension -- its longer life-span and relative permanence supports stability with respect to long term community interests while ‘infill’ accommodates change in respect to individual preferences in the shorter, more immediate, term.

Debatably Open Building’s evolution has been more dedicated to the technical development of ‘support and infill’; while the discussion over the design, character and aesthetics of these buildings have been largely overlooked. In a previous paper, the authors introduced the notion of ‘aesthetic flexibility’ (Safarzadeh, Mousazadeh & Sinclair, 2011) as a complementary concept to already established notions of ‘spatial flexibility’ and ‘functional flexibility’. The notion of ‘aesthetic flexibility’, as a novel dimension in Open Building theory, holds promise to celebrate ‘identity’, foster ‘customization’ within the design equation, and strengthen built outcomes. The idea of ‘aesthetic flexibility’, in this sense, applies to two different levels in the theory of “decision-making levels”. First, it applies to the ‘infill’, which allows the users to adjust their interior environment according to their changing spatial needs but also modify it to reflect their personal character, culture and aesthetic preferences. Second, it applies to the façade of the building, which interestingly lies between the domain of community interest and individual preference. Consideration of such duality is arguably a crucial and innovative step in the advancement of Open Building. The concept of ‘aesthetic flexibility’ further positions itself within a broader understanding of the design & construction milieu, including a significant resonance with the notions of and framework for Agile Architecture and Integrated Design (Sinclair 2009, 2010). Such considerations are not merely about the physical material realm, but rather clearly incite dimensions psychological and sociological. While the authors have researched and written extensively on Open Building and Agile Architecture, the focus has been (as it tends to be in the field) overly concerned with the physical outcomes of design and construction. The following section of the present paper therefore, in response to such limitations, reviews & highlights a model (Sinclair, 2012) that moves well beyond the physical realm to explore and encourage other, equally vital, dimensions of agility.

## ESCALATING AGILITY AND ENCOURAGING PLASTICITY

*Flexible buildings are intended to respond to changing situations in their use, operation or location. That is architecture that adapts, rather than stagnates; transforms, rather than restricts; is motive, rather than static; interacts with its users, rather than inhibits. Robert Kronenburg (2007)*

Open Building and Agile Architecture have been almost exclusively focused on the tangible qualities of design and construction – perhaps best illustrated by attention to support and infill. The first author, an architect and psychologist, argues that other less tangible parts of the equation now warrant our serious attention – from a research perspective, from a testing viewpoint, and from an application outlook. Moving beyond concentration on the physical, also key to conceiving and constructing more flexible, adaptable, responsive and responsible architecture are heightened awareness of regulatory considerations, individual concerns, and group expectations. Sinclair’s synergistic model for amplified agility in architecture encompasses four areas: 1. Physical, 2. Legal, 3. Psychological, and, 4. Sociological.



**Figure 1:** Synergistic Model of Agility (Source: Sinclair 2012)

**Physical:** The construction of agile architecture encourages great mutability and adjustability across all realms of the building (and beyond). Such flexibility includes not only moveable walls, fixtures, and fittings, but also structure, infrastructure and envelope. As noted the authors have written extensively on the more tangible aspects of agility, most recently exploring the limits that the façade can be dynamically configurable, and the unique roles of the envelope as part of the building shell but also part of the urban sphere. In this instance many questions arise concerning opportunities and obligations from both a private citizen and public entity point of view.

**Legal:** There has been some research conducted, within the academy as well as in practice, concerning policy, code, statute and regulatory dimensions of Open Building and Agile Architecture. Some of this work has considered ownership questions, such as support versus infill, government versus citizen, etc. While such efforts are important and influential, examination of prevailing legal aspects and development of new systems of regulation are crucial. Legal challenges will need to be realized in order to push Open Building to new levels, and especially so in traditionally resistant markets (such as North America). In order for buildings to be far more responsive, and by extension responsible, many established ways of working will need to be overturned. A key pursuit in this regard is towards performative rather than prescriptive guidelines and measures. Also urgent is reform around litigation on the construction field. In the authors’ view movement toward greater agility, modularity, prefabrication and systems approaches hold promise to reduce building failures, heighten abilities for solving problems (e.g., due to plug + play), and foster more reasonable renewal of buildings (versus the typical age-in-place story of decay, death then landfill). Undeniably this

area of the model will require assumption of risks. Exactly how such risk is managed and exposures limited remains to be explored.

**Psychological:** Individual reaction, resistance or acceptance to change within Agile Architecture is a topic that has seen virtually no serious and scholarly consideration. The first author, as a psychologist, has begun to study concepts of change, including cognitive and behavioral aspects of living and working in mutable environments. The simple fact of providing the ability of a space to change (even if it's straightforward and effortless) does not translate into spaces that will actually be changed by users. There are many variables that must be considered, including personality, knowledge of systems, understanding of implications, levels of comfort (physiological, mental, cultural, etc.), and willingness to act. Historically in buildings limited control has been afforded to end users. Environmental systems have been centrally driven. Windows have not always been operable. Lighting is typically predetermined. So, when the environment shifts from highly regulated and rigid to highly adjustable and dynamic it is difficult to determine how people will respond. This realm of inquiry is a significant focus for the author, with an awareness that all aspects of the present model need to be advanced in unison if agile architecture is to see wider deployment and more meaningful embrace.

**Sociological:** Lastly, it is critical that architects and researchers grasp the relationships, perceptions and expectations at play at a broader community level (e.g., the residents of a building, the members of a community, the politicians on a council, etc.). Better understanding of the group dynamics, including reaction to agility, resistance to change, willingness to pioneer, etc. proves essential to the successful introduction of more agile architecture. At a sociological level a given community must be able to overcome fears and to seize the novel, untried and untested if consequential change is to occur. We have witnessed impressive cultural swings as society has become more cognizant of the seriousness and significance of global warming. A similar renaissance must occur in the way we conceive of and construct buildings. Rather than fixed objects that deliver service over a set period then see demolition, buildings must be seen as living, dynamic and mutable entities that can be assembled, reconfigured, upsized, downsized, repurposed then disassembled (e.g., for recycling and/or reuse in subsequent projects). This dramatic shift in mindset will be especially difficult to realize in North America, due in large measure to a very entrenched, complicated and conservative modus operandi.

## DELVING DEEPER INTO MATTERS SOCIOLOGICAL + PSYCHOLOGICAL

*It is not the strongest of the species that survives, nor the most intelligent that survives. It is the one that is the most adaptable to change. Charles Darwin*



In our quest for heightened mutability and adaptability of environments it is essential to consider change in a much broader fashion. While the technical capabilities of change in environments can be developed and realized, such possibilities prove moot if users of the resultant space(s), or the community at large, are resistant to adjustment, unwilling to take action, and reluctant to transform. In other words, the provision of flexibility in environments does not, de facto, translate into environments that will be modified by users. Key to the equation of greater mutability is not merely the ability of a user to effect change or the community to endorse change, but more importantly the willingness and desire to actually effect change. Sinclair, an architect and psychologist, previously considered the literature on change as it pertained to human perception, cognition and behavior. He delineated a model,



illustrated above, whereby change is explored via the inter-related qualities of physical, legal, social and psychological factors. Building from the foundation of his Holistic Framework for Design + Planning (see Sinclair 2009, 2010), and the aforesaid model, the current paper critically examines seminal research most notably on the psychology and sociology of change. The present authors envision and advocate an approach whereby designers more fully consider and deploy knowledge of human behavior when pursuing, crafting and constructing more flexible environments.

While there is a great need to consider the challenges of agility in Architecture from a more comprehensive perspective (i.e., physical, legal, sociological, psychological), this paper is especially interested in dimensions pertaining to the psychological and sociological realms. In many ways these two aspects are the most elusive, complex and arguably important. Architecture and Environmental Design must place people at the very core of the enterprise. Resistance to change, or to the new and novel, in the built environment can be seen as a form of self-defense against things unknown or unfamiliar. Sigmund Freud acknowledged that we must first recognize our resistance and acknowledge our defensiveness if we aspire to overcome or circumvent them. Architects in their education and practice should gain sound awareness of human behavior, on both personal and group levels, in order to realize advancement of built environments that prove more adaptable, responsive, appropriate and successful. The authors urge the schools and the profession to advocate for such timely knowledge, skills and values.

There are always levels of conflict and zones of discomfort within the built environment. For example, the conflict between valuing the historical fabric which holds memory of the past and embodies previous progress and accepting the need for modern facilities that accommodate growth and speak to our future. From a psychological perspective it is intriguing to consider the often intense resistance to moving forward, especially when it challenges habits, conventions and existing material culture. Moving outside of our ethos of comfort is difficult, so we engage in avoidance. In endeavoring to better understand why people resist change it is worthwhile to consider why we resist change. Nietzsche suggested that “A thought, even a possibility, can shatter us or transform us.” Often shifts in our world cause us to be reluctant, apprehensive or even fearful. Sometimes these shifts pertain to our relationships with each other and sometimes to our interactions with our surroundings in a more tangible sense. With the advancement of technology, including building technologies, we now have the possibility of our physical world (e.g., our home or our office) moving, shifting and changing to degrees before unimaginable. From a psychological vantage point it is contingent on designers to understand how we react and respond to change, including those aspects that are debilitating as well as those that are liberating. Given the complexity of perception and cognition such challenges are profound to fully grasp and even harder to apply. In an ideal scenario Architects should understand the users, and their processing and perceiving of environmental cues and sensory stimuli, to a degree sufficient enough to empower rather than inhibit and to support rather than hinder. These matters intensify in complexity as we move from the sphere of the individual to the territory of the group. Our sensory systems and the mental processing of environmental information prove phenomenally rich at a personal level. This complexity moves to unfathomable heights when interpersonal interaction, with all its combinations and complications, arrives to the equation.

The connection between architecture and psychological/social aspects of change is largely an unexplored domain. Nevertheless, these connections exist and are important to study today more so than ever before, as “change” is becoming the central discourse in architecture from many perspectives. Considering the dearth of such studies, the current research crucially contemplates literature on “change” within psychology/sociology fields, and metaphorically postulates relevance between the established body of theories on change and architectural transformation. Some common ground, with respect to mutability of environments in cities, might be theories in urban psychology/sociology and change. The most relevant theories address resistance and opposition to change. In this sense “urban psychology” and “urban sociology” seem apropos for both reflection and speculation. Of particular relevance to these points are the urban-related theories of NIMBYism, Cynicism, and Spectacle | Mega-Events.

Sassen (2000) suggested that contemporary cities and metropolitan regions emerge as sites where macro-social trends and their particular spatial patterns intersect and materialize. This argument does not exclude the obvious micro-social trends which materialize in the city; and more importantly their intersection with the other macro-social trends that is facilitated by information technologies and various communication tools. Indeed enormous complexity arises from this interaction and interrelation. In this manner the city emerges as a strategic lens for the study of major macro and micro social transformations and, as pertains the present research, with numerous connections to urban psychology and sociology. Sassen argues that urban sociology, in particular, can address such challenges and in so doing produce some of the analytic tools for understanding the social phenomena, trends, changes and paradigm shifts.

It is valuable to explore more deeply these sociological qualities as they relate to change. If we accept that the sociology of change in the context of urban environments captures communal protest and resistance to alteration & difference, it is important to discuss what this notion of 'community' means. Bell and Lyall (2000) mention that "community" as both location and structure of relationships has largely altered because of vast growth in communications tools, cyber communities, and interactivity in such communities. In a sense, we are faced with arguably a much stronger sense of community that may or may not be geographical. Thus community is more sensitive to the point that creates an increased sense of "social control" that in highly conservative communities leads into conformity (Bell & Lyall, 2000). Politically-conscious demographically young groups and neo-environmentalists are common examples of communities that may or may not be geographical and are often very sensitive to changes brought by new developments and their characteristics including their design features.

It is also helpful to consider how reactions to change manifest more tangibly in actual cases. Pendall (1999) studied social/communal oppositions to housing projects in San Francisco Bay Area. His essay is significant and relevant from different perspectives. First, he defines NIMBYism (i.e., Not In My Back Yard) and some other forms of social opposition against urban change. Second, he argues that to better cope and deal with these oppositions, one should not be misguided by referring to all different types of resistance to change as singular nor interchangeable. NIMBY, according to Pendall, "connotes a selfish desire to abdicate responsibility for important community facilities. Where housing is concerned, NIMBY is a label most commonly applied to people who oppose subsidized dwellings, group homes, and shelters for the homeless". Such opposition significantly impacts a given community and its physical environment (e.g., planning, architecture, landscapes, urban design), when the effects of new developments spill over their borders (i.e., site boundaries) to be borne by the entire community. This is specifically relevant to the authors' research in the emerging area of dynamic facades (see Mousazadeh Sinclair 2012), as the effects of those architectural surfaces co-exist and are interdependent at the levels of the city, building and interiors.

Pendall (2000) mentions that protest of change can reflect racial or class antagonism, ideological commitment to home ownership, desire to protect neighborhood ambiance, and fear of decreased home value. "Protest may also be an excellent source of information about the current state of neighborhood services and, as such, can contribute to the development approval process". He differentiates these factors from more conventional NIMBYism where motivations may prove less about being responsible and more about being selfish. Accordingly, at a community level, opposition to some bigger scale projects, for example with pervasive media screens or LEDs embedded in the façades, may be driven by concerns for health and safety, energy consumption, light pollution and even waste of resources. To the authors' minds such resistance to change, driven by broader concern and more informed resistance, is not only fair and reasonable but should be a positive factor in shaping more effective agile and adaptable environments.

Piat (2000) has studied what happens when a community rejects a new development proposal. Her research is unique in the sense that she studied NIMBYism in communities that already had, for example, group homes or social housing. Therefore, what guided the research was the implicit assumption that community residents had something important to say about their experience. This approach presents a very interesting consideration for the present paper – in

that it would be beneficial to study community opposition to a new project with dynamic façades or other agile features in those communities/districts where buildings with such qualities already exist. In other words, it would be valuable to assess community positions for or against more agile buildings in those cases where community members are familiar with such innovative and non-standard design and construction approaches. This could be studied in contrast to projects where psychological and sociological resistance is high due particularly to the novelty and unfamiliarity of the architecture – for example the arrival of highly responsive facades or other inventive features of agile buildings.

Berman (1997) explored the theory of 'citizen cynicism' and examines the extent of cynicism and the extent to which it can be reduced by adapting better communication strategies, improving public participation in decision-making, and building trust. Cynicism is relevant in the context of social trust and social capital (Berman, 1997). He refers to trust as purposive and as a lubricant of relations that provides a sense of belonging that serves the emotional needs of community. Damon (1995) defines cynicism as low trust, specifically a pervasive disbelief in the possibility of good. Cynicism increases social distance and diminishes public spirit (Gore, 1994). In contrast, social capital refers to trusting and mutually supportive relationship among community members to realize their economic, social and political aims (Loury, 1987). Projects that invest in their public engagement processes to achieve the social capital support can ease their approval processes. If development proposals for buildings with dynamic facades and other mutable & responsive aspects fail to build trust (that is, concerning whether their proposed agility systems actually work) the cynicism that will ensue among community members as well as authorities with jurisdiction will be inevitable and of course difficult. To this end the authors underscore the need for more research, education, communication and vitally demonstration around emerging technologies of agility and responsiveness. In introducing these novel approaches it is wise to build trust and social capital rather than risking cynicism and barrier-building.

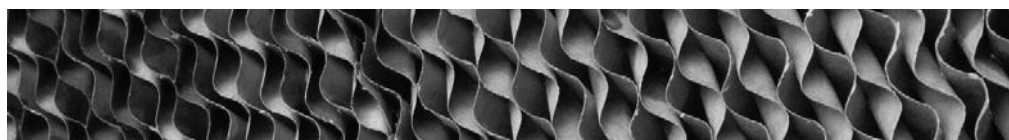
Gotham (2009) discussed growing significance of 'Mega-Events' in the economic revitalization strategies of cities around the world. Mega-Events, or 'hallmark' or 'landmark' events, are large spectacles that have a "dramatic character, mass popular appeal, and international significance" (Roche, 2000). Mega-Events like the Olympics, World Cups and World Fairs, are controversial as they are associated with costly investments in infrastructure. They are often immense and usually over-whelming 'epic' architectural projects that incorporate cutting-edge design, materials and technologies – they prove relevant to the present study as the controversies and social opposition that surfaces around such projects often include spectacular design, dynamic façades and agile building components. Such projects are not only dramatic moments on the landscape, but are also spectacular in their design and their break from convention. These projects are often dynamic in many ways, creating uneasiness through the force, scale and character of change. The work of Chuck Hoberman, in the context of interactive stage and component design for Mega-Events, provides a germane example. These projects are sometimes questioned at the beginning due to a lack of understanding and perhaps a discomfort with originality; however, such initiative advance to become urban boosters and tourist attractions over the longer term. Despite initial resistance to the dynamic and spectacular qualities, such projects tend to generate public money and create social pride (Gotham, 2009). The change in public perception about these projects is interesting to consider and very relevant to the present paper at both the individual and collective perception/behavior/response levels.

Through examining these selected psychological and sociological dimensions of conflict, discomfort, resistance and reluctance an objective is to find paths that will more reasonably encourage the deployment of agile architecture and, on a human level, empower users to not only accept change but further to advocate and pursue change in the built environment. A key proposition within this position is that enacting change, and taking initiative and control therein, results in environments which respond to users versus scenarios whereby users must respond and accommodate to environments. When environments are static and non-mutable the only choice is for the users to adapt. If environments are agile and flexible, they can be manipulated, morphed and managed to effectively meet the needs of users. With the ensuing arrival of more agile, dynamic and responsive buildings (and building components) it is

contingent on designers to have a much better understanding of people's needs and desires, of sensory systems, perception, cognition and inevitably human behavior. It is interesting to note that many schools of architecture have limited or no curricular content that directly tackles such psychological and sociological dimensions. Too often the pedagogical directions place the container above the contained, the uses above the users, and products above people. Likewise the profession has not yet tackled such nuance of more performative, dynamic and agile architecture. The authors call for courage, reason and balance by the schools and the profession, whereby as agility heightens so does our grasp of how agility translates into improved health, increased satisfaction, more productivity, greater sustainability, and enhanced interactions and a better fit between people and place.

## **FLEXIBILITY, MANEUVERABILITY + ASTUTENESS ACROSS MULTIPLE DIMENSIONS**

*People are very open-minded about new things - as long as they're exactly like the old ones.*  
*Charles Kettering*



There is little doubt that architects and environmental designers need to better understand human perception, cognition and behavior as the complexity of design, construction, buildings and cities rapidly escalates. This need is especially critical as more agile, flexible and mutable landscapes, buildings and interiors arrive to the market and into our communities. Building from several seminal models developed by one of the authors, the present paper pursued the exploration of psychological and sociological parameters pertaining to change. In many instances our instincts result in strong resistance to the new, the novel and the different. With regard to architecture and environmental design, reactions to mutable buildings and agile building components can range from unease, resistance and reluctance to cynicism, distrust and fear. Such responses can be seen in individuals and in groups, including building developers, users, communities and authorities with jurisdiction. The consequences of such attitudes can be as mundane as apathy or as severe as protest. Regardless of how individuals and groups might react to pioneering design projects, it is critical that architects be as informed and as in-charge as possible. Increasingly politics, for good and for bad, are shaping the fabric of our cities and the nature of our buildings. Change is commonplace in our urban environments. Architects need to understand change, not only on a physical and legal level, but crucially across the psychological-sociological spectrum as well. Individuals encounter and react to change in many ways, some driven by fear and apprehension and some inspired by understanding and empowerment. As we design buildings with greater opportunities for responsive facades, mutable interiors and dynamic parts, architects have an opportunity to consider users as far more integral to the Architecture. Groups also react and respond to change but arguably in different ways than are seen at individual levels. Examining NIMBYism, cynicism and response to Spectacle | Mega-Events affords us key insights into communal perception, information processing and human behavior which can guide our efforts to design and construct projects that are more responsive and responsible at a civic scale – through dynamic components, elastic facades and other agile features. Research into, and education concerning, such topics is seriously lacking yet urgently needed. The present paper provides a very initial examination and preliminary consideration of issues pertaining to the interplay of people and place when aspects of change are introduced. While complexities of such equations prove intense and demanding, the responsibilities and opportunities for architects to understand and deploy better awareness of human reaction to change are both undeniable and exciting. The authors believe that such understanding and awareness needs to be deep, broad, rich, meaningful and, above all, holistic. Undeniably, education presents a vital vehicle for advancing the cause.

Research addressing many critical areas pertaining to Open Building and Agile Architecture remains in its infancy. The authors are actively exploring facets of contemporary architecture

that have potential for greater adaptability, flexibility + reuse. Key questions relate to the interdependency and causality among & between physical, regulatory, psychological and sociological qualities of the environment. To what extent, for example, might legal issues around agile design be informed by the sociology of cities or psychology of users, and vice versa? Further, to what extent might the psychology of architects, or the sociology of the environmental design professions, influence our resistance to change and hamstringing our efforts to reform, revise and innovate the nature of design and the ‘behavior’ of buildings? In many ways the present research proves an initial foray into pressing, complex, interesting & important emerging areas of practice. Our studies and ruminations might best be seen as inaugural in extent and formative in intent – beginning to lay the steps and illustrate the topics that could comprise a rich investigative framework moving forward. The many and significant problems facing our cities, our buildings and our profession, warrant new ways of seeing, thinking and acting today in an effort to be more relevant, responsible and sustainable tomorrow.

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# Occupant participation in energy conservation

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**ABSTRACT:** The performance of energy efficient buildings and building systems relies not only on intelligent design and use of appropriate building technologies, but is also largely dependent on the ways in which these advances in 'smart' green building systems integrate with occupant use patterns to enhance overall life quality and support long-term behavioral transformation toward energy conservation practices.

Research has shown that while approximately half of the energy used in the home depends on the physical characteristics of a house and its equipment, residents and their behavior influence the balance (Janda 2011). Differences in individual behavior have been shown to produce large variations – in some cases as much as 300% - in energy consumption, even when controlling for differences such as housing, appliances, HVAC systems, and family size (Keese 2005; Hawk et al. 1989).

This paper reviews our understanding of existing energy use patterns and adoption/utilization of energy conservation practices in residential and workplace settings. Our intent is to explore the critical human and social dimensions of sustainable building/community design, and to understand those characteristics that enhance inhabitant life quality and support long-term energy conservation practices. The paper reports on an initial phase of a project exploring how the use of embedded energy feedback technology is used to inform and support occupant energy conscious behavior.

**KEYWORDS:** Occupant Interface, Feedback, Energy Consumption

## INTRODUCTION

Buildings consume 72% of the electricity produced annually in the United States; this share is expected to rise to 75% by 2025 (EPA 2009). The character, composition and capacity of the building envelope and its relation to HVAC systems, is one of the most significant factors in defining the overall environmental performance and energy use of a building (Wigginton 2007; Wigginton and Harris 2002). As a great deal of the operational energy consumed by a typical building is dedicated to the provisions of comfort (heating, cooling, ventilation, humidity control, and lighting), designing multifunctional building envelopes and systems of operation that reduce HVAC demand, yet respond to occupant comfort and health has been identified as a research priority by the USGBC (USGBC 2008). While efficient equipment and advanced building envelope technologies can reduce this energy load, further energy conservation can be achieved by involving occupants *directly* in the control of comfort provisioning. Research has shown that while approximately half of the energy used in the home depends on the physical characteristics of a house and its equipment, residents and their behavior influence the balance (Janda 2011). Differences in individual behavior have been shown to produce large variations – in some cases as much as 300% – in energy consumption, even when controlling for differences such as housing, appliances, HVAC systems, and family size (Keese 2005; Hawk et al. 1989). Social scientists have long recognized that motivations to consume or conserve energy are societal issues, arguing that deep social change is necessary to achieve real and lasting energy reduction in buildings (Keese 2005).

When advances in envelope design/construction are combined with sensing and feedback-informed occupant control, significant reductions in overall building energy use can be achieved. The advance of digital technology integration into the physical components of building systems has the potential to promote the engagement of non-expert occupants with

building system operation, and the internalization of sustainable patterns of behavior (Velikov and Thün 2010).

This paper begins with an exploration of the social issues involved in household energy consumption through a summary of a variety of behavioral interventions aimed to promote household energy conservation and durable behavior change. Results show that combinations of methods that provide targeted information about energy consumption, goal-setting and feedback are likely to result in more durable behavior change, including energy conservation behaviors. The paper concludes with a description of the initial phase of a project that examines the role of technologically integrated feedback in engaging building occupants in energy conservation behavior.

## **1.0 INFORMATION STRATEGIES**

A common approach when attempting to influence behavior change is the dissemination of information. Interventions that emphasize information as the main predictor of environmentally responsible behavior do so with the assumption that a deficit in environmental awareness precedes the absence of the environmentally desirable behavior. In this theorized behavioral change system (Hungerford and Volk 1990), knowledge is expected to result in changes in awareness or attitudes about environmental issues, which in turn is expected to result in some action taken. From this perspective, information-based strategies can be particularly beneficial, especially considering a number of householders lack basic knowledge about energy conservation. A 2010 national online survey of household energy use revealed most participants were confused as to the most effective means for reducing household energy consumption (Attari et al. 2010). The majority of respondents reported they believed curtailment activities (like turning off their lights when not in use or lowering the thermostat) were more effective than efficiency improvements (like installing more efficient light bulbs and appliances). In contrast, efficiency improvements actually offer the highest potential for energy savings. However, it is generally acknowledged that curtailment behaviors can have significant impact on home energy emissions, as it is estimated that householders' adoption of simple everyday conservation behaviors could save up to "123 million metric tons of carbon emissions per year or about 7% of US national emissions" (Osbaldiston and Schott 2011, 281). Additionally, in contrast to technological efficiency, energy savings through behavioral change has the potential to spread across multiple contexts as energy-aware users begin to interact more conservatively in the environments they frequent every day.

### **1.1. Type of information**

There are several categories of information or knowledge with respect to creating awareness of environmental issues (Kaiser and Fuhrer 2003). The first type is referred to as Declarative knowledge, which essentially seeks to create awareness of the environmental issue by defining the problem. Informational interventions that focus solely on declarative knowledge generally only result in increased levels of knowledge, which does not translate to behavioral change (Abrahamse et al. 2005). Declarative information about an environmental issue often must be accompanied by some Procedural information about how to achieve a particular conservation goal (Kaiser and Fuhrer 2003).

Understanding the purpose of different types of information is useful for knowing how to interject information into a basic model of behavior change involving three phases: the detection phase, decision phase, and implementation phase (Pelletier and Sharp 2008). For a person who is unaware that a problem exists (at the beginning of the detection phase), procedural information about how to reduce household energy conservation would be useless. Similarly, more declarative information about the nature of a problem would not motivate a person who is in the decision and/or implementation phases of behavior change (p. 212).

Research has shown that people desire access to procedural guidance with respect to energy conservation. In a 1996 study, 83% of respondents indicated that accurate information of how to reduce the electricity consumption of their appliances would help them to reduce their household's electricity bills (Mansouri, Newborough, & Probert, 1996, p.260). In addition to desiring information at the point of purchasing a more efficient appliance, householders desire procedural knowledge about how they might more effectively change their daily behavior to

conserve energy, suggesting that householders derive pleasure in the self-interested pursuit of exhibiting their competency or efficacy in these tasks (Parnell and Larsen 2005).

## **1.2. Form of information**

In a review of 41 intervention studies, Ester and Winett outline a number of characteristics pertaining to the effective dissemination of information. A cited weakness of this strategy is the pervasive use of the written medium alone and the use of information as the singular point of intervention. Informational interventions are strengthened when the information is about specific behaviors (i.e., procedural information that highlights simple, yet detailed behaviors to try to conserve energy), convenient behaviors and salient to the receiver of the message (emphasizing the importance of message tailoring, where applicable) (Ester and Winett 1982).

In general, results have shown that information strategies are useful for increasing knowledge about an issue, but information strategies alone rarely account for actual behavior change or energy savings. Approaches utilizing an information-based intervention can be effective for reducing household energy consumption, especially when used in conjunction with other approaches including goal-setting and feedback (Abrahamse et al. 2005).

## **2.0. USER FEEDBACK**

### **2.1. Form of feedback**

For the everyday householder, feedback about energy consumption is an important component in attempts to conserve energy. Yet the effectiveness of this type of information is often far from ideal in terms of optimizing users' energy conservation. In general, there are three types of household energy feedback: 1) direct feedback in the home (in the form of electricity meters), 2) indirect feedback in the form of a monthly utility bill about total energy used and 3) inadvertent feedback, which is a by-product of technological, household or social changes. Direct feedback involves the greatest potential for energy reduction, specifically offering the highest savings potential when linked to an individual appliance (Darby 2000).

One of the central problems with the majority of feedback householders receive is the lack of itemized information that details the usage of each appliance, according to certain times of day. This has been likened to trying to shop for groceries and only receiving a bill for the total sum rather than for each individual product (Fischer 2008). In an extensive literature review of several international studies utilizing feedback to promote household energy conservation, Fischer highlights numerous characteristics of successful feedback. The medium and mode of presentation is particularly important. Computerized feedback with multiple options available according to the user's choice presented in an aesthetically appealing format (a balance of text and graphics) has been shown to be an important characteristic. Detailed, appliance-specific breakdowns of information presented very frequently are also effective. (Note: No studies with feedback offered less than monthly have been effective. Daily and more frequent feedback have shown the greatest results in energy reduction.) Additionally, studies have shown the importance of combining frequent, appliance-specific feedback with procedural information about ways to reduce energy consumption (Brandon and Lewis 1999).

### **2.2. Feedback and goal-setting**

Testing the combined effect of feedback and goal-setting, Becker (1978), asked 40 families to set a difficult energy conservation goal of 20% and 40 families to set an easy goal of 2%. Within each of these groups, half of the families received feedback (three times per week) and half only received feedback at the end of the intervention. Twenty families served as a control group who only received information about energy conservation. The combined effect of feedback and goal-setting was supported, as only the 20% goal combined with the feedback condition statistically differed in energy conservation from the control group.

Building on the work of Becker (1978), McCalley & Midden (2002) tested the efficacy of product-integrated feedback and goal-setting on household energy conservation in a simulation study wherein participants could enter an energy conservation goal into a washing machine interface and receive energy feedback in real-time. Expanding on Becker's work, participants were either assigned a conservation goal or were responsible for self-setting a



conservation goal. The results of the study conclude that product-integrated feedback, when combined with a means for the user to set an energy conservation goal, offers an effective means for energy conservation.

In summary, while a number of techniques offer effective results, no single approach has been shown to affect durable conservation behavior change. Rather, the research suggests that interventions adopting a combination of tactics, including detailed, specific declarative and procedural information and goal-setting with frequent, specific feedback are likely to result in the greatest conservation effects (Abrahamse et al. 2007)

### **2.3. Feedback and technology**

With advances in the research have also come significant advances in material and computer technologies that define the nature of the feedback systems available. The research has been evolving to include emerging technologies of iPhone applications, social networking sites, and Internet energy dashboards. Advances in technology have now opened doors to the study of the effectiveness of fine-grained energy information that allows consumers to increasingly connect energy use to specific sources in the environment (Froehlich 2009). Much research has focused on the nature of the feedback, often manipulating variables such as frequency, content, access, and even information about social norms.

As a follow-up to a study that involved users in setting goals and receiving feedback on a simulated washing machine interface, Midden and Ham (2006) explored the effect of social, in addition to factual, feedback via a robotic agent displayed on the machine interface. The social feedback via the robotic cat, which gave visual positive and negative feedback to users, resulted in the strongest persuasive effect on energy conservation. Exploring the ways less overt modes of feedback might influence user energy conservation, Maan et al. (2010) employed ambient lighting changes to provide users with subtle, less cognitively demanding, cues about positive and negative energy performance. The results indicated that the feedback through ambient lighting had a stronger persuasive impact than factual numerical feedback.

The North House Project (Velikov and Bartram 2009) explored both the technical and the human dimensions of energy consumption. The project involved the development and construction of a prototype high performance, energy producing home which incorporated advanced technologies that not only functioned to manage building energy, resources, and comfort, but also make it possible for inhabitants to actively participate in the operation of the home in order to achieve their environmental goals.

The ALIS (Adaptive Living Interface System) developed for the North House project, incorporates multiple modes of graphic user interface to provide occupants with energy systems control and feedback, as well as architecturally integrated devices that signal resource use in haptic and ambient ways. In addition the system provides social motivation tools to foster sustainable patterns of living.

The ALIS was integrated with automated building controls and sensing systems that optimized energy and water use in the home. ALIS provided feedback and control through an array of interfaces that used web browsers on both building embedded displays and home computers; a mobile application; and ambient feedback displays embedded in the house (such as the Ambient Canvas described below). The ALIS allowed users to control all aspects of the interior environment (ie. override automated systems) including lights, temperature, humidity, ventilation, as well as privacy, daylight, and glare through the interior blinds and exterior shades. Feedback and control could be personalized for individual users. Users had the opportunity to set personal milestones and challenges, and the system also included a community interface to encourage collaboration/competition.

An additional feature of ALIS, described by Velikov and Bartram (2009), was the Ambient Canvas. "In an age of information overload, there is increasing interest in the cognitive value of "calm technology," that is, technology and information that inhabits the periphery of human attention, and that provides attunement to conditions without requiring attentive focus" (Weiser and Brown 1997). The Ambient Canvas is an information display that was embedded in the

kitchen backsplash of North House that provided ambient feedback (through color changes) on levels of energy consumption. This subtle feedback system promotes awareness of resource use to assist and influence sustainable decision-making.

A continued pressing area of research in need of advancement is the development of new forms of occupant interface, such as those developed for the North House project, to enable meaningful information exchange between systems and users. In order for building systems to realize the potential of embedded intelligence promised by advanced sensing and computational integration, it is critical that users are able to interact with systems in didactic, real-time, and projective modes. User interface systems support tasks to help occupants control building systems (through touchscreen development, smartphone applications, web applications and community networks). 'Tools' should integrate with use patterns (coordinated with online tools, messaging, calendars, etc.) and provide meaningful performance feedback that supports long term behavioral transformation.

An example of a current research project on the use of embedded intelligence to inform and support occupant energy-conscious behavior is described below.

### **3.0. THE INTEGRATED RESPONSIVE BUILDING ENVELOPES (IRBE) PROJECT**

The Integrated Responsive Building Envelopes (IRBE) study (Lynch and Thün 2011) explores the development and implementation of environmental sensing/feedback systems and occupant responses/behavior related to energy control systems and daylight strategies in a test-bed office building on the UM campus. To optimize sustainable system performance, a portion of the project (with involvement of the authors on the research team, and K. Velikov from the North House project) explores how users interact with sustainable systems and ways to augment sustainable behavior through educational materials. The project examines ways in which integrated controls and feedback mechanisms in buildings can be designed to support and even transform behavior of building inhabitants toward more sustainable patterns of living and building use habits.

The first step of this project was the administration of a survey to all occupants of exterior offices in the building to understand how they perceive and interface with energy control systems and daylight strategies in the building. The survey included a set of questions related to satisfaction with environmental features and performance (including natural and artificial lighting, glare, environmental control features (opening windows, thermostats, etc.) and so forth), as well as occupant knowledge related to the building and its energy conscious features.

We also conducted walk-throughs of office use. During the same time period as the survey was administered, members of our research team walked through selected portions of the building recording occupancy, behavior (for example use of space heaters, lights left on in unoccupied spaces, weather appropriate clothing), and operation of building control systems (open windows, thermostat settings, position of window blinds, etc.). Any other occupant interventions for environmental control (blocking vents, covering windows, use of portable space heaters/fans or other devices, individual desk lights and so forth) were noted. We also recorded temperature, light, and humidity readings for each office. These methods (survey, walk-throughs, measurement) will be administered in summer, fall, and winter to assess any seasonal effects. To date we have administered the fall walk-through and survey.

Walk-through results indicated that all window blinds were in the fully down position, except for less than 10% of offices. Occupants appeared to adjust the position of the blind slats to adjust environmental conditions. 70% of blind slats were fully opened on the North side (20% partially or fully closed); a similar percentage on the West side had blind slats either fully open or partially open (31% partially or fully closed). 40% of blind slats were partially or fully closed on both the East and South sides of the building. Since the walk-through took place between 10 am and noon, the position of the blind slats on the East and South sides of the building may have been influenced by sunlight.

The majority of occupants turned overhead lights on when they occupied the office. This ranged from all overhead lights on in occupied offices on the East and North sides; 88% in

occupied offices on the West side; and 75% of occupied offices on the south side. 44% of unoccupied offices on the North side had lights on; 25% unoccupied offices on the South side; 19% on the West side; and none on the East side (although some of these offices may have been only temporarily unoccupied).

Thermostats in the building control banks of multiple offices, while individual occupants have control of individual air vents. None of the individual office air vents were turned off or blocked. Portable heaters were observed in 25% of North facing offices, and 10% of East facing offices. Portable fans were observed in several offices, but none were in use. Average office temperature recorded was 22.7; for East facing offices, recordings averaged about .5 degrees higher noted during the walkthrough (10 to noon). Average humidity readings were 50.2% for North and East facing offices, and 51.8% for South and West facing offices.

Results of the initial surveys indicate that the majority of occupants are satisfied with the operability of office control systems and generally satisfied with office environmental conditions. It appears that there is potential for educational intervention regarding energy conservation strategies related to building energy systems and the use of overhead lights.

A separate portion of the IRBE study involves the design and implementation of sensing systems integrated into the physical components of building systems. From the behavioral perspective, we will again study occupant energy behavior following the installation of these feedback systems. We will also provide educational materials regarding energy conserving behavior, and explore this intervention as a means to promote long-term sustainable behavior.

## CONCLUSION

Critical human and social dimensions of sustainable building and community design have the potential to support long-term energy conservation practices. Research suggests that interventions adopting a combination of tactics, including detailed, specific declarative and procedural information and goal-setting with frequent, specific feedback are likely to result in the greatest conservation effects. Feedback systems such as the ALIS introduced in the North House project offer exciting possibilities. The intent of the IRBE study is to begin to test approaches to the integration of new technologies within the building system that engage occupants with building system control and feedback, encourage energy conservation, and lead to durable behavior change.

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## **Ends**

The Dystopia in Utopia and the Final Cause.  
Forces, Causality, Ideology, Values, Myth



# The Future is Fixed

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ABSTRACT: Isaac Asimov once commented that nothing ever changed in the science fiction of the former Soviet Union. Any suggestion that the future might be different brought the risk of censorship. Soviet cinema could not take place in time. As a result in films like *Mechte Navstrechu* (1963) erratic and discontinuous plot devices allowed a vision of the future in which no alteration of the present occurred. The future remained the same as the present: No change was allowed.

Martin Heidegger made a similar observation about the inability to change as a key characteristic of any environment in his 1929-30 lectures on metaphysics. Heidegger differentiated between the environments of the animal and of the human by noting that both were trapped in a set of fixed relationships. However, the human could imagine the possibility of changing the environment. Heidegger thus defined humanity by a capacity not to change but to envision the present differently. Read closely, these transitional lectures reveal the inability of technology to offer anything new.

Curiously, Soviet-era science fiction worked critically within a previously established future condition. These fictions deployed the future as a signpost from which detours could be taken. Breaking the narrative allowed for seemingly unimaginable alternatives to be presented without truly effecting any change. The future was never a goal to be obtained within the context of these films. It was an orienting distraction, and as such it offers a new way of thinking about the intent of computation for architecture. If the image, model, simulation are conceived as orienting distractions from the ensnarement of time—*αχρoνία*—can they be used to displace the future from the present and restore critique to the architectural *utopia*?

KEYWORDS: utopias, time, drawing, science fiction

## INTRODUCTION

In Soviet era science fiction the prohibition of a future, which differs from the one already known, reveals a problem for the creation of a contemporary utopian critique. Isaac Asimov once commented that nothing ever changes in the science fiction of the former communist state. Any suggestion that the future might be different brought the risk of censorship. (Asimov 1962, 12-13) Soviet science fiction cinema needed to take place outside of time. As a result, in films like *Mechte Navstrechu* (1963), erratic and discontinuous plot devices allowed a vision of the future in which no alteration of the present occurred. The future remained the same as the present: No change was allowed. If Soviet science fiction only draws out possibilities that are already known, what critical function does it offer? Films like *Mechte Navstrechu* offer insight into the potential of a replacement for the now dysfunctional utopian literature with drawings that are *αχρoνία*. These drawings out of time form a second-order critique that became necessary when no other place existed from which a utopia could function.

### 1.0 Out of place

In utopian discourse, removing the utopia from the space of the real creates a distance from which reality is critiqued. In Thomas More's text, *Of a Republic's Best State and of the New Island Utopia*, the island that interrogates and makes sense, or non-sense, of sixteenth-century Europe is located somewhere on Earth. In this sense, the utopia—*ουτοπία*—is the other place. But Copernicus's decentralization of the earth within the universe and Descartes's reduction of place to space initiated a process by which no other place on earth could be postulated as the location for the utopian project. Utopia was displaced from the earth to the wandering stars—the planets. The possibility of this shift can be seen in works like Athanasius Kircher's *iter extaticum coeleste*, where the seventeenth-century Jesuit writes about a flight through Tycho Brahe's solar system framed within a dream. In effect the space race of the late 1950s and



1960s completed this historical arc in which the other place became a non-place. When the earth could be imaged as no different from any other planet, the possibility of locating a utopia anywhere completely disappeared.

In response to the lack of place from which to be critical, the dislocation of the utopia in space had to be supplemented. The utopia became an other place in an other time. The utopia as place dislocated in time is precisely how the Soviet author, Ivan Yefremov, framed the work of science fiction. In the introduction to his novel, *Tummanost Andromedy* (1957), Yefremov describes the goal of science fiction as the revelation of humanity's ultimate potential, which demonstrates the *happy future* that will result from the progress of communism (Yefremov 1980, 17). It is important to remember that More's own utopia was etymologically slippery; the *ou* of *ουτοπία* can also be translated as 'good'. This is the positive interpretation of the utopian critique, where the other place is bound to Plato's *Republic* as the place of the good.

Something strange happened as Yefremov was writing *Tummanost Andromedy*. He was unable to maintain the spatial and temporal distance from his projection of a happy future. In his introduction to the novel, Yefremov notes that he began writing the story to be published serially in 1956, but the progression of the nascent space race kept forcing him to rewrite and adapt the timeline of the novel. Yefremov comments that events like the launch of the Sputnik satellite forced him to revise how far ahead in time the events of his novel could be placed (Yefremov 1980, 16). What started as thousands of years shifted closer and closer to his present day, and as a result Yefremov could not hold open the temporal distance that differentiated his *happy future*. It continuously collapsed back into the conceptual framework for contemporary Soviet life and culture. This is why Asimov could comment that nothing changes in Soviet science fiction. (Asimov 1962, 12) The utopia that attempts to present a happy future is already the happy present. Not only is there no other place to locate the utopian critique, there is no other time, no future other than the present.

## 2.0 Out of time

The 1963 film, *Mechte Navstrechu*, relies on a narrative structure that builds from Efremov's lack of a differential future. To overcome the lack of any time in which to situate the possibility of a future different from the present, *Mechte Navstrechu* places itself outside of time.

The film opens with a scene of the earth from space and zooms into scenes of everyday life in the Soviet Union carefully narrated as if they represent not a specific city or place, but one typical of all places on the planet where men and women from diverse backgrounds and disciplines join together in a harmonious life. Following this presentation of the perfect potential of contemporary communist society and life, the archetypal team of cosmonauts—including the computer operator, the commander, the mechanic, the engineer-painter, the radio astronomer and the academician—who explore the universe for signs of other life is introduced. The narrative then shifts to a conversation between the academician, Krylov, and the ominous and foreign Dr. Laungton.

Laungton and Krylov have an ongoing argument over whether the discovery of alien life in the universe will result in catastrophe or will simply provide a wondrous extension of the already harmonious existence on Earth. Laungton, standing in for Western ideology, believes aliens will only destroy the Earth. For him there is neither happy present nor happy future. Suddenly their conversation is interrupted as Tanya, the radio astronomer, receives a signal from another world. The scene shifts to a conversation with her lover, Andrey—the mechanic—at an ambiguously located boat in a lagoon, which prefigures the film's unannounced rocketship, *Ocean*. Is the signal real? Andrey believes it is, and thus the narrative arc of the story begins as a worldwide announcement is made about the aliens who have crashed on Mars during their trip to the Earth. Preparations are made to advance the launch of the *Ocean* already under construction through the cooperation of all the nations of the Earth, in order to rescue the aliens now stranded on the red planet.

The narrative progresses as one might expect with a series of scenes depicting the overcoming of the challenges to space travel, arrival at Mars, and the rescue of the one alien still alive from Mar's moon Phobos. Having successfully completed the mission and negated

Dr. Laughton's pessimism about the possibility of an alien encounter leading to the destruction of the Earth, the narrative arc effectively ends in the preservation of the Earth in its state of happiness. The future has been proven to be the same as the present in this sense. Even Dr. Laughton must now be happy.

But one thing has gone wrong. In the course of rescuing the alien, Andrey is trapped on Phobos and unable to return to the Earth. Tanya must return to the Earth without her lover. In the only plot twist of the movie, the film cuts back to the scene of Andrey and Tanya at the boat, but Tanya is now crying as she had been on the return trip from Mars that left Andrey behind. Tanya announces that we should not let Andrey die. The narrator intervenes and announces that we have spent an hour in the dreams of Andrey while his companions have been in reality singing songs of the universe. This in turn will sing more new songs of the universe. Suddenly, as in the opening of the film, a worldwide signal announces that the rocketship, *Ocean*, has launched on its way to Mars.

*Mechte Navstrechu* ends where it begins with the same present and seemingly with the same future. There is no indication whether the launch of the rocket, *Ocean*, at the end of the film initiates the modified rescue mission or if it begins the original mission planned for the ship. The argument between Krylov and Dr. Laughton about whether the happy present will be a happy future remains unresolved as is the case in real life, outside of the film, where Western influence continues to be the only force that might undermine Soviet progress. No time has transpired. No events have taken place. No change has occurred, so what has happened? *More new songs of the universe have been sung*. This is an odd utopia.

#### 4.0 Drawing out time

In fact *Mechte Navstrechu* is not in any way a utopia. The film has a place. It is located on Earth, not in an other place or no-where but in an everywhere that includes the possible other planets where we might meet aliens that are just as happy as us. This expansion of where the narrative of *Mechte Navstrechu* has the potential to play out transforms place into homogenized, universal space. But that space, the space of the film, has a strange relation to time. *Mechte Navstrechu* is structured by the dream of Andrey, beside which *new songs of the universe are sung*. As such it exists outside of time. It is an achronia—*αχρονία*—but what on Earth is that? To understand what an achronia is, and how it is a critical supplement to the utopia, the linear, historical nature of the narrative has to be abandoned. Achronias draw out time. This requires confronting an image not a text.

Alberto Perez-Gomez has noted that Piranesi's etchings like those of the *Carceri* series questioned the relationship between the Cartesian explication of space and the possibility of drawing (Pérez-Gómez 2006, 87-88). Piranesi's *Carceri* etchings reveal an excess outside of the assumed homology of descriptive geometry and lived-space. Within the logic of drawing, impossible spaces are created by manipulating the disconnect between the rules of perspectival representation and what is actually perceived in experience. These impossible spaces only exist in the other place of the etching, and in this sense the excess space of Piranesi's *Carceri* can be understood as utopian. But like the other place of More's utopia, Piranesi's excess space is confronted by a problem of time.

With respect to the space of drawings like Piranesi's, Roger Penrose has explained away the excess that the *Carceri* present to the viewer. Penrose has noted that if one breaks up drawings like the *Carceri* into fragments, one can make sense of them as perceived moments in time. Any given fragment of the drawing makes sense with respect to spatial habitation (Penrose 1992, 245-47). Penrose's critique makes sense if one thinks about the infinite stair drawings by M.C. Escher that he inspired. If you take a single flight from one of Escher's stairs by itself, it makes spatial sense. It stops making sense when assembled with other stairs that are temporally incompatible with it. Penrose calls this effect the cohomology of impossible figures. In combination with his notion of twistor space, this cohomology explains away the excess space of Piranesi's etchings in a manner that Cartesian space is unable to accomplish.

The shift from the inexplicable space of Piranesi's etchings to the impossible figures of Penrose and Escher is a second-order collapse of lived-space. Where Piranesi's etchings

drew upon our assumption that descriptive geometry and lived-space are homologous, Pernose's cohomology of impossible figures represented by Escher's stairs is explained away by a collapse of multiple relationships to time. The spatial homological reduction becomes a temporal homological reduction. As in Yefremov's struggle with maintaining a temporal distance for *Tummanost Andromedy*, Pernose/Escher's drawings struggle with maintaining the difference that critiques our assumptions about spacetime.

*Mechte Navstrechu* posits a present and future without any spatial or temporal difference at all, but in spite of a lack of difference the film manages to question the relationship between time and the possibility of drawing. By temporally displacing the entire movie into a dream, the film reveals an excess outside of the assumed homology of relative time and lived-space. The dream within which the narrative arc of the movie exists has some other time, but there is no where for that time to go. It cannot progress. It simply is. Tanya knows that this other time, drawn outside of her own, exists. At the end of the film, unlike at the beginning, she is crying and implores that Andrey not die. This small change is happening in the space of the film as the narrator tells the audience that it has inhabited Andrey's dream, but this does not explain the excess time that has been created within the dream. The time that does not *run*.

The narrator of *Mechte Navstrechu* provides the only clue to what might be happening in the film with its strange structural displacement of a time outside of the movement from present to future that remains fixed at the moment of the rocket launch from beginning to the end of the movie. *More new songs of the universe are being sung*, but what can this possibly mean within the context of a time with no when?

Lee Smolin offers potential insight in his geometrical description of the boundary at spatial infinity. Smolin notes that this type of bounded infinity is necessary to solve the equations of general relativity. To understand what this boundary condition is, Smolin offers the following explanation:

Imagine a flat two-dimensional plane. Pick a point, then pick a direction going outward from that point. That defines a line in the plane. Follow that line as far as it goes. It goes an infinite distance, but in the mind's eye of the mathematician it nonetheless goes somewhere. Where it goes is called a *point at infinity*. Pick another direction from the original point. You get another line. Follow that as far as it goes; it takes us to another point at infinity. The points at infinity make up a circle. The directions you can go from a point in a plane define a circle. Following those directions as far as they go, you reach the boundary of points at infinity. The same thing obtains in flat three dimensional space, except that the points of infinity make up a sphere (Smolin 2013, 291-292).

For Smolin, the description is a way of understanding the limit that exists at the end of space, but has no other space beyond it. In the case of relativity, only information crosses that limit. I am interested in his description for another reason. Smolin describes bounded infinity as if it were a drawing. Make a line from here to here. Go back and make another line from here to here, and so on. The problem, of course, is that to draft such a drawing would take an infinite amount of time. The drawing of infinity can be conceptualized, but only if it is divorced from temporality. The drawing has to exist outside of time, otherwise it will never exist as it will always fail to be complete.

Transposed to *Mechte Navstrechu*, Smolin's drawing of the boundary at spatial infinity starts to make sense of the film's structure. The dream can only exist if it is drawn out from the space of the film. In order for this to happen, no time can pass within the space of the film. If time happens within the film, the representation of time that is the dream can never be fulfilled. It will always fail prior to appearing. Time in this sense is drawn out from the film itself. When time returns with the launch of the rocket at the end of the film the infinite labor that is the attempt to complete the drawing of infinity within time resumes. This infinite labor that will never be completed is the infinite harmony of the songs sung by Andrey's companions. Only Tanya, left in tears, and the audience know what the completed drawing might appear to be.

For both the dream of Andrey is the achronia, the no-other-time that reveals life outside of the labor of history. But what is the critical role of this strange representation of time that replaces the utopia?

### 5.0 Being human by withdrawing time

In his 1929-30 lectures on metaphysics, Martin Heidegger stated that the fundamental attunement to world of the human being is the *langeweile*, the long while, boredom. Heidegger explained this ontological state, unique to the human, through the experience of waiting for a train at a station. In the terminal, you wait for the train to arrive. The clocks on the platform reveal time to you as you wait, but the time that they present to you is disconnected from your lived experience. Despite what the clocks tell you, you do not know if the train will arrive or not (Heidegger, 1995). This is an elision of your future into the representation of time. The clocks steal your future. Waiting without a future is being bored, inhabiting the long while. Recognizing that one is trapped in the long while without time and without a future is being human.

The problem with being trapped at the train station in the long while with no time is that the train will never arrive. The world cannot change from the present to the future when the train would be there at the platform. The future is fixed. It is not simply subsumed within its representation, the clock face. It has no means to come into being. This is not just the space of the train station. It is also the space of *Mechte Navstrelu*. But in the film Andrey's dream is not the same as the clocks in Heidegger's train station.

Andrey's dream is otherwise located. It draws out a future to completion even if it exists outside of human time and space. By doing so it recreates the possibility of a future that does not exist in the train station. But it is a strange sort of future. The dream does not give a future to the Earth of the film and to the cosmonauts. It only provides a possible orientation away from Tanya's and implicitly the audience's suffering that will never be achieved.

This possibility of orientation seems to be what the achronia creates. By pointing outside of the present the achronia reveals a time outside of the clocks that ensnare Heidegger in his station. Even if that outside never appears or never offers a future, it suggests humanity can turn away from the long while.

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# Applying a dissident's stance on recent trends in urban research - quantitative methods as a symptom of growing marketing pressures on the city

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**ABSTRACT:** The paper investigates the rapidly increasing use of data in urban research, questioning cause and effect in order to understand how the usually publicized reasons for this trend - scientific progress and ecological threats - relate to wider economic interests as the actual underlying forces of transformation. Dealing in essence with a whole discipline within the philosophy of science - the relation between scientific progress, human behavior and the economic realm - the author does not endeavor to bring new findings to the philosophical discussion as such, but applies elements of it to the urban realm. Just like the fast development of mobile devices - as one example among many others - cannot simply be attributed to technological progress, but also to the market's fervent demand and the product's considerable profitability, the author argues that the impressive change of paradigm in urban research might as well be motivated by something else than simple pragmatic needs and a new fashion for computation. He also observes the dissolution of a formerly existing discussion between experts towards a situation in which the wider public is addressed as the consumer of a product that is defined by an oligopoly of public-private interests. The character of this marriage leads for the urban professional to a new method of not only approaching, but also perceiving and "selling" the urban realm, one example being different types of city rankings that are using figure-based information in order to attract investment through the creation of an image. This duality and tension, between the rationality of a figure-based approach and the marketing pressure that consists in provoking irrational buying decisions, crystallizes as one of the study's major outcomes.

Is what we see just the agreeable tip of a manipulative iceberg? How can the urban designer adjust to these trends, avoiding to be used as a mere tool for empty marketing campaigns?

Keywords: urban research, quantitative tools, data, marketing pressures, process

## Introduction

In an unrestrained way, the author of these lines had until recently welcomed the increased use of metrics in the field of architecture and urban design. Arguably offering a more rational base for the development of new solutions to contemporary challenges - mainly sustainability related - he felt a certain relief and fascination to become more acquainted with the quantitative tools that other disciplines seemed to have successfully applied over long periods of time. An opportunity opened up through which the body of design knowledge could finally experience the gradual growth that the "non-artistic" scientific disciplines were used to. At a second glance - as influential as they might have been for insiders - the major works used in architectural education, from Rossi's *Architecture of the City* over Venturi, Scott-Brown's *Learning from Las Vegas* to Rowe and Koetter's *Collage City*, appeared as isolated one-offs if seen as research resources for all professions involved in the making of our built environment. In contrast, the unlimited comparative opportunities of GIS, cell-phone data and climatic computation could provide an interdisciplinary insight that would allow for a genuinely problem-solving approach to urban issues. In *Collage City*, partly based on the work of the British philosopher Karl Popper and his concept of piecemeal social engineering, Rowe and Koetter scrutinized the non-utopian opportunities for master planning with reference to the "bricoleur", but the result seemed somewhat to still have been understood in a mainly visual way. The fact

that the collage was not only meant as a more complex image, but also a process, did not really leave a lasting imprint on the profession. Neither did the warning, again based on Popper, that the artistic utopian approach was inherently linked to authoritarian tendencies towards the tabula rasa. Once again, the author of these lines felt that the new figure-based techniques, and the methods that they provoked, could finally lead the way out of this dilemma. Interestingly, another major trend occurred in parallel: the emergence of a new urban age, and the understanding of urbanism as a main societal driver, comparable in its impact to the concept of the nation-state that influenced intellectual thought since the early 19<sup>th</sup> century. The author himself has written about how the growth of metrics relates to these developments, and how it challenges the theories developed for the industrial city. Building on the work of intellectuals like Henri Lefebvre, and later David Harvey or Manuel Castells, the claim is made that the urban realm and its elements are subjects on their own, rather than just physical results of more conventional parameters. A city is hence not only an accumulation of factories, residential buildings, monuments, public spaces, and so forth, but also a creating force that impacts its environment and the people that inhabit it. The assertion can be made that such ideas were already part of the oldest philosophical discourses, but they were reinvented in the current version under influence of postmodern thought. The strong logo centric focus of modernism and the Enlightenment Project, insisting through polarization on a clear dichotomy and hierarchy between action and reaction, original and copy, truth and approximation, made it difficult to acknowledge the workings of communication and exchange functions in a genuinely complex network.

The French philosopher Jacques Derrida, insisting on the importance of language and signs in such a world without final truth and obvious significance, was probably the most influential advocate of these concepts for the architectural world, explicitly serving as an inspiration for, and partly even collaborating with architects like Peter Eisenmann and Bernard Tschumi. The intense semiotic role that architectural language plays in the projects of these two architects, or even Ricardo Bofill or Michael Graves - to state another branch of postmodernism - is different from the clean white surfaces of modernity and their obsession with structural honesty, acting just as an abstraction of holy truth, to be discovered in its entirety somewhere in the aftermath. In postmodernity, the signs become all the truth that exists, or at least the only connection to a truth that is rooted in history. Despite their profane nature, they hence gain rather than lose in importance.

In the realm of urbanism, rather than architecture, the rules are slightly different, but from a philosophical point of view, postmodernism allowed for the (re-) understanding of urban elements as bearers and creators of original sense, but also economic value. The technocratic and functionalist tendencies of the pre-war times did not really allow for such a vision to unfold. In line with this thinking is the modern perception of space as an essentially empty container, increasingly opposed to the more complex cultural understanding of « place ». If postmodernism really invented anything new is a question that the author is not able to answer, but the fact is that a new vision towards urban questions had been enabled, offering the field of urbanism a substance that allowed for new perspectives to emerge.

This little digression in the world of philosophy and architectural theory helps to understand from a more theoretical perspective how city and design issues did gain importance in current economic and political discourse. It complements the more straightforward explanation of these trends based on the fact that cities have become the more apt entities to answer contemporary economic dynamics, rather than nation states. London's currently booming real-estate market is a good example of an urban entity that global investment forces have disconnected from the still gloomy outlook of its national hinterland in the aftermath of the European debt crisis.

### **Main part**

The preceding paragraph tried not only to highlight the growth of metric approaches to urban design, but also the reasons for an alleged growing interest for urban issues in general. The real interest of the study question sits in the interrelation of these two phenomena. Special importance must be given to the question of exchange and communication value provided through quantitative tools and the spread of descriptive figures. Though presented above as an

opportunity for inter-disciplinary collaboration - one that is lacking in a completely formal and artistic approach towards the city - the problematic of data-driven approaches to urban morphology, and maybe figures in general, is the fact that they tend to be sooner or later correlated to economic value. As one of the central points of this paper, the question hence intrudes, if economic forces cause this whole process or if their application is just a side effect? Do we only bother to explore these new techniques, because they help to further optimize financial returns? As an almost ironic reversion of the designer's usually qualitative approach to urban questions, the consequence of the figure-centric methods is the fact that almost everything that can be comprehended in figures can become commodified. Measured and compared only in quantities, the high exchange value can hence very easily become ingested by purely economic motives. This argument is not new, and already Marx wrote about capitalism's obsession with commodities. Closely linked to this phenomenon is the discussion about the consumer society, and its pertinence in urbanist terms. In the article *Generic City*, published in his book *X, M, L, XL*, Rem Koolhaas explains the pressures that surround contemporary city making. With an interesting twist, he dwells on the specificity of real estate compared to other, not place-specific products: the uniqueness and immobility of land and historic built structures. His skepticism towards nostalgia in architecture and urban design is based on the simple fact that an ever-growing world population looks for authenticity in an ever-decreasing amount of historic buildings and cores, and that this can only transform them into major places of consumption. His point is that such tendencies, due to the pressure of obvious economic gains, will come with growing planning control and less design freedom. Seen as a final product, a distinction between Disney Land and Disney-Land-like-situations will become almost obsolete (another author, Maarten Hajer makes this point for Salzburg). Going back to the 1990s, and a discussion turning around "themed urban experiences" which could also include projects like Seaside or Celebration, these cases are early and simple examples of metric urbanism, focusing on the economic potential of design features in a way that did not exist, or was not reflected upon, during the preceding decades. Today, we are just pushing the boundaries further, complementing the tourist approach to urbanism with all kinds of other reflections. The current question might be, how to attract the "creative class" to a specific city or district for the long-term, rather than to limit ourselves to the attraction of tourists, retirees or secondary homeowners.

To return to our initial question, the problematic of an enhanced use of metrics is hence the high probability that these figures will be predominantly used in order to further exploit the city as a profit-maker. This is not a problem as such, but raises two major questions: one is moral, questioning the fact that profits will be equally shared on a long-term base, and the other one is professional: the loss of the above-mentioned relative irrelevance of architectural thought can now be seen as a loss of freedom and an intensification of pressures on the design profession. Like a Trojan horse, the application of quantitative methods has the potential to hollow out the profession's content, drawing decisions away from somebody who could be considered an urban expert. The enormous complexity of the field makes it even more probable that the result of such a scenario will be unpredictable. Figures can be interpreted in any possible way, and counter-indications are difficult to foresee. Examples vary greatly: city rankings and campus rankings are examples in which living or studying quality is determined on a quantitative base. It can be assumed that the decision to react to such important rankings through the definition of a development program will not be left to the designer and his poor credibility in economic affairs. The point to make, or rather the thesis to be established, is that this will not only be the case for the "hard" part of the program, but increasingly also for the "soft" factors that are part of the urban designer's work, like distribution of functions, building heights and the character of public space. The master plan of the future will not be designed, but managed. One of the motivations to write this paper is to suggest that this management should still be done and controlled by somebody who has a slight understanding of the impact of design, as is allegedly the case of the urban designer. Another problematic of a figure-based attitude lies in the fact that everything has to be based on comparisons. Despite the obvious usefulness of such a method, a side effect lays in the dilution of the uniqueness of place. Famous cities or districts will be able to acknowledge these special features, as mentioned above, but lesser-known entities might run across place-specific opportunities in favor of an increasingly generic face that has proven its relative financial success elsewhere, but only in the short- and mid-term.



These tendencies become further complicated through the still growing importance of the end-user for our markets and the increased use of social media. If design and urban features do gain in importance, what better idea than to test new proposals in advance, through surveys and simulations that are presented to the future consumers of a specific proposal? In a next and more sophisticated step, proposals can be produced as a reaction to consumer behavior that has been surveyed through smart phone applications and geographic data analysis. The opportunities are manifold and fascinating, and so is the pressure produced through the demands of a potentially manipulated public. We find ourselves eventually thrown back to the same issues that are currently discussed regarding the political realm, with the difference that the feedback coming from social media and mobile technologies can better focus on a specific, geographically defined area. In the “real elections”, voters have to deal with the abstract notion of a whole nation, one that it is not easy to relate to. Seen from that perspective, urbanism can now be perceived as the pragmatic implementation of politics. “Crowd-funding”, interventions that are financed through the direct support of the local community via Internet, just pushes these ideas further, including the problematic of potentially circumventing the public realm and its institutions.

These concepts complement an older and partly confirmed claim of the new communication technologies, liberating work patterns from geographic restraints. The theory prescribes that almost all types of services can be digitally provided, and that the city as a major cross point and market place becomes obsolete. Except of a rise in the number of home offices, we know that this has not really happened, for various reasons, but a different application of a similar logic has allowed for cities to implement change at a much faster pace than previously imagined. Miami, the author’s current residence, is a good example of a city that tries to attract tech-workers and start-ups on the base of leisure and climate advantages that previously would not have been sufficient as an argument. An important airport, the sea port, and the geographic proximity to Latin America cannot be dismissed as incidentals, nor the influx of highly skilled Cuban immigrants for political and not economic reasons, but for the first time a real change seems within reach, and is linked to the flexibility and lifestyle demands that the new technologies offer. The attempt might fail, but it is undertaken. These dynamics do certainly work in both directions, established cities being threatened to loose attractiveness that is not based on “hard” economic factors. Are we talking about the same development cycles that cities like Manchester or Leeds went through, or has there really been a change?

Coming back to the impact that economic pressures exert on design and sustainability trends, questioning causality between action and reaction, the “return to the center” and “smart growth” strategies can also be viewed as financial operations: due to increasing fuel prices and the acknowledgment of sprawl’s social cost, developers have to look for new solutions, and - as a reaction - urban designers do by now provide them in denser populated areas. If sustainability concerns really are the driving factor is difficult to say. Some years ago, green tech has mainly been seen as an economic burden, questioning the roots of our capitalist system. Today, politicians present it as a new technological revolution and major economic driver. The point is not to criticize the fortunate congruence of ecological conscience and economic success, a truth that would be convenient for everybody, but the understanding of causality, if such a concept all-together exists.

Going back several decades in history, we have observed the reinvention of public space, but also an almost monopolizing obsession with this topic in the world of urban theory. Is it possible that this happened, because its implementation did not hurt the major stakeholders as much as it was propagated? Projects like the business district Broadgate in London, partly built above the tracks of Liverpool Street Station, exemplify the fact that the renovation or addition of public space was mainly achieved in order to raise land values. The question is, if other issues had been discarded from public discussion for one that found easy success with clients, the city and even the general audience? False Creek North, a prominent redevelopment zone in the south of Downtown Vancouver, is another example in which the indeed very generous provision of public green and walkways somehow overshadows the fact that a huge piece of land had been sold to a single developer.

Is it under these circumstances unfair to question, if the application of quantitative methods in urban design - another much discussed trend - really is motivated by the positive outcomes that it can produce? Or is it just a tool that helps to further optimize profits in a realm that business had previously not fully comprehended? If increased sales are the methods' real aim, how rational will we allow the figures to be?

## Conclusion

This paper is overambitious in its outreach, if not confused, but the author prefers not to isolate the topics in separate papers for the fear of the message's dilution. The aim is not a detailed scientific analysis of each phenomenon, but a description of changes that currently occur in the designers' work environment as a reaction to the rise of new technologies and growing economic pressures. As the title suggests with a humorous note through the reference to the "dissident", the author endeavors to explicitly apply and test a very critical perspective on these issues, one that can be considered to lie on the verge of a conspiracy theory, never to be proven wrong. The truth however is that in everyday life architects and urban designers are service providers, and that it does not serve them well to question the background of their work. To do so is a privilege of academics who believe that critical thinking is a prerequisite for progress.

These lines should hence not be seen as a purely pessimistic exercise, but as an invitation to reconsider the urban designer's position in the world of urban development. If the author previously deplored the latter's little impact on urban decision taking, this should not be understood as a fatality, but as an opportunity to change such a historically entrenched situation. The heydays of the formally operating urban designer are over, barely 50 years after the profession's official birth. At least in western countries, the design of new cities or whole districts is increasingly rare. The future is about strategies to implement inner-city densification and renewal, not about urban design in the conventional way. If we still want trained designers to have an impact on what happens, they will have to better understand the rules of the game. The success of a handful of globally operating starchitects might from that perspective be misleading, suggesting power and control, where in reality marketing and political reasoning are the ulterior motives for their appointment.

The problematic of the urban field is its enormous complexity, to the point where the roles of different professions, but also their responsibility and accountability become deeply confused. This is the situation in which figures can provide a deceptive notion of « the way forward », in a positive as much as negative way. Theoretically, it could be claimed that the designer shall stick to his primary task, the design of buildings, but in reality he is often also the element of the development team that is required to communicate to the community and wider public audience about social and cultural issues. In the typical scenario, the planner represents the city, the developer his own interests, the geographer observes, and the architect has a fling at playing the urban designer. If he does not have the education to really comprehend the deeper issues, he will increasingly be used as a tool and further lose credibility. We might have to (re) contemplate a situation, in which the disciplines of urban design and architecture are clearly separated: if the architect relies on a relatively unambiguous set of skills, the urban designer will in contrast have to be trained as an urban professional, merging in terms of skills with the planner, real-estate expert, sociologist and urban geographer. If this does not happen, his impact might be limited to the conception of mega-projects in the Middle East or China.

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# Indigenous architectural futures: Potentials for post-apocalyptic spatial speculation

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**ABSTRACT:** The representation and discussion of the future in architecture has remained almost exclusively within the realm of western science fiction (sf) where technological determinism, either utopian or dystopian, is the primary force for social and cultural change and adaptation. However, there are significant instances from outside of western industrialist sf traditions that offer immense opportunities for reconsidering the idea of ‘the future’ in architecture. This essays posits the potential value of indigenous sf to enrich current architectural discourse, where ‘indigenous’ does not necessitate a strictly backwards orientation towards ‘primitive’ technologies and social organizations, which is often the case in architectural discussions of indigenous building and design, but is instead situated within the projected temporal territories often reserved for western-dominated visionaries. Such sf offers examples of post-futurist (the idea of linear time being underemphasized in indigenous cultures) and post-apocalyptic (the apocalypse for many North American indigenous groups being the arrival of Europeans) visions that offer indispensable diversity to our current capitalist trajectory. The essay focuses on three novels: D. L. Birchfield's *Field of Honor*, Zainab Amadahy's *The Moons of Palmares*, and Leslie Marmon Silko's *Almanac of the Dead*.

**KEYWORDS:** Science fiction, indigenous futures, architectural speculation

## INTRODUCTION

James Cameron's film *Avatar* (2009) remains the highest grossing film in history (*Box Office Mojo*, 2013), gaining global attention for its explicitly colonial narrative about the invasion of the planet Pandora to mine the rare mineral unobtainium at the expense and destruction of the local Na'vi people and their sacred ‘Hometree’. A moral dilemma ensues in the protagonist and his accomplices as they turn to assist the Na'vi in an epic battle between eco-spiritual and industrial ideologies. While the film obtained critical acclaim from leaders such as Bolivia's Evo Morales who linked the Na'vi cause to indigenous groups confronting greedy corporations throughout Latin America (Adamson 2012, 144), as Annalee Newitz writes, it also sparked wide criticism for its portrayal of the “classic scenario you've seen in non-scifi epics from *Dances With Wolves* to *The Last Samurai*, where a white guy manages to get himself accepted into a closed society of people of color and eventually become its most awesome member” (Newitz 2009).

While offering an entertaining film with a potent message, *Avatar* thus remains largely entrenched in sf conventions with regards to its technological and social projections through a spectacularly western heroic and futuristic lens. Newitz's critique of *Avatar* presents a significant question with regards to not only such futuristic narratives, but also the largely western hegemony over spatial visions of the future. How would the future appear when viewed through an indigenous lens given that we already live in a post-apocalyptic reality for many indigenous groups, and within these visions what role would or could architecture play? As architectural discourse continues to diversify its relationship with the idea of ‘the future’, how could such speculation contribute to how we more inclusively think about design? For instance, could indigenous futures provide a unique imaginary framework that could inform how we teach and practice architecture? This essay attempts to address these questions by considering what such an ‘alternative’ vision of the future offers architectural thinking, using three key texts by North American aboriginal authors.

## 1.0 AN “OTHER” FUTURE?

It is worthwhile to first posit the added value of an ‘alternative’ vision of the future. The idea of ‘alternative’ is already imbued with conceptual limitations given that it sets out to establish an

opposition that is neither static nor productive in architectural discourse. As Awan, Schneider and Till (2011) argue, the definition of 'architecture' is evasive enough to begin with, making the definition of an 'alternative' equally difficult to identify. Furthermore, the 'alternative' is necessarily reactive to the norm and thus "in thrall to it," and thus "marks itself through casting off the attributes of the centre, and in this there is a danger that the baby will be thrown out with the bathwater" (Awan, Schneider, and Till 2011, 26). Consistent with this position, an indigenous-framed future is not intended to polemically replace or supersede any other approach to 'the future' in architecture. Visions of 'other' places, societies, forms, and ideas have provided inspiration for architects and designers for centuries and 'the future' has persistently offered fruitful grounds for visual and theoretical speculation (Boullée, Sant'Elia, Le Corbusier, the Expressionists, Archigram, Lebbeus Woods, Neil Spiller, etc.), along with textual contributions such as Charles Jencks' *Architecture 2000* (1971) and various writings by Reyner Banham, whose career was largely defined by "his quest to find a dynamic and persuasive *alternative* to...conventional thinking" (Whiteley 1990, 188-9). Banham enthusiastically wrote about the materiality of *Barbarella*, Isaac Asimov's "The Naked Sun", *Star Wars*, and H. G. Wells' *The Sleeper Awakes*, all of which he considered relevant to progressive architectural thinking (Banham 1981).

Yet despite a persistent and productive trend for architects and designers to envision the future through technological and aesthetic projection (May 2013, Foster and Partners 2013, Rosen 2013), architecture's disciplinary relationship with 'the future' has diversified over the past half century, finding comparable inspiration from sf authors such as J. G. Ballard (Clear 2009, Ultav 2007), William Gibson (Spiller 2005), and Philip K. Dick (Jackowski and deOstos 2008, Fortin 2011, Fortin 2012). Here the interest in sf shifts from the overtly 'futuristic' to issues more consistent with what Vivian Sobchack calls a 'postfuturist' movement in sf film. A more complex temporal collage is offered here with the emphasis, consistent with Jameson's "waning of effect" (Jameson 1984), placed on the "lack of novelty" and "awesome and wondrous *familiarity*" in the future, rather than relying so narrowly on alienation (Sobchack 1987, 252). Similarly, recent architectural texts have explicitly scrutinized the trite use of techno-utopias and grand visions in architectural imagery. Nic Clear argues that our post-recession global condition has revealed a crack in the utopian armor of assumed universal prosperity and subsequent building booms. For Clear, "[the] architectural world has proved completely incapable of suggesting what the future may hold," due to its perpetual infatuation with grand-scaled corporate development (Clear 2009, 6). Instead, he argues, there is emerging "a gritty 'new realism'...in architectural discourse" (Clear 2009, 6) that finds inspiration in authors like Ballard, Dick, Orwell, Huxley and Wells, because in their work, "...the future is depicted in a variety of different hues, not all of them as rosy as the futures promised by the architectural profession" (Clear 2009, 9).

If it is the rose-colored optimism in architectural representations of the future linked to unfettered capitalist expansion that has proven impotent to current socioeconomic issues and concerns, it is possible that indigenous sf could provide a valuable contribution to such speculative thinking by intimately addressing spatial topics arising from on-going challenges of social inclusion, identity, and place. As Judith Legatt writes,

The growing sub-genre of post-colonial speculative fiction does more than just describe the ills of the present; it also suggests methods of dealing with current crises. In its dystopian form, it illustrates the dangers of continuing on a current course. In its utopian form, it suggests how solutions might be reached (Legatt 2010, 127).

There have been multiple representations of indigenous cultures in sf, *Star Trek: Voyager's* first officer Chakotay being a recent example, and yet there are often significant issues involving stereotyping within a broader western narrative. In this way, by directly facing the troubled history of colonization through various cultural outlets such as literature and film, as Brian Attebery writes,

...cultural interactions depicted within sf are laden with longing and guilt. The indigenous Other becomes part of the textual unconscious – always present but silenced and often transmuted into symbolic form (Attebery 2005, 387).

Regarding the near invisibility of Australian Aborigine contributions to sf, he further argues,

...[as] the genre within which concepts of the future are formulated and negotiated, sf can imply, by omitting a particular group from its representations, that the days of that group are numbered (Attebery 2005, 385).

And yet in countries such as Canada the aboriginal population increased by 20.1% between 2006 and 2011, compared to 5.2% for non-Aboriginal populations (Statistics Canada 2013) - hardly an indicator of a receding presence.

## 2.0. ABORIGINALITY AND THE FUTURE

In Toronto during the early 2000s, Ojibway playwright Drew Hayden Taylor offered a stage performance of *alterNatives*, a play about a dinner party hosted by a contemporary couple, one of whom is an indigenous sf author. As Dillon writes, this character, named Angel, “views sf as a freeing arena and wonders why it should be only reserved for the likes of Arthur C. Clarke, William Gibson, and Ursula K. Le Guin” (Dillon 2012, 1). Angel proposes sf as an alternative to what Dillon describes as “the Great Aboriginal Novel” which typically performs as a ‘window’ into indigenous communities, and instead foregrounds the future as “an equally valid way to renew, recover, and extend First Nations peoples’ voices and traditions” (Dillon 2012, 1-2). Emphasis on the future is not a radical concept in indigenous cultures if one considers rituals such as the Blackfoot Shaking Tent ceremony to “predict whereabouts of game, success of hunters, recovery of the sick, location of lost people or objects, etc.” (Schaeffer 1969, 16). Yet this is not to imply that ‘the future’ exists here as a simple linear time-map as is often the case in western sf. For many indigenous peoples time is more Bergsonian; as Sherman Alexie writes, “That’s what Indian time is. The past, the future, all of it is wrapped up in the now” (Dillon 2012, 34).

In architectural discussions of contemporary ‘indigenous architecture,’ already a grossly simplified idea in its implied homogeneity, a common issue is negotiating between respecting and celebrating traditional knowledge and meaning, while embracing contemporary building practices and technologies. Yet, as Krinsky writes, this is not easily reconciled.

Forms that once had meaning seem to have been reduced to ornament. Ralk Weber calls this ‘socio-romantic drapery’, because the forms thus discovered originated in socio-cultural conditions and patterns we no longer share (Krinsky 1996, 231).

A frequent challenge for contemporary indigenous architects has thus been to bridge the gap, or as a young Navajo architect notes, a need to return to “pick up threads dropped in pre-contact times and leap from there to the present” (Krinsky 1996, 52). The question offered here, then, is whether a similar leap has been, or can be, made from the future to the present, or vice versa. How do indigenous authors such as Angel use the future as an opportunity to envision ‘other’ built environments and societies? How does the struggle between tradition and technology play out in the relatively unbounded arena of sf imagination?

While a comprehensive exploration is well beyond the scope of this essay, a brief discussion of the following three novels will offer insight into these questions: D. L. Birchfield’s *Field of Honor*, Zainab Amadahy’s *The Moons of Palmares*, and Leslie Marmon Silko’s *Almanac of the Dead*.

### 2.1. *Field of Honor*

D. L. Birchfield’s *Field of Honor* is a satirical novel about an underground Choctaw society thriving unnoticed in the deep caverns of the Ouachita Mountains in Oklahoma. The protagonist is a former US Marine Corps, Patrick Pushmataha McDaniel, who believes he is a deserter due to his confusion over his disappearance in Vietnam, and is thus hiding in the

remote American landscape. His father was similarly a Choctaw Marine named Breakneck McDaniel, described as the “craziest goddamn Indian that ever lived,” as well as the “the best damn sergeant [ever]” (Birchfield 2004, 56). The underground Choctaw society of Ishtaboli, described as technologically advanced, retreated to avoid the cultural genocide being implemented by “the cult of the dead Jew” on the surface (Birchfield 2012, 127). In the story, the treatment of the ‘American Indian’ by the United States government and colonists – reciprocally reduced to ‘Germans’ by the Choctaws - is further described as follows:

Their single most distinguishing characteristic is the ruthlessness with which they suppress religious freedom on this continent. It is why we must hide until the threat is over, or they will do to us something similar to what they have done to English orthography (Birchfield 2004, 128).

In their secluded underground territory, competitive games and the study of gaming theory are considered sacred and essential to daily activity, including the prominence of chess, but Ishtaboli, a traditionally brutal stickball game akin to lacrosse provides the foundation for Choctaw social structure and cultural cohesion.

The majority of the spaces inside Okla Hannali, the Ishtaboli community where McDaniel unintentionally finds himself, including classrooms, cafeterias, healthcare facilities, theatres, and vast corn greenhouses, are not provided much, if any, descriptive attention. The cavern itself is noted as always having been there, consistent with Choctaw origin stories (Birchfield 2004, 108). However, a central component of the narrative is McDaniel’s accessing of multiple private and public spaces through an immense mechanical system that consequently confuses and disorients him (Birchfield 2004, 171). While the system is not detailed further than its labyrinth-like network, Birchfield sets up a relevant juxtaposition when describing a meeting room where the elders are reciting past territorial battles with the Fast-Dancing People.

The room was like a large theatre in the round, with log walls and a roof covered with brush. It appeared to have a hard-packed dirt floor. The interior looked like the inside of a large, nearly round, brush arbor, with four circular rows of wooden benches rising like stairsteps along the outer wall of the structure. Colonel McGhee stood in a large open expanse in the center of the floor, directly beneath a large circular hole in the roof. The grille plate was at a level that let McDaniel see both above and below the roof of the brush arbor. Suspended well above the circular hole in the roof, out of sight from the audience, was a huge heat lamp, shining directly down on Colonel McGhee. The scene suggested a speaker being required to stand in the full heat of the Mississippi summer sun, while his audience remained seated in the shade (Birchfield 2004, 172).

It is not insignificant that the only room warranting Birchfield’s close attention is an implied sacred space where stories of past conflicts, horrific events, and treaty manipulations are retold. The grille plate in this passage negotiates McDaniel’s perspective, himself half ‘German’ and half Choctaw, to observe Weber’s ‘socio-romantic drapery’ of traditional materials and spatial arrangements inside what is essentially a large industrial system designed by kidnapped ‘German’ slaves. As Birchfield writes,

...whenever the Choctaws might need to know how to do something new, it’s not much trouble for them to go up there and kidnap whatever particular kind of German scientist or engineer they might need, no matter how specialized that may be (Birchfield 2004, 108).

Thus, despite the Choctaw desire to dissociate themselves from the inferior religious and economic systems of the ‘Germans’, where people “hoard things,” compete for everything, and where everyone is overly protective of their possessions (Birchfield 2004, 109), they remain utterly dependent on them for the technology that structures their built environment. A key contribution to Birchfield’s satire could thus be read as the collective lack of self-initiative in developing Choctaw technology, instead cultivating a techno-paternalistic relationship with the

loathed 'Germans'. In *Field of Honor*, rather than developing unique spatial solutions to match the distinctive plot, the environments suggest an intentionally disjunctive relationship between the Choctaws and technological innovation. The indigenous brush arbor is instead staged as a mere simulation of a past era when Choctaws did not require a German-engineered heat lamp in order to feel the sun's warmth.

## 2.2. The Moons of Palmares

While *Field of Honor* distances its story by locating it underground, Zainab Amadahy's novel is set in the far future on the planet of Palmares. Established by the Terra (Earth) based Consortium as a mining colony, the planet has established its sovereignty, however, as in many contemporary indigenous treaty agreements, Terra still holds rights to the minerals on the moons. The extensive lunar mining has made Palmares geologically unstable and a series of activist groups, such as the militant Kituwa, continue to protest against the presence of the Consortium while petitioning for increased local control over resources. The new chief of security on Palmares is Major Leith Eaglefeather, a North American indigenous descendent whose assignment is to defend the Consortium mining operations from the Kituwa 'terrorists' in a jarring reversal of roles from that of his ancestors on Earth. Eaglefeather becomes increasingly aware of the corruption and injustices within the Consortium, eventually assisting the Kituwa in their resistance and renegotiations over mineral rights.

In contrast to Birchfield, Amadahy, of Cherokee and African-American heritage, offers extensive spatial descriptions throughout the novel that weave together traditional building techniques with more 'futuristic' elements. Early in the novel Eaglefeather engages in a brief discussion with an undercover Kituwa leader and love interest, Zaira, about the value of tradition. When he suggests that old "isn't always useful...is it?" she responds,

No, not at all. But old isn't always obsolete either. We need to take what we can use. In our case, it's whatever lets people be connected – related – to each other. Something besides consumerism and technology (Amadahy 1997, 12).

Zaira admits that this is how she characterizes Terran society and it is later confirmed that Palmarans believe they "are politically and culturally far in advance of the Terrans," despite their technological shortfalls (Amadahy 1997, 75). Throughout the novel the architecture is used to highlight the emphasis on the instrumentality of technology, not its inherent value. For example, on Basilea, the planet of Eaglefeather's former post, people live in a dome made of four-centimeter thick "transluminum" where they are "totally dependent on the technology that controls the domes," and are therefore peaceful under the political assertions of the Consortium (Amadahy 1997, 39). However, on Palmares, the original laborers developed the requisite technology to transform the atmosphere, thus rendering the dome unnecessary and leaving it in a state of ruin. The imposed technology of the Consortium is here rejected and retrofitted, allowing the inhabitants to be more connected with their natural surroundings while fortifying their independence.

The buildings on Palmares are largely built of local materials, using masonry and adobe construction. There is also a wedding ceremony canopy made of thatch, and the leader of Kituwa's house is described as modest with a tiled floor and clay walls painted "tranquil green." There is also a computer console suggesting an acceptance of technology depending on its intended use. Another example is the local entertainment complex where, set in a series of alcoves indicating the mass and solidity of the walls, there are holographic displays of historical events. Yet while the buildings throughout the novel suggest a balance between digital gadgets and traditional building techniques, there is a relevant design critique by one of Eaglefeather's Kituwa captors who is also an architect. When Eaglefeather asks him why there are so many hexagonal designs on the planet he responds with the following:

Well, contrast it with the way many Terran cities were designed, especially following the invention of the automobile: a tic-tac-toe arrangement of filing cabinets, with cars given priority access to every building. Here we put our roads around the plazas. That way, groundskips don't intrude on our daily activities. Each plaza is [a] small self-contained community. Buildings face each other.



You can't leave your building without facing a neighbouring one, no matter which way you turn. And everyone has equal access to recreation, usually a park at the centre (Amadahy 1997, 97).

Here, in a strikingly similar design to renowned aboriginal architect Douglas Cardinal's master plan for the Kamloops Indian Band (Douglas Cardinal Architect Inc. 2011), the debate is centered not on technology and/or tradition, but instead on establishing community and equality through design. For Amadahy and Cardinal, the use of repeated geometry and equal access to recreational and natural space emerges as a central critique of our more solipsistic 'Terran' culture.

### **2.3. *Almanac of the Dead***

Similarly, Leslie Marmon Silko's *Almanac of the Dead* focuses on the inherent socioeconomic complexities involved with envisioning a future from an indigenous perspective. *Almanac* presents a near future where indigenous North Americans begin a unified and massive scaled revolution against existing capitalist forces in order to reclaim their territories. The narrative weaves together multiple characters and plots into a powerful critical commentary on a series of existing temporal relationships in indigenous cultures: between the living and the dead through the pre-contact Aztec and Mayan libraries, between the past and the present through an indictment of five-hundred years of brutal colonialism and genocide, and between the present and the future through a Marxist critique of capitalism and its inevitable demise, thus fulfilling the prophecies of the ancient authors.

Unlike the previous examples, however, Silko's critique of architecture is blatant and sharp. One of her key characters is Alegría Martínez-Soto, a young associate in one of "the most prestigious architectural firms in Mexico City" (Silko 1991, 266). Alegría is assigned the task of designing a mansion for the successful businessman Menardo, and subsequently engages in an affair with him. When Menardo's wife dies in a fall down the signature marble staircase designed by Alegría, she marries Menardo solely for his capacity to provide for her. While the design of the house strives to capture the poetic quality of light filtered through the jungle, Alegría's work also reveals her disturbingly detached approach to design. When her architectural classmates ask what meaning her building designs have for them, she responds with a rant about "taking power," followed by Silko's insights regarding her thought process.

She loved making the drawings – floor plans of vast rooms, interiors flooded with light from high windows and domes, the pearly-yellow light framed on white walls. She wanted the gardens to penetrate the rooms. The only criticism of the drawings for her final project had been that they contained no human figures...She does not tell [the professor] the human figures she draws spoil everything (Silko 1991, 320).

It is later revealed that Alegría was intentionally relocated throughout her childhood because her father desired that she be "a citizen of the world, not just Mexico," yet this cultivates her added indifference to places (Silko 1991, 487). Her resulting apathy to human and geographic sensibilities leads her classmates to label her as "selfish" and her pseudo-Marxist lover Bartolomeo to challenge her vocational contributions given that Mexico does not need more architects since "the ruling class was so small and all the others were too poor to build designer houses" (Silko 1991, 295). As Silko writes, "Bartolomeo argued Alegría's services rightfully belonged to the poor who need shelter, and not to the sweat hogs of capitalism" (Silko 1991, 289). Instead, she finds inspiration only in "what [is] fresh and exciting" (Silko 1991, 498).

In *Almanac* the stereotype of the architectural profession as an elitist service for the wealthy provides Silko with an ideal critique of capitalism and its culturally destructive path. And while the novel was written prior to people like Sam Mockbee, Cameron Sinclair, Sergio Palleroni, and Teddy Cruz leading a wave of advocates for socially conscious design, there persists a challenge for architects to better serve the underprivileged, including indigenous communities worldwide.

## CONCLUSION

There are a few essential observations to consider from this very brief overview of indigenous futures and architectural speculation. First, it should be noted that all three novels were authored and interpreted here in English by authors of mixed ancestry. This highlights not only the complexity of contemporary aboriginal identities and voices, but also the essential issue of cultural translation and the critical void of indigenous language. Indigenous sf, conceived of and written in the native language would present rich interpretative opportunities and further research is clearly needed in this area.

Second, similar to much western technophobic sf (Ryan and Kellner 1990), there is evidenced here an uncomfortable link between unabated technological projection and indigenous cultures. Birchfield's satire of the Choctaw dependence on the 'Germans' to structure their built environment highlights a paternalistic legacy of colonial buildings being designed 'for' indigenous groups, not 'by' them, resulting from centuries of academic and professional discrimination with very few indigenous people being trained as architects (Krinsky 1996, 52). Barring a few exceptions such as Cardinal, they have most often been tasked with cultural revival, not innovation, and yet there cannot be a simple correlation drawn between the idea of indigenous innovation through speculation, and unbound techno-enthusiasm either. For example, despite offering a comprehensive and valuable contribution to the documentation of indigenous architecture in North America, Nabokov and Easton reductively state, "Indians had no choice but to build with raw materials from the land around them" (Nabokov 1989,16). A timeless relationship with the land that does not endorse mineral extraction for economic gain can surely be interpreted as a definitive choice, and one that would seemingly be central to indigenous futures. As Cherokee descendent Celu Amberstone writes in her sf short story "Refugees",

'We know about the high technologies,' I told her quietly. 'We use what you would call computers, air cars, and the technical things too. But...we decided that a simple lifestyle would be best for all of us for a time. There is no shame in living close to the land in a simple way, daughter...Our benefactors teach us that technology must never interfere with our Communion with the Mother, lest we forget the Covenant, grow too greedy, and destroy our new home' (Amberstone 2004, 165).

Thus, even if it is acknowledged that technology has no cultural boundaries and could be seamlessly woven into indigenous visions of the future as Amadahy implies in *The Moons of Palmares*, there remains the far greater problem of who has access to, expertise in, and power over, its implementation. If, as Clear implies, the time is ripe for recognizing indigenous contributions to both sf and architectural speculation, then one cannot ignore the role that current power structures play in suppressing marginalized voices. As Raibmon writes, "Diverse societies are threatened not because they cannot adapt to modernity (they can) but because the political and economic configurations of global capitalism deny people control over the pace and degree of change in their lives" (Raibmon 2002, 192). It is for these reasons that all three novels have, at their core, strong socio-political undertones and why Silko's near future Marxist revolution may be a first step in resuscitating what Jameson describes as a 'Utopian impulse' for indigenous communities, the absence of which he argues "saps our political options and tends to leave us all in the helpless position of passive accomplices and impotent handwriters" (Jameson 2005, 56). The final point to be made here is thus one of sovereignty and hope – sovereignty over ones future can only occur with a hope for political, technological, and socioeconomic empowerment. The incalculable potential of sf is to imagine, as Silko does, a vastly improved collective future, but to avoid the mishaps of *Avatar* it is essential to recognize that an indigenous future can, and will, only originate from the imaginations of indigenous people. If architectural speculation is to provide an essential contribution to this, it seems critical that indigenous harbingers will need to invent or master the emerging technologies before deciding for themselves whether to embrace them or discard them like the ruined dome on Palmares.

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# The ideological ends of mid-century Student Union buildings: a study of disciplinary connections

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**ABSTRACT:** This paper closely considers the ideological underpinnings of Student Union buildings during the postwar period, when there was general agreement among student union proponents that the programs and buildings should prepare students for the political and economic realities of the postwar period. Underlying the ideological purpose of mid-century Student Union buildings were a crucial set of interdisciplinary professional connections that made the ideas of Unions manifest. Using the writing and professional work of two Union proponents – Union Director Porter Butts and architect Michael Hare – as well as several built and un-built mid-century Union buildings, this paper illustrates the disciplinary contributions of these men, what ideologies shaped the form and function of Unions, and what buildings effectively taught students in the postwar period.

**KEYWORDS:** mid-century, College Unions, consultants

## INTRODUCTION

Members of the Association of College Unions helped establish Student Union buildings on North American campuses during the first half of the twentieth century. In these early years, a new, heterogeneous group of professionals drawn from the ranks of university presidents, Union directors, and architects, believed these buildings were instruments of social education and subsequently cooperated on the architecture and programs that would best teach students important social lessons.<sup>1</sup> In this way, the physical Union building represented an essential social enterprise on college campuses for the diverse group of Union proponents. The building type, however, came of age during the postwar period when G.I.s (and later baby boomers) populated college campuses in unprecedented numbers. For Student Union proponents then, the buildings and the activities in them remained important instruments for social education, but the meaning of social education, and the way architecture responded to it, transformed. The architecture and social programs after World War II were best if they allowed young college students to learn the meaning of democracy and citizenship, freedom and consumption, during the cold war period.

While Student Union proponents at large wrestled with the meaning and application of social education in the buildings they already had or desired, Union director Porter Butts and architect Michael Hare busied themselves serving as consultants for the burgeoning Union industry by offering their services to universities planning new Student Union buildings. Trained in different fields – one in student services and the other in architecture – their efforts were guided by several agreed-upon social concerns, namely activities and spaces necessary to ensure desirable student character and citizenship, the reintroduction of GIs into civilian life, and the possibility of unruly student behavior. Although particular solutions to achieve these goals on campuses varied, Porter Butts and Michael Hare were representative leaders of a heterogeneous group of Union proponents that shared an ideological vision for mid-century Student Union buildings. With the buildings seen as instruments to attain the goals of collegiate life, this analysis of Student Union buildings reveals inseparable disciplinary connections among the social aspirations outlined by proponents, assumptions about the didactic role of architecture, and the architecture pursued by Student Union proponents on North American college campuses.

## 1.0 STUDENT UNIONS ON THE EVE OF WORLD WAR II

Unions built before World War II housed recreational activities which were thought to be essential for a productive adult life. Thus, leisure activities in a building devoted to recreation, culture, and the social life of campus were part of a comprehensive educational approach. Educators concluded then that leisure, if defined and ordered, would increase productive hours at school. Moreover, because schools trained students for life, teaching students how to spend leisure time meant that graduates would become more efficient and well-behaved workers. With Union facilities available, graduates stood a chance of exhibiting good character and values.<sup>2</sup> This meant that learning, once coveted by faculty in the confines of the classroom, found a place in Union buildings. Thus, Student Unions were valuable buildings on college campuses, with the potential to translate ideological aims into desired social behavior.

Early Student Union buildings accomplished social education through a formal set of spaces designed to guide student conduct. The Wisconsin Union, for example, like other Unions constructed during the 1920s and 1930s, housed formal lobbies, offices, lounges, dining rooms, committee rooms, a theater, kitchen, library, game room, art gallery, craft room, and barber shop. Through these spaces, students received cues about behavior and activities. Upholstery, wood paneling, and built-in cabinetry framed rooms for formal occasions and quiet study. In contrast, informal spaces for socialization and games, such as cards and billiards, contained more appropriate, durable interior finishes.<sup>3</sup> Together these environments balanced the various activities favored by students, and social conduct expected by administrators. The spatial organization of Wisconsin and other early Unions also adeptly defined environments for men, women, and staff, further establishing expectations about appropriate leisure.<sup>4</sup>

The problem with early Unions arose when the tenor of the United States changed during World War II, and when politics and economic realities of the Cold War took hold. Because of the G.I. Bill more students entered college after World War II, crowding older Union facilities, more administrators concerned themselves with student behavior. Unions required larger dining rooms and cafeterias, more flexible spaces, and the recreational activities popular during the postwar period, including environments for coed socialization.<sup>5</sup>

## 2.0 NATIONAL VISIONARIES BRING EXPERTISE TO COLLEGE AND UNIVERSITY CAMPUSES

To achieve the desired social and programmatic changes, Student Union leaders at the national level orchestrated discussions about Student Union buildings at conventions between 1946 and 1950 and bolstered the role of official Association of College Union consultants for new and planned Student Union buildings.<sup>6</sup> These efforts fueled a building boom, consolidated expertise, and gradually helped define key characteristics of the postwar Student Union building as a place for leisure and casual consumption.<sup>7</sup>

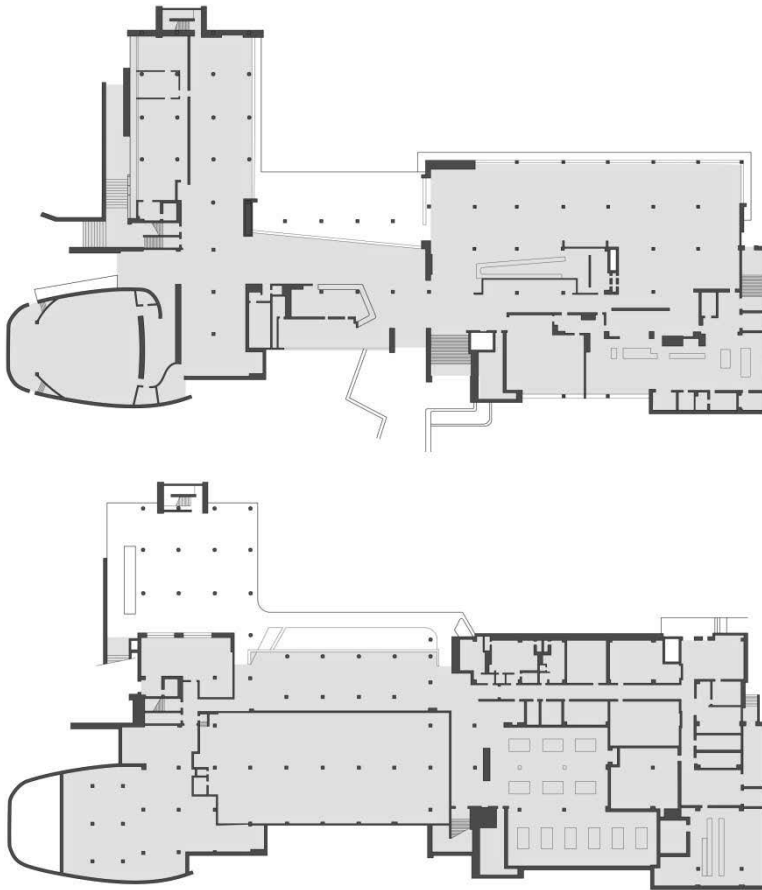
Most instrumental were Porter Butts and Michael Hare. Butts, the long-time Director of the Wisconsin Union and Editor of Publications for the Association of College Unions was *not* an architect, but saw errors in the early pioneer buildings he hoped future buildings would avoid. Thus, he diligently organized a panel with architect Michael Hare on the subject in 1946 and again in 1947.<sup>8</sup> In 1948, a group of Association leaders from Unions across the country organized sessions on topics that ranged from coeducational Unions, men's Unions, small coeducational unions, temporary Unions, and Unions in large cities. Each year session topics became more specific and varied. Hoping to consolidate expert advice, the Association of College Unions promoted Porter Butts and Michael Hare as the official consultants for planning and designing new buildings.

### 2.1. Porter Butts, Union Director

As a Union Director and consultant, Porter Butts advised the University of California at Berkeley, Boston University, Kansas State, and the State College of Washington in Pullman on the social and programmatic aspects of Union buildings. Although Butts tailored his recommendations to match the needs of each university, most Unions shared several elements, but his advice was not unchanging boilerplate prose, nor did the results of his work duplicate the interiors of other buildings.<sup>9</sup>

Among the programmatic amenities recommended by Butts for the University of California at Berkeley were a ballroom, lounge, cafeteria, bookstore, and theater. These were the largest spaces and the most predictable pieces of postwar Student Unions. Butts, however, also recommended several smaller rooms for specific needs and social activities: a place for students to stash belongings while enjoying Union facilities; quiet rooms furnished with cots and bedspreads; and dressing rooms and individual lockers for commuting students. Other recommended spaces to be vital assets were a record-playing room, browsing library, photographic darkrooms, craft room, woodshop, art gallery, and outing office.<sup>10</sup> Butts included a post office and athletic ticket office, as well as a cumbersome list of spaces that supported the daily operations of a Union building.<sup>11</sup> Between his advice – a long list of carefully crafted descriptions of programmatic amenities – and the buildings themselves lay a new building type that promised the best possible social etiquette for the postwar period.

An example of this new type of building was the Kansas State Union. Celebrated by college business administrators for its thorough planning, it had many traditional Union features but in a new architectural form (Figure 1).<sup>12</sup> Unlike Butts' own Union, designed in the monumental Beaux-Arts style, the Kansas Union was modern. Its ballroom was easily divisible into four smaller banquet rooms. Moreover, unlike the recreational facilities found in basements in older Unions, Kansas placed them on the ground level and dedicated nearly the entire building footprint to leisurely pursuits. The longstanding Union sport of billiards met rooms for table tennis, bowling, and crafts. On the main floor, the lobby divided the snack bar and cafeteria from an art lounge, a library, music rooms, and a lecture hall. All of these spaces were expressed in modern architectural materials. Columns visibly bore the weight of the building, while non-load-bearing walls divided activities. Gone were the heavy stone, ceremonial thresholds, and symmetrically arranged rooms many of the older Union had. In their place came glass, aluminum, stone veneer, columns, and lightweight walls that created seamless connections between activities.



**Figure 1:** Plan of the Kansas State Union, c1958. Source: (Author, 2013)

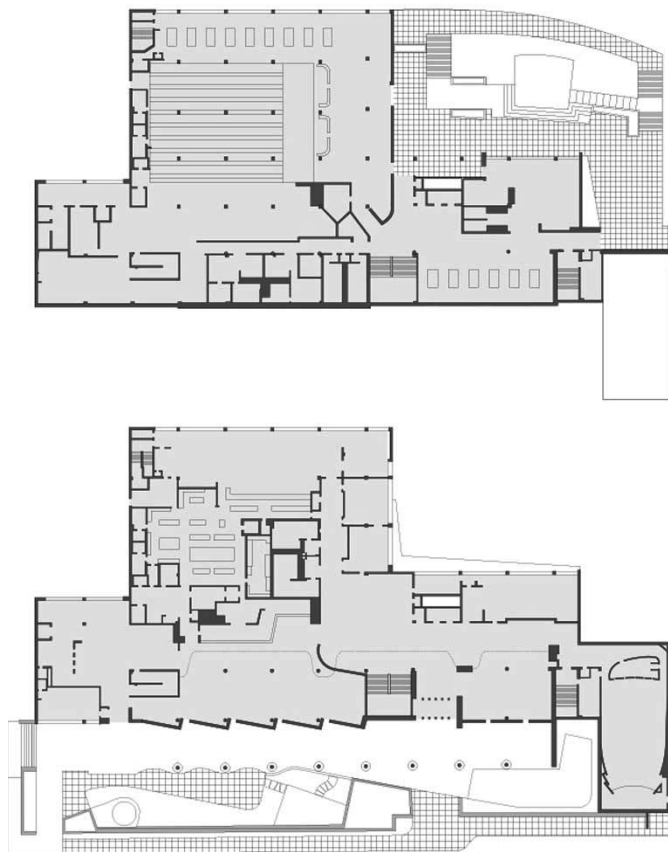
## 2.2. Michael Hare, Architect

Michael Hare steered many of these architectural changes by championing the reorganization of space within the Union building. Although Hare's principal aim may have been to secure design work for his architectural firm, he more often answered inquiries by mail about buildings and equipment costs, assisted college authorities and architects with planning problems, and worked alongside Porter Butts.<sup>13</sup> The promotion of an architectural consultant by the Association streamlined how technical and design expertise reached schools planning Unions, and acknowledged that Unions were complicated, specialized buildings that ought to be designed with expert guidance. To this end, Hare's leadership was invaluable. He cemented the importance of both the architectural *and* ideological vision for Student Unions.

By 1945, Hare had either drawn plans or assisted with the plans for postwar Unions at Rhode Island State College, University of Oregon, Washington State College, William Jewell College in Missouri, DePauw University in Indiana, Case College in Cleveland, and the University of Maine.<sup>14</sup> At the Wilson Compton Student Union building at the State College of Washington in Pullman, Hare worked alongside Butts (Figure 2). With Butts' steadied professional opinion and Hare's architectural ambition, the consultants guided architect John Maloney and campus architect Philip Keene. Completed in 1952, the Union was among the first postwar Student Union buildings to open and demonstrate how tested programmatic elements could readily and successfully adapt to modern architecture and social agendas. On the ground floor, students could easily survey activities in the bowling alley from an outdoor terrace. Moreover, students passing the table tennis room could view tournaments and causal games through an interior glass wall. On the main level, ceiling finishes and walls hovered above and between structural



columns, which visually linked the soda foundation, lobby, and lounge. Without dedicated corridors, the plan was free, open, and ambitious.<sup>15</sup> In this way, the Wilson Compton Union combined new ideas about architectural space and materials with desirable leisure activities of the postwar period.



**Figure 2:** Plan of the Wilson Compton Union at the State College of Washington in Pullman, c1951. Source: (Author, 2013).

Michael Hare claimed many of these ideas as his own. Looking to Lewis Mumford's pointed critique of the machine in *Technics and Civilization* (1934), Hare ventured to argue that only College Unions could satisfy the fundamental needs of college students because these buildings could recalibrate the balance between civilization's new-found love for the machine and human life.<sup>16</sup> In addition, sounding much like his colleague Butts, he thought that the Union gave students an environment for activities that are "naturally" part of life, including art, entertainment, and self-governance.<sup>17</sup> But Hare distinguished himself from his predecessors by showing what he described as a well-rounded program. In place of previous creeds calling for social order among men, women, staff, and students, Hare blended social spaces together, distinguishing only between staff and users, and promoted spatial flexibility as an essential component of Union buildings.<sup>18</sup>

As an example, Hare used plans for the Rhode Island State College to illustrate how a single co-educational lounge, social room, browsing room, music room, Ping-Pong room, billiards room, bowling alley, craft shop, and auditorium could be arranged and adapted for specific needs over the course of day or long-term capital building program.<sup>19</sup> Although older Unions had many of the activities of Rhode Island's Union, Hare's example reconstituted the program

in an entirely new form. Approached obliquely, the Union retained only a suggestion of formal symmetry. More important, however, was how Hare grouped activities and streamlined circulation. Hare's circulation system organized discrete programmatic elements by floor. Programs demanding a degree of social etiquette were on the first floor while active recreation was tucked into the lower floor. Large formal spaces and an obvious means for Union staff to monitor the activities of students were gone and replaced by a tacit understanding about the rituals and rules of recreation. Hare assured readers that well-roundedness (a desirable personality characteristic of the postwar period) was maintained because the building provided specific activities and a degree of flexibility with the spaces themselves. The social room on the first floor, for example, could double as dining rooms and be reconfigured to accommodate different-sized gatherings. He even supposed that the auditorium could be added later, if construction were phased. Flexibility in a larger set of interconnected spaces, rather than discrete spaces for men and women, dominated Hare's architectural ideas and reinforced the broader ethos of postwar collegiate community life.

### 3.0 THE IDEOLOGICAL ENDS OF STUDENT UNION BUILDINGS

The belief that buildings could embody community ideals, or teach occupants desirable virtues, is an old one shared by early Union proponents who reflected the ideas of John Dewey. Although Dewey did not write about college education, college educators and students were astutely aware of Dewey's philosophical principles. Dewey's primary message in *Democracy and Education* (1916) – that education has a social purpose that requires formal as well as informal settings – gave educational credence to leisure time's importance and to the social forces at work in a Student Union.<sup>20</sup> Thus, early iterations of the "Union Idea," fleshed out by Union directors and college presidents, resonated with the educational philosophy of Dewey and his followers. For example, President Clarence Dykstra of the University of Wisconsin, who would later serve as Chancellor at UCLA, formed his opinion about the purpose of the Union at Wisconsin after living in one of its hotel rooms. In his mind, education could not be a "cloistered or removed-from-life experiment." Education, Dykstra thought, must prepare a student to be an individual in society.<sup>21</sup> Other early Wisconsin presidents, such as President E. H. Fred, invoked the idea of a laboratory for the Union, where students would partake in a community enterprise and continually practice democracy.<sup>22</sup> The value of social education pivoted on preparing successful leaders of the industrialized world. Students properly socialized were educated and therefore prepared to live among others. A campus without a Student Union might fail to achieve such socially minded goals.

After World War II, the goals of social education shifted from business culture to managerial culture, and from democracy and citizenship to also freedom to choose among a variety of Union activities, making social education all that more important. In particular, Porter Butts believed that Unions should be laboratories for citizenship. "Good citizens," he wrote, "are not made through the advancement of science or by reading the history of our democratic past" but are made "when men begin to feel a responsibility for their general welfare, when their interests include not merely vocational matters, or personal gains, but the destiny of the group to which they belong."<sup>23</sup> In other words, citizens were made through the practice of citizenship. In Butts' opinion, the social programs and spaces Unions allowed students to join activities, to discover and express themselves, and to develop themselves into whole individuals.

In parallel, architect Michael Hare vehemently argued that new Student Union buildings were the architectural answer to social education on campus and tried to persuade readers about the value of their thoughtful design. Hare feared that after World War II young men no longer knew how to think or live, and to his dismay saw them find extraordinary pleasure in food, money, and women.<sup>24</sup> He also thought that the years preceding World War II witnessed the construction of too many buildings without enough thinking. Great architecture, Hare imagined, was not just plumbing, wiring, brick, and stone but a philosophy of life made manifest in physical form. Cautioning architects against trivial matters, he asserted that woodshops and dining halls served a purpose in Unions but that Unions were not built to provide schools with these facilities. Instead, Hare argued that if administrators wanted students to appreciate the pleasures of life, students must be shown what those pleasures in life were. Thus, any Union

architect should weigh what is important in living – during college and *after* graduation – before determining the design of Union buildings.

If Student Unions were to prepare students for life as Porter Butts and Michael Hare thought, then they also prepared students to be ardent consumers of leisure activities and food. With more space dedicated to affordable cafeterias, bookstores, and bowling alleys, students learned to choose among numerous activities and vendors. These choices, and the underlying importance of consumption, paralleled broader efforts to ensure that families during the postwar period achieved material wealth and experiences expected by members of the middle-class.<sup>25</sup> Thus, the ideological position of Union proponents of the postwar period placed the longstanding ideals of democracy and citizenship in the buildings themselves, as well as the freedom to choose and consume.

## CONCLUSION

Porter Butts and Michael Hare understood from their own disciplinary perspectives that Union buildings played a crucial role in human development and held convictions about how Union buildings and programs in them could usher students through the rites of college years. Both believed as well that, upon graduation, students who had participated fully in Union programs during college would be well prepared for adult life. Porter Butts stressed the importance of specific spaces that together would represent a model building for social education and citizenship. Michael Hare stressed the importance of specific activities and the architecture that would best support and encourage them. In addition, built unions gave students ample opportunities to choose (and consume) among many different activities.

Although particular solutions to attain community life on campus varied, Porter Butts and Michael Hare represent the heterogeneous group of Union proponents that shared an ideological vision for mid-century Student Union buildings. Viewed as instruments to attain the goals of collegiate community life, Student Union buildings reveal how disciplinary connections mattered to the underlying goals and physical expression of social education.

## ACKNOWLEDGEMENTS

Advisors, mentors, family, and friends have supported and offered guidance on this Student Union research. For this paper, Bernardo Teran, my research assistant enthusiastically assisted with the production of figures for this paper.

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"Wilson Compton Student Union Building." December 1951. *Architectural Record*. Pages 32-32, 32-33.

#### Archives

Bancroft Library, University of California at Berkeley

National Student Affairs Archives, Bowling Green State University

University Archives, University of California Los Angeles

University Archives, University of Wisconsin

#### ENDNOTES

<sup>1</sup> See Edith Outz Humphreys, *College Unions: A Handbook on Campus Community Centers* (Association of College Unions, 1946) for synopsis for this ideology and cooperation.

<sup>2</sup> See Eugene T. Lies, *The New Leisure Challenges the Schools: Shall Recreation Enrich or Impoverish Life?* (Washington, DC: National Education Association, 1933); Paul P. Boyd, "Extra Curricular Activities and Scholarship," *School and Society* XIII (February 5, 1921); Donald S. Bridgeman, "Success in College and Business," *Personnel Journal* IX (June 1930); Delisle C Burns, *Leisure in the Modern World* (New York: The Century Co., 1932); Stuart F Chapin, "Extra-Curricular Activities of College Students: A Study in College Leadership," *School and Society* XXIII (February 13, 1926); Alzada Comstock, "Time and the College Girl," *School and Society* XXI (March 14, 1925); W. H. Cowley, "Explaining the Rah Rah Boy," *New Republic* XLVI (April 14, 1926); Irwin Edman, "On American Leisure," *Harper's Magazine* (January 1926); Christian Gauss, *Life in College* (New York: Scribner's, 1930); L. P. Jacks, *Education for the Whole Man* (New York: Harper's, 1931) and *Education Through Recreation* (New York: Harper and Bros., 1932); and Woodrow Wilson, "What is College For?" *Scribner's Magazine* Vol XLVI (November 1909).

<sup>3</sup> See Arthur Peabody, "The Memorial Union Building, University of Wisconsin, Madison, Wisconsin" in *The American Architect*, July 5, 1929, Vol CXXXVI No 2572, pp1-8, (p6); *The Bulletin of the Association of College Unions*, January 1933, p2.; The Association of College Unions Convention Proceedings, 1929, p13 (National Student Affairs Archives, Bowling Green State University); and "Short History of Memorial Union" (University Archives, University of Wisconsin, General Files of Porter Butts [Series 26 11 1 Box 1]).

<sup>4</sup> See for example Irving Pond, "The College Union" in *Architectural Forum* (June 1931): 771-778.

<sup>5</sup> See Clare Robinson, "Postwar Student Unions as Crucibles for a Middle-class Art of Living" in *Student Union: The Architecture and Social Design of Postwar Campus Community Centers in California* (Ph.D. Dissertation University of California, Berkeley, 2012).

<sup>6</sup> See Convention summaries in Chester Berry and Alfred Looman, editors, *College Unions ... Year Fifty*. (Stanford: Association of College Unions, 1964), specifically years 1946, 1947, 1948, and 1949.

<sup>7</sup> See especially *Bulletins* published between 1947 and 1960 for the "roll call" of Union buildings remodeled and added to college campuses in the United States. The number and geographical breadth are impressive.

<sup>8</sup> This was the same year Edith Ouzts Humphreys published her seminal and first-of-a-kind book *College Unions: A Handbook on Campus Community Centers* (Association of College Unions, 1946).

<sup>9</sup> The congruency of Butt's consulting work and ideas published in the Bulletin suggest one of two things: Butts' editorial comments shaped the mission of the Association, or Butts ably synthesized and mirrored the viewpoints of the Association presidents and the diverse group of proponents on individual campuses. Regardless, the California report on Student Union buildings observed that Butts was known throughout the Association of "Mr. Union Himself" (meeting minutes from the Student Union committee, University Archives UCLA [RS 359 Box 276 F88]).

<sup>10</sup> The craft room and art gallery were Butts' favorite suggestions because he had nurtured art education and gallery programs at the Wisconsin Union.

<sup>11</sup> See Office of the President files on the Student Union 1941-1955, Bancroft Library, University of California at Berkeley [CU-5 Series 3, 20:11] for the complete report.

<sup>12</sup> Loren Kottner, "Thorough Planning Makes Union" in *College and University Business*, September 1958, Vol 25 No 3, pp28-31.

<sup>13</sup> See “Building Planning Service Offered” in *The Bulletin of the Association of College Unions*, March 1941, pp1-2.

<sup>14</sup> *The Bulletin of the Association of College Unions*, July 1945, p5.

<sup>15</sup> “Wilson Compton Student Union Building” in *Architectural Record*, December 1951, pp32-32, 32-33.

<sup>16</sup> Michael Hare, “The College Union Building Offers Substitute for Home” in *College and University Business*, March 1949, pp14-15.

<sup>17</sup> *Ibid*, p14.

<sup>18</sup> Hare’s predecessors were arguably Pond and Pond who built and wrote about the merits of Student Union buildings in the 1920s and 1930s. See Irving Pond, “The College Union” in *Architectural Forum*, June 1931, pp771-778.

<sup>19</sup> Michael Hare, “The College Union Building Offers Substitute for Home” in *College and University Business*, March 1949, pp14-15.

<sup>20</sup> John Dewey, *Democracy and Education: An Introduction to the Philosophy of Education* (New York: MacMillan Company, 1916). Also see Dewey’s *School and Society* (Chicago: University of Chicago Press, 1915).

<sup>21</sup> C. A. Dykstra at curtain talk at theater opening in 1939. Before moving into the president’s house in 1937, he lived in the Union and served as president until 1945 (General Files of Porter Butts, University Archives, University of Wisconsin [series 26 11 1 box 1]).

<sup>22</sup> President E. H. Fred, n.d. Served as president 1945-1958 (General Files of Porter Butts, University Archives, University of Wisconsin [series 26 11 1 box 1]).

<sup>23</sup> See University of Wisconsin archives and also concise summary in Bancroft Library, “Student Unions at Some Universities” compiled by Wm. J. Norton, business manager [CU-5 Series 2, 1949:120]. Provost Dykstra of UCLA and President Sproul of UC Berkeley joined Butts as proponents of citizenship in public addresses and official welcome statements.

<sup>24</sup> Michael Hare, “Thoughts on Union Architecture” in *The Bulletin of the Association of College Unions*, February 1945, Vol XIII No 1, p1.

<sup>25</sup> See Clare Robinson, “Postwar Student Unions as Crucibles for a Middle-class Art of Living” in *Student Union: The Architecture and Social Design of Postwar Campus Community Centers in California* (Ph.D. Dissertation University of California, Berkeley, 2012) for a discussion of these parallel histories.

# Bringing theory into practice: seeking constitutive utopian potential in Astana

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**ABSTRACT:** Contemporary architectural and urban theorists have called for resurrecting a utopian spirit as a means of imbuing urban design with social imagination, which they argue is currently lacking and badly needed (cf. Harvey 2000, Pinder 2002, Coleman 2005, 2011, 2013, Hatuka and D'Hooghe 2007, Picon 2013). Toward this end, this essay poses the city of Astana, capital of Kazakhstan and host of Expo 2017, as a site to begin examining how utopian analytical frameworks might inform certain readings of the city, which could in turn guide practical design decisions. Western journalists to Kazakhstan's new capital city frequently label it 'utopian', in the popular, disparaging sense. And allusions are often made to capital-relocation and nation-building projects from the modern era, with Astana representing a postmodernist or late capitalist variation on a theme ostensibly bound for social disaster. But if utopianism is deserving of reconsideration, as recent scholarship maintains, so is Astana. Recent academic literature and experiential accounts of Astana's urban growth, when considered alongside contemporary utopian theory, challenge hasty classifications. Indeed, Kurokawa's 'flexible' development plan for Astana initially sought to avoid the totalizing tendency of modernist master plans. Moreover, despite the garish character, as seen through foreign eyes, the genuine hopefulness Astana evokes in its residents should not be cynically disregarded. For designers contributing to the Astana project, utopian praxis means taking seriously the city's 'constitutive' utopian potential and developing designs that aim to foster inchoate opportunities for social development.

**KEYWORDS:** utopia, Astana, theory, practice

## INTRODUCTION

At first glance, Kazakhstan's glitzy new capital city, Astana, seems well-deserving of the popular label 'utopian', directed derogatorily at its placeless, mythical quality. Such characterizations of Astana by Western visitors and critics tend to convey attitudes of contempt and mockery, which speaks as much to the predominantly negative Western/postmodern views toward utopianism as it does to urban realities on the ground. But with utopian theory now enjoying a reawakening in academia, scholars are earnestly considering the potential for utopian thinking to inform urban practices (Coleman 2005, 2011, 2013, Harvey 2000, Hatuka and D'Hooghe 2007, Picon 2013, Pinder 2002). And if the utopian project is deserving of a second glance, so is Astana. There, as architectural representations of the past, present, and future are at once juxtaposed and superimposed, "the city is imagined as a locus of practical solutions that will bring about a viable, morally and materially improved future" (Laszczkowski 2011a, 86).

Recent attempts to salvage and reconstruct the utopian imagination following its postmodern fall from grace include necessary historic revisionism and theoretical (re)interpretation. Much of this work also functions as a critique of contemporary architectural schemes, built or otherwise, which tend to offer purely *spatial* visionary imagery, lacking the utopian criteria of *social* imagination or critiques of present-day conditions (Coleman 2013, Contandriopoulos 2013). Thus, reconsidering utopia offers an opportunity to reform the discipline of architecture, as well, infusing it with a renewed political agency exerted through suggestive and substantive ideas for bettering society. As Coleman (2011) contends: "When allowed to flourish, Utopia can catalyze the radical reinvention of architecture, infusing it with the conviction that society can be improved through reconceptualizations of the world 'as it is' via imaginings of its transformation into something else or other, into an alternative" (184). This paper is an attempt to build on this scholarship by offering an urban project currently underway as a site for theoretical exploration.

With its reputation as an authoritarian ruler's sandbox for global 'starchitect' projects, Astana is certainly not the most logical choice for such an undertaking. On first pass, it would appear, in fact, to meet the criteria of a 'degenerate utopia', like Disneyland, with hegemonic fantasies overwhelming any possibility for critical engagement (Marin 1990 [1972]). Yet, as Pinder (2002) argues, even accurately-applied negative utopian classifications should not preclude more nuanced, hopeful readings:

In some literature, it is as if all alternative readings of these spaces are necessarily written out in advance: that, in the attempt to convey the enclosing and alienating nature of what is being targeted, critics neglect the possibilities for other perspectives and points of struggle. The more compelling the portrait presented of degenerate utopias, the more the critic succeeds in conveying the closing of hopeful horizons, the less other readings seem possible. It should be noted, however, that even in some of the most apparently bleak assessments of spectacular urbanism, there are gaps and opportunities for struggle, and the developments themselves may be read in ways that exploit such gaps as well as uncover the desires that remain embedded within the developments as the basis for oppositional politics (237).

So whereas social criticism and scholarly analysis may reach cynical conclusions, urban designers seeking to genuinely engage with utopian projects are compelled to identify and pursue such 'gaps and opportunities'. Toward this end, Astana is employed as a foil to engage questions regarding utopian theory's role in the design process. If, as Coleman (2011) observes, "the real possibilities of Utopia always require an architectural frame" (2), Astana offers a vivid contemporary milieu for investigating the role of utopian theory to inform urban design.

## 1.0 ASTANA

On the flat, barren Central Asian steppe a skyline emerges like a mirage, seemingly produced overnight. As one of the most ambitious city-building projects in recent history, the envisioned Astana is being rapidly translated into real space. When Astana was designated the new capital of Kazakhstan in 1997, its development quickly became a significant economic engine of this resource-rich, former Soviet nation, attracting international investors as well as migrants from across the country in search of a better life. Amongst elites and non-elites, Astana embodies the future of the nation of Kazakhstan, as well as the region. At the heart of this promise is Astana's Left Bank, a collection of over-scaled projects mainly by foreign design teams; a veritable dreamscape of iconic architecture commissioned by Kazakhstan's president, Nursultan Nazarbayev, framed by a colossal glass pyramid and a giant tent-shaped shopping mall, with a tower referencing a local origin myth at its center (Figures 1-4). Each of these structures employ typological and symbolic references that ostensibly project "various codes referring to (official) Kazakh symbols, statues, myths, stories, and history" or more contemporary leitmotifs that underpin the nation-building project, notions of cultural inclusivity, regional leadership, and environmental sustainability (Köppen 2013, 598). As photographs of these spectacular projects made the rounds through Western media outlets, Astana's global brand soon took hold. Western journalists who actually traveled to the Kazakh steppe disseminated predictable narratives of the city, their words infused with eye-rolling, head-shaking, and shoulder-shrugging (cf. Gessen 2011, Green 1998, Moore 2010, Myers 2006). They described Astana as "utopian", in the sense that it seemed more imaginary than real—more like a contrived idea of a city than a place to call home. In its most reductive form, this 'utopian' characterization carries with it a certain level of orientalism, cynicism, and moral superiority (Koch 2012). It may serve as a humbling reminder to recall that we Americans undertook a similarly extravagant, similarly 'utopian' capital-building project not so long ago along the banks of the Potomac River.



**Figure 1:** Palace of Peace and Reconciliation, designed by Foster + Partners.  
Source: Flickr user Ken and Nyetta, 2011



**Figure 2:** Khan Shatyr Entertainment Center, designed by Foster + Partners.  
Source: Flickr user Ken and Nyetta, 2011



**Figure 3:** Astana's capital mall with Presidential Palace in center.  
Source: Flickr user Ken and Nyetta, 2011





**Figure 4:** Astana's capital mall with Bayterek Tower in center.

Source: Flickr user Ken and Nyetta, 2011

Critical dismantling of such casual 'utopian' characterizations, as well as attempts to elicit Astana's positive utopian potential, begins with resolving several inaccuracies. First, the city is not "no place", as Thomas More's original meaning of "Utopia" suggests, nor was it constructed on a blank slate. In fact, the site has a deep history, much of which remains—albeit not always visible to outsiders or newcomers. While the most recent chapter of Astana's history began in 1997 when it was declared the capital, the present condition is a palimpsest of layered histories of human settlement. In spite of this quality, the trope of 'emptiness' or 'no place' has played a significant role throughout the site's modern history, employed by colonial and native elites as a means to "legitimate the exertion of power to shape political and social life" (Buchli 2007, 48). As the latest historical inflection point, the rebranding of the site as the nation's capital offers the potential of transcending the trope of 'emptiness' in favor of a more nuanced narrative of place. While it is "plausible that Kazakhstan's state planners likely preferred a 'blank slate' for its nation-building project—where the population could be 'shocked' and would lack the 'social resources for resisting and refashioning the transformation planned for it'" (Koch 2010, 772-3, quoting Scott 1998, 256), in selecting an occupied site, those charged with constructing Astana have had to negotiate the realities of it being located 'somewhere': "Efforts to construct governing apparatuses and create popular national identification occurred not on *tabula rasa* but on terrain littered with the partially viable edifices from previous state-building and nation-building experiences" (Schatz 2003, 131-2).

While scholarship has scrutinized government-issued narratives for relocating the capital (cf. Huttenbach 1998, Wolfel 2002, Schatz 2003, Anacker 2004), local, non-elite attitudes receive much less attention. Recent interviews of Astana's inhabitants reveal that the nation-building project of the Kazak state has largely been adopted by the populace, who "enact their own situated visions of modernity" in the context of their rapidly growing capital (Koch 2013, 2). Indeed, Koch (2012) notes that

ordinary Kazakhstanis do not see Astana as a utopian dreamland, and especially not the residents, for whom it has become 'their' city. It is something they have made their own, and many with great pride. For Astana's residents, it is part of their life and their lives are 'real' (9).

Through what Laszczkowski (2011a) refers to as the 'Astana effect', "a restored sense of a cohesive, progress-oriented sociality [is] directed toward a collective future which affects individuals' imaginings of their personal futures" (84). Astana's promise of a radically better future could certainly be interpreted as pure ideology; but the very character of the built environment, however garish to foreigners, is ostensibly a key factor in evoking genuine hope

in the people of Kazakhstan. Moreover, the fact that Astana can be perceived by inhabitants as an ongoing, open-ended project as opposed to a *fait accompli* suggests the potential for a multiplicity of urban interpretations, engagements, and futures—whether conflicting or harmonious.

## 2.0. EVALUATING ASTANA'S UTOPIAN POTENTIAL

Utopian theory offers conceptual clarity and complexity to a term that is riddled with contradictions and whose meaning shifts depending on cultural and historical circumstances. Several utopian theorists have proposed taxonomies for classifying utopia's positive and negative potentials. Coleman (2005, 24-40, 56-62), for instance, draws upon the work of Mannheim and Ricoeur. In Mannheim's conceptualization, utopia and ideology ostensibly function in a co-leveling process: "utopia could be a corrective for ideology" (Sargent 2010, 123). Thus, insofar as ideology is a conservative force wielded by those in power, utopia is its revolutionary counterforce, "the beliefs of those who [hope] to overturn the system" (*ibid.*, 120). Ricoeur further developed this relationship between ideology and utopia, adding a key layer of complexity:

Contrary to Mannheim, [Ricoeur] set out to construct what he called a single conceptual framework encompassing both, which could link utopia and ideology dialectically...Ricoeur suggested that ideology and utopia each have two traits, 'a positive and a negative side, a constructive and a destructive side, a constitutive and a pathological dimension'. The positive, constructive and constitutive dimension of one can function as a corrective to the negative, destructive and pathological dimension of the other (Coleman 2005, 57).

Convinced that the concept of utopia itself cannot be considered inherently good or bad, Ricoeur sought to distinguish between socially productive or progressive utopias and those that were socially destructive or reactionary. He referred to the 'good' utopias as "constitutive" and the bad utopias as "pathological", each with certain identifiable characteristics. In Ricoeur's taxonomy, pathological utopias are identifiable through their unrealizability, their immediateness, and their matter-of-factness. With the goal of escaping contemporary circumstances and breaking with historical trajectories, past and existing conditions are ignored in a "total disregard for pre-existing and ongoing patterns of life" (*ibid.*, 58). In terms of their architectural manifestation, we can think of pathological utopias as "buildings or large complexes envisioned as requiring total and immediate implementation", thus "deprived of the benefits that partial implementation over time offers" (*ibid.*, 58). Such features are what make pathological utopias inevitable social tragedies when built, as they (deliberately) rupture social life and remain inflexible to any quotidian engagement by their inhabitants. Constitutive utopias, on the other hand, exhibit

a deep understanding that memory, place identification and orientation are valuable qualities inextricably linked to human desire...In contradistinction to the speed with which pathological utopias must be realized, constitutive utopias value the benefits of slow, considered change. Moreover, utopias of this sort begin with compassion for the attachments individuals and groups establish with all aspects of the existing milieu they inhabit...Simply put, constitutive utopias are situated. They emerge out of conviction that reasonable and intentioned progress is good (*ibid.*, 59)...

This suggests a design process that draws upon intimate knowledge of the particularities of places and communities. Yet, in striving for social progress, constitutive utopias cannot merely reflect or reproduce the status quo: whereas pathological utopias disregard existing conditions, constitutive utopias stem from a situated, critical perspective. A further point of distinction involves post-occupied conditions:

Unlike pathological utopias, constitutive utopias can embrace action, practice, obstacles and incompatibility. Furthermore, they exhibit tolerance for conflict between goals, embracing divergences as opportunities...Elasticity opens

projects up to the potential of re-evaluation during processes of implementation that are ideally comprehensive and gradual (*ibid.*, 60).

In sum, whereas pathological utopias are total, immediate, and dislocated from considerations of place, constitutive utopias are situated, progressive, and flexible.

With this theoretical orientation in mind, it is worth examining Astana's development plan, which was premised on the very concept of flexibility. Originally delineated by Japanese architect Kisho Kurokawa, the plan makes explicit reference to the fatal error of modernist city planning:

The traditional master plans have always given a great importance to the process of finalizing the ideal form. In contrast with the traditional idea of these master plans, [this] proposal...proposes a new system that analyzes and reviews the situation every five years, and modifies the plan in a flexible way (Kurokawa 2002).

Here, Kurokawa is attempting to resolve the flaw of pathological utopias, in which image and reality inevitably dissociate, and alternative visions enacted in everyday life are rejected out of hand. Instead, the Astana master plan purposefully “lacked any concrete details concerning the actual architecture. There were only general guidelines that prioritized freedom and flexibility for local interpretations of urban and architectural quality while counseling against ‘imported’ aesthetics” (Köppen 597). Thus, whereas capital city-building projects like Brasilia were governed by totalizing plans, Astana's master plan calls for a flexible organization open to recurrent revision, with a concept for urban growth that incorporates “the past, the present, and the future; local tradition and global trend—all in relations of creative ‘symbiosis’” (Laszczkowski 2011b, 93). Of course, grounding an urban vision on the notions of flexibility and symbiosis logically turns the plan's execution into an *ad hoc* process, for better or worse:

Just as Kurokawa's plan for Astana has been only partly implemented, not all elements of his philosophy are fully embraced by the local architectural establishment...Rather, his discourse is appropriated, modified, and turned into a new, original, locally meaningful form. In the process, Kurokawa's often aloof language is reduced to speak more directly to local concerns and commonsense (Laszczkowski 2011b, 94).

Kurokawa's plan also foregrounds issues of environmental sustainability, including language based on notions of metabolism and ecological resiliency, as well as organizational systems for waste management and public transportation. And though the actual construction of Astana has certainly not been a model of sustainable development by most measures, potential remains on the horizon: Kurokawa's core ideas have been carried forward as the guiding principles for Expo 2017, the theme of which is “Future Energy”. Again, cynical readings of such efforts would not necessarily be misguided; but for those seeking to contribute to the quality of Astana's built environment, there remains ample possibility for positive utopian inspiration.

Overall, Kurokawa's plan for Astana draws upon many of the qualities of constitutive utopias—it can be interpreted as being situated in place, socially conscious, as well as flexible in its piecemeal rollout. However, it certainly has its shortcomings. Whereas the master plan contains some seeds of constitutive potential, its lack of specificity means that it falls short of certain other benchmarks that comprise a more robust vision of utopian principles, such as what Coleman (2013) proposes:

In my view, a persuasive assertion of utopia in architecture would, at a minimum, depend on the following four elements: social and political content; a significant level of detail in the description (in social terms) of what is proposed; elaboration of a positive transformation of social and political life as key to what is proposed or constructed; and, not least, a substantive—ethical and

aesthetic—critique of the present as the first steps beyond it, informed by a critical-historical perspective (24-5).

Embedded in this conception of architectural utopias are a host of issues demanding deeper elaboration. But at this juncture it should be underscored that the analytical role of utopian theory in architecture is not to determine whether a design is utopian in an absolute sense, since

projects for cities and buildings, even when constructed, are partial, remaining proposals about future occupation and action momentarily realized through the presence of sentient bodies: social life completes building (Coleman 2005, 62).

In this case, then, analyzing Astana's master plan is of limited use from the perspective of a designer seeking to engage in the city's utopian project. In addition to referencing Kurokawa's guiding principles, drawing upon the lived experiences of Astana's residents would signify a logical and prudent resource for maximizing constitutive utopian potential.

### 3.0 TWO ASTANAS

In part to establish the historical-psychological break deemed necessary for the goals of the capital-building project, the post-1997 development of Astana has been almost exclusively on the previously-unoccupied Left Bank of the Ishim River (see Figures 1-4). There, great effort has been paid to circumscribe a symbolic center for both the city and the nation by framing a monumental mall with various structures that express politically-strategic, representational functions. As Köppen (2013) writes, "the district was intended to display and convey a general sense of Kazakh political and economic power, but also specifically built as a representation of Kazakh cultural dominance within the de facto multi-ethnic state" (600). Despite the district bearing obvious similarities to the layout and proportions of the Washington Mall, amidst such dissimilar historic and cultural contexts, the resemblance is primarily a conceptual one. For instance, the programmatic functions of the framing structures in each city differ greatly, and this, tied with cultural symbols, largely determines local connotations. Moreover, whereas the Washington Mall was conceived as the nucleus of an urban system of grids overlaid with diagonal avenues, Astana's government district establishes no such logic of a layered, total geometry. Following Kurokawa's master plan, the mall does define the cardinal grid of new development to its south, but the city's patchwork configuration to the north is left wholly intact.

With Soviet-era planning principles enduring on the north bank of the Ishim River, the overall result is a veritable collage city comprised of utopian urbanism from two historic and socio-political paradigms. The spatial dichotomy and disjunction experienced between the historic and new portions of the city (those being the communist and capitalist portions) has led to an experience Laszczkowski (2011a) refers to as "the two Astanas", felt most strongly by the city's newest residents:

Those who migrate to the city are often surprised to find out that large parts of it look much different from what they were prepared to see, and deny the name 'Astana' to areas which do not match the picture (85).

Citizens have developed strategies to reconcile or cope with this perceived discrepancy:

If one lives and works in the old, right-bank part of the city, which is by far most often the case, one develops a habit of taking Sunday walks in Nurzhol Boulevard [on the Left Bank] 'to feel that one lives in Astana'...The image is granted more authenticity than the material city; the representation defines what counts as the 'true' material referent of the name 'Astana' (*ibid.*, 86).

However, in terms of land surface, those areas appearing unlike the 'real' Astana still outnumber the 'real'. Even today, village life and informal settlements remain only a stone's throw from the capital mall: "Behind massive metal barricades along the city's broad new avenues, one can find neighborhoods of decrepit shacks just like those found in the country's

provinces" (Koch 2010, 774). In fact, the most recently constructed informal structures are those built to house the many migrants who lack affordable housing in the very city whose skyline they helped erect (Köppen 2013). Other scholars have highlighted this striking, discordant relationship between the image of Astana and its lived reality (Buchli 2007, Danzer 2009). In their attempts to reduce latent discrepancies, elites employ various modes of power (Anacker 2004). This, ironically, can open up sites for struggle over Astana's uncertain future. For instance, the Soviet portion of the city received a facelift as part of the capital relocation project—not to blend in with the Left Bank, necessarily, but to appear less 'Soviet' in foreigners' eyes—consisting mainly of inexpensive undertakings like installing vinyl siding over concrete housing blocks. As Koch (2010) writes, "Many of the colorful new facades are literally just facades: one can walk around to the back of a building and see the old Soviet structure" (774). Shoddy corrugated metal fencing is often erected to conceal and reinforce socioeconomic disparities along edges of greatest variance. Buchli (2007) argues that, not only do such tactics highlight the government's inability to maintain the city's pristine image, they expose limits to hegemonic control; 'public secrets', embedded in the physical imperfections of the built environment,

permit subdued criticism of political life and become the opposition texts literally to be pointed at and read from the crumbling walls with the discussions and rumors they elicit (47).

This potential is echoed by Danzer (2009) who claims that, "although the state can supply identification opportunities, it cannot control whether and how artifacts are appropriated" (1564). Or, in other words, "people always use buildings and cities in ways architects and planners have never anticipated" (Coleman 2011, 6). And herein lies the seeds of utopia residing in everyday life. The multiscale dichotomies embedded in Astana's development patterns can serve another utopian function. As Zygmunt Bauman (1976) argues,

Utopias relativize the present...One cannot be critical about something that is believed to be an absolute. By exposing the partiality of current reality, by scanning the field of the possible in which the real occupies merely a tiny plot, utopias pave the way for a critical attitude and a critical activity which alone can transform the present predicament of man. The presence of a utopia, the ability to think of alternative solutions to the festering problems of the present, may be seen therefore as a necessary condition of historical change (13).

Thus, not only can the elite-constructed image of Astana be read as fallible, its juxtaposition with other Astanas may function to relativize the present in a way that promotes alternative projections. So long as the city can be experienced in this fashion, hope for real social progress will continue to persist in Astana, if only in the utopian potential of its residents' minds.

## CONCLUSION

As an object of inquiry, Astana reveals how even an urban setting that at first blush seems totalizing, placeless, and socially reactionary—when considered with a genuinely utopian attitude—contains inchoate seeds of situated and progressive possibilities. While we can assume this applies to every urban setting, in Astana, the processes and juxtapositions are made ever-present in exaggerated form. As a project still very much underway, Astana offers urban designers the chance to participate in shaping its utopian image—by relativizing existing conditions and rejecting attempts to interpret the city as a *fait accompli*. It could be argued, in fact, that participation in the Astana project (or any urban project, for that matter) ethically obliges architects to take seriously the possibility of the city's utopian potential.

Within the burgeoning literature on architecture and utopia, there remains a lack of scholarship written with consideration for practical design decisions, specifically how utopian theory might impact the design process, particularly the constraints and realities of practice, including those related to time, knowledge, information, power relations, and cultural dissonance. This perhaps stems from what Coleman (2005) describes as the paradoxical 'unthinkability' of utopia in architectural practice (254-6). Regardless, if the potential of utopian theory is to transcend its

purely analytical function, the process of design itself requires taking seriously the utopian problematic—engaging with utopia, not merely analyzing its partial forms. This essay is an attempt, albeit modest, to span utopian theory toward the realm of practice. As future-oriented professionals, architects and urban designers must critically (not cynically) contend with existing, constitutive utopian elements in a given context to begin constructing particular visions of urban futures. Engaging utopian theory in a more conscious and reflective manner will, at the very least, help guard against the tendency to produce purely spatial visions. However, the extent to which critical-reflective design processes might inform utopian *and* practical architectural practices demands greater attention.

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## **Scramble**

Knowing, Structuring, Configuring, Processing, Assembling, Consuming



# Developing building performance in the comprehensive design studio

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**ABSTRACT:** Building performance metrics such as those used to evaluate energy consumption, light levels and temperature are often used by architects and owners to assess environmental parameters that affect the function, comfort and economics of building designs. A majority of architects in practice rely on collaboration and recommendations from design professionals, in specialized technical fields, such as mechanical engineers, lighting designers and acousticians to help develop efficient and effective architectural solutions to meet the required technical demands. This collaboration and coordination positions the architect as a generalist who shepherds all of the disparate and broad-ranging aspects of the project towards a common design vision. To be effective at this task presumes the architect is knowledgeable and experienced enough in the project's quantitative and qualitative design parameters to balance the positives and negatives of the many factors and to not only lead the project towards a common goal but to help maximize its potential. It is this exact juncture between technical and artistic design which often is the crux of the comprehensive design studio in architectural education.

This paper examines pedagogical research in building performance analysis that supports qualitative design objectives. This paper proposes that one of the difficulties that students and designers have in technical integration stems from a lack of iterative design opportunities requiring relevant technical analysis in studio. To explore this proposition the author reviewed pertinent literature in the design of technical design curriculum and surveyed instructors and students in building technology courses and design studios. The results of this research suggest that when studio requirements in the comprehensive design studio are mapped closely with technical objectives initiated in the building technology courses, students have a greater likelihood of developing long-term skills and confidence in technical design integration.

**KEYWORDS:** building performance, comprehensive design studio, technical integration

## INTRODUCTION

Building performance metrics such as those used to evaluate energy consumption, light levels and temperature are often used by architects and owners to assess environmental parameters that affect the function, comfort and economics of building designs. A majority of architects in practice rely on collaboration and recommendations from design professionals in specialized technical fields, such as mechanical engineers, lighting designers and acousticians to help develop efficient and effective architectural solutions to meet the required technical demands of the project (sometimes these are required by building codes; other times, to meet the functional needs/desires of the owner). This collaboration and coordination positions the architect as a generalist who shepherds all of the disparate and broad-ranging aspects of the project towards a common design vision. To be effective at this task presumes the architect is knowledgeable and experienced enough in the project's quantitative and qualitative design parameters to balance the positives and negatives of the many factors and to not only lead the project towards a common goal but to help maximize its potential. It is at this exact juncture between technical and artistic design which often is the crux of the comprehensive design studio in architectural education. Often the comprehensive studio is positioned in the 4<sup>th</sup> or 5<sup>th</sup> year of a 5-year undergraduate Bachelors of Architecture program. Thus, with only a few years of academic instruction, students are required to develop a complex, collaborative studio project with meaningful integration of technical, economic and artistic parameters.

This paper presents research and ongoing study of pedagogical methods to create curricula promoting the meaningful integration of building performance analysis and enhancing

qualitative design objectives in the comprehensive design studio in a NAAB accredited program. Building performance and analysis, although usually integrated into the overall architectural curriculum with classes specifically devoted to technical analysis (such as energy use, structures and thermal comfort), often are not well integrated into the process, deliverables and outcomes of the design studios. Critical thinking skills related to design implementation of building performance are often not fostered in the studio environment, limiting the future success of architects in coordinating and directing technical integration in their designs.

### **1.1. Analysis for support and generation of ideas**

Building performance and analysis is often assumed to be merely a quantitative exercise related to the size and cost of equipment or materials. While economics and spatial impact are important factors in architectural design, these are often seen as limitations rather than supportive or generative elements in the design process. For building performance to become a more meaningful portion of the design process, the quantitative analysis must become more intricately linked to qualitative outcomes. That is to say that the analysis or numerical results should support and enhance qualitative architectural design objectives. In architectural design, an iterative design process is often expected, with back and forth input and participation with the client and design consultants. But even in the professional realm, analytical results are often only employed to vet or fix predetermined designs.

Rarely is quantitative analysis of building performance used iteratively to help generate or support qualitative design goals. For instance, most engineering consultants do not provide any quantitative analysis until the design development or construction documents phase of a project. Many conceptual and schematic design proposals have only loosely considered technical parameters and, as such, consultants are often not yet meaningfully integrated in to the design teams. This is largely due to a perception of technical parameters as constraints since the analysis and expertise is provided by an external party (the consultants). In addition, architectural design teams (much like architecture students) often wish to operate with greater flexibility in early design phases without the perceived burden of technical factors. What is unfortunate here is that many architects may have unconsciously shifted the responsibility of technical parameters so far outside of their ken that they no longer have the critical exposure to these parameters to include them into conceptual and schematic design iterations for meaningful support and generation of their design ideas.

Instead, imagine that designers are academically trained to directly integrate technical design parameters to exploit them towards positive design outcomes. For example, when considering structural layout and materials, the architect could anticipate (or even push to generate) how the repetition, orientation and depth of structural members could be utilized to increase the spatial or geometric reading of their designs much like how patterns and panelization greatly increase our ability to read volumes and contours of objects and spaces. When considering thermal comfort and HVAC systems, perhaps the architect could envision and direct the type of systems and thermal zones to decrease energy use while maintaining the thermal quality of main programmatic areas and utilize transition spaces such as corridors along the exterior as thermal buffers zones. By doing so, the size of the duct work and mechanical spaces along with their costs could also be decreased, thus shifting resources to other aspects of the project's design. Reaching a high level of conceptual architectural design integration with building systems and performance rarely happens as mere serendipity. Utilizing building performance and analysis as part of the process is important, but more importantly, designers must make the link between quantitative analysis and qualitative outcomes. To achieve high levels of successful integration, architects must develop a sense of how each technical parameter not only impacts the quality of the space but how it can be supportive and potentially generative in its design process.

### **1.2. Iteration and reflection**

How can architects attempt to bring building technology and performance back into our design repertoire for greater beneficial design impact? Learning how to use building performance analysis can be similar to learning how to draw a wall section or construct a 3-dimensional drawing as analytical and revealing design tools. Practice, iteration, reflection and scale are

methods for developing and integrating design skills whether it be drawing, modeling or analyzing a building. Thus, for building technology and analysis to have the potential to play a meaningful role, architects must practice integrating and reflecting on building performance as part of their design process. This is no different than what designers expect when using 3-dimensional computer modeling, physical models and drawings. Perhaps factors that may be missing in the use of building performance analysis are the steps of iteration and reflection of analytical results within the design process.

Reflection can help designers target and shape future analytical attempts. Instead of merely solving a problem, such as the number of light fixtures needed or the size of a steel column, by reflecting on their potential impact, these technical parameters can become more supportive elements. For instance, the size and frequency of light fixtures may be mathematically related to recommended light levels in a space, but ultimately they can also become a field of objects that help define the reading of volume and intensify emotions within a space. The size and frequency of structural elements are mathematically related to the anticipated gravity and lateral loads, but as large visual elements they can also greatly affect our reading of scale, proportion and perspective within a space. Thus, by reflecting on the results of technical analysis in conjunction with design objectives, technical parameters can become supportive elements in the design process.

In an academic setting, architecture students should practice developing a critical understanding of building performance design and metrics not so that they will become performance specialists but rather to be better positioned to maximize design potential when collaborating with future technical consultants and to gain greater insight and understanding of the fundamental correlations between quantitative performance parameters and qualitative design outcomes. One of the difficulties that students and designers confront in technical integration stems from a lack of iterative design opportunities requiring relevant technical analysis and integration in studio. This paper will examine some of the obstacles common in technical integration and also propose methods for creating successful exercises for technical analysis in an iterative design process at conceptual and schematic design phases (phases during which technical iteration is typically absent in the studio design process).

### **1.3. Support courses and studio design**

In most architecture programs, students and curricula place a large emphasis on the design skills practiced and developed in the design studios. The curricular structure of many programs thus is centered on design studios that become successively more complex, layered and sophisticated as students' abilities and methods develop (Banerjee 1996). Classes such as history, theory, structure, systems and modeling are often viewed as courses that provide context, skills and exposure to parameters that can contribute to and support design ideas in the studios. These support courses, although intended to feed into design studios, often are not successful in integrating themselves into the design outcomes of the students' studio-based work. There are three obstacles that reduce the effective transference of knowledge and skills from the support courses to the design studios. The first is a lack of critical understanding of the course material and its context within achieving improved designs. The second is lack of cross-course coordination of specific outcomes from the support courses into the design studios. The third is the lack of analysis as an iterative inclusion in the studio design process (Chung 2013). The first issue in the case of technical support courses often requires increased reflection and critical thinking activities in the technical course curriculum with a specific focus for students to link quantitative analysis with qualitative design goals. The second issue requires close coordination between support course and studio course faculty to arrange for the required documentation and deliverables in the design studio that specifically ask students to demonstrate reflection and integration of support course material as it directly applies to their studio designs. The third issue requires mapping the use and practice of analysis over multiple semesters in both the technical support courses and the design studios and working towards repeating analytical procedures in an iterative studio design environment. Each of these issues requires faculty to not only develop changes or modifications in the curriculum (in both the technology and studio courses) but to also develop assessment techniques that help gauge the development of critical thinking and confidence levels (related to technical integration) of students and to provide feedback to the instructors.

#### **1.4. Student-centered activities**

Technical material related to building systems taught to design students is often taught in a lecture format that relies on rote memorization of facts (Bower 2007). These courses frequently are designed to help students become familiar with a broad range of topics and pass the multiple choice questions anticipated on the Architectural Registration Exams. Thus, they may not be effectively designed to enable technically proficient outcomes in design studios. To achieve critical understanding of technical material requires students to not merely be exposed to topic areas, but requires them to integrate and apply the knowledge into their design experience through student-centered active learning methods (Schneps 1988). Problem-based learning methods utilized in science and medical educational fields are proposed as a way to facilitate critical thinking skills and abilities for architectural students regarding technical analysis for building performance (Roberts 2007). Most often this requires the students to be posed with a technical problem that they lack the skills to solve so that they can first analyze their own abilities and create a mental context for future information. Once this is accomplished, faculty help facilitate the implementation of established analytical methods for technical solutions (Hemlo-Silver 2004).

#### **1.5. Structures as a precedent for building performance analysis**

Most architects can agree on the importance of a solid education in structural analysis, having conceded that the structure and building frame are integral physical elements of their projects. Structural analysis education in architecture is required even though a majority of architects utilize structural engineers as design consultants. But when it comes to building performance such as energy, lighting and thermal comfort few architectural programs attempt to instruct students in the quantitative and analytical processes to measure the technical success of their projects. An education and early experience in building science analysis with strong correlations to design studio objectives allow for greater understanding and confidence for design students to meaningfully integrate these technical elements into their design process. By primarily using methods of hands-on analysis and evaluation (not via prepackaged software), students can develop meaningful correlations between technical parameters and design outcomes.

Architects routinely attempt to calibrate the size and shape of building spaces based on their programmatic analysis, attempting to fine tune and tailor a building to relate to the function and experience of users of their buildings. Now imagine if the size and shape of the structural elements were conceptually integrated into the design process to be linked as not only an economic factor but one exploited to enhance spatial readings and intensify the legibility of design concepts. This type of integration is actually not that rare, and examples are readily available when looking at larger scale buildings such as stadiums and large office towers where structure plays a pivotal role in the creation of building forms. Examples such as the Hancock Building in Chicago, the Seattle Public Library and CCTV are just a few examples of buildings that are fundamentally linked to their structural designs and display large lateral framing and structural elements on the skin of the buildings. The architectural payoff in each of these examples, with their strong structural strategies, is that each has a unifying façade language that has effectively increased the reading of the formal building massing as well as having improved the interior spaces by reducing the size, frequency and location of internal lateral framing systems, thus allowing for larger and more unconstrained interior spaces.

#### **1.6. Goals and relevance**

Ultimately the instruction of technical analysis for architects is an attempt to enhance their understanding of technical material so they are better able to make design decisions related to technical parameters (Chung 2013). So that building performance parameters (such as the type of structure or thermal systems used) that are often blindly relegated to technical consultants become integrated more fluidly into the design process, thus increasing the opportunity for those parameters to be supportive rather than a hindrance to the overall design vision of the project. By practicing and experiencing technical analysis, designers are given the opportunity to develop an understanding of the relative leverage that individual parameters have in determining spatial outcomes that impact design goals. This does not mean that

architects would not utilize technical consultants, but that they would be better able to lead consultants in accomplishing project goals and design ambitions.

### **1.7. Seven technical topics for building performance in the comprehensive studio**

To explore the proposed effectiveness of implementing iterative analysis as part of a studio design process as a means for more meaningful integration of building performance in design (and in particular in the comprehensive design studio), I investigated over a three-year period the instruction of technical support courses and their cross-course, cross-semester outcomes in related design studios. The research started in 2010 and has continued through 2013, with the author participating in the instruction and/or coordination of the structures, environmental systems and design studio curricula for architecture students in a 5-year B.Arch program. The following seven technical areas were analyzed in both the technical support courses (in the third year) and the comprehensive design studio (in the fourth year).

- 1) Lighting levels and energy use (USEIA 2001),
- 2) Acoustical reverberation time, reflection and absorption,
- 3) Structural member sizing for beams, slabs and columns,
- 4) Solar energy production and sizing of PV arrays,
- 5) Thermal balance points, heating & cooling loads, and thermal system sizing,
- 6) Project capital costs,
- 7) Project operational costs.

The technical analyses were practiced at least three times (in class, labs and assignments) during the technical support courses by the students for each of the seven areas and at least twice during the comprehensive design studio (directly applied to student design projects). During the comprehensive design studio, students were asked to utilize technical analysis first to establish a baseline for building performance given their designs and then to improve the design over the course of the semester. Thus, many elements were redesigned by students in direct response to technical analysis. By integrating the analysis into student-created Excel spreadsheets that were directly related to their 3-D models, students were able to quickly update their analyses and use them as iterative design tools. The seven technical areas can be shuffled, reorganized, edited and tailored to aid in the design of studio projects in the comprehensive design studio so long as the size and scale are substantial enough that project budgets become a limiting factor. By providing capital and operational cost constraints related to regional or national averages (USEIA 2001), students begin to see the cost-benefit correlations to design decisions.

### **1.8. Surveys to track implementation**

I conducted surveys of both students and faculty at my institution as well as faculty members from other institutions that coordinate building technology and studio courses in NAAB accredited architecture programs. In addition, I researched pedagogical teaching methods through surveys, assessment techniques and literature reviews in how technical material can be more meaningfully integrated into studio courses (Chung 2013).

As part of the literature review on teaching methods of technical material to non-technical students, a well-documented correlation (demonstrated by pedagogical researchers in chemistry and medicine) showed that student confidence levels in discussing the relevance of technical material outside of class and relating the material to their other courses were significant indicators of long-term knowledge transference into other contexts (Bower 2007). Thus, student surveys in both the technical courses and design studios utilized questions to gauge their confidence related to technical material rather than only testing them on specific technical ability or content.

Student surveys were performed in both technical support courses such as the environmental systems course (taken in the third year) and design studios such as the comprehensive design studio (taken in the fourth year). The website [slagsite.org](http://slagsite.org) was utilized for the surveys to provide a method for anonymous participation for students within the classes while also providing quick access to quantified survey data. Figures 1-4 are included to provide examples of the questions used in the surveys (implemented via [slagsite.org](http://slagsite.org)) completed by students in



both the technical support courses and the comprehensive design studios at the beginning, middle and end of each course. This is one of the assessment tools used to track confidence levels and the likelihood of technical integration into students' future design processes.

Understanding

1. Presently, I understand...	1: not applicable	2: not at all	3: just a little	4: somewhat	5: a lot	6: a great deal	Mean	N
1.1 The following concepts that will be explored in this class							Mean	N
1.1.1 How climatic conditions impact building design form and organization	0%	0%	0%	25%	58%	17%	4.9	12
1.1.2 How structural systems are organized and impact building design concepts.	0%	0%	25%	50%	17%	8%	4.1	12
1.1.3 How building systems and the building envelope are responses to cultural, contextual and climatic conditions.	0%	0%	8%	42%	17%	33%	4.8	12
1.1.4 How building science and performance metrics can be used to evaluate designs.	0%	0%	8%	58%	17%	17%	4.4	12
1.2 The relationships between those main concepts	0%	0%	0%	50%	33%	17%	4.7	12
1.3 How ideas we will explore in this class relate to ideas I have encountered in other classes within this subject area, such as Tech 1, 2, 3, 4 and Structures 1 and 2	0%	0%	0%	25%	50%	25%	5.0	12
1.4 How studying this subject helps people address real world architectural design issues.	0%	0%	0%	33%	50%	17%	4.8	12

Figure 1: Survey questions completed by students gauging their perceived understanding of course material (2013)

Skills

2. Presently, I can...	1: not applicable	2: not at all	3: just a little	4: somewhat	5: a lot	6: a great deal	Mean	N
2.1 Effectively diagram and incorporate schematic structural systems into my studio design process.	0%	0%	8%	17%	67%	8%	4.8	12
2.2 Effectively incorporate and diagram building systems meaningfully into my studio design process.	0%	8%	8%	42%	33%	8%	4.2	12
2.3 Effectively analyze and draw material assemblies related to the building envelope in regards to structure, climate and constructability	0%	0%	8%	50%	33%	8%	4.4	12
2.4 Effectively determine and discuss the intent and character of my studio project.	0%	0%	0%	17%	58%	25%	5.1	12
2.5 Develop logical arguments in regards to design decisions and concepts	0%	0%	0%	25%	58%	17%	4.9	12
2.6 Write documents in discipline-appropriate style and format	0%	0%	8%	33%	42%	17%	4.7	12
2.7 Work effectively with others	0%	0%	8%	17%	42%	33%	5.0	12
2.8 Prepare and give oral presentations	0%	0%	8%	17%	58%	17%	4.8	12

Figure 2: Survey questions completed by students gauging their perceived skills related to course material (2013)

Attitudes

3. Presently, I am...	1: not applicable	2: not at all	3: just a little	4: somewhat	5: a lot	6: a great deal	Mean	N
3.1 Enthusiastic about the subject of comprehensive design studio.	0%	0%	0%	8%	33%	58%	5.5	12
3.2 Interested in discussing the subject area with friends or family	0%	0%	8%	17%	50%	25%	4.9	12
3.3 Confident that I understand the subject matter.	0%	0%	0%	17%	67%	17%	5.0	12
3.4 Confident that I can effectively design in a comprehensive manner.	0%	0%	0%	42%	50%	8%	4.7	12
3.5 Comfortable working with complex ideas	0%	0%	17%	17%	50%	17%	4.7	12
3.6 Willing to seek help from others (teacher, peers, TA) when working on academic problems	0%	0%	8%	8%	50%	33%	5.1	12

**Figure 3:** Survey questions completed by students gauging their perceived attitudes related to course material (2013)

Integration of learning

4. Presently, I am in the habit of...	1: not applicable	2: not at all	3: just a little	4: somewhat	5: a lot	6: a great deal	Mean	N
4.1 Connecting key ideas I learn in my classes with other knowledge. For instance creating meaningful links between technical, theoretical and design classes.	0%	0%	0%	25%	42%	33%	5.1	12
4.2 Applying what I learn in classes to other situations. Such as using Tech or Structures class material in studio design.	0%	0%	8%	25%	42%	25%	4.8	12
4.3 Using systematic reasoning in my approach to problems	0%	0%	8%	33%	50%	8%	4.6	12
4.4 Using a critical approach to analyzing data and arguments in my daily life	0%	0%	17%	8%	58%	17%	4.8	12

**Figure 4:** Survey questions completed by students gauging their perceived integration of course material outside of the course (2013)

Figures 1-4 show the surveys questions that are focused on assessing students' perception of their understanding, skills, attitudes and integration of course material, goals and objectives.

**1.9. Results from surveys**

The results of this research suggest that when studio curriculum and assignments in the comprehensive design studio are mapped closely with technical objectives initiated in the building technology courses, students have a greater likelihood of developing long-term skills and confidence in technical design integration. Surveys showed that confidence levels sharply increased after the second time an analysis was performed, and each time the analysis was performed within a studio setting all four survey subsections results increased in a positive direction.

The results of the three-year curricular study have shown a significant increase in the integration of analytical tools in the students' design process leading to more thoughtfully considered designs and economically viable attempts at higher performance-building designs. Perhaps more importantly, surveys have indicated that student confidence in the use of technical analysis is high enough that they expect to integrate it into their future design work outside of the requirements of the design courses and that many students believe that the design profession can and should be capable of utilizing analytical tools within the day-to-day design process to achieve high-performance buildings.

## CONCLUSION

This paper presents some of the perceived and real difficulties of incorporating building performance analysis into an iterative architectural design process and offers an implementation method for education programs to provide students with the means to build technical skills so that they can meaningfully utilize building performance analysis toward high-performance designs. It is the early educational application of fundamental building science analysis through basic building science calculations on a student's own studio design project is a highly effective method of creating a curriculum where students are empowered to use building performance analysis as a meaningful design tool.

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# 'Earthship' as Model for an Urban Co-op Health Clinic?

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What these kinds of houses are doing is taking every aspect of your life and putting it into your own hands ... A family of four could totally survive here without having to go to the store.

Michael Reynolds on Earthships (Garbage Warrior 2008)

...this clinic will provide community-based healthcare that is genuinely non-profit, preventive, humane and fun. It is a refuge for doctors and nurses who want time to heal patients. It is a refuge for patients who want to be treated with dignity.

Patch Adams Free Clinic of Philadelphia Building Committee Project Statement, 2011

(<http://www.paulglover.org/patchadams.html> - herein further referred to as *Client Project Statement*)

**ABSTRACT:** In Fall 2012, the Patch Adams Free Clinic of Philadelphia building committee (PAFCP) optioned a five acre parcel in a North Philadelphia disadvantaged neighborhood upon which they plan to build a co-operative health clinic offering care based on the ideals of Dr. Patch Adams. The desired building typology is an "earthship." The committee teamed with the Philadelphia University Architecture Program to explore both the site and prospective clinic.<sup>1</sup> A two semester research and design exploration was completed by students as part of their fourth year comprehensive technical integration design studios. Programming sessions were conducted with the client to determine project goals, program needs and components. Design workshops were conducted with the neighborhood association and interested residents to determine community goals and interests. The charge of the studios was for the students, in groups, to explore and propose designs for an energy efficient, urban co-operative health clinic.

Design research explored the following typological categories: 1) The earthship as an energy model, 2) The earthship as a health clinic model, and 3) The earthship as a community building model.

This paper summarizes the student/ faculty research and the common approaches found in the seventeen group design solutions. Base-line energy modeling of a typical earthship is compared to a conventional clinic building type and basic student solutions to understand its performance and potential use. Conclusion will present the findings on the viability of this building typology as model for an urban health clinic.



**Figure 1:** View of Site North to Westmoreland Street. Source: (Google Maps; <http://maps.google.com>)

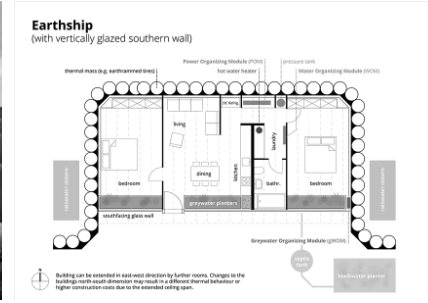
## 1.0 INTRODUCTION

The Patch Adams Free Clinic of Philadelphia is envisioned as an “open” medical facility operating outside of the insurance based, for-profit, healthcare system. To be supported by the surrounding community with the help of donations and public grant funding, the intent is to offer “free” on-going and preventive care delivered through a co-op model. Residents, by paying a yearly fee of \$100-\$300, will receive unlimited healthcare services. Emergency care responsibility will remain with the local hospitals. Expanded care such as optical/ eyewear, chiropractic, dental, acupuncture, and counseling services will be obtained through use of sweat equity “dollars” received when residents invest time and energy in the running and maintaining of the facility. The PAFCP goal is to create a self-sufficient facility “owned” and managed by members of the community itself.

After an exhaustive yearlong search, the committee found a suitable site in the Tioga section of North Philadelphia. The surrounding community is distinctly disadvantaged and has some of the highest rates of teen pregnancy, obesity, and diabetes in the city not to mention one of the lowest income rates. PAFCP estimates that upwards of 200,000 citizens lack some form of health insurance in Philadelphia. The property is a five acre industrial parcel where an abandoned manufacturing facility was razed in 2005. (Figure 1) It is bounded to the south by a busy east west artery in four lane Allegheny Avenue and to the north by West Moreland Street, a small two lane street traveled by local traffic and defined by archetypal Philadelphia rowhouses. A SEPTA rail line bounds the western side of the site while an eight story industrial building borders the east. The building committee found in the site the right combination of open space and disadvantaged community within close proximity to public transportation. An earthship built on this site would be the first urban version and one of its largest examples.



**Figure 2:** “South and East Side of an Earthship Passive Solar Home.” Source: (Author: Biodiesel33. Wikimedia Commons. 4 July 2011, <http://en.wikipedia.org/wiki/Earthship>)



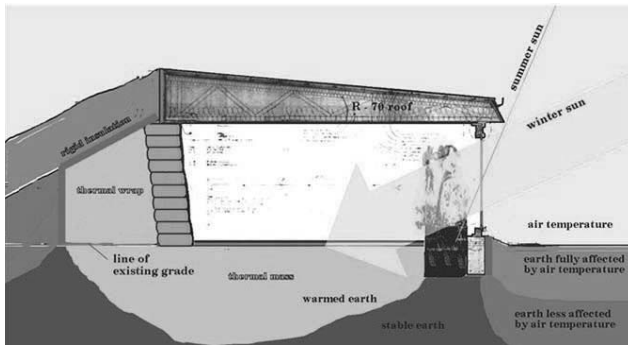
**Figure 3:** “Earthship plan with vertically glazed southern wall.” Source: (Author: Muller, Felix; Wikimedia Commons. 20 August 2013, <http://en.wikipedia.org/wiki/Earthship>)

## 2.0 THE EARTHSHIP

Because clean air and clean water are foundations of personal health, this building will exemplify green technologies. Building materials are regional, recycled, and hypoallergenic. The entire single-story building will be passive solar and earth sheltered to reduce heating and cooling costs. (Client Project Statement)

“Earthship” is term credited to architect Michael Reynolds and refers to a sustainable building typology developed initially in the southwestern United States after the oil embargo of the 1970’s.<sup>2</sup> (Figures 2, 3, 4 & 5) 20,000 examples are claimed to exist around the world.<sup>3</sup> The earthship utilizes recycled materials and natural building techniques to create an energy efficient, solar powered, “off the grid”, building which is purported to perform as net zero structures if properly designed and managed. “Earthships are buildings that capture and meet 100% of their energy and water needs, treat and recycle domestic wastewater, provide both indoor and outdoor spaces for growing food year round and use natural and recycled waste materials to construct energy efficient, durable structures.” (Schlesinger 2013) They have become especially popular with environmental groups wanting to live apart from corporate sources of food, energy and our commodity culture. Earthships have tended to be marginalized by the architecture and construction communities due to their eclectic, whimsical language and perceived socio-political agendas.

Located primarily in arid rural sites, earthships are typically linear buildings recessed into the ground and bermed on three sides for greater insulation value. They generally oriented along an east/ west axis opening to the south/ southeast for solar harvesting. Interior functions are organized around open sun filled rooms with thermal mass floors and rear walls. Natural ventilation systems are integral to the envelope and shading devices are often incorporated to control overheating. The retaining wall structures are often earth filled tires with a cement parge finish exposed to sunlight as thermal mass heat sinks. The exterior walls tend to be made of recycled materials such as bottles and cans some of which are filled with water or oil for greater thermal mass qualities. The roof and remaining portions of the building envelope are super insulated with R-Values as high as 70 BTU/(h °F ft<sup>2</sup>). Given the variables of thermal mass, ventilation and the sun, to live in an earthship requires an active relationship with the passive environmental systems to manage temperature and comfort.



**Figure 4:** “Packaged Earthships. Earthship Cross Section.” Source: (Author: Reynolds, Michael; <http://www.greenhomebuilding.com/recyclematerials.htm>)

**Figure 5:** “Earthship Tire Retaining Walls.” (Source: Author: Paul Glover; <http://www.paulglover.org/1006.html>)

## 2.1 Earthship as Energy Model

As an energy model, the earthship is an earth sheltered, hyper insulated, passive solar building with thermal mass storage systems. For a building to be a good solar building, it must: a) collect the sun's energy, b) store this energy and c) distribute the energy during times when the sun is not available. In the case of the earthship, the sun's energy is collected via large south glazing with storage primarily via thermal mass floors and walls; the energy is redistributed by direct radiation and convection offsetting the heat loss resulting from the south glazing. While many earthships employ active collection and redistribution energy systems, the basic energy model is that of a direct gain solar heated thermal mass which together with the constant temperature of the earth bridges the peak high and low temperature internal building cycle. These structures are akin to the adobe rammed earth structures with high thermal mass envelopes.

Thermal performance studies have shown that southeastern US earthships tend to perform well in balancing heating and cooling loads tracked over the period of a full year. (Ip & Miller 2009) In consideration of the weekly or daily trends, though, the basic earthship is subject to peak overheating and underheating depending upon the season and climate as result of the large solar collection glazing area. In summer they tend to overheat requiring shading and greater ventilation while in the winter they require supplemental heat due to heat loss. (Grindley & Hutchinson 1996) These peaks are often offset by constant interaction of the inhabitants in deploying sunscreens or insulating devices, adjusting ventilation, controlling amount of exposed thermal mass, and introducing supplemental heating in winter. This ongoing interaction with the thermal envelope without question results in an emotional

attachment to the buildings which is part of the earthship's allure. Similar to the wind sensitivity a yachtsman develops, earthship residents must have a keen awareness of the exterior environment and corresponding adjustments needed to maintain their thermal comfort.

Earthships are predominately houses and the most efficient range from 1,000 to 2,000 sf. Initial programming for the Patch Adams Clinic concluded that 17,500 sf was needed. The earthship's ability to maintain constant temperatures is most successful when the air volumes are low and thermal mass high. When compared to a similarly sized, conventionally framed structure with punched openings on all four sides, basic energy modeling found the earthship generated roughly the same total heating loads as the conventional envelope in the Philadelphia climate.<sup>4</sup> As a small volume, initial heating sketches found the thermal mass adequate to offset the heat losses resulting in performance similar to conventional construction – but no better. For total cooling loads, though, the earthship runs hotter and generates twice the cooling loads – a factor of the heat gain from the solar glazing array which can obviously be improved by careful shading. In doubling the sizes of both the earthship and conventional structure while maintaining a similar 40% solar aperture size to air volume ratio, for sake of argument, basic energy modeling found the earthship performed roughly fifteen percent better for both heating and cooling load standpoints overall. As we add fenestration to the other sides of the earthship enclosure for proper daylighting, though, and consider the amount of air exchanges required for healthcare facilities, a Philadelphia earthship does not generally offer significant building performance advantages over conventional construction with elevated insulation as air is the primary thermal delivery medium and there is simply too much air to heat and move in a passive and even active delivery format. Both will need supplemental heating and cooling with this aperture percentage in roughly the same amounts and as the conditioned spaces approach 17,500 sf, they perform similarly. Obviously, as the solar aperture becomes proportionally larger, the earthship will tend to perform worse than conventional punched opening construction due to the high heat gains and losses.

## **2.2 The Earthship as Health Clinic Model**

For a small annual fee, members will own this clinic, gaining diagnosis and referral, dentistry, chronic and urgent care, counseling, pediatrics, birthing, hospice care, massage, family planning, chiropractic, acupuncture, and other therapies. (Client Project Statement)

As a healthcare facility, the earthship can create a series of spatial and functional challenges. With an open space around which spaces are organized, ancillary functions operate best when open to the solar space for daylighting, ventilation and thermal transfer. For proper healthcare functioning, though, clinics require a series of layered zones of public and private spaces separated by security thresholds. Patient privacy needs result in acoustically and physically separated program zones. Secondary waiting areas for the ill tend to be located outside public circulation zones to minimize infectious contact. Exam, office and support spaces tend to be small, private isolated rooms. Security thresholds separate areas of clinics for the protection of information, assets and personal safety. Areas of the facility must be locked down when not in use especially in a community based clinic where hours of operation may extend beyond normal business hours. In short, clinics tend to be a collection of multiple, non-communicating rooms and spaces most of which do not want to open onto large or public spaces. The earthship with its large open communal sun space(s) does not tend to fit the basic clinic typology – especially when approaching 17,500 SF.

## **2.3 The Earthship as Community Building Model**

The Patch Adams Free Clinic therefore offers healing, learning, play, food and work....The facility will contain meeting rooms, quiet rooms, cafeteria (local foods), musical instruments, art materials, clown costumes and health library.



These spaces face a central circular atrium featuring plants, mosaic paths, and acoustic concerts. The waiting areas offer ergonomic chairs, cushions, cots, playpen, board games and health literature. (Client Project Statement)

Early in programming workshops, the students and clients collaboratively arrived at the shared goal of creating a place where “people can hang out all day.” This realization drove the exploration of a spatial character for the clinic charged with framing a social system. The earthship model of open central shared spaces does satisfy this goal even if it offers little advantage from energy use and clinic standpoints. As described in the initial client statement, the central space(s) provides the platform for social performance and community interaction. Many of the functions listed in the Client Project Statement have little to do with the health operations of the clinic but everything to do with educational, inspirational and social needs of the neighborhood. For the committee, the primary vision is to create a unique place which the community can control and take ownership of. Mentioned repeatedly in programming sessions was the importance of child care, elder care, job training and education – all functions which would operate outside of the administration of the healthcare organization. It became clear that the Free Clinic is intended to be a center whose foundation lies in physical and mental wellness and not just pragmatic healthcare.

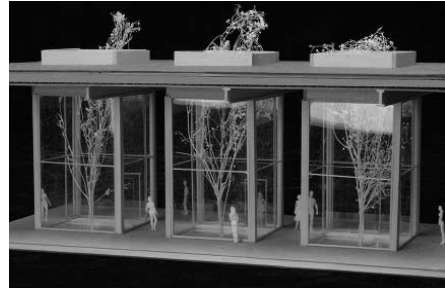
#### **2.4 Tioga United Neighborhood Association**

The success of such a place lies squarely on the buy-in from the neighborhood. Initial presentations by the PAFCP building committee to the Tioga United Neighborhood Association unfortunately focused on the earthship building typology surrounded by orchards and gardens rather than first and foremost a place of health and wellness. (Figures 6 & 7) The association spent years wrestling with the industrial owner over a plethora of issues pertaining to the blighted site eventually persuading him to demolish the dilapidated buildings. New issues then arose as the open site became a favorite dumping ground for used tires and construction waste which, in turn, created health risks for the neighborhoods. Discussions of an earthship made of recycled materials and used tires immediately alienated a majority of the association members derailing the deliberations. The new Philadelphia Zoning Code requires formalized meetings with registered neighborhood associations and without the blessing of Tioga United, the project would not be realized. Dr. Patch Adams met with the association in support of the project alongside a number of the student design proposals. Dr. Adams is 6'-6" and dresses in clownesque garb which only further complicated the situation and led to a spirited community meeting with a long list of distrusting questions and accusations. (Figure 12) As a result of unfortunate circumstances resulting from the best of intentions, the Philadelphia University students entered a contentious situation as they began work. While the initial presentation/workshops with the association tended to get sidetracked with questions of tires, compost, urban farming and smells; the students were able to assist in repairing the bridge between the committee and association through continued focus on differing energy efficient buildings strategies – the earthship being but one version.



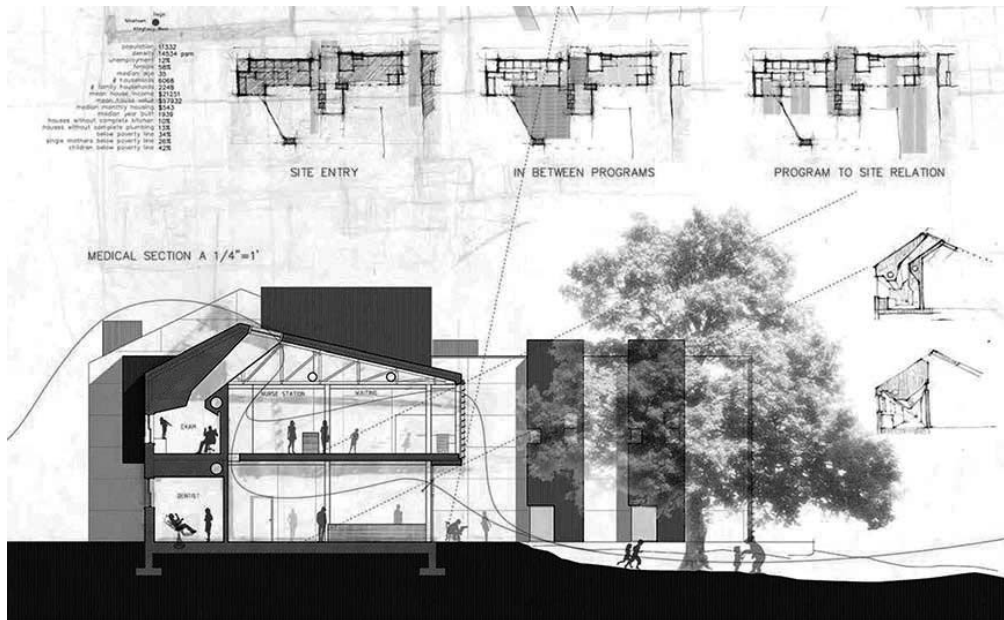


**Figure 8:** Atrium Solar Space, Student Design Proposal (Authors: Ryan Doll, Taylor Klemm & Brandon Runnels)



**Figure 9:** Interior Solar Gardens, Student Design Proposal (Authors: Marika Mavroleon, Sean Tiche & Natasha Trice)

As a challenge to the client's initial intentions, the majority of the other students proposed smaller passive solar sub-centers which framed individual clinic components and offered more efficient means for solar heating assistance. While losing some of the symbolic qualities of a central realm, the sub-center schemes began to align the thermal mass/ air volume proportions closer to those found in an earthship house resulting in a greater chance of thermal and energy success (Figure 9).



**Figure 10:** Student Design Proposal (Authors: Thomas Burghart, David Trapp & Daniel Silberman)

Emanating from initial passive solar design research, the remaining sixteen student design proposals oriented their facilities along an east west axis open to the south for solar harvesting same as for an earthship. As programming unfolded, the inherent differences between the clinic and community functions together with the need for secure thresholds led to their physical separation. It was a unanimous conclusion that the programs would operate

individually and interact by their adjacency. A number of the proposals split the clinic functions around community spaces with the goal of greater social interaction but majority of the schemes either “barbelled” the two prime functions on either side of an “arrival” space or layered them side by side or on top of each other. (Figure 10) These organizations were consistent across the schemes and could be concluded as inherent responses to the program.



**Figure 11:** Southern Solar Exposure Allegheny Street, Student Design Proposal (Authors: Kenneth Roposh, Melanie Whedon, & Michael Rothman)

Relative to the site, there were three primary organizations equally proposed by the students. Facilities located to the north part of the site tended to be organized as individual expressions of program components resulting in a scale more akin to the adjacent rowhouses. While appealingly “village-like,” the downside of these organizations is the vehicular traffic and drop offs required of a clinic that will be difficult to achieve on a two lane, quiet back street. The proposals, by being to the back of the site, also did not have the larger identity requested by the PAFCP – the building wants to advertise its mission and program to the average passerby. Proposals locating the facility to the south side and center of the site tended to be organized into larger massing arrangements scaled more in keeping with the four lane east/ west arterial Allegheny Avenue and want for greater image. Vehicular and pedestrian access is direct and opportunities for street presence more available. For the students locating the facility in the center of the site, the distance to either street averaged 75 meters, a tough distance to comfortably negotiate for pedestrians – especially in a challenging neighborhood. This distance imbued the schemes with a suburban quality complete with automobile roadways, turnarounds and drop offs. To maintain the urban character and pedestrian access so important for community ownership, it became clear to the majority of students that the facility was best located in close proximity to either Allegheny or Westmoreland streets. (Figure 11)

## CONCLUSION

The Patch Adams Free Clinic offers healing, learning, play, food and work. Designed and decorated whimsically in the spirit of Dr. Patch Adams, our clinic reminds that true healing touches the soul.  
(Client Project Statement)

From a winter heating and thermal comfort standpoint, earthships perform ideally in the arid southwestern U.S. where diurnal temperatures fluctuate as much as 30–40°F overnight. The sun is powerful enough to charge the building thermal mass during the day to maintain comfortable temperatures overnight until recharged early the next day. The solar radiation/days in this climate are strong enough to provide a steady and reliable heat source. The small size of the buildings and corresponding air volumes together with large thermal mass heat sinks and a high R-value envelope all create an ideal balance for consistent temperature control. Unfortunately, when transplanted into northern climates the earthship performs less well due to the limited solar time and consistently low winter temperatures. While the passive solar glazing component does offer heat assistance, the energy stored struggles to overcome the evening heat loss. While the additions of an interstitial glass “sun” room between the solar glazing the inhabited space (a thermal buffer zone), double skin facades and insulating glass curtains can help offset the heat loss, the earthship as a passive solar volume cannot provide adequate winter heating without assistance from active HVAC systems – especially when it is expanded beyond the size of a house – a common problem with passive solar buildings. The claim that this typology can capture and meet 100% of its energy needs is presumptive in northern climates. While it can be argued that the detrimental heat loss occurs during the overnight hours when public buildings are closed, the amount of solar energy needed to recharge the thermal mass the next morning is difficult to attain. As the earthship model is enlarged from the house scale its thermal performance drops to levels similar to conventional construction. Add the clinic requirement for greater ventilation and loss of infiltration control due to the arrival and egress of many visitors, and the performance quickly drops below that of conventional construction.

The earthship model does provide a unique spatial environment for a community health building. The model develops awareness for, and exemplifies the importance of, a respectful relationship between users and the natural environment. These buildings can educate and demonstrate the ease and availability of passive solar/ ventilation systems, waste processing, storm water management, recycling, the growth and preparation of foods, urban agriculture, and overall wellness – especially in a disadvantaged neighborhood unfamiliar with many of these opportunities. In this specific case the earthship also embodies the “whimsical spirit of Dr. Patch Adams” who believes that “laughter, joy and creativity are an integral part of the healing process.” ([www.patchadams.org](http://www.patchadams.org)) There is no question that the earthship here is as much a symbolic and metaphoric building typology forwarded by an organization wishing to distance itself from standard forms of healthcare and its subsequent institutions. The architecture here is a direct expression of counter-culture political and social ideologies – a fringe building strategy for a fringe healthcare provider. At a time during which the American healthcare system is in full upheaval, alternative delivery models cannot be discounted and in this case, the architecture can support and frame the larger social ideals of the client.

While the earthship model offers positive sustainable attitudes and expresses well the character of the client, the community continues to be at odds with the project. The student proposals for energy efficient versions of the clinic have helped temper the discussion but the neighborhood is unfamiliar with the tectonics, language and presence of this building typology. Unfamiliarity breeds distrust and the earthship is distinctly alien to the surrounding residents most of whom have spent generations housed in traditional northeast US rowhouses. As such, the project has stalled in its attempts to find financial and community support similar to

Patch Adams's twenty-plus year campaign to build his own hospital in Pocahontas, West Virginia - also based on the earthship model.

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## ENDNOTES

<sup>1</sup> Patch Adams Committee Team Leaders: Paul Glover and James Wurster. PhilaU Team: Faculty: David Kratzer (Coordinator), Brian Johnston & Daniel Chung. Fall 2012 Students: Logan Dry; Kevin Peters; Michael Opdahl; Amber Freedman; Stephanie Geraghty; Lauren Arrington; Jared Bilsak; Ryan Doll; Thomas Frank; Sean Tichy; Muzalier Gaussaint; Brandon Runnels; Daniel Rich; Taylor Klemm; Erik Tsurumaki; Austin McInnis; Robert Garcia; Stephanie Smith; William Brostowicz; Marika Mavroleon; Natasha Trice; Eike Maas. Spring 2013 Students: Sara DeMuth; Matthew Anderson; Nathan Ellenberger; Timothy Schaefer; Fatema Kanji; Joshua Voshell; Matthew Ziembra; Nicole Boris; Marian Jony; Philip Rivera; Kenneth Roposh; Dylan Wilson; Melanie Whedon; Thomas Burghart; Tristan Emig; David Trapp; Michael Rothman; Brandon Lansing; Kyle Burke; Ellen Wright; Daniel Silberman; Darpan Patel; Phillip Luu; & Brandon Saiz.

<sup>2</sup><http://www.earthship.com>

<sup>3</sup> Others have placed the number as low as 3,000 as of 2009. (Ip & Miller 2009)

<sup>4</sup> Energy modeling was completed utilizing IES software (Integrated Environmental Solutions, LTC)

# Privacy, Security and Dignity: POE of Safe Haven Dorm Partition Environment

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The housing problem can be, and often is, solved in a manner that creates homelessness.

Kim Dovey; "Home and Homelessness: Introduction." (Dovey 1985, 1)

Architecture is not just a matter of style, image, and comfort. It can create encounter – and prevent it. Oscar Newman, *Defensible Space - Crime Prevention Through Urban Design*. (Newman 1972, 12)

ABSTRACT: *Defensible Space* is a seminal text on the relation between urban design and personal safety. It focuses on the importance of territory, boundary and visibility in the design of spaces that are conducive to activity and safe, comfortable inhabitation. *Ownership*, for Newman, is critical to the success of any space and promotes its care and upkeep. *Visibility* is the foundation of public safety – to see and be seen. The book explores specific spaces associated with public housing in order to glean conclusions which can be applied to more expansive design conditions. A person's "home base" becomes central to self-image and the basis of territory. But what if the users have no home or home base?

This paper presents post occupancy evaluation findings of a homeless shelter dorm station design + build architecture student project completed in December 2012. Fourteen architecture students in a socio-political + design-build studio at Philadelphia University programmed, designed, and prototyped dorm stations for a "safe haven" homeless shelter managed by Project H.O.M.E. in Philadelphia.<sup>1</sup> Project H.O.M.E. fabricated the stations which were then assembled and installed by a team of students, faculty and volunteers. Founded on the belief that architecture can provide for social need, effect behavior and support social change, the studio required the students to complete research on the homeless condition, the social agency and the political context for public services. This paper will touch upon this research as a means of qualifying the solution and POE.

The post occupancy evaluation utilized interview, questionnaire, and observation data gathering methodologies. The evaluation involved three primary subject groups including administrators, staff, and residents. Specific dorm station design conditions were addressed including:

Boundaries in the Definition of Territory  
Personalization and Ownership  
Visibility, Privacy and Safety

## 1.0 INTRODUCTION

Project H.O.M.E. is the largest private social service agency in Philadelphia and the founders believe the primary determining factor creating homelessness is poverty.<sup>2</sup> They prefer a general working definition of homeless as "a person who does not have a fixed, regular and adequate nighttime residence. This person may be sleeping on the streets, with friends or family, in cars or abandoned buildings or in shelters."<sup>3</sup> Project H.O.M.E.'s mission is "to empower people to break the cycle of homelessness, address the structural causes of poverty, and attain their fullest potential as members of society." Their central core value is "dignity," whether it is in how they provide services or reinforcing that character within their residents.

Project H.O.M.E. provides housing on three levels; entry level “safe havens,” transitional housing and permanent housing. Most social service agencies struggle with “treatment first” or “housing first” philosophies. (Padget 2007, 5) With treatment first, agencies require residents to undergo treatment as a condition of the housing. In cases of addiction, residents are not permitted to partake in their vices and use can result in expulsion from the facilities. Project H.O.M.E. primarily utilizes the housing first model where residents have few conditions other than vices are not permitted on site. Residents can arrive drunk or high, but they cannot partake while on site. These are considered “wet facilities” and this model focuses on developing trust with residents as a foundation for building dignity. It is the belief that many residents will leave if required to be “dry” or participate in formal treatment. Project H.O.M.E. prefers to provide a stable environment prior to initiating treatment. This is an important distinction as the design and performance of the dorm stations was directly affected by the condition of the residents – resulting in this case with construction that needed to be extremely durable from abuse, easily cleaned and disinfected.



Figure 1: Original Safe Haven Shelter Dorm Condition. Station Design. Source: (Author Students)

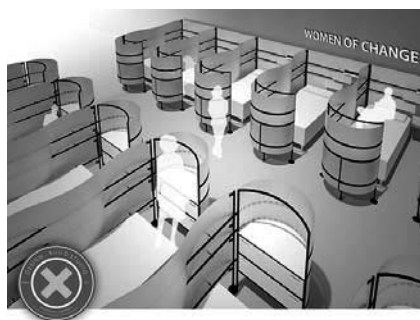


Figure 2: Final Student Dorm Station Design. Source: (PhilaU)

The entry-level safe haven shelters are the first step off the street. The Women of Change Safe Haven, the site for this project, is a small scale women’s environment for the most vulnerable homeless population many of whom are older, physically frail and suffer from mental illness, addiction and health issues. Twenty-five chronically homeless, seriously mentally ill women, ranging in age from 21 to 60, are housed in one dormitory room with adjacent community, health and dining rooms. The shelter space is leased meaning any construction could not be physically attached to the building in any way.

The residents of Women of Change lost their privacy partitions due to repeated bed bug infestations and abuse (Figure 1). Shelters world-wide suffer from a lack of appropriate partition systems often relying on fabric or wood office systems which are not adequately durable and create suitable environments for insects. Without partitions to create even the most basic levels of privacy, the residential environment at the safe haven had become unsafe and unhealthy.

In the Spring of 2011, Project H.O.M.E. teamed with Philadelphia University Fifth Year Architecture students to program, design, and prototype a design for a homeless dorm station (Figure 2). The design was fabricated and installed the following December. As part of the fabrication, construction documents were generated by the students involving interactions with the contractors, facility administrators and included a value engineering process to align the project with available funds.



## 2.0 STATION DESIGN AND PROGRAMMING

### 2.1 House, Home and Homelessness

Initial student design proposals offered familiar homelike environments based on the premise that shelter residents would prefer housing similar to the student's own. Quickly discovered, the causes of homelessness are extremely complex and extend beyond the simple provision of shelter. Well described in *The Soloist*, it is a typical reaction when working with the homeless to assume they simply want what "we" have. (Lopez 2008) In most cases, this is far from the actual reality. In dealing with the homeless, one must reframe an understanding of "house" and "home."

Provision of shelter can solve "houselessness" - an episodic temporary loss of shelter. The more difficult problem is with chronic homelessness. HUD's definition of chronic is, "someone who has experienced homelessness for a year or longer, or who has experienced at least four episodes of homelessness in the last three years and has a disability."<sup>4</sup> Generally, 16% of the homeless population is considered chronic. The women of this specific shelter suffer serious mental illness compounded by addictions and behavioral afflictions. The majority exhibit a deep distrust and irritation with authority and their homeless peers, undoubtedly developed by their previous experiences in the "institutional circuit of shelters and the streets." Summarized by Deborah Padgett, there are three dimensions of the relationships between housing, health and psychological well-being: 1) the material benefits of housing as shelter, 2) the health threats associated with substandard housing and neighborhoods, and 3) the psychosocial benefits of housing as 'home.' (Padgett 2007, 2) While the provision of shelter and the addressing of health threats can more easily be achieved, the psychosocial issues of home are especially complex in the case of the mentally ill.

For Joseph Rykwert, a house is a physical condition – the "fabric" of shelter. Home, though, is inherently metaphysical and requires no "building." (Rykwert 1991, 55-56) For Kim Dovey, a home is "a kind of relationship between people and their environment." (Dovey 1985, 1) Rykwert continues with home as a "communal and neighborly manner of dwelling," and that "a house, whether it is rural or urban, can be a true home only in such neighborly circumstances." What makes a house a home here are the communal relationships surrounding the physical shelter which create a place of meaning and personal attachment. The first issue to evaluate in designing a homeless environment was whether the solution provided the basic conditions of house, first, and home, second. In this instance, the mental capacity of the residents was a governing factor.

The term "ontological security" "and the lack thereof" has been used to describe the experience of those with serious mental illness. (Lange 1965) The "subjective sense of being at home" is the "feeling of well-being that arises from a sense of constancy in one's social and material environment which, in turn, provides a secure platform for identity development and self-actualization." (Giddens 1990) For Dupuis and Thorns, ontological security is a sense of confidence and trust in the world as it appears to be. It is a security of being. (Dupuis & Thorns 1998, 27) For Deborah Padgett, "It is ironic that those people whose ontological security is most threatened due to mental illness are also those least likely to be in housing circumstances that would promote ontological security." (Padgett 2007, 2)

In expanding the discussion, for Dupuis and Thorns "the home can provide a locale in which people can work at attaining a sense of ontological security in a world that at times is experienced as threatening and uncontrollable." Ontological security can be assessed, and strengthened, through four primary conditions: 1) Home as the site of constancy in the social and material environment, 2) Home as a spatial context in which the day to day routines of human existence are performed, 3) Home as site free from the surveillance that is part of the contemporary world which allows for a sense of control that is missing in other locals, and 4) Home as a secure base around which identities can be constructed. (Dupuis and Thorns 1998, 29)

While on the surface simply a partition project, the central charge for this design + build project was to re-establish ontological security for the residents by provision of not simply dividers but

enclosing stations that created spatial boundaries for daily routines and could become a secure “home” base. To truly make a difference in the resident’s lives, it was necessary to consider the basic tenets of home as a secure platform for identity development and self-actualization utilizing the four primary conditions above as form determinates, and evaluation tools.

## 2.2 Program Dichotomies

Through the programming workshops, the following goals were identified for the project and partition system: 1) To improve the resident’s living conditions, 2) To provide a safe environment for residents and caregivers, 3) To provide a degree of personal privacy, 4) To provide a comfortable, stress free environment, 5) To provide durable stations that can be disassembled, cleaned and easily moved, and 6) To provide cost effective, readily repairable and easily maintained stations.

Through identification of the goals alongside the mission of Project H.O.M.E. for dignity as a foundation for self-esteem, it was decided that individual stations would be provided for each person regardless of how tight the spaces would become. The quantitative program for each station was provision of a dorm-sized bed, storage, circulation space, and a privacy element all within fifty-five square feet. As programming continued, three design dichotomies emerged which greatly affected the deliberations and eventual design.

### 2.3 Program Dichotomy One: Privacy versus Safety

For Leon Pastalan, “Life in society generates such tensions for the individual that both physical health and psychological health demand periods of privacy for various types of emotional release.” (Pastalan 1970, 93) The number one survey request from the users was for an increase in privacy. Project H.O.M.E. initially listed “opportunities for privacy” as a vital component for establishment of resident dignity but were quite strict on this being minimal for safety reasons. Contrary to the conditions of privacy run the issues of safety and security which are founded in visibility. In comparison of Newman’s and Crowe’s texts, a set of five safe design criteria emerge.<sup>5</sup> People feel safer in spaces that are: 1) bright and well lit, 2) are colorful, 3) are clean, 4) are visible (one can see into them and be seen from them), and 5) are claimed and owned. Residents expressed during the programming phase the want for a place in the shelter that was private and “theirs” – a place they could be responsible for. (Figures 3, 4, 5 & 6) Privacy leads to ownership and for Crowe, it is “axiomatic that people will take care of space and assets in which they have a proprietary concern.” (Crowe 1991, 103) The ability to create opportunities for privacy while allowing sightlines and visibility for safety created the most obvious design dilemma. Threats to safety for residents and staff in the facility were evident at the time of programming.



Figure 3: Prototype Client Discussion on



Figure 4: Installed Dorm Station.

### 2.3 Program Dichotomy Two: Insects, Cleanliness & Durability versus Home

It was a very high priority for Project H.O.M.E. that the stations not harbor insects, be easily cleaned and extremely durable. Bed bug treatments can run into the tens of thousands of dollars per incident when factoring in facility down time and staff costs. Woods and fabrics support insects. Insects avoid slick plastics and metals which are easy to clean and maintain

making them ideal choices. The haptic qualities of these materials, though, can be impersonal, institutional, and not homelike.

### 2.4 Design Dichotomy Three: Nice, But Not Too Nice

The most caustic programming condition was the requirement that the stations not be “too nice.” If the design was too comfortable residents would not want to leave. Current trends in homeless services support “rapid re-housing,” a national best practice of moving the homeless quickly into permanent housing instead of emergency shelters.<sup>6</sup> With the want for the residents to “claim” the stations and establish ownership, the character was of great focus during the design phase – if too alienating resident ownership would be difficult to obtain but if they were too well liked the users might not be motivated to leave.



Figure 5: Station Prototype.  
Source: (Author)

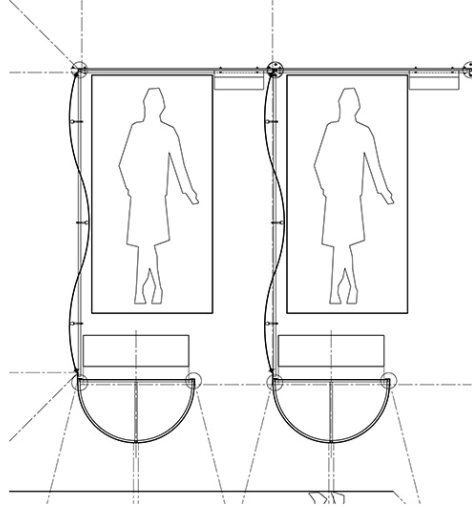


Figure 6: Station Schematic. Source: (Author)

### 2.5 Station Design

The final station solution is a plastic and steel system comprised of three components which can be detached and reconfigured in a variety of modular arrangements – a head board, a side privacy panel and a circular privacy end unit. Each component is comprised of plastic sheets layered with painted steel tube frames resulting in lightweight durable construction. For the side wall a thin layer of plastic is woven with the structure exposing bars for hanging storage to both sides as well as stabilizing the lightweight panels. All three components provide a variety of space for storage and have varying degrees of translucency offering a balance of visibility and privacy. The headboard has sliding drawers while the curved privacy unit offers a high desk/ shelf and lower shelves for additional storage. The components are raised above the floor for ventilation/ cleanability and extend 1.4m above the floor allowing easy visibility over the top. The storage unit has translucent plastic panels to the corridor allowing partial visibility for staff observation while offering a degree of privacy.

## 3.0 POST OCCUPANCY EVALUATION

### 3.1 POE Tools and Areas of Focus

In completion of the evaluation, the primary tools for gathering assessments were observation, interviews and questionnaires – one for the staff/ administrators and a separate one for residents. While a number of staff completed the questionnaires, the nature of their work and shortage of time limited the number of responses. The residents, given their degrees of mental illness, struggled with the questionnaires. As such, observations and interviews for all three user groups were the primary means used to obtain data. Topics for discussion included:

1) Station Layout, 2) Program functionality, 3) Privacy and Safety, and 4) Territory and Ownership.

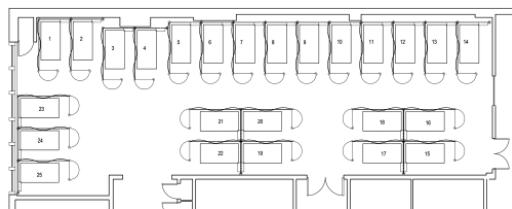


Figure 7: Original Dorm Layout. Source: (PhilaU Students)

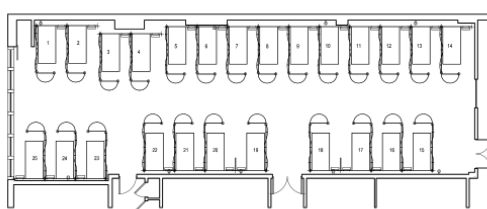


Figure 8: Revised Dorm Layout. Source: (Author)

## 4.0 SUMMARY OF INITIAL POE FINDINGS

### 4.1 Station Layout

The provision of individual spaces for residents lowered the number aggressive incidents dramatically with some staff estimating the drop to be between 75 and 80%. The layout was based on a resident observation that it was disconcerting to wake up and find someone watching you. It was planned such that no resident could see another's head while laying down (Figure 7). This layout resulted in differing arrangements for the two sides of the room, though, and three different unit characters. The resulting inequality created issues amongst the residents, especially those with greater degrees of mental illness, and necessitated a layout change after a period of only six months. The stations were rearranged during which time numerous residents walked from unit to unit measuring the stations to make sure they were all the same size. (Figure 8). Equality became so important that the even the slightest differing detail would trigger an emotional episode. Evidenced by these emotions, the residents had developed a strong sense of ownership in their stations to the point of meticulously comparing each with their neighbors. Unfortunately, the limitations of the space resulted in two – two person stations which have since created much angst for those particular residents. Students are currently designing a stand-alone dividing partition for these two stations which is proving to be a difficult assignment from a safety standpoint.

### 4.2 Program and Functionality

While the design satisfied the immediate needs for sleeping and the daily routines of life, residents and staff took issue with storage and residents "stuff." For the homeless, the ability to store and protect their belongings can mean the difference between staying or leaving a shelter and is extremely important. (Lopez 2008) In the curved privacy units, the lower shelves are difficult to access and clean which is actually more troubling for the staff than the residents. The top shelf is too large and is constantly overflowing. Each of the residents has a lockable storage closet and the general consensus by the staff was that too much storage space was provided in the stations. Too much room = too much stuff = purging and angst.

When asked what was missing, a phone charging spot was unanimously identified first, and a dorm reading light second, by both staff and residents. Phones have become the number one possession for the homeless and the unavailability of outlets is resulting in scattered groups of residents huddled around receptacles guarding their devices as they charge. It can be argued that in this situation, the phones are promoting physical social interaction in addition to the social airwaves.

### 4.3 Privacy and Safety

The number one response from residents, staff and administrators, regardless of the question, pertained to privacy. The amount provided is extremely successful to the point that more is desired. Initially, Project H.O.M.E. strongly requested only minimal privacy opportunities for safety reasons due to the vices and mental state of the residents. Staff make "census" rounds every thirty minutes marking down attendance and they need unrestricted visual access to all spaces in the facility. Any private, non-visible area could offer opportunity for improper

behavior and challenges to safety. Ironically, in contrast to the original condition, no staff or residents currently feel unsafe in the dorm day or night even with the individual stations.

Given the lightness of the partitions and the ability to see/ hear under and over them to monitor residents, the design has provided enough comfort that staff is now willing to allow more privacy. This is having a positive effect on the demeanor of the residents most of whom now drape a towel across the entry openings. There does not seem to be the hard line stance of visibility originally aggressively required. Interestingly, a privacy design flaw became evident in the diameter of the round holes in the side wall panels to accommodate the steel frames. Sized for on-site assembly tolerances, the holes are large enough to peek through. 75% of the residents have covered these holes with tape, paper or clothing. (Figure 12)



Figure 9: Examples of Personalization During Re-arrangement. Source: (Author)



Figure 10: Personalized Dorm Station. Source: (Author)

#### 4.4 Personalization, Marking of Territory and Ownership

Claimed and owned spaces result from the striking of territory and the responsibility for order that results. Ownership is by nature a defensible condition and safe areas are bounded by adjoining territories that best offer surveillance and protection. With the lack of dorm partitions and the clashing zones of privacy, it became obvious that the shelter had lost its resident territories and as such was besieged with social duress, vandalism and an overall lowered sense of safety and wellbeing. The claiming of territory begins with the marking of personal boundaries. The ability to personalize a space “creates links with the places when residents fill them with meaning. In this way, the place as a physical space is converted into a psycho-social space.” (Werner, Altman & Oxley 1985) Territory is marked through the act of personalization, ownership established and the dwelling can become a home.

In evaluation of the station design, the definition of the space and its ability to be personalized are the strongest attributes (Figures 9 & 10). Each person's dorm space is bound on three and one-half sides creating physical, interpersonal borders. The entry to the space is tight, .5m, which creates a very clear and definable threshold (Figure 11). The plastic panels layer upon, and weave around, the steel supports offering many joints to display personal stuff which act as identifying markers. Items in the curved storage units are visible through the translucent privacy panels further identifying a person's station and entry.

The personalization of the stations has bred a strong possessive quality in the majority of the residents many of whom became agitated and upset when students entered “their” places during the rearrangement. They only settled down after seeing that their spot had just been moved and not changed. It is the hope of all involved that this quality will act as a foundation for transition out of the cycles of homelessness.

## CONCLUSION

*We not only give a sense of identity to the place we call home, but we also draw our identity from that of the place. Dialectics of home involve more than inside versus outside. Home is a place of security within an insecure world, a place of certainty within doubt, a familiar place in a strange world, a sacred place in a profane world. (Dovey 1985, 10)*

The majority of the Women of Change population is quick to convey that their presence in the shelter is a temporary condition. They spend large amounts of time out in the city and only a few “hang out” in the dorm or community spaces. Most have a distrust of public housing and shelters - likening them to institutional straightjackets. In the attempt to strike a balance between the program dichotomies, the students inadvertently created an abstract enclosure system not rooted in any typical cultural experiences of house or home. The steel and plastic is foreign to most home languages but fits well the needs of the Client. Project H.O.M.E. is happy to report no bed-bug infestations have occurred in the ten months since original install. The “inorganic” materials ironically create an anonymous “blank slate” condition which residents generally feel comfortable to personalize and claim for themselves in establishment of a home base. It is the hope that this base can provide a temporary foundation for reconstructing identities and the promotion of ontological security. The POE confirmed that the design provides a safe level of privacy and territories are well established as residents have taken ownership of the stations. While the final solution does not create an environment most would equate to a homelike “good place”, for a person with “no place”, the stations offer residents “some place” to occupy on their way towards permanent housing.<sup>7</sup>

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## ENDNOTES

<sup>1</sup> Project Team: Project HOME Client Team: Paul Sassani, (Past) Vice-president of Property and Assessment Management, Chris Rivera, (Past) Director of Facilities; Sue Smith, Vice President Operations; Robin Bonfield, Director, Women of Change Safe Haven; Alex Shaw, (Past) Social Case Worker; and select residents of Women of Change. PhilaU Team: David Kratzer, Associate Professor of Architecture; Justine Tarrant, Matthew Link, Matthew Marcarelli; Christopher Class, Elliott Schwartz, Tom Lee, Jeff Delaquilla, Tyler DiRenzo, Kimberly Smeltzer, Lauren Printz, Nick Germani, Veronica Keefer, Nicky Petrozzo, Adrienne Williams. Additional Workshop Participants: Wendy Krupnick, Director, Occupational Therapy Program, Philadelphia University and twenty-six Occupational Graduate Students. Industry Partners: Cavo Design-Build, Philadelphia; Curbell Plastics, Moorestown, NJ; Metal Stock, Philadelphia, PA; Northeast Plastics, Philadelphia, PA; Rodon Signs, Jenkintown PA; Tom's Automotive, Philadelphia; Corian Division, Dupont Corp.; Trespa Meteon Panels

<sup>2</sup> [www.Project.H.O.M.E.org](http://www.Project.H.O.M.E.org) All quotes in this paragraph are from the website.

<sup>3</sup> <http://Project.H.O.M.E.org/advocacy/facts.php>

<sup>4</sup> [http://www.endhomelessness.org/pages/chronic\\_homelessness](http://www.endhomelessness.org/pages/chronic_homelessness)

<sup>5</sup> These criteria are paraphrased in comparison of the texts from Newman and Crowe.

<sup>6</sup> City of Philadelphia Office of Supportive Housing, 2009.

<sup>7</sup> Final sentence is an obvious play on the etymological enigma of utopia as “no place” and eutopia as “good place.” The studio returned often to the discussion of utopia and its subjective frames of reference in the design of architecture for the “public good.”

# Collaborative design of a multi-functioning building envelope

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**ABSTRACT:** This paper details the design evolution of a multi-functioning building envelope. The range of functions and performance achieved by the envelope were the result of close collaboration of faculty, students, and external consultants in architecture, electrical engineering, mechanical engineering, structural engineering, composite materials science, lighting design, and computer science.

The envelope was designed with particular attention to tropical climate conditions. Negative factors, such as high heat, humidity, material degradation (e.g., rot, termites, rust), floods, and hurricanes were considered. At the same time, the tropics typically provide high insolation levels and potential for energy harvesting. A main focus of the research was to investigate the unique conditions present in tropical climates and to evolve responsive building envelope design in order to increase human comfort and lower energy use in this large world region.

The envelope is comprised of: (a) semi-*monocoque* shell structure with tension bracing, (b) thermally-broken stressed FRP interior/exterior skins, (c) aerogel cavity granular insulation encapsulated in polycarbonate panels, (d) computer-controlled color-changeable LED light strips, (e) variable cavity ventilation system, and, (f) external photovoltaic computer-controlled louvers. These elements were designed to have the following attributes and functions: (a) lightweight structure for minimal material use, (b) watertight enclosure for flotation, (c) minimal thermal envelope gains/losses, (d) variable daylighting, (e) variable artificial lighting color, intensity, position, and pattern, and, (f) variable incident PV angle for optimal energy harvesting. The steps in discovering, understanding, and capitalizing on the various and synergistic relationships among materials, assemblies, and systems to achieve high-level performance design objectives are detailed.

The paper uses the specific case of a building envelope design to argue for the more general need to assemble collaborative relationships in order to provide multi-functionality and systems synergy and to thereby achieve higher levels of performance and materials/system efficiency.

**KEYWORDS:** multi-functioning, envelope, tropical, photovoltaic, daylighting

## INTRODUCTION

Tropical regions comprise around 40% of the earth's surface, and hold approximately the same percentage of the world's population.<sup>1</sup> Due to rapid growth and infrastructure development in many of these nations, such as Brazil, India, and Vietnam, it has been projected that within the next 20 years, tropical and sub-tropical nations could be responsible for more than half of world carbon emissions from the burning of fossil fuels for electricity.<sup>2</sup> The pressure of increased population places additional pressure on energy infrastructure that in many areas may already be insufficient. To address the current and growing need for reduced energy usage to achieve more sustainable architectural solutions, tropical building design should seek to incorporate appropriate active and passive systems to minimize heat gain, decrease overall energy consumption, and harvest solar energy. Self-contained "off-grid" solutions may be appropriate in certain situations to ease the burden on developing new or improving existing infrastructure.

Tropical regions are characterized by having high temperature, solar radiation, and humidity throughout the year.<sup>3</sup> Such conditions present challenges to providing adequate human comfort while utilizing minimum energy resources. Other factors need also be considered



when designing tropical buildings, such as high winds, heavy rainfall, and flooding. The combination of these factors presents particular challenges in the design of an envelope seeking to achieve high energy performance and structural integrity, while resisting material degradation.

This research project sought to address these multiple issues connected with tropical building design and pursued an extension of the pioneering mid-century bioclimatic tropical research by Maxwell Frey, Jane Drew, and Victor Olgay. The research was conducted within the framework of a U.S. Department of Energy Solar Decathlon 2011 award.<sup>4</sup> The project team determined at the outset that in order to achieve high levels of performance a close collaboration of experts from different fields would be necessary. In the early stages of design the team was comprised of individuals representing architecture, electrical engineering, mechanical engineering, construction management, and composite materials science. In the latter stages, people from structural engineering, computer science, and tropical agriculture/aquaponics fields were added.

## **1.0 DESIGN CRITERIA**

### **1.1. Foundational Principles**

Initial formulation of the guiding ideas and technologies for the project were conducted in a class comprised of faculty and students from architecture, mechanical engineering, and electrical engineering. Students were formed into interdisciplinary teams, and were challenged to develop initial design proposals. From these proposals, key guiding principles were formulated. First, the design was to focus on climatically responsive building strategies for the tropics. Second, the design would utilize traditional/indigenous tropical building solutions and modify these as appropriate. Third, the design would be conceived as a flexible prototype that could be adapted to varied sites and microclimatic conditions.

### **1.2. Research Methodology**

It was understood that the project would involve whole building design and construction, and that all work would need to follow the prescriptive path mandated by the grant. The work was initiated by a two-stage proposal. The first proposal stage laid out the main organizational, technological and financial factors. After approval from the organizers, the team prepared the second stage proposal, which involved a conceptual building and systems design. The prescriptive project trajectory following the proposal stage was divided into schematic design, design development, construction documents, construction, and event display. This phased approach follows A.I.A. contract language and is typical in architectural practice today. This approach generally promotes a method whereby general programming, space planning, and site response is considered first, and where integration of systems and detailing follow later on in the process. While the required deliverables followed this ‘general-to-specific’ mode, our actual process was much less linear. This was due to the team’s decision to allow climatic response and technological systems to be significant drivers in the overall building form.

The team decided that all primary collaborators would be involved at outset. This was thought to allow all disciplines to have “buy-in of the initial concepts, and to allow each discipline to inform the other. Since the overall project was to take the form of a house, architecture would need to be involved. Also, since the house needed to provide high-level energy performance, mechanical engineering would be added. And finally, since the house was designed to be “net-zero”, using only photovoltaic and solar hot water systems, electrical engineering was also included. A faculty from architecture (author of this paper) served as the PI for the project, and the two faculty from engineering served as the Co-PI’s. These three faculty played an active role throughout the project’s duration. Therefore, an interdisciplinary approach was taken throughout the project, and in this, the main disciplines were given equal weight. We wanted to avoid a typical architectural process where engineering fills in later in the process to make the architect’s aesthetic vision “work”. More importantly, it was felt this method would result in a higher level of research and application and ultimately yield a higher performance building.

**Table 1:** Team disciplines represented showing subjective impact on the final building envelope design

Discipline	High	Medium	Low
Architecture	X		
Mechanical Engineering	X		
Structural Engineering	X		
Electrical Engineering	X		
FRP Material-Construction	X		
Computer Science		X	
Construction Management	X		
Daylighting/Lighting	X		
Aquaponics			X
Marketing			X
Culinary Arts			X

The majority of building design adapts existing technology to specific project circumstances, and is therefore typically considered applied research. The team wanted to explore beyond the application of existing technologies given the understanding that these technologies may not always be optimal. Therefore, a degree of basic research was conducted which focused in areas pertaining to translucent shell envelope construction, double skin envelope (having the outer skin able to simultaneously control daylighting, shading, and solar energy harvesting), phase change material thermal storage systems, and building automation systems able to control unique variables.

Finally, the research sought not only to coordinate among various systems, but also to find particular synergies between them. For example, the translucent envelope simultaneously provides structure, rain protection, flotation capability, privacy, insulation, cavity venting, daylighting, and artificial lighting. The steps in arriving at these design objectives will be traced through the primary development stages of Conceptual Design through Design Development.

**1.3. Design Criteria/Goals**

The 2011 Solar Decathlon used the following ten contests for judging the completed houses: (1) Architecture, (2) Market Appeal, (3) Engineering, (4) Communications, (5) Affordability, (6) Comfort Zone, (7) Hot Water, (8) Appliances, (9) Home Entertainment, and (10) Energy Balance. Each contest was worth 100 points, for 1000 possible total points.<sup>5</sup>

The team had the objective to obtain the maximum points in each category. At the same time, however, other key criteria were deemed important in developing a prototype house for the tropics:

1. Human comfort: address principally using ventilation and shading, with mechanical system backup
2. Net-zero: minimize energy use and provide solar energy harvesting
3. Hurricane resistance: efficient, aerodynamic enclosure/structure
4. Flotation capability: lightweight envelope able to survive flood events
5. Sustainability: low-energy, recycled/recyclable, reusable/demountable parts
6. Material Integrity/Resistance: materials resistant to rot, corrosion, termites
7. Integrated adjustable daylighting and artificial lighting: automated controlled louvers with user override

**2.0. CONCEPTUAL DESIGN**

**2.1. Lessons from Indigenous Tropical Buildings**

The team’s study of indigenous tropical buildings turned up a number of typical and recurrent design features. The floor is typically raised above the ground, protecting the structure and occupants from ground moisture and floods, and helping to capture cooling breezes. Such benefits were determined to be advantageous, and the raised floor feature was incorporated in

the conceptual design. Tropical houses also typically have a large overhanging roof that serves to shade and keep the house cool, and that directs rain away from the house. For the conceptual design, it was decided to use a double-skin enclosure. An outer porous layer comprised of vegetated and photovoltaic panels would provide shading, and a watertight shell envelope would protect against rain. Finally, indigenous tropical houses commonly use a narrow floor plate with an open plan to maximize natural ventilation. The team elected to incorporate these features for the benefit of passive ventilation.

## 2.2 Structural Strength and Efficiency

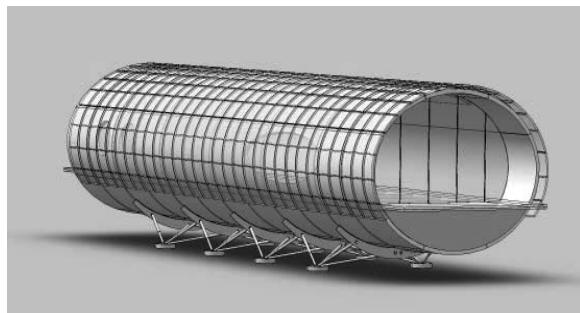
Shell structures are among the most efficient because they minimize the need to resist out of plane forces. Shell structures can also be shaped to minimize wind resistance. Given these benefits, the team developed a *monocoque* Fiber Reinforced Plastic (FRP) shell structure so as to provide a lightweight structure capable of resisting hurricane winds and moisture. Because the house would need to be shipped and constructed quickly at the exhibition site in Washington, D.C., the shell was designed as a series of post-tensioned barrel-like staves. Shell structures require complex analysis, and FRP is not commonly used for building structures. As such, the team needed specific expertise and elected to contact Arup Group, Ltd. Arup agreed to donate structural engineering consultation services for the project. Arup ran initial Finite Element Analysis (FEA) models to check the feasibility of the shell structure.

## 2.3 Flotation

A high percentage of people in the tropics live in areas subject to flooding, and such events are likely to continue or worsen due to climate change. Therefore, the team elected to incorporate flotation capability in the house envelope. FRP was chosen as the best material to provide a watertight enclosure. FRP is commonly used for boats due to its high strength-to-weight ratio, ductility, formability, and imperviousness to water. With the decision to use FRP, the team brought in a community college partner that has a boatbuilding program and facility. Though discussion with this new partner, it was decided that a foam sandwich *monocoque* shell would provide optimal structural strength and buoyancy.

## 2.4 Layered Envelope

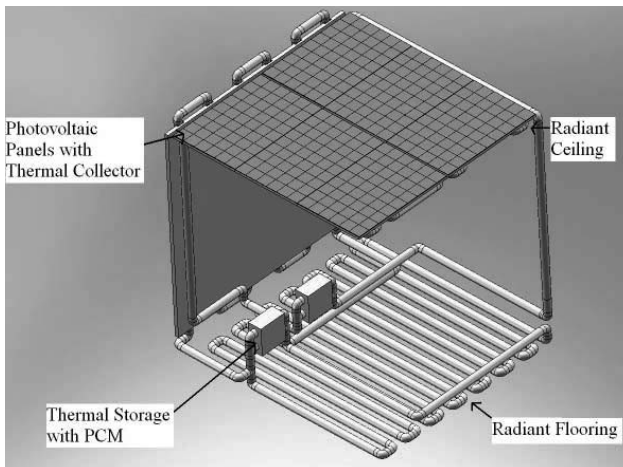
The team first considered a Building Integrated Photovoltaic (BIPV) approach, and to imbed thin-film photovoltaic (PV) modules into the foam sandwich FRP panels. However, members from electrical engineering cautioned about the difficulty of wiring the modules through the FRP foam sandwich, and members from mechanical engineering expressed concern about heat conductance from the modules through the envelope. In an effort to reduce conductance and radiant effects, the team decided on a double skin strategy whereby the outermost skin would be comprised of PV and solar hot water panels in areas positioned optimally toward the sun, and vegetated panels positioned in the remaining locations. The double skin strategy provided a number of advantages. An air gap between the outer and inner skin would decrease conductance, allow air ventilation between the two skins, and provide a concealed space to run wires to the PV modules. The outer skin would also serve to shade the structure.



**Figure 1:** Exterior view of Conceptual Design phase design

### 2.5 Phase Change Material (PCM) Thermal Storage

The team determined that heating would not be required in most tropical locations, and that cooling and dehumidification—given proper shading and ventilation—would only be needed in more extreme conditions. However, the competition was scheduled for fall in Washington, D.C., and both mechanical cooling and heating were deemed necessary in order to score in the Comfort Zone and Energy Balance contests. Since the house was designed as a prototype for the tropics, space-conditioning systems would typically be unnecessary, however they would be needed for the competition. Therefore, the team elected to include a space conditioning system that could be installed only when circumstances warranted. The mechanical engineering members analyzed weather data in Washington, D.C. during the completion period and determined that 24-hour temperatures were likely to range between 78 – 45 degrees Fahrenheit. Also, the house would need to be closed during the competition, and using natural ventilation cooling would not be possible. Therefore, a highly efficient space conditioning system was needed to achieve a net-zero energy balance. Nighttime temperatures, if stored, could be used for daytime cooling. Similarly, daytime temperature could be captured for nighttime heating, and for preheating domestic hot water. To best capture the thermal energy, a system using separate hot and cold water tanks was designed. Phase Change Material (PCM) was to be used in each tank to decrease their volume. An all-water radiant heating and cooling system was designed so as to minimize water-to-air conversion losses.



**Figure 2:** HVAC concept diagram, showing PCM storage, radiant ceiling/flooring and thermal collector.

### 2.6 Building Automation System

In order to achieve optimal energy balance and system efficiency, a building automation system (BAS) was proposed. The BAS included sensing, monitoring, reporting, and override functions. The space conditioning system was unique, and review of existing BAS systems and optimization algorithms were deemed to be a poor fit. Therefore, an additional partner from computer and information science was brought in to develop a custom software solution.

## 3.0. SCHEMATIC DESIGN

### 3.1 Semi-Monocoque Shell

Discussion with Arup, construction management members, and a composites researcher from the university, resulted in a decision to abandon the *monocoque* shell developed in the conceptual design phase. The project was subject to the International Residential Code which does not include provision for structural use of composite materials. As such, lengthy and expensive third party testing would be required to meet code. Given our cost and time constraints we shifted our thoughts toward development of a semi-*monocoque* shell. This shell

type uses spaced-apart structural ribs with stressed skins. We quickly realized that we could use translucent FRP skins to have daylight filter between the ribs and allow the shell to be part of a daylighting solution. A first shell was developed as a round tube form to be built in sections and post-tensioned together on site. The round cross section was selected as it evenly distributes the compressive force exerted by the post-tensioning hoops.

**3.2 Second Skin**

In the conceptual design phase the *monocoque* shell was mostly opaque, and the second skin was comprised of fixed vegetated, PV, and solar hot water panels. The change to the semi-*monocoque* shell opened up the potential for daylighting. Numerous studies have shown that human subjects prefer daylighting over artificial illumination. Natural light has a dynamic quality and color temperature that cannot be reproduced with electric light. Cited benefits include increased health and productivity.<sup>6</sup> Daylighting would have to be balanced with shading in order to mitigate excessive heat gain. To provide this balance under different external conditions and times of day, an adjustable controlled louver solution was proposed.

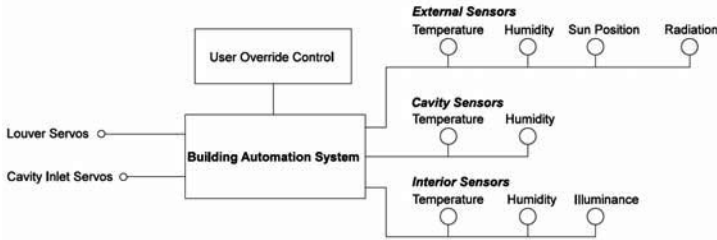
The electrical and mechanical components for a controlled adjustable louver system are fairly complex and expensive, and the team therefore wanted to have further justification of their utility. The option of placing PV modules on the louvers provided this additional utility. Controlled PV louvers could be made to track the sun position, and thereby achieve greater energy harvesting efficiency.



**Figure 3:** Exterior view of Schematic Design phase design

**3.3 Building Automation System Development**

The team performed Autodesk Ecotect simulations to test PV tracking, daylighting, and shading/heat gain. Initial studies showed that each of these three functions could be made to perform well on an individual basis, but there were questions regarding the trade-offs that would be required between them in certain conditions. The computer science team initiated study of algorithms to help provide proper balancing of the three functions that would be integrated in the BAS. A variety of external, cavity, and interior sensors would be linked to the BAS.



**Figure 4:** Building Automation System schematic diagram

#### **4.0. DESIGN DEVELOPMENT**

##### **4.1 Shell Shape Optimization**

The round cross section using post-tensioned connective structure was further studied and improvements made. First, Arup recommended replacing post-tensioning with simple bolting to simplify technical on-site assembly issues. Second, the shell was morphed into semi-oval cross section in order to decrease the interior volume of conditioned air. This had the added benefit of making the shell more aerodynamic and to lower wind pressure on the structure. Third, a small courtyard space was added, and the shell was bent into a doubly curved shape. This shell configuration offered a dynamic architectural expression and increased potential for natural ventilation. Unfortunately, this shell shape produced another series of challenges. It was difficult to stiffen the shell sufficiently in key areas, and a number of bracing schemes were tested until a viable, albeit complex, solution was found. Perhaps most importantly, the doubly curved shell required a high number of unique rib, bracing, and FRP skin components. The shell shape resulted in conflicts in accommodating the thermal storage tanks, and some other key below floor mechanical components. Feedback from the construction management team indicated that these factors would increase construction time and cost. As a result, the shell was changed back to a straight extrusion. The cross section was optimized for interior use and volume, servicing systems accommodation, structural strength, and aesthetics.



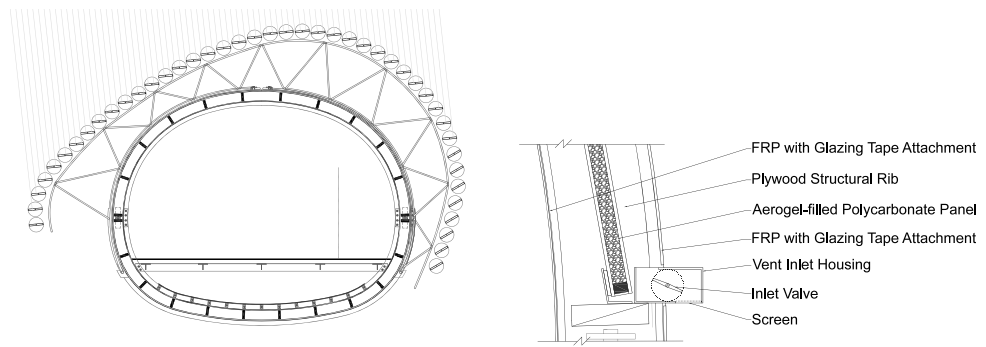
**Figure 5:** Exterior view of early Design Development phase multilayered envelope with doubly curved shell



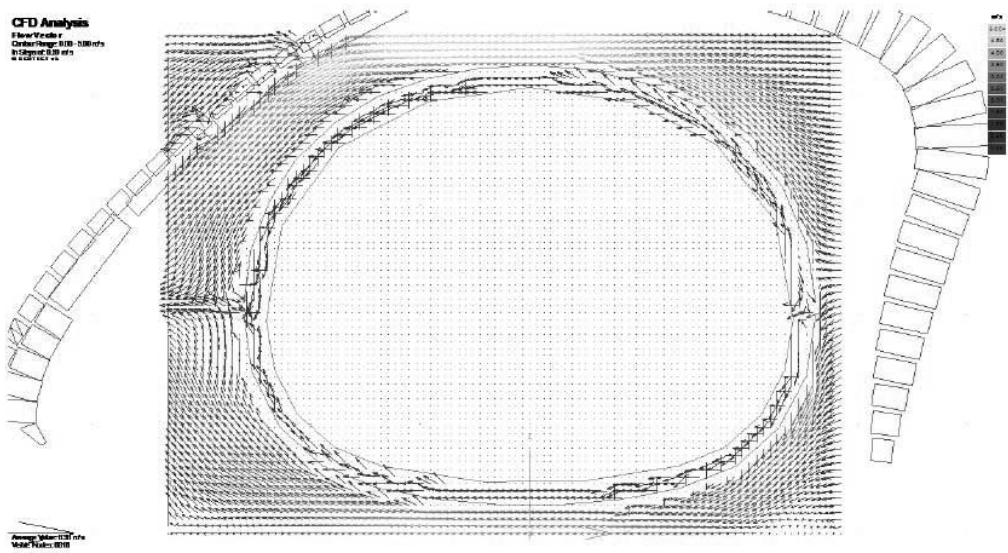
**Figure 6:** Longitudinal section view of Design Development phase multilayered envelope with straight extrusion shell

**4.2 Shell Cavity Insulation and Ventilation**

Of all known commercially produced insulating materials, only aerogel possesses relatively high light transmittance.<sup>7</sup> While aerogel is quite expensive, calculations determined that a thickness of around 2.5 cm was sufficient. At this thickness, the aerogel offers a U-value of 0.6W/m<sup>2</sup>K, and the overall shell assembly provides a U-value of 0.5W/m<sup>2</sup>K.<sup>8</sup> Keeping the aerogel relatively thin had the added benefit of maintaining a higher level of light transmission through the shell. Physical measurements indicated that the approximate average total visible light transmission through the shell assembly would be 0.35. This figure is dependent on exterior environmental conditions and shading factors produced by the second skin. Simulations and bench testing of physical prototypes were used to evaluate tradeoffs between cost, light transmittance, and thermal conductivity of the shell assembly. As part of this optimization process, cavity ventilation studies were conducted. Simulations indicated that significant benefits could be obtained by using a relatively simple passive system. This would be effective during the hotter days in the competition period; however, open ventilation would present a liability during the colder periods. Therefore, a variable controlled inlet was designed to adjust the airflow as desired under anticipated temperature and radiation conditions.



**Figure 7:** Cross section through Design Development phase design with detail of cavity inlet vent



**Figure 8:** Computational Fluid Dynamics (CFD) analysis diagram showing airflow vector field

### 4.3 Photovoltaic Modules

The team secured an initial sponsorship agreement with Samsung Electronics Co., Ltd. to provide the photovoltaic modules for the project. Samsung had built a solar demonstration house using a narrow width thin film module. These PV modules had the proper width and properties to enable them to be incorporated into the controllable external louver second skin design. Toward the end of the Design Development phase however, it was found that these modules could not be supplied. As a result, changes were necessary in the second skin superstructure design to accommodate standard dimension panels. A bi-facial panel was selected as it provides light transmission, and can collect light energy reflected off the building shell.

### CONCLUSION

The research aimed to find solutions to achieve comfort in interior spaces in the tropics while using a minimum of energy. A first strategy was to lower demand side energy use by capitalizing on traditional passive means to augment perceived comfort by minimizing solar heat energy transfer, and providing maximum ventilation and daylighting. At the same time, energy would need to be harvested from the sun to power modern conveniences (lights, appliances, hot water, etc.) and provide space conditioning to meet the competition contest criteria. The current research indicates the promise for a layered system approach where external shading devices, reflective building envelope surfaces, thermal breaks, cavity vents, and insulation panels work together to lower heat transfer. At the same time, selected elements in the system can be used to harvest solar energy, and to tailor interior daylighting levels. For conditions where high humidity causes discomfort that cannot be alleviated using shading and ventilation, a backup air conditioning system is provided that is coupled to a solar hot water and photovoltaic panel array, and a PCM thermal storage system. Simulations and calculations indicate that the system can be operated to maintain the net-zero goal under most tropical environmental conditions. A building automation system assists the occupants in maximizing the parameters of energy collection, daylighting, and shading, and to ultimately balance the needs of comfort with responsible energy use.

Each of the variety of systems incorporated in the design is relatively complex, and the development of each benefited from team experts in respective fields. In this research a high level of systems integration was sought, and was only able to be achieved via a tightly coupled interdisciplinary approach. The multi-functioning building envelope is shaped by a variety of conditions that necessitate responses to structural forces, sun path and radiant effects, wind flow, and energy management. The envelope takes the form of a shell to provide high strength with minimum material, an efficient use of living space, and flotation capability. The ribbed semi-*monocoque* construction allows for the passage of light into the interior, and the cavity to be vented to minimize thermal transfer. The under floor area provides an efficient means to house and route mechanical and electrical services. The bladder thermal storage tanks serve as ballast to minimize overturning. The second skin cooperates with the shell to provide shading and control daylighting levels while tracking the sun to optimize solar energy collection. Because the complete house was not built, full testing and monitoring of the total system was not possible. Evaluation of energy performance was limited to testing of selected prototype components, and calculation and simulation of other systems, such as ventilation and daylighting. Therefore, much additional research, testing, and evaluation of the individual components and total system function is a necessary area for future research.

In summary, the collaborative research model shows promise as a method to evolve new strategies for low energy building envelope design for tropical locations. A number of technologies were developed and integrated in order to develop multifunctioning and synergistic system behavior. This approach shows promise for future research into energy efficient design that can positively impact the significant populations inhabiting tropical regions.



## ACKNOWLEDGEMENTS

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## ENDNOTES

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<sup>6</sup> W.J. Fisk, "Health and Productivity Gains from Better Indoor Environments and Their Relationship with Building Energy Efficiency", *Annual Review of Energy and the Environment* 25 (2000): 537-566.

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# The “New” Gated Housing Communities in China: Implications for Urban Identity

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**ABSTRACT:** Housing typologies in China have changed dramatically over the past hundred years. Economic liberalization is accelerating these changes, shifting the understanding of housing in ways that cannot be explained through Western housing theory. Most of China is moving towards housing in “sealed residential quarters” (gated communities), yet these communities have a role and significance very different from those in the West.

Historical analysis of housing types in China brings out the ingrained role of enclosing walls in housing, a cultural value that is centuries old yet being given new meaning through the introduction of Western-style, developer-driven housing estates. This is contrasted by a Western understanding of urban systems as consisting of interlocking spaces and flows, where social interchanges may be initiated or sustained. To explore this interplay, we examine two communities in the industrial city of Shenyang, analyzing the role that their outdoor spaces play for the residents and their urban context. We find that the population readily accepts China’s new, gated communities, even as they call into question the city beyond. This paper discusses several implications, both at the micro and the macro level.

**KEYWORDS:** China, Housing, Gated Communities, Urban Design, Open Space

## **GATED COMMUNITIES IN CHINA**

For Western eyes, the transformation of China’s economy and the ensuing privatization of the housing stock has led to a housing form that seems all too familiar: the gated community. In the United States, gated housing communities, which began to appear as luxurious enclaves in the nineteenth century (Wright 1983, Hayden 2003), have usually been seen as offering a select community a perceived sense of physical and economic safety through class and racial segregation, as well as access to amenities such as landscaping and recreational facilities. In part, this holds true for contemporary gated communities in China as well, yet the story here is more complex. Modern-day China’s “sealed residential quarters” (*fengbi xiaoqu*), have deep historical roots, and gated communities remain a housing form for a variety of social classes. The prevalence of such housing in Chinese cities may point to more than one set of reasons for their popularity.

What remains indisputable is that China’s privatization of housing has resulted in a proliferation of a new type of status-laden complex whose scale threatens to overwhelm the sense of urban unity (Miao 2003, Song and Zhu 2009, Pow 2009). With demand for such housing on the rise, this raises the question of how policymakers, planners and architects should proceed in defining the future of Chinese urban morphologies. While we clearly cannot answer this question fully, we do point to concerns that we feel are overlooked in the current building frenzy.

A second question that this article examines is how residents use the open spaces offered in the new, gated communities. This question, we feel, is intricately linked to the need for other types of urban spaces in Chinese cities, and also to the question of spatial theory in general. Urban recreational, cultural and commercial spaces (which in the gated community become part of a pseudo-public system) have been extensively theorized in the western context (Lynch 1960, 1984; Jacobs 1961, Whyte 1980, Gehl 1987, Sennett 1990, Jacobs 1993, among others). Despite this, few authors have considered the role of the gated community’s neo-urban space in the Chinese context. We hope that this text will encourage further theoretical exploration of such spaces in China’s fast-changing society.

## 1.0 SOCIAL CAPITAL AND “SEALED RESIDENTIAL QUARTERS”

Depending on which texts one reads, gated communities in China are either defined as a symptom of an upper class perception of social and moral superiority over lower classes, or as a continuation of a deep-rooted collectivist culture, including that culture’s social control. In the first case, gating is described as a retreat from a more traditional Chinese culture, one characterized by crowded housing, a minimum of individual space resulting in oversight both through family and neighbors, and a socialist system of government control over nearly all aspects of one’s life. In the second case, gating is described as a form of community building, one that has evolved naturally from decades of housing that has centered around defined groups: first the *siheyuan*, a traditional courtyard house of the extended family, then the socialist work-unit housing, and now, under a commoditized housing system, the “sealed residential quarter”. New in this last system is that residents choose to buy into it, as opposed to being assigned.

The role of housing in China is going through large changes. Zhu, Breitung and Li (2012) have theorized that housing has shifted from being people-centered to commodity-centered, or from providing a “social arena” to providing “privatized living environments”. Neighborhood cohesion, they argue, does not imply cohesion of the society beyond the neighborhood. Miao (2003) concurs, arguing that the street, a traditional public forum in China, has been adversely marginalized in the process. The newly privatized community allows for both feelings of security (Miao 2003) and self-determination and escape from government control (Pow 2007b). Privacy, and the spaces required to sustain it, are an evolving concept in Chinese society, which helps explain some of the differing views on spatial seclusion and exclusion.

The question of privacy is also one of class. Residents of wealthy communities rely less on local social networks – neighbors helping neighbors – as services can now be bought, or obtained through the estate management (a form of deferred purchase). Thus, social connections for “utility value” have diminished in importance (Zhu, Breitung and Li 2012). We argue that exactly this point can be seen as a criticism of China’s new gated communities – they fulfill the needs of a limited segment of the population, yet do not necessarily serve the needs of poorer classes, women, the elderly, children, or others who traditionally rely on local social networks.

Pow claims that public discourse in China has depoliticized questions of social exclusion through framing them as “questions of differing civilised lifestyle and morality” (Pow, 2007a, 1539). Other researchers highlight the relationship between social status and expectations of privacy. (Pow 2007b, 2009; Naftali 2010). Developers stress the importance of buying into a setting where larger and more luxurious apartments offer settings for family privacy, while walls and gates allow middle or upper-class residents to remove themselves from the surveillance of those who cannot buy into their physical setting. These “others”, at least in Shanghai and other coastal cities, are often rural migrant workers, perceived by wealthier urbanites as a threat to both physical security (Miao 2003) and, emotional comfort (Pow 2007b). Nevertheless, the privacy bought by living in a guarded community means that state policing, sometimes veiled as social services, has been replaced by privately bought surveillance services, such as estate guards (Pow 2007b).

The prestige of upscale environments continues to be one of the main marketing points used by developers, who emphasize the many amenities and unique physical properties of the complexes. Advertisements for gated estates stress convenient access to commercial areas, offices, or good schools, or deceptively show estates swathed in lush greenery, with wooded forests surrounding them. In the latter case, the idea presented is one of a secluded and tranquil world away from urban bustle, a wholly unrealistic image considering the density and the growing car ownership that has beset Chinese cities.

Due to urban densities, much of the new developer housing is in the form of high-rise towers or slabs. With ever more gated communities juxtaposed within the urban fabric, the city has in many areas become a series of large walled spaces, around which the visitor must navigate. (Miao 2003) The new communities, in offering better physical environments and less social

obligations, may express the direction of a China in the process of social reorganization, with physical and social fragmentation a consequence of this process.

While a hermetic separation of inside and outside is often assumed to be essential for a “sealed residential quarter”, many communities, especially those that are not marketed to China’s ultra wealthy, are simply enclosed by walls, with access remaining open. In Shanghai, over two thirds of all housing communities, and almost half of the newer commodity-built estates were found to have no access control at all (Yip 2012). This explains some of the debate over “gated communities” in China. Many older communities have been retrofitted with “gates” by reducing the number of entrances from the street to the interior open spaces (Miao 2003). Despite gates, however, many communities remain fully accessible, evoking the feeling of security and “quality of life” without the management investing in features or personnel that would truly seclude the residents inside (Yip 2012).

Taking this view one step further, Huang (2006) has theorized that gating is a new expression of a longstanding collectivist culture in China, offering both community and social control. China’s traditional neighborhoods, defined here as the pre-Maoist and Maoist-era housing forms, may have stronger social cohesion than the new gated communities, yet members of the latter have been found to feel no less attached to their communities, and seemingly welcome the lack of social control through local government agencies (Zhu, Breitung and Li 2012, Yip 2012).

The extent of social control may be a matter of perception. The government, which allowed commodity housing through legislative changes in the first place, interestingly enough reacted to their creation by launching a new program of “community building” in 2000, with “Community Committees” and “Community Service Centers” providing social, welfare, health and administrative services (Ministry of Civil Affairs 2000, cited in Huang 2006). Continuing a policy of involvement in people’s lives – a policy that those choosing commodity estates often attempt to evade – the government has kept its hand in social organizing, with individual communities augmenting or replacing these offers by private security and service offerings, as well as technological innovations, such as card-activated entry systems. As such, a system of surveillance, policing, or otherwise controlling and “keeping order”, continues to exist, albeit with different rules for different social groups.

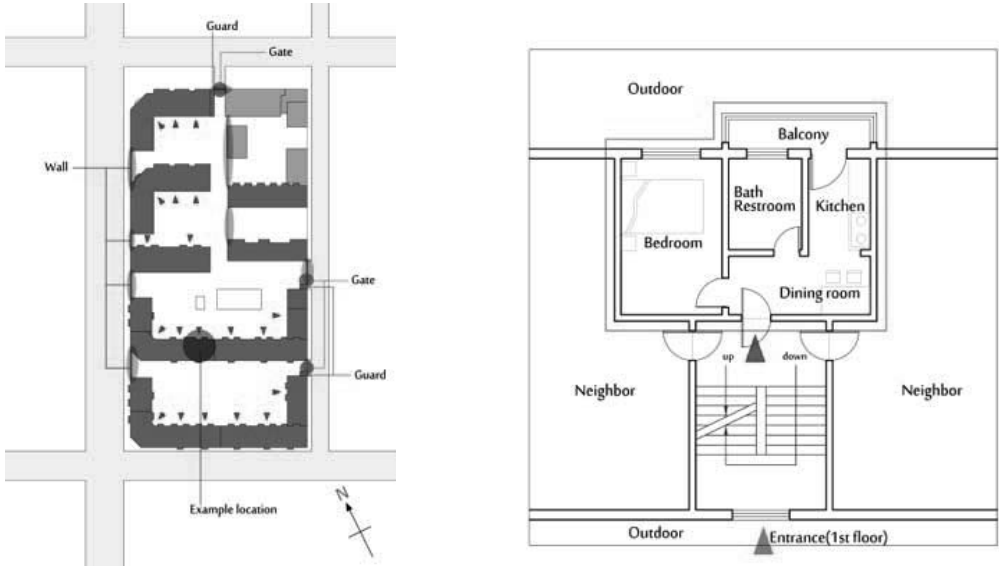
Most qualitative studies on “sealed residential quarters” have used surveys or interviews to assess residents’ attitudes towards their neighborhood or its physical environment. Many of these studies examine why people are choosing “sealed residential quarters” as their housing form, and to what extent those gated communities may be compared to gated communities in the West. In the next section, we go another route, examining two communities and analyzing how residents use their common space. In doing so, we find that residents of the Chinese communities act in ways consistent with Western theory about the use of public space, and that Chinese residents seem to prefer spatial qualities that can be predicted according to such theories. This would call for a re-examination of the role of public urban space in Chinese cities, as well as re-stating the question if the new gated communities can offer a sustainable replacement for such urban space, especially as China continues to open her doors to an international community.

## **2.0 COMMUNAL SPACES IN TWO “SEALED RESIDENTIAL QUARTERS” IN SHENYANG**

Chinese society has always been organized into discrete living groups: first the extended family living in their *siheyuan*, then the work community living in factory-provided housing, and now large estates individual families can buy into. The estates are defined as communities, yet are they communal in the sense of residents’ interactions with their surroundings? In order to answer this question we observed two Shenyang housing estates to analyze how residents used the common spaces: Zhongxingli Community, built in 1992 and Fuyunxindu Community, built in 2005.

Zhongxingli Community was built as company-provided housing, but has since been privatized. A high fence surrounds the community, with three gates with guardhouses providing access. Housing is of the perimeter-block type, with seven-story buildings surrounding a series

of four courtyards (Figure 1). Zhongxingli is an example of a permeable gated community: guards prevent outside vehicles from entering the complex, although pedestrians are usually allowed to enter freely. The buildings, too, remain accessible, as entrances have no security features. The units are tiny by Western standards, providing a vestibule that doubles as a dining area, a bedroom of approximately seven square meters, a small bath and a simple kitchen for a family typically consisting of two parents and a child (Figure 2).

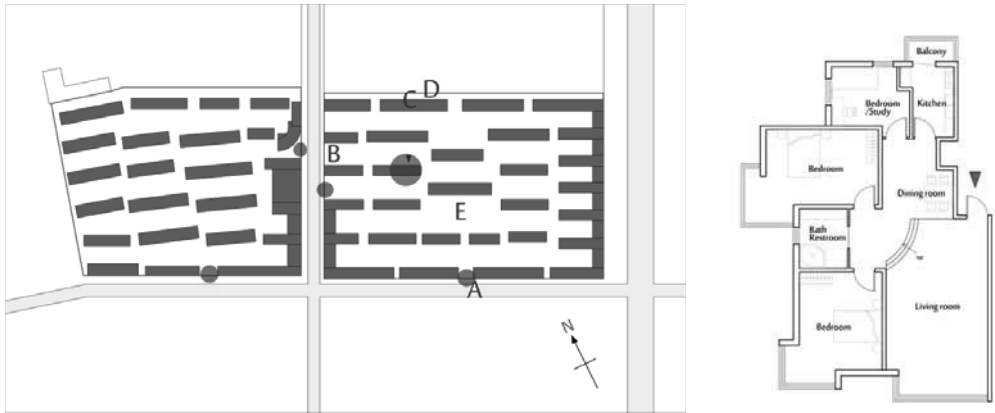


**Figure 1** (left): Zhongxingli Community (no scale). The complex has four courtyards and three controlled entrance points.

**Figure 2** (right): A typical apartment unit in Zhongxingli Community (no scale). The tiny kitchen and dining area double as a living area.

Fuyunxindu Community is in the Tiexi District of Shenyang. A much larger complex built as private housing from the outset, it has been broken into two complexes separated by a thoroughfare (Figure 3). Similar to Zhongxingli Community, the complex is surrounded by buildings placed on the perimeter and by a high fence, with gates controlling access. Strangers and outside vehicles are not permitted to enter, and residents are required to display a parking permit when driving into the community. Parking is mostly on street and, as there are more cars than parking spots, residents have taken to parking on the lawns. Each building has three to four stairwells, with an intercom door providing security at each entrance.

This study has concentrated on the eastern half of the community, a collection of slab high-rises that create a loose series of courtyards, most of which are open at two ends. A shift in the grid of buildings has created a central open space with communal amenities such as a wading pool, a playground, and decorative features such as outdoor sculptures. Individual units are much larger in this complex than in Zhongxingli Community, and they are arranged in a typical Western floor plan, with a living room, bedrooms, and a larger kitchen and more luxurious bath (Figure 4).



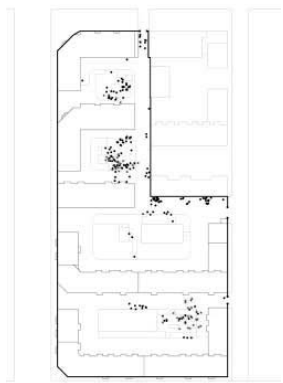
**Figure 3** (left): Fuyunxindu Community (no scale). This large estate has only four entry points. The eastern portion contains two central courtyards with community amenities.

**Figure 4** (right): A typical apartment unit in Fuyunxindu Community (no scale). Units are much larger than the ones in Zhongxingli Community, and rooms are functionally specialized.

Residents were observed over a period of several days in the open spaces of both communities. In addition, we noted where residents had made changes in these communal spaces to express territoriality or adapt them to their specific needs. Through these observations, we were able to discern which spaces had the most appeal for residents, and to what extent residents exhibited “ownership” of the spaces by using and adapting them.

**2.1 Charting spatial use in Zhongxingli Community**

In Zhongxingli Community, the courtyards that provided the best overview of activities in them tended to be the most popular (Figures 5 and 6). Thus, courtyards one and two (at the top of the plan), where residents could see into the yard and easily initiate contact with others, tended to be more popular than yard three, which despite being much larger had views blocked by two buildings located within the yard. Courtyard two was the most popular: it afforded good views of people passing on the main path at its eastern edge and provided views into the neighboring yards. We found that more people gathered here, and that they stayed longer than in the other yards.



**Figure 5** (left): Activity levels in the courtyards of Zhongxingli Community (yards are numbered one through four from top to bottom). Although all four yards had amenities, yards one and two were more popular as they afforded a better overview of the space and views into adjoining spaces.

**Figure 6** (right): Yard one (at top in plan). Note the seating areas at the edges of the space.

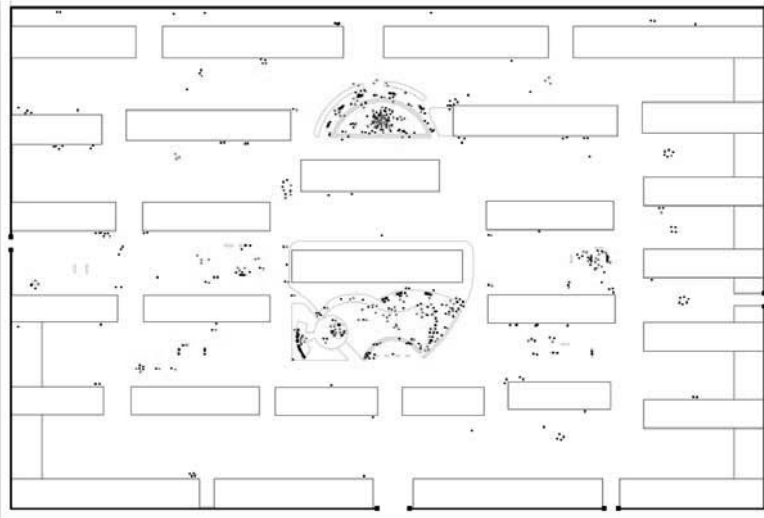
Residents of Zhongxingli Community often stayed in areas we call “transitional “or “edge” spaces: in this case by the gates to the community (transition between inside and outside), in close proximity to the boundary curb of yard two, or along the edges of the community walls, especially when there was an opportunity to view into an open space. Transitional spaces by building entrances were also popular, and many people would collect there and interact with others.

Interestingly, residents in both Zhongxingli Community and Fuyunxindu Community exhibited territorial behaviors towards what was designed to be communal property. In Zhongxingli Community, residents of an adjacent housing block that was, in fact, under different management, created doorways from the ground-floor apartments to yard three, and took over a strip of garden area located next to their building’s outer wall, treating it as a private garden. Families used this “acquired” area for storage, planting vegetables, and for outdoor recreation such as barbecues.

Aside from this example, most spaces in Zhongxingli Community remained communally used. The outdoor spaces were too small and too intensely used to allow for privatization, with stairwell entrances leading directly onto the communal spaces and not onto a transitional strip of grass. While three families who lived in ground floor apartments had turned windows of their apartments into doors to create direct access to the courtyard space, they did not further privatize the outdoor space.

**2.2 Charting spatial use in Fuyunxindu Community**

The eastern half of Fuyunxindu Community has twenty yards. Two are clearly meant to be the focal point of the community, as they are larger and offer central amenities. One yard offers a playground, while the other has a large shallow pool surrounded by wide paths, a pavilion, benches, and landscape features. As the pool in this yard is almost entirely devoid of water, older children have taken to riding their bikes here, while younger children and their parents or grandparents are concentrated in the yard with the playground. Many of the other yards are defined as spaces only through being bordered by two of the slab housing blocks, with the other two sides being relatively open. Even these “secondary yards” are not equal, however, as those offering better views of activities in neighboring yards, especially the two main yards, tended to attract more people (Figures 7 and 8).



**Figure 7:** Activity levels in the courtyards of Fuyunxindu Community (eastern half). The central yards, offering community amenities, are the most popular, yet adjacent yards also have high activity levels.



**Figure 8:** One of the central yards of Fuyunxindu Community.

Since Fuyunxindu Community provided larger areas for play than did Zhongxingli Community, children were able to pursue activities that required more space, such as biking or scooter riding. Both children and adults were outside longer in the Fuyunxindu Community yards than the Zhongxingli Community yards; in Zhongxingli Community the yards were empty by 7:00 p.m. while in Fuyunxindu Community they were still lively after 7:30 p.m.

As in Zhongxingli Community, the residents of Fuyunxindu Community tended to congregate in “transitional” and “edge” spaces, especially at the edges of the playground and the shallow wading pool that now acts as a sunken plaza. Fuyunxindu Community buildings included a private garage on the ground floor of some of the buildings, and a small private garden adjacent to the building for some of the others; these provided further “edge” spaces that residents used extensively. Residents expanded upon these private territories, however, by placing furniture on the street in front of the garages to gain an extra “room”, by planting flowers or vegetables on the public lawn next to their private gardens, by decorating the common spaces with little statues, or by paving a path leading to their gardens. Some residents went so far as to erect fences around once-common spaces they had taken over. While some of these activities, such as placing ornamental statues, were clearly designed to enhance the common spaces, others, such as taking over once-public space and excluding others from using it, were extreme forms of territorial activity.

### **2.3 What determines spatial use in Zhongxingli Community and Fuyunxindu Community?**

In examining both communities, three spatial elements were found to influence the extent to which specific outdoor spaces were used by residents: 1) Visibility into areas and the activities taking place there, 2) Transitional and “edge spaces” that provide a link between two spaces and their activities, and 3) Threshold spaces that allow residents to assume a territorial attitude.

While both communities had such spatial elements, we determined that in Fuyunxindu Community they were far more salient. More interestingly, we found that the patterns of behavior observed align largely with those described in Western theory about the use of public space. For example, spaces that allow unhindered views of activities, such as people strolling by or children playing have been shown to be more popular than spaces that allow no views of activities (Gehl 1987). Edges of spaces tend to be popular because they allow both a view into a space and a sense of territoriality and control for the observer (Gehl 1987), while transitional



areas allow a feeling of being part of the activity (Whyte 1980). Watching activities from the edge of a space also allows what William Whyte has termed “triangulation”, in which the activity provides the ice-breaker stimulus for two people observing it to initiate contact (Whyte 1980). Fuyunxindu Community is spatially more complex than Zhongxingli Community, with more spatial “layers” between the community gates and the entry to the individual units, leading to residents’ having more opportunities to interact with others within the complex itself. Fuyunxindu Community also offered more diversity of spaces than Zhongxingli Community, with central features an integral part of the estate’s offerings.

The greater saliency of the three spatial features in Fuyunxindu Community – visibility, transitional and “edge” spaces, and threshold spaces – corresponded to longer use times and more instances of residents’ “adopting” spaces it for their own needs. We argue that this pattern of use demonstrates residents’ connectedness to their community (see also Yip 2012), yet we also argue that this attachment prevents Fuyunxindu Community residents from seeking engagement beyond the walls of their complex. By contrast, the sparser and much more porous Zhongxingli Community showed less activity within its courtyards, yet a public park nearby provided an outlet for its residents and those of similar communities nearby: here children played while their elders chatted, an afternoon dance provided opportunities to socialize, and street barbers offered haircuts to passers-by.

### **3.0 GATING: A UNIQUE CHINESE PROBLEM?**

China’s “opening up” reforms have led to a society in rapid transition, and with the market economy increasing its hold, individualism, expressed in part through the ability of individuals to purchase a luxurious lifestyle, will play a greater role in everyday life. In choosing housing, larger the community and the more features it offers, the less residents will need to leave to find material amenities and social opportunities. This is seen in how the public park near Zhongxingli Community is intensely used by those living in the smaller-scale communities surrounding it, whereas Fuyunxindu Community residents spend evening hours within their enclave. In both housing estates, we found Chinese residents to be using their open space in much the same manner as Western theory would predict. We thus argue that in an urban sense, the criticisms made for Western gated communities may be assumed to also hold true for their Chinese counterparts, that the prevalence and scale of such communities holds power to destroy what is commonly seen as a collective urban experience. Miao (2003, 45) writes of “urban space [that] looks like a giant stage set without actors [despite the area having] nearly 10 000 residents per square kilometer.”

China’s “sealed residential quarters” are not all comparable, and walled communities are certainly not a recent phenomenon. While the smaller communities result from an older social system, the larger, upscale communities, we argue, do not follow from a “Chinese way of life” but rather from an economic system that, as in the West, has privatized open space, in this case replacing the older familial or state regulation with an economic control that reserves use of open space to those with authorization to be there. With residents’ gaze focused inward, the long-term effects of such large estates on the urban fabric are not immediately visible nor would residents necessarily see them as their concern. Yet the scale of these estates is changing cities through a process of stealth, with no end in sight.

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# Dystopia in the world of utopia: Unsustainable realities of sustainably themed expositions

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**ABSTRACT:** Since the 1970s international expositions have celebrated advances in science and technology as potential ways to lessen modern man's impact on Earth's natural resources. Expositions held in the past couple of decades have presented themes that more directly relate to issues of sustainability. This paper explores the disconnect that exists between the utopian ideas promoted at these "sustainable" expositions and the dystopic realities of the events themselves. In particular, it does this by revealing how both the immense quantity of resources used in the creation and operation of these short-lived events and the decomposing remnants left behind after closing day present tangible evidence of the failure of "sustainable" expositions to reflect fully the fundamental principles that organizers set out to disseminate at these grand, festive events.

**KEYWORDS:** Expositions, World's Fairs, Sustainability, Utopia, Dystopia

## INTRODUCTION

In 1992 the city of Hanover, Germany commissioned William McDonough Architects to prepare guidelines for the construction of Expo 2000. Known as the *Hannover Principles*, the series of declarations McDonough produced addresses the rights for humanity and nature to co-exist in a holistic and sustainable manner, and calls for the optimization of the full life-cycle of products and processes to prevent waste (McDonough 1992).<sup>1</sup> While the *Hannover Principles* have played a significant role in setting the stage for current attempts to *green* modern society (at least in rhetoric and theory), their actual impact on Expo 2000 and, more specifically the site of the event, has been considerably less than what organizers initially envisioned. This paper examines the disconnect that has arisen not only at Hanover but also at other more recent world exposition between the utopian visions of a more sustainable world projected by fair organizers and the reality of the events themselves, particularly in regards to the physical remains of the fairgrounds after closing day festivities have faded into memory.

### 1.0 Exposition Themes

Since the first international exposition, held in London at the Crystal Palace during the summer of 1851, world's fairs have served as events where nations and corporations could promote ideas, goods, and services to visitors from all over the world. Over the years, these fairs have exhibited a variety of important underlying agendas. For example, expositions held in the nineteenth century highlighted agricultural and industrial advances, including inventions like the McCormick Reaper and the electric light bulb. After the turn of the last century, European fairs were used to maintain and generate greater interest in colonization among both the host country's residents and the subjugated peoples of the colonies during an era when public support for colonization was beginning to wane. In the 1930s, a series of American expositions were held to promote a better tomorrow through highlighting manufactured goods made possible by advances in science and technology in the hope of drawing the nation out of the Great Depression through increasing consumption. In Europe, events, such as the 1937 *Exposition Internationale des Arts et Techniques dans la Vie Moderne* in Paris, tried to hide the emergence of growing political tensions in Europe during the lead up to World War II through the presentation of magnificent festivities.

After an 18-year hiatus due to upheaval from World War II, international expositions returned to a significantly altered world. The central focus of the events evolved to reflect new political and technological realities. While the promotion of corporations and their consumer products continued, the Cold War cast a new competitive atmosphere on expositions, especially apparent in the displays of space-age technology found in the massive Soviet and U.S. pavilions as the two countries battled for the hearts and minds of the peoples of the world. The devastating impact of the atom bomb witnessed in August 1945 caused eyes to open to the darker side of advances in scientific technology. Although Expo '58, the first international exposition held after the war, dramatically celebrated atomic energy with its centerpiece the Atomium, a 335-foot tall giant model of a unit cell from an iron crystal magnified 165 billion times, the fair also began to address more fully the immense impact of modern technology on mankind (*Futuristic and Universal Since 1958*). By the 1970s, as awareness of pollution, population growth, and human-related destruction became more apparent, reactions to the negative effects of human action and inaction on the world's environments and the rapid use of limited resources began to shape the central agenda of these international fairs.

## 2. Expos and the Environment

While nineteenth-century expositions relied upon themes to help generate publicity, they typically acknowledged the anniversary of major historic events. The 1889 *Exposition Universelle* in Paris celebrated the centennial of the storming of the Bastille, while the 1893 Columbia Exposition in Chicago commemorated the 400<sup>th</sup> anniversary of Christopher Columbus's discovery of America (albeit a year late). The visibility of the themes themselves at the events was usually limited to historic reenactments and related imagery on souvenirs. Central themes began to become more pervasive during the 1930s, beginning with the Century of Progress International Exposition in Chicago, when organizers attempted to provide a sense of cohesion to hundreds of wide ranging exhibits by linking the displays and attractions to the central theme: "Science Finds—Industry Applies—Man Conforms" (Schrenk 2007). However, numerous venues and presentations with no clear relationship to the main theme still filled the fairgrounds.

After World War II central themes permeated expositions much more thoroughly. Expo '67 in Montreal was the first to present an environmentally related theme—"Man and his World" (Berton 1997).<sup>2</sup> It echoed throughout the fairgrounds through the presence of thematic pavilions, such as Man the Explorer, Man the Producer, and Man the Creator. Although the fair did not take a specific stand on environmentalism, it used multi-screen audiovisual presentations and interactive exhibits to suggest to the global community the need to assess seriously the current ecological state of Earth.

Since Montreal, environmentalism has played a more sophisticated role at most international expositions, as organizers attempt to answer the challenges of the growing unsustainable conditions of our world. In reaction to the 1970s energy crisis, when OPEC disrupted oil supplies to the United States, the 1982 World's Fair, known as the Knoxville International Energy Exposition, presented the theme "Energy Turns the World". The central goal, as promoted in official fair publications, was to achieve a deeper understanding of energy issues by bring the nations of the world together to consider man's relationship with the pervasive force of energy (Krouse 2008). The fair, which featured the Sunsphere, a 266-foot tall tower topped by a five-story high reflective bronze-coated ball, was poorly attended and beset with financial and administrative mismanagement (Kramer 2008). While a local goal for the event was to revitalize a blighted area of the city, after the exposition closed large segments of the grounds were transformed into a parking lot or fenced-off and left to decay, forming a ruin in the heart of the city for over the next twenty years (Kramer 2008).

What to do with the remains of modern expositions is a major issue that organizers have attempted to address more directly with varying levels of success since the Knoxville event. Sites of many pre-World War II fairs, such as the 1876 Centennial Exposition in Philadelphia and the 1893 World's Columbia Exposition, were turned into large civic parks. Paris, meanwhile, recycled the same site along the Seine for most of its later international

expositions. There was only minimal concern regarding the physical remains of temporary individual pavilions at these earlier fairs, as most were constructed with wood or metal frames and facades made of *staff*, a mixture primarily of gypsum plaster and fibers that could be molded into ornate forms. Except for the framing, little of value remained after the demolition of these short-lived buildings. The 1933-34 world's fair in Chicago was the first to seriously consider the potential resale value of building materials in the finances of the event. In the desire to produce a modern fair, the architectural commission turned to new manmade products, such as Sheetrock and Masonite, to face the pavilions instead of using staff. To make disassembly of the buildings easier after the close of the fair, panels of these products were attached to steel frames with screws (Schrenk 2007).

Ninety-nine years after the World's Columbian Exposition, Seville decided to hold a fair that would symbolically celebrate the 500<sup>th</sup> Anniversary of Columbus with the theme "The Age of Discovery".<sup>3</sup> While the exposition did include several pavilions that highlighted environmental issues, the main focus of the fair was innovative technological developments envisioned to improve modern life, such as satellites, computers, and even biometric fingerprinting. Most conspicuous was the use of technology to alleviate the uncomfortable environmental conditions Seville's extreme summer heat presented fairgoers (Chadwick 1992).<sup>4</sup> Water mist sprays, as at the Bioclimatic Sphere, provided cooling. A variety of natural and artificial features produced shaded areas offering respite from the hot sun. Examples of environmentally friendly designs were often more show than effectual, such as the water walls that covered the facades of a number of the buildings. The largest, however, at the British Pavilion was powered by 1760 solar panels located on the building's roof



**Figures 1 and 2.** The post-event derelict remains of the Pavilion of the Future area and an aerial tram entrance from Expo 92. Source: M. Jensen 2011.

(Davies 1992). While exhibits within the Pavilion of the Environment featured energy-saving machines and highlighted the vast disparities between different countries' energy use, the most influential presentation was a film that used 3-D footage to dramatically illustrate deforestation, toxic waste, and other negative impacts of modern, industrial societies on the environment (Marteau 2008). At the exposition's close, plans were made to transform part of the 530-acre site into Cartuja 93, a research and development office park by remaking fair pavilions into corporate and institutional headquarters. Nearby, a lake, once surrounded by the Spanish and provincial pavilions, was re-envisioned as a theme park (Marteau 2008). While these areas have seen relative success over the years, large portions of the fairgrounds were left to deteriorate. Visits to the site by the authors in 2004 and 2011 revealed many abandoned structures, such as the national pavilions for Mexico, France, and Turkey, as well as the once popular Avenue of Europe (figure 1). And while the cable cars from an aerial tram that provided bird's-eye views of the fairgrounds are long gone, entrances to the attraction remain, but are in a state of decay (figure 2). Today, pigeons, lovers, and homeless people are the main visitors to large abandoned areas of the former fair site.

### 3.0 Expo 2000, Hanover

In reaction to post-exposition situations, such as those found in Knoxville and Seville, the organizers of Expo 2000 carefully considered not only issues of sustainability in the construction and running of the event, but also the full life of the fairgrounds and the individual pavilions. William McDonough's *Hannover Principles*, which was first published years before the exposition opened, was an early reflection of the organizers' desire for hosting a more sustainable event. Unfortunately, as with Knoxville, severe mismanagement played a major role in the predominately distopic outcomes of the fair (Janssen 2010).<sup>5</sup>

While Hanover (like Knoxville) did not at first glance seem like a logical site for an international exposition, as it was not a major tourist destination, it was already home to the largest permanent fairgrounds in the world where annual trade shows are held. (Maloney 2008) Several immense permanent halls were incorporated into the fairgrounds. A massive thematic pavilion and some smaller venues built for the exposition remained for use during future trade shows.<sup>6</sup> The theme for the exposition, "Humankind—Nature—Technology, a New World Arising," grew out of *Agenda 21*, a non-binding proclamation in support of sustainable development created at the 1992 United Nations' Earth Summit in Rio de Janeiro and signed by 178 countries. The city of Hanover adopted the principles of *Agenda 21* and made them a binding theme for all nations partaking in the event. Participants were asked to exhibit local solutions to global problems (Malsberger, 2000). Five large thematic pavilions held exhibits that related to the *Agenda 21* initiative, including elaborate displays illustrating how man and technology could improve the natural world. In addition to presentations at the fairgrounds, organizers expanded the event beyond the physical site by sponsoring global initiatives, such as *Projects Around the World*. Envisioned as a worldwide network to solve current and future global problems, it attracted 3000 entries of programs that promoted a wide range of solutions for better living, which potentially could be replicated elsewhere in the world (*The Expo-Guide* 2000). Expo 2000 also hosted a series of Global Dialogue forums to shine attention on critical global issues, such as health and sustainability. These meetings were broadcast throughout Europe (Maloney 2008).

In keeping with *Agenda 21*, all participating nations had to submit a detailed post-exposition plan for their fair pavilions, both "in the name of sustainability and to avoid an 'exposition graveyard'" like the one left behind in Seville (Malsberger 2000). Japan's pavilion, designed by Shigeru Ban, was built out of recycled paper, which was then recycled once again after the fair closed (Malsberger 2000). The wood from Peter Zumthor's Swiss Pavilion was sold as seasoned timber and then recycled for a pavilion at Expo 2002 ("Key Projects" 2009). Other pavilions were moved to different locations, reassembled, and then given new lives. Nepal's wooden temple was moved to Hamburg for use as a tourist information center, while Ricardo Legorreta's Mexican Building went on to serve as the library and media center for the *Hochschule für Bildende Künste Braunschweig*.



**Figures 3 and 4.** The Dutch Pavilion in Hanover by MVRDV in 2000 and in 2011. Source: R: L. Schrenk, L: M. Jensen.

The area of the fairgrounds that houses the trade fair halls is in regular use today and the adjacent fair pavilions have been replaced by a large parking lot. In contrast, much of the “Pavilions East” section of the site that once held rows of national pavilions from Europe and elsewhere sits largely abandoned. While some buildings have found new uses (the French pavilion is now a BMW dealership), large areas of the fairgrounds sit vacant. About half of the buildings in this area, however, still remain in a “post-expo purgatory” despite the fair’s official reuse policy. Most prominently, the Dutch Pavilion by MVRDV, slated to be demolished immediately after the event, lingers as organizers decided to try to find someone to purchase the popular attraction. Even after going up for sale on eBay in 2006, it remains in its original location deteriorating behind metal fencing (figures 3 and 4). The escalators and layers of trees, flowers, and windmills are long gone. In the place of throngs of fairgoers are now occasional party seekers and hundreds of birds (MVRDV 2006). According to Gina Memenga, who works for the real estate firm marketing the Expo Park development with a sleek brochure touting the site’s benefits, “It is hardly the sustainable outcome envisioned by the masterminds of the exhibition” (Janssen 2010). The slump in the economy, particularly for the information technology sector, as well as the fact that land-use requirements prohibit the development of individual retail stores or apartments at the site, and that new owners are required to bring the exposition pavilions in line with the latest energy efficiency standards, have made finding businesses willing to move to the former fairgrounds difficult (Janssen 2010).

#### **4.0 Expo 2005, Aichi**

Organizers for Expo 2005 took the lessons of Seville, Knoxville and Hanover to heart as they planned for their own sustainable-themed fair in Aichi, Japan. But like those in earlier exposition cities, they sought to host an international event primarily as a means to attract capital for major civic improvements, as well as to boost civic pride. The presentation of environmental themes at recent expositions has largely served as a “feel good” front for achieving underlying development goals. In the case of Aichi, the Toyota Motor Corporation and other local manufacturers were attempting to secure major research institutions for the area. The fair offered an ideal way to attract both institutions and the infrastructure needed to support those organizations (Heller 2008).

The goal to maintain the natural setting of a significant portion of the Aichi fairgrounds grew out of the discovery of endangered hawks nesting in the area just as planning for the event was underway (Heller 2008). This eventually led to the selection of “Nature’s Wisdom” as the exposition’s official theme and the decision to scale back the overall design of the fair to protect as much of the site’s forest and other natural features as possible by focusing most of the new construction on parts of the fairgrounds that had already seen development (Heller 2008). Pavilions and raised walkways were designed to minimize damage to the land and to help facilitate the eventual transformation of the site into a nature park. For the first time, foreign pavilions were constructed out of standardized, prefabricated units. Harking back to the 1933-34 Chicago fair, the construction of these buildings consisted of panels attached to steel framing for easy disassembly and later reuse elsewhere.<sup>7</sup>

The stated goal of Expo 2005, echoing *Agenda 21* and the *Hannover Principles*, was to encourage “the global society of the 21st century to work together in the pursuit of a sustainable and harmonious coexistence for all life on Earth (*Expo 2005, Aichi, Japan 2005*). The “greenest” of the modern expositions, the event attempted to boldly address environmental concerns by deeply integrating them into the experience of the fairgoers. It introduced new forms of cleaner transportation to both reach the fairgrounds and to move through the site, including the Linimo, the first commercial magnetic levitation train, and hydrogen-powered hybrid buses. The exposition prominently featured the Bio-Lung, the largest green wall in the world. The Japanese Pavilion included a roof of photocatalytic tiles and an exterior bamboo cage to illustrate how a second skin could reduce a building’s energy costs (*Japan Association 2005*).

Organizers dramatically incorporated Expo 2005’s subtheme “Reduce, Reuse, and Recycle” not only in the design of the national pavilions, but throughout of the fairgrounds. Garbage, for example, was separated into 17 categories for easier recycling, including separate bins for chopsticks. Enthusiastic attendants at trash stations attempted to educate fairgoers both on how to properly separate their waste and on the benefits of recycling in general. Within the forested part of the fairgrounds was the Seto Area where visitors could learn “how to love the Earth” (*Japan Association 2005*, 155). An educational center and other pavilions presented exhibits on global environmental issues, while instructive nature tours were offered along forest paths (*Japan Association 2005*).



**Figures 5 and 6.** Global House and open green at Aichi Expo in 2005 and in 2013. Source: L: L. Schrenk, R: Z. Pierog.

While nature and the environment played more visible roles at Expo 2005, as at other expositions, innovative technologies dominated many of the exhibits, especially in the corporate section. The most popular fair venue was the Toyota Pavilion, which housed a show featuring trumpet playing robots and personal concept vehicles.<sup>8</sup> Like many other corporate pavilions, Toyota’s fair building, powered by wind, did reflect the exposition’s environmental theme, with outer walls of plastic coated recycled paper and a frame that was assembled with



friction joints to make the building easier to disassemble and elements reused after the close of the fair (*Japan Association* 2005). Although Expo 2005 was admirable in its attempt to promote sustainable practices and the importance of protecting the natural environment, the thematic message (as at other expositions) was lost on many fairgoers who were more interested in being entertained than educated.

Unlike earlier fairs, Aichi organizers have been largely successful in achieving many of their post-exposition goals. All of the prefabricated national pavilions of the Global Commons Area have been removed, while a number of other fair structures remain, housing amenities for current visitors (figures 5 and 6). The park is well kept and a popular place for people to spend their free time. Local residences take advantage of onsite features such as a gymnasium, a conference hall, and sports fields. Teahouse tours and formal tea ceremonies, along with the Satsuki and Mei House from the popular film *My Neighbor Totoro* built for the fair, attract tourists. Other areas, such as the Forest Experience Zone, the remaining section of the raised boardwalk from the Global Commons Area, and an exposition museum see smaller numbers, in part due to their distance from the main train line to the fairgrounds. Maintenance workers and friendly hosts can still be found throughout the site attempting to ensure that people have a positive experience during their visit.

## 5.0 Expo 2010, Shanghai

In contrast to Aichi's emphasis on nature, Shanghai's Expo 2010 was the first world exposition to specifically focus on the urban condition. It was the largest exposition ever held in both the scale of its site and in the number of participating countries and organizations (Expo 2010 Shanghai Editorial Office 2009).<sup>9</sup> Building upon Confucian philosophy, its official theme "Better City, Better Life" reflects the concept of a "city of harmony." The role of the theme became more pervasive than at earlier fairs, as participants were encouraged to highlight specific projects that promoted environmentally friendly improvements in city living. As at Hanover, the fairgrounds included a series of large thematic pavilions; in Shanghai they explored different aspects of urban development.<sup>10</sup> Also like Hanover, Expo 2010 included a series of events beyond the exhibition itself that directly addressed the fair's theme. Included were a series of academic forums held at other sites in China on the relationships between livable cities, globalization, and sustainable development (Expo 2010 Shanghai Editorial Office 2009).

What was new at Expo 2010 was the Urban Best Practices Area, a large section of the fairgrounds given over to 70 city-sponsored pavilions that showcased practical solutions relating to the exposition's urban theme (Connery 2011). While some of the participants, like Xian, presented poorly veiled promotions for tourism, others, such as London and Madrid, offered innovative, practical solutions to urban issues.<sup>11</sup>

Original post-exposition plans for the fairgrounds included the demolition of all but five of the 54 major pavilions and the site transformed into "China's pre-eminent symbol of sustainable growth" through the creation of a large, high-density residential community designed to serve as a model alternative to the massive sprawl that has appeared on the outskirts of many Chinese cities (Powell 2011). According to the *Master Development Plan of Shanghai Municipality: 1999-2020*, by 2020 the Expo site is projected to house an eco-friendly zone of homes, parks, conference and convention centers, and pedestrian-friendly retail and commercial spaces ("Joint NGO Appeal for 18,000 Victims" 2010).<sup>12</sup> Renewable energy—mainly wind and solar—is proposed to be the primary source of power and all new construction is to consist of eco-friendly materials, including some recycled from demolished fair pavilions.

How much of this plan will be carried out is yet to be seen. Zone B, which housed national pavilions, was cleared in 2011 to make way for the headquarters of "centrally-administrated state-owned enterprises." ("Foreign Pavilions 2011). A former factory building that served as the thematic Pavilion of the Future reopened in 2012 as the Power Station of Art, China's first state-run contemporary art museum, while the massive Chinese Pavilion is now the China Art Palace. Planners expect that construction of a World Expo Museum at the site will be completed by 2015 ("City Gets Official Expo Museum" 2011).<sup>13</sup> However, discussions of a

large-scale, eco-friendly residential development at the site are curiously absent from the international press.

## CONCLUSION

Demolition photographs of Zone B at Expo 2010, which recall images of the piles of post-fair debris from nineteenth-century expositions, clearly illustrate a major disconnect between practices put forward in documents such as *The Hannover Principles* and *Agenda 21* and the massive carbon footprints of recent international expositions, particularly in regards to the construction of short-lived pavilions. Fairs since Seville have attempted to lessen the waste of energy in constructing the temporary events by reusing existing buildings, finding long-term uses for pavilions, and making the structures easier to disassemble and parts reused. It remains, however, difficult to repurpose the hundreds of thousands of square feet of space in the dozens of exhibition halls necessary for these events, particularly when the pavilions are of experimental or unusual designs. Combine the immense use of raw materials for the physical fair with the enormous quantity of energy used to bring the “people’s of the world together” (an estimated 20 million metric tons of CO<sub>2</sub> carbon emissions for Expo 2010 alone), and the result is an event that cannot in any realistic way be viewed as sustainable.<sup>14</sup>

While Aichi made great strides in realizing an environmentally sensitive post-exposition plan, the partially redeveloped fairgrounds of Knoxville, Seville, Hanover, and Shanghai illustrate that this is not an easy task. Even when plans do come to fruition, it can take years of good economic conditions for the transformation to happen. While expositions attract significant economic development to the host city in the years leading up to and during the event, they act like vacuums, drawing the momentum of future development into the present. Once the lights of the fairgrounds dim and the exhibitors and visitors return home, the cities are often left with a colossal exposition hangover marked by massive civic debt and a large patch of real estate to repurpose.

Experiencing underutilized or abandoned former fairgrounds leads one to ask the question: Is it responsible to host an international exposition in the 21<sup>st</sup> century, especially one marketed as sustainable? Organizers of the upcoming Expo 2015 in Milan, Italy are currently preparing a “sustainable event” with the theme “Feeding the Planet, Energy for Life” that addresses links between food, sustainability, and biodiversity. Expo 2017 in Astana, Kazakhstan plans to more directly explore the goal of sustainable living through the theme “Future Energy”. Cities currently bidding for Expo 2020 are focusing on health or global harmony, with sustainability presented as a strong subtheme.

While current expo organizers have learned much from past events and are more critically addressing uses of energy in the construction and operations of the fairs, as planned these future events will not be not radically different from the expositions of the recent past—large fairgrounds with numerous experimentally pavilions and entertainment venues designed to attract millions of visitors. Even if an exposition does manage to become “fully energy self-sufficient,” as the organizers for Expo 2017 boast that their event will be in promotional videos, it will take substantial amounts of energy to construct the buildings and bring the crowds to the fairgrounds (Astana 2013). Is there a better way? Is it possible to design a holistically sustainable exposition? Or does it make more sense to coordinate a virtual global event? The Urban Best Practice area at Expo 2010 allowed cities to demonstrate their innovative initiatives at the fair. A virtual expo would let them to build venues within their own boundaries and then connect the individual, distantly located pavilions to millions of “visitors” from throughout the world via modern technology.

The non-fairground initiatives connected to earlier fairs, such as the “Projects around the World” program, could serve as models for various expo-related symposiums and other events providing the impetus for worldwide dialogs through virtual conferencing and other innovative technologies. Would too much be lost in holding a site-less world’s fair? Or is the extra energy involved in presenting a traditional international exposition worth the larger benefits of being able to experience face-to-face interactions? Would witnessing people from all over the world

join together to celebrate in peace the many facets of human civilization, the latest technological developments, and the dreams of mankind's future potential be lost? These are all important questions worthy of further exploration.

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## ENDNOTES

<sup>1</sup> The term *sustainable* is used in relation to the built environment in many different ways. By 1996 scholars had identified over 80 different definitions for just the phrase *sustainable development* (Fowke 1996).

<sup>2</sup> The theme was inspired by the philosophy of French airman and author Antoine de Saint-Exupéry, whose book *Man and his World* was widely read in the mid twentieth century.

<sup>3</sup> A related exposition was planned for Chicago in 1992, but was later canceled as plans were underway.

<sup>4</sup> August temperatures in Seville have reached as high as 113 degrees Fahrenheit.

<sup>5</sup> Mismanagement, political infighting, and a lack of publicity led to a poorly perceived and attended event, despite reduced cuts in ticket prices and parking fees.

<sup>6</sup> At the time of its construction the new exhibition building, now known as Hall 13, contained the largest interior space in the world without internal structural beams.

<sup>7</sup> The downside to this practice was that it limited the formal aesthetics of the national pavilions and the more elaborately designed corporate pavilions often overshadowed the foreign buildings.

<sup>8</sup> The Toyota androids were not alone. Human-like robots could be found throughout the main fairgrounds.

<sup>9</sup> The fair covered over 1300 acres and included presentations from 192 countries and 50 organizations.

<sup>10</sup> These included the harmonious co-existence of diverse cultures, harmonious economic development, harmonious living in the age of science and technology, harmonious functioning of communities, and harmonious interactions between urban and rural areas.

<sup>11</sup> Unfortunately, the area was located on a less prominent section of the fairgrounds and received significantly fewer visitors than the national and corporate zones.

<sup>12</sup> It is not yet clear how many people and businesses the new plans are to accommodate. Over 18,000 families, 275 factories, and 10,000 workers were displaced from the site before the fair was held.

<sup>13</sup> Plans are for the museum to house more than 30,000 exhibits from Expo 2010.

<sup>14</sup> This estimate was reached by using 1.5 metric tons of CO<sub>2</sub>e per international visitor (five percent of fair attendees) flying to the fairgrounds and .21 for domestic travelers (95 percent of visitors).

# Constructing Utopias: China's Emerging Eco-cities

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**ABSTRACT:** Each year about 16 millions of China's rural residents – equivalent to the total population of the Netherlands – are moving into cities. This trend has continued for nearly two decades in this "largest mass migration ever seen in human history" (David Harvey). Amid such dramatic demographic shift and the resulting construction boom are ambitious plans throughout China to create new towns to house swelling population and to sustain economic growth. A series of prototype eco-new towns have been proposed in this wave of mass urbanization. They are often conceived as exemplary piece of urbanism showcasing the latest design and environmental technologies in town building, and represent a new chapter in China's continuing effort of organized urbanization as a strategy to address complex economic and environmental issues.

This paper studies three eco-new town projects, including Dongdan Eco-city, Binhai Eco-city, and Qingdao Eco-block. They were intended as "models" to showcase the best practice in planning and development and to provide duplicable experience for other cities in the country. The paper examines these eco-new towns through the lens of urbanism and utopianism, focusing on the relationship between place making and social development. These projects were either initiated by the governments or created by private organizations or joint ventures, demonstrating different strategies of developing eco-city and representing different political and economic agendas. However, they were all encountered some dilemmas due to the current land policies and prevalent patterns of urban development in China, which indicates more fundamental issues to tackle to move toward a sustainable society. Studying China's emerging eco-city movement from design and policy perspectives, this paper contribute to the understanding of new patterns of urban growth in our globalized era, and shed a new light on the strategies of dealing with the current environmental crises.

**KEYWORDS:** Utopia, Dystopia, Eco-city, Model new town, Architecture and social change

## INTRODUCTION

China has been undergoing massive urbanization for more than two decades, which has resulted in an unprecedented construction boom and generated numerous plans of new towns. These ambitious new town projects not only serve to house the swelling population but also provide new venues to sustain economic growth in major cities. Concurrently, the country's economic marketization and entrepreneurial governance tend to encourage investments in previously untried environmental technologies, which are used in various eco-city experiments to explore future urban forms. The residential quarters often constitute the main component in the eco-cities, and embody primary planning ideas. To a great extent, these new towns and ecological communities represent emerging urban forms under China's rapid urbanization, and reflect the changing relationship between physical environment and social structure.

This paper studies three eco-city and eco-community projects, analyzing their different approaches to environmental technologies and ecological urbanism as well as different notions in applying them in community design. They were intended as "models" to exemplify the best practice in planning and development using present-day technologies, and supposedly able to be duplicated in other cities across the country. However, they often ran into practical difficulties themselves when attempts were made to implement these plans. As a result, some of them still remain on the drawing board, and for others the initial environmental agenda was substantially cut back in the process of realization. It calls into question the economic and market feasibility of eco-city concept and its compatibility with current Chinese land and planning system. Through these case studies, the paper compares different approaches to

eco-community and discusses the challenges facing the sustainable development of Chinese cities.

## **1. CHINA'S URBANIZATION AND NEW TOWN MOVEMENT**

China's national development agenda set a goal of sixty percent urbanization by 2030, which means that each year about sixteen million of its rural inhabitants – equivalent to the population of the Netherlands – are moving into cities of different sizes. This trend has continued for more than two decades in what sociologist David Harvey regards as “the largest mass migration the world has ever seen.”<sup>1</sup> In 1985, less than 20 percent of Chinese people were urban residents. Since then the urban population has grown at a rate of about one percent each year. It exceeded 50% of the national population in 2011 despite the fact that the birth rate has remained low in the cities because of China's family control policy.<sup>2</sup> In the meantime, the rural population has continued to drop due to the steady outflow.

The outcomes of this massive urbanization have been seen in tremendous infrastructural projects and large-scale building sites across the country from dams, bridges, and highways to gated communities, shopping malls, and spectacular civic buildings. Eleven millions units of housing are built each year in China, and ten to fifteen new communities are created every day.<sup>3</sup> They have fundamentally changed China's urban landscapes. More significantly, this dramatic demographic shift and construction boom has led to ambitious plans of creating new towns. At the beginning of the new Millennium, Chinese government announced that they would build 20 new cities each year for 20 years; therefore 400 new cities would emerge by 2020.<sup>4</sup>

In addition to the changing demography, China's “great leap forward” of new town building also has to do with local government's search for new areas of economic growth. There are more than 150 so-called National Economic Development Zones or High-tech Industrial Parks – and the number is still growing – as well as numerous similar arrangements on the provincial level. Although originally created for industrial use, most of them shifted the focus to residential and commercial development since the late 1990s under the real estate boom. These new towns are often associated with China's large cities both to decentralize urban population and to attract investment for economic development. For instance, there are about ten new towns in Zhejiang Province, most of which are located around the three major cities, Hangzhou, Ningbo, and Wenzhou.

The only precedents of such massive town building were the postwar British New Town Movement and the Urban Renewal in the United States in the 1950s and 1960s, but China's ongoing urbanization surpasses both in scale and scope of intervention. While the British movement was a systematic project of decentralization under the national planning and the US Urban Renewal focused on enhancing or replacing old neighborhoods and building affording housing, these emerging Chinese new towns are created by municipalities of the country's large cities as an economic engine to attract investments and as a branding tool to enhance the image of the cities. They thus come with a strong imprint of globalization. Carried out under an elaborate process of design and development to control physical environments, they are often conceived as exemplary pieces of urbanism, showcasing the latest technologies in town building and exploring various themes of planning.

The eco-city represents a recent development in this new town movement. China surpassed the US to become the world's largest emitter of greenhouse gas in 2007. Many projects have tried to address the environmental issues. In the meantime, China has become a laboratory for new technologies and designs where global talents seek to realize their futurist visions. The economic marketization and centralized governance continue to stimulate tremendous investments in cutting-edge environmental technologies and ideas that are sometimes harder to implement in the West. As a result, China has become the sites of many recent eco-city and eco-community experiments. They vary in scale and adopt different approach to urban planning and ecological technologies. The following sessions will focus on two groups of eco-community projects, one initiated by governments and the other created by private sectors. They represented different agendas of sustainability and approaches to ecological planning, yet both encountered issues when carrying out the plans.

## 2. PROTOTYPE ECO-CITIES: DONGTAN AND BINHAI

The first group includes two ambitious flagship eco-cities established by Chinese government, comparable to Masdar of the United Arab Emirates. They are Dongtan New Town in Shanghai and Binhai Eco-city in Tianjin. They were both intended as wholesale experiments of ecological planning and design on a comprehensive urban scale. Dongtan was created in 2004 and boosted as the world's first carbon-neutral eco-city. It was endorsed by Chinese and British central governments. Arup was hired for its master plan, and it will be carried out by Shanghai Industrial Investment (Holding) Co. Ltd. (SIIC) as a global example of sustainability. The 630-hectare site is located at the tip of Chongming Island, an alluvial island in the Yangtze River. The new city was expected to house 400,000 by 2050.



**Figure 1:** Rendering of Dongtan Eco-city East Village (Source: Courtesy of Arup).

The Arup team introduced the latest environmental technology and laid out a fairly ambitious agenda. The goal was to use 60 percent less carbon footprint than in conventional Chinese cities, and to achieve 66 percent reduction in energy demand. When built, Dongtan would run on 100 percent renewable energy, including 40 percent of the energy supplied from bioenergy. The city would recycle and reuse all wastewater. Landfill waste would be marked down by 83 percent. No fossil-fuel transportation would be allowed, with only hydrogen and electric vehicles permitted within the city. Visitors coming with conventional petrol-fuelled cars would have to leave their cars outside Dongtan and take public transit.<sup>5</sup>

The first phase of the new city would be organized into three villages around the city center. All housing would be located within seven minutes' walking distance to public transport. Moving away from the prevalent highrise typology in Chinese cities, the plan of Dongtan proposed midrise dwellings of five to eight stories, resulting in a density of 75 units per hectare. It would also create expansive green and water features across the city. To support employment within the city, an institute of environmental study was proposed as the central program for the first phase, along with commercial, entertainment, and culture.

Arup's work on the project was completed in 2006 and handed to SIIC to be reviewed by the government. The original timetable called for the first phase to be completed by 2010, the year Shanghai hosted the World's Fair, enabling the city to showcase its commitment to building a green future. However, no construction ever took place and the project was cancelled in 2009. Among other factors like political scandal and protest of environmentalists, there is a conspicuous gap between a radical vision and the concrete design and financial measures to

realize it.<sup>6</sup> The worldwide recession in 2008 also raised the concern whether the project can afford the high cost of building and operation when international funding became unavailable, and if it could be a valid model for other cities to imitate.

In 2007, the Central Government of China created another flagship new town, Binhai Eco-city in Tianjin, under a partnership with Singapore against the backdrop of increasing global attention on the importance of sustainable development. The two countries have collaborated in developing Suzhou Industrial Park since 1994, which has seen great success in urban planning and development and is now a thriving city of 700,000.<sup>7</sup> Binhai Eco-city was the second joint venture between the two countries. A groundbreaking ceremony of the project was held on September 28, 2008, attended by Singapore Senior Minister Goh Chok Tong and Chinese Premier Wen Jiabao. About forty kilometers from another mega-city Tianjin, the Eco-city occupies a total area of 30 square kilometers and will be home to 350,000 residents when completely built in 2020. The choice of the site with its majority being saline-alkali land and wasteland indicates the governments' awareness of ecological challenges and shrinking land resources and determination to tackle these issues. The parties creating this project learned from the lessons of Dongtan, and were able to push forward the development with a comprehensive planning framework, higher density, yet less ambitious environmental agenda.

The design guidelines of Tianjin Eco-city called for 26 Key Performance Indicators (KPIs). They refer to national standards of China and Singapore as well as international standards like LEED. Buildings would be insulated, double glazed and made of materials that abide by the government's green standards. Sixty percent of waste will be recycled. Tap water would be potable. Fifty percent of water supply in the eco-city would be from non-traditional sources such as desalination and recycled water by 2020. A mass transit will be established, including a light rail line, aiming to cut car journeys by ninety percent by 2020.<sup>8</sup>

Although some of these goals seem impressive considering China's current environmental conditions, compared to Dongtan's sustainable agenda, Binhai's approach to the eco-city concept is more pragmatic, even a bit low-key in terms of environmental performance. For instance, the renewable energy would account for only 20 percent of the total energy consumption by 2020, compared to China's national plan that requires 15 percent for renewable energy by 2015.<sup>9</sup> The majority of buildings in the Eco-city would only reach the basic level of the Green Building standards. Another KPI call for 20% of residential development to be subsidized affordable housing, but the number of affordable housing units in Tianjin has been around 50% of the total number of new housings since 2011.<sup>10</sup>



**Figure 2:** Street views of Binhai Eco-city (Source: Author, 2012).

The plan of Binhai Eco-city envisions developments to take place around a central core of rehabilitated wetlands, with four neighborhoods connected by the light rail line. The primary use is residential, but there would be a business center for the city, a commercial sub-center in each neighborhood, and some industries. The administrative building, one of the first structures, showcased most of the building standards, including double glare skin, a nice rooftop garden, solar-powered lighting fixture and solar-powered parking facility. The first neighborhood was completed in March 2012, and 60 families have moved in this residential



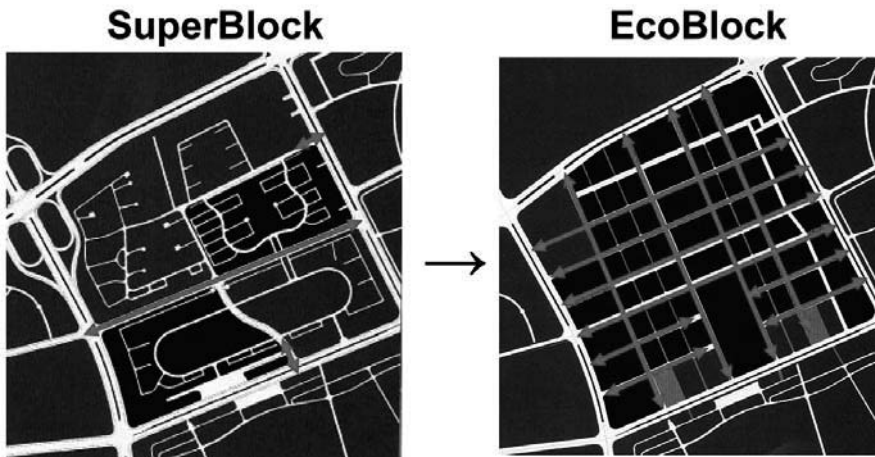
area. Numerous solar panels and wind turbines have been erected along major roads across the city, indicating the distinction of this city from other new districts in China.

However, when one takes a closer look at its planning and architecture, Binhai Eco-city turns out to be quite conventional. The residential neighborhoods and business centers were designed as clusters of free-standing towers indifferent to the site and context. The highrise buildings were laid out on super blocks along wide avenues where automobiles are apparently the dominant means of transportation, and cyclers and pedestrians are barely considered. The same attitude is present in the community design. The residential buildings are elevated to sit upon a one-story podium of parking deck that occupies the entire block. As a result, the shared outdoor spaces of the community, which in this case are located on top of the deck, is completely segregated from the surrounding streets and sidewalks. The design reflects the gated-community mentality that dominates Chinese new towns. Housings were designed to meet a minimum green building standard. The technological improvement was unfortunately compromised by the conservative approach to urbanism. The brand of eco-city largely becomes a form of technical legitimization of a conventional solution.

### 3. MODEL ECO-COMMUNITIES: QINGDAO

In addition to the national eco-city projects like Dongtan and Binhai, there have been numerous attempts across the country to explore ecological planning. They often involved local governments and private sectors that collaborate in the search of innovative approaches to community design. These experiments targeted a particular region or a particular type of development, and usually proposed a smaller scale of intervention compared to the eco-cities. They aimed to invent a model of sustainable community design that could be duplicated and would thus influence the wider practice of urban development.

In 2006, an international team involving the College of Environmental Design of University of California at Berkeley, Tianjin Urban Planning and Design Institute, and Huahui Design Group was looking for a site for an eco-planning concept called “Eco-block.” The objective is to invent a sustainable model of urbanism that could be applied throughout the developing world. The planning and design of this experimental project would be funded by the Gordon and Betty Moore Foundation in San Francisco. Eventually their proposal was accepted by the city of Qingdao with an administration also quite interested in sustainable development, and a site of about 50 hectares in Fushan District was identified to building the first Eco-block community.<sup>11</sup>



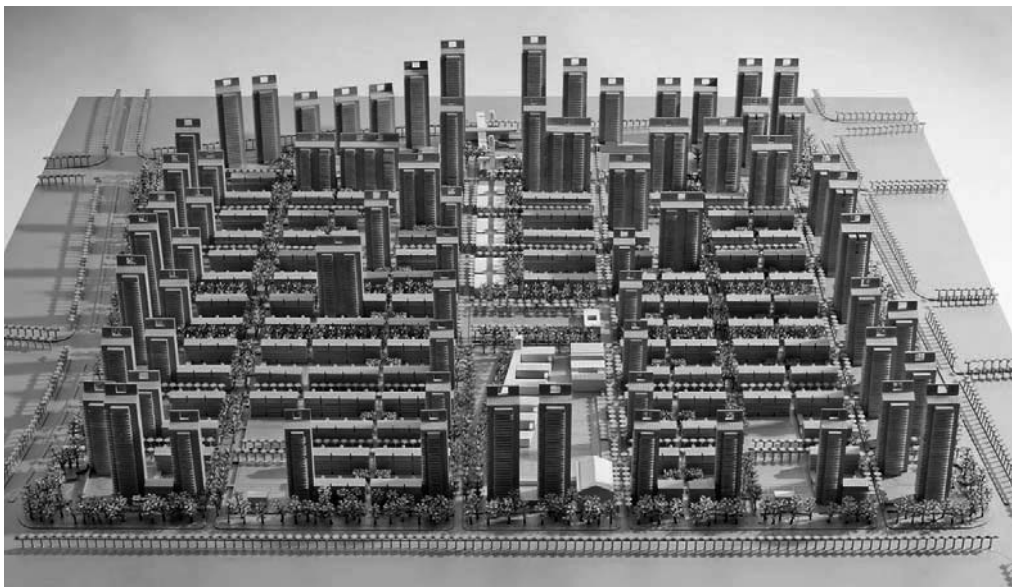
**Figure 3:** Diagrams of Eco-block v/s Superblock (Source: Courtesy of Huahui Design).

Eco-block is a concept coined by Harrison Fraker, then dean of the College of Environmental Design at Berkeley. He contends that conventional city planning in China usually involves the Superblock, a model that not only leads to automobile-driven gated-communities, but also relies on a centralized infrastructure of power plants and electric power lines, sewage

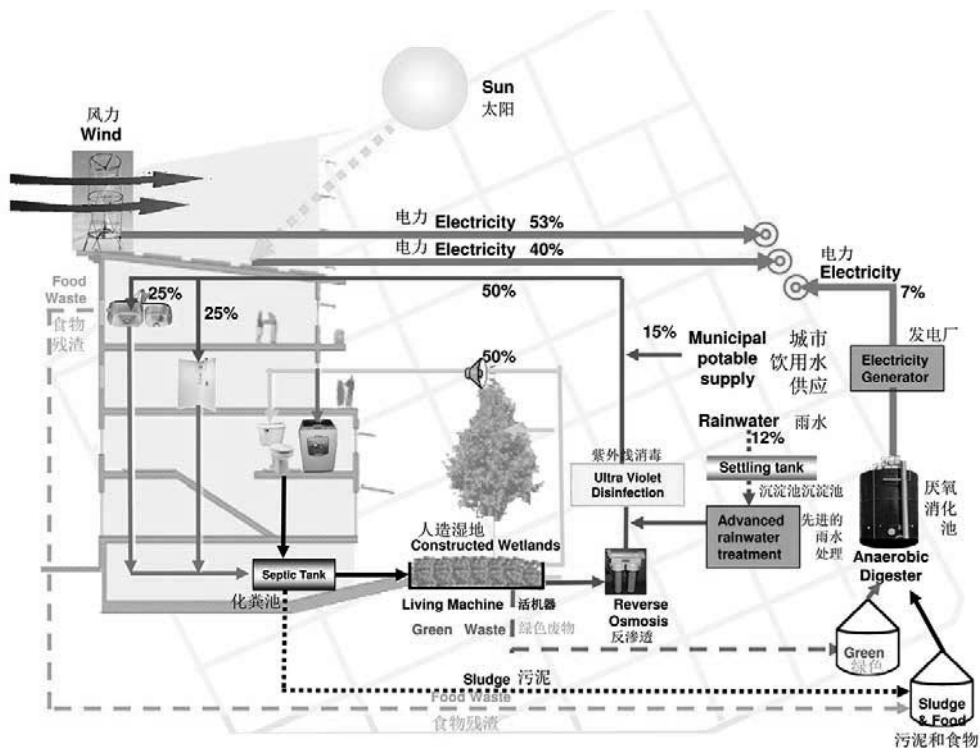
treatment plants and sewers, and a sanitary water supply provided by the city or provincial utilities. Superblock represents an unsustainable model of development, generating enormous energy consumption, carbon emission, and untreated waste and water. As its alternative, Eco-block will be a self-sufficient community with respect to energy, water, and waste. An Eco-block would generate renewable energy on-site to meet 100% of its demand, recycle 100% wastewater on-site and reuse it, and treat its own waste. Therefore demand of infrastructure and natural resources would be significantly reduced. Fraker and his team envisioned that a basic Eco-block would occupy 3.5 hectare of land with a density of 171 units/ha, and consist of 600 housing units for 1,800 residents. It constitutes a community “module” and could be duplicated multiple times into a larger self-sufficient neighborhood with its own infrastructural system combining power supply, water recycling, and waste treatment.

The planning team of Huahui Design Group led by Leon Huang moved forward to develop a master plan for Fushan Residential Area site. It consisted of 16 Eco-blocks and would provide 10,000 housing units in total. The plan was characterized by interconnected street network in contrast to the Superblock layout originally prepared for this site, and a pedestrian and biking system connecting numerous courtyards enclosed by mid-rise and high-rise buildings in the block. Each Eco-block would be a rectangle of about 90 meters by 400 meters. The plan also envisaged a Bus Rapid Transit (BRT) line to connect the neighborhood with Qingdao’s center city that should substantially reduce the need of automobile usage, and reserved a spot for the BRT stop in the north end of the linear central green in the neighborhood.<sup>12</sup>

The plan proposed an integrated system of energy generation, water conservation and supply, and waste treatment. With various ecological design features such as building shading, high-performance glazing, passive solar heating, shaded walkways, and using energy efficient equipment, the energy consumption was expected to be 40% lower than conventional development, or a saving of 1.65 million kWh/year by each Eco-block. The remaining demand should be covered by the energy supply generated internally through a comprehensive system of building integrated wind turbines (53%), photovoltaics (40%), and anaerobic digester (7%). With a series of measures of water conservation and increasing efficiency, demand of potable water would be cut down by 35%. Non-drinking water supply would be primarily gained through various wastewater treatment and rainwater harvesting, leaving only 15% to be supplied from off-site. In addition, the system would transfer 54% of waste into energy, recycling 29%, and dispose only the remaining 17% of waste.<sup>13</sup> Arup provided technical consulting and evaluation for this plan.



**Figure 4:** Model of Qingdao Eco-block (Source: Courtesy of HHD).



**Figure 5:** Diagram of the Integrated System, Qingdao Eco-block (Source: Courtesy of HHD).

From the beginning, these planners understood that the Eco-block not only meant a major breakthrough in ecological planning and design but also, more importantly, a revolution of the way a city is developed and operated, and its outcome would depend on whether the prevalent development process could be overturned. Fraker argued: “[S]uch eco-city developments will require a completely different way of doing business because the way the system is set up currently is slanted heavily in favor of developing fast and getting out, with minimal responsibility for environmental impact over the long term.”<sup>14</sup> Eco-city developments, he believed, would require some sort of property management with self-interest in operating and maintaining these different, distributed small scale systems. In the Fushan project, the team experimented with this new approach of developing and managing a community, and their effort was backed by a few large multinational corporations. Although Moore Foundation later dropped out from its commitment of sponsorship, it was soon picked up by Microsoft. Siemens was to provide the Integrated Host System of energy, water, and waste treatment, and the return of its investment would be generated through property management. Cisco agreed to provide support of the system. Such international collaboration among enterprises, professionals, academia, and local government represents an effective model in the promotion of eco-planning.

Despite such productive collaboration and popular support, the Fushan project was not able to move forward into construction. The direct cause was the complication related to the land – it was previously leased to another developer. However, there were also a number of issues in the economic side that prevented an eco-block project from being carried out. For instance, the power that photovoltaic and wind turbines can generate fluctuates through a day, and there is a significant discrepancy between the pattern of energy production and that of energy usage during 24 hours. Using battery to store the surplus energy during off-peak hours of energy consumption and release it during peak-hours is quite costly. So the better solution would be to connect the internal system to the state grid. However, the State Grid Corporation did not accept such a proposal. The upfront cost of building an eco-block community is also about

10% higher than conventional community – although it could be paid back in a few years of operation – and developers are not willing to take on this approach without substantial subsidy. As a result, the planners have to search for other opportunity to realize the Eco-block concept.

## CONCLUSION

The three projects discussed in this paper, Dongdan Eco-city, Binhai Eco-city, and Qingdao Eco-block, represented different scale of intervention ranging from a couple of hectares to thirty square kilometers in area. All of them, however, were intended as “models” of eco-planning that was expected to influence the wide practice of urban development under the current massive urbanization in China. The ambitious eco-cities represented top-down governmental initiatives as wholesale introduction of cutting-edge ideas of planning and technologies. They aimed to establishing examples to guide new town developments in the decentralization of many major cities across the country. The eco-community projects created by the private sectors, although relatively modest in scale, were equally ambitious in their agenda. They started from the basic component of the city, a block, and tried to invent a new pattern of urban development incorporating ecological design and sustainable strategies. They explored the possibilities of turning technological advantages into marketable products.

However, neither the governmental initiatives of eco-city nor the private experiments of eco-community has seen much success in practice. Two out of the three studied examples stay unrealized. The only ongoing project Binhai Eco-city, after rounds of planning revision and execution by profit-minded developers, has degenerated to nearly a commonplace development, with some sorts of ecological features but without an ecological soul in general. There are a few obstacles that prevent an eco-project from being carried out or having a larger impact in Chinese urbanism, including technical readiness, economic feasibility, and land policy, which are somewhat connected to each other. The technical capacity is becoming less an issue. According to Leon Huang, the technologies to build an Eco-block are all matured techniques that have been used in other projects. In fact, a number of Zero-Emission Developments (ZED) or self-sufficient communities have been built in Europe, not to mention the flagship eco-cities like Masdar. China has also become the world leader in production and usage of photovoltaic equipment and wind installations. Economy wise, the building cost of an eco-community is estimated at 5-10% more than that of a conventional community, which is not a formidable cost and, in most cases, could be recovered by saving in energy and resources in a few years of occupancy.

The barrier more difficult to overcome is one related to land policies and patterns of land development in China. Eco-block was invented to counter the prevalent pattern of Superblock. However, the Superblock approach could not be replaced without tackling the fundamental issues of land and energy policies it is based on. In China, municipal governments control the land and tend to lease it out in large parcels to maximum revenue through bidding process as well as to achieve an impressive city image. The real estate sector relies on land speculation as primary means of profitability, which encourages developers to build fast and pursue maximum profit with little concern about the after-market performance of the properties. As a result, the interests of three parties involved in community development – the governments as landholder, the developers as producer, and the residents as consumer – are often inconsistent.

Although sustainability is apparently in the national agenda as the eco-city projects suggest, essential infrastructural and financial supports are either not in place or mismatched. In the case of Eco-block, the state-run energy corporations like the State Grid would not share their resources to support community-based systems. There is also lack of financial stimulus for developing new sustainable communities or improving the environmental performance of existing communities. The state has demanded building of enormous number of affordable housings across the country – 36 million units of subsidized housing are supposed to be built between 2011 and 2015.<sup>15</sup> The main objective of such state funding however, is the quantity (number of units to be built) not the quality.

Nevertheless, these emerging eco-city and eco-community projects are pioneers in guiding China's urbanization toward a more sustainable path, and they represent some meaningful

experiments of alternative concepts of planning. They are far from mainstream yet, and in some cases like Binhai, such eco-planning is developing with a Chinese characteristic. Apparently there are many things that should be done in order to develop a livable and truly sustainable city. Instead of showcasing uses of environmental technologies, ecological cities and communities should play a more fundamental role as a comprehensive social project in changing the urban pattern toward a more holistic development of society, economy, and environment.

## ENDNOTE

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<sup>1</sup> David Harvey, *A Brief History of Neoliberalism* (New York: Oxford University Press, 2005), 127.

<sup>2</sup> The China Science Center of International Eurasian Academy of Sciences, *The State of China's Cities 2012/2013* (Beijing: Foreign Languages Press, 2012), 11.

<sup>3</sup> Catherine Durham, "Qiandao Eco-block Sustainable Model Project, 2007," a presentation at China-Germany Sustainable Development Forum, Shanghai, Sep. 19, 2009.  
<http://www.goethe.de/ins/cn/lp/kue/arc/ua/se/zh5247331.htm> (accessed Dec. 12, 2012)

<sup>4</sup> Jean-Pierre Langellier and Brice Pedroletti, "China to Build First Eco-City," *The Guardian*, May 7, 2006.  
<http://english.cri.cn/811/2006/05/07/301@85444.htm>. Accessed 7/12/2012.

<sup>5</sup> Helen Castle, "Dongtan, China's Flagship Eco-city: An Interview with Peter Head of Arup," *Architectural Design* 78 (2008): 68-69.

<sup>6</sup> The site of Dongtan is one of the important habitats of migratory birds in the east coast of China. Therefore, environmentalists had protested building a new town there although Arup's plan reserved large areas of wetlands. Chen Liangyu, the CCP chief of Shanghai was arrested in 2006 for economic issues. He endorsed Dongtan and the other new town projects in his tenure, and his step-down was widely regarded as one of the reasons of Dongtan's stagnancy.

<sup>7</sup> For a thorough study of planning and development of Suzhou Industrial Park, see Kuang Shi, Hao Liu, and Zhongjie Lin, *The Making of a Chinese Model New Town: Planning and Development of Suzhou Industrial Park* (Beijing: China Architecture and Building Press, 2012).

<sup>8</sup> "KPIs" in Tianjin Eco-city official website "Tianjin Eco-city: A Model for Sustainable Development."  
[http://www.tianjinecocity.gov.sg/bg\\_kpis.htm](http://www.tianjinecocity.gov.sg/bg_kpis.htm) (accessed Dec. 14, 2012)

<sup>9</sup> Ibid.

<sup>10</sup> "New buildings of affordable housing in Tianjin account for more than 50% percent of new housing units, leading the country." In Sina.com News. <http://news.dichan.sina.com.cn/2011/02/14/275182.html> (Accessed Dec. 14, 2012).

<sup>11</sup> Interview with Leon Huang, Nov. 20, 2012.

<sup>12</sup> Huahui Design Group, Presentation of "The Eco Block: Sustainable Development Demonstration Project."

<sup>13</sup> Ibid.

<sup>14</sup> Catherine Durham, "Qiandao Eco-block Sustainable Model Project, 2007," a presentation at China-Germany Sustainable Development Forum, Shanghai, Sep. 19, 2009.  
<http://www.goethe.de/ins/cn/lp/kue/arc/ua/se/zh5247331.htm> (accessed Dec. 12, 2012)

<sup>15</sup> The China Science Center of International Eurasian Academy of Sciences, *The State of China's Cities 2012/2013* (Beijing: Foreign Languages Press, 2012), 19.

# The temporality of style in exposition architecture

## Raimondo d'Aronco in context and comparison

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**Abstract:** Since the early twentieth century “style” has been particularly suspect in relation to architecture. A tendency to cross out the word “style” in architecture continues today in the self-presentation of many younger architects.

Speaking generally, the crossing out of “style” was at first a reaction to the pre-1914 modernists. In this regard the work of Italian architect Raimondo d'Aronco is instructive. This paper argues that his stylistic inventions at the 1902 Decorative Arts Exposition in Turin, in which ephemeral construction methods and a unique program associated with modern decorative art led him to devise a hybrid that only existed in built form for six months. Critical responses were mixed, but this isn't a sign of failure, given that the buildings were both evidence of and containers for very current debates about the meaning of “modern” design in Italy.

D'Aronco's work suggests the validity of an approach to modern styles drawn from actor-network theory. Instead of concentrating on a defining set of formal principles or visual ticks, “style” is understood here as a material stabilization of controversies, as a set of visual traits that increase the density of connections between materials, technologies, and stories about social groupings. To further explore this idea, the paper looks briefly at two much more famous modernist examples, Mies' German Pavilion and Le Corbusier's Philips Pavilion, each of which shows a different approach to the architect's role as an actor within the networked context of a large exposition.

**Keywords:** World Expositions, Style, Historiography, Temporary Building, D'Aronco

In the recently published monograph of their work, SHoP Architects begin one of their chapters with the question of style. Their answer should sound familiar to any student of modernist architectural theory: “Style is the mannered repetition of an aesthetic theme; it is the inverse of innovation.” After a sentence that directs the point specifically to the firm's work, they conclude, “In the wake of countless architectural –isms, there is no need for another short-lived style.” (Holden 2012, 65) While the target here is clearly the theory-driven –isms of the '80s and '90s, the sentiment could easily have come from the 1920s, in which the targets were both eclecticism and the modernist ornamental styles of the pre-1914 period. The similarity is reinforced in the SHoP book by placing the denunciation of “style” opposite a film still of a flirtatious couple in eighteenth-century costumes, thereby repeating the graphic argument of Le Corbusier's *The Decorative Art of Today*, in which the eclectic “styles” are ridiculed as artifacts of bourgeois efforts to ape the discernment of the aristocracy. The durability of the theoretical stance taken by SHoP is noteworthy, but so is the stubbornness of the word “style.” In spite of the best efforts of several generations of architects and critics, it fails to wither away in popular and critical usage.

“Style” is a frustrating term, and it's not only practicing architects who often want to excise it. It also bedevils historians and critics, who nevertheless can't write much of anything without citing styles or christening new ones. Sarah Williams Goldhagen has explored this problem with reference to modernist architecture, cataloging the ways in which the definition of modernism as a style has impeded our understanding of key designers and aided the preservation of the narrow cannon of modernism presented in survey courses. She proposes

to replace the historical category of “style” with “discourse,” treating modernism as “A heterologous array of individual positions and formal practices within a loosely structured field.” (Goldhagen 2005, 145) This valuable contribution to historical method nevertheless has to leave “style” crossed out, rather than erased. As Goldhagen explains, modernism was defined as a set of aesthetic traits by its early propagandists, who translated their idealist views about the relationship between form and history into a formula that would support the acceptance of modernism as *the style of the industrial age*.<sup>1</sup>

It is this implied relationship to history that makes the stylistic definition of modernism a different historiographical problem from the stylistic definition of rococo or Greek revival. For that reason, the key to understanding SHoP’s denunciation of “style” may be the words “short-lived.” If we consider the possibility that a short-lived style is not necessarily a deficient, inauthentic style, we can begin to understand comparative durations within the cannon-broadening modernist discourse that Goldhagen proposes. Working under the assumption that all stylistic formations eventually “wear out,” we can perhaps learn to understand their moments of validity as significant products of temporary circumstances. This is where expositions come into the argument.

The organizers and designers of an exposition—like the 1925 one for which Corbusier published *Decorative Art of Today*—must necessarily emphasize architecture as communication. The goal of most exposition buildings is not to speak to the ages, but to participate in a highly concentrated field of signs for about six months. The ideological and commercial success of the many expositions staged between 1890 and 1970 depended partly on the creation of a stabilized semantic field generated through the creative and open-ended combination of built forms, made and natural objects, and groupings of bodies. This required the work of many actors with disparate views on words like “modern” and “modernism,” not all of whom were conversant with specialized debates around design. It is perhaps not surprising that the organizers and planners of many of these fairs defined a signature collection of visual traits, as with the short-lived but important style named after the 1925 *Exposition des Arts Decoratifs Modernes*.

“Style” in this context may or may not take the form of a definitive code or design guideline. The stylistic unity of the 1925 exposition, for example, was mostly enforced by four strategically placed pavilions, and the actual stylistic range of the buildings was much larger than in what has come to be identified as “Art Deco.”<sup>2</sup> Nevertheless, “style” is useful and unavoidable because discourses are never as completely heterologous as Goldhagen suggests. While the participants in them are best understood as actors in a proliferating network composed of texts, images, institutions etc.,<sup>3</sup> the work that goes into keeping that network active requires—and wears out—more or less stable and bounded semantic capacitors. In the context of an exposition, architectural style is particularly suited to play this role, as it hybridizes the ideological and physical components of the exposition, combining messages about technical progress, national identity, and political and economic power.

Perhaps the clearest example of “style” as a semantic capacitor is Raimondo D’Aronco’s work as master planner and chief designer of the 1902 Decorative Arts Exposition in Turin. This exposition was unlike the larger universal expositions of the period in that its explicit purpose was to explore a style for modern life. This is stated clearly by Ernesto Thovez, one of the exposition’s chief propagandists, in a 1902 article, in which he writes that international exhibitors were essential:

So that the displays would assume the shape for visitors and Italian artisans of a teaching a prodding to towards a more decisive and enlightened activity, directed toward the complete renewal of decorative trends and of the material environment, both domestic and public.(quoted in Garuzzo 1999, 11)

Behind this intention is the often-repeated complaint of young Italian architects of this period that Italian design was behind Paris, Brussels, and Vienna in emerging from academicism and coming to terms with a stifling historical legacy. As Richard Etlin has documented, this was a primary concern of the architects coming out of the polytechnics of Turin and Milan in the

1890s, and their debates around the problem framed the proposal for the 1902 exposition, as well as critical responses to it. (Etlin, 1991)

Given this background, it's pretty clear that no design for the exposition was going to fully satisfy people like Thovez. In this context, D'Aronco's victory in the competition for it is both surprising and fortuitous, as he was something of an outsider to the debates of his Italian contemporaries, having followed them from a distance in Istanbul, where he was fully employed on projects for the Sultan and for private clients. These projects involved a very different set of stylistic investigations from those of the younger Italians. While they were attempting to derive distinctly Italian lessons from Franco-Belgian art nouveau, D'Aronco was creating virtuosic fusions of "western" elements with the powerful Turkish and Byzantine traditions of Istanbul. Manfredi Nicoletti argues that D'Aronco's training in Austria—outside of the romantic eclecticism of the Italian schools—helped him to develop solutions based on study of the tectonic and typological bases of the traditions of Istanbul. (in Quargnal, 1982)

What D'Aronco created for Turin was arguably a less comfortable mixture, combining simplified massing inspired by the Wagnerschule and Olbrich, floral patterning borrowed from art nouveau, and applied color in bright hues that clearly owed much to "the east." In all of this, there was no direct reference to Italian tradition. Instead the exposition marked the debut (and the farewell) of a whole new stylistic hybrid. This is best known from the centerpiece Rotonda d'Onore, with its dome inspired by Hagia Sophia and mural imagery suggesting a *Torinese* version of the Viennese sacred spring. But the style is more audacious in some of the less central buildings, particularly the photography and automobile pavilions; their interpenetrating volumes show careful study of Olbrich, whose work in Darmstadt D'Aronco had toured in preparation for his designs for Turin.

This brief description says nothing about D'Aronco's work that can't be explained, clumsily, using traditional art historical tools, but it fails to address the most noteworthy aspect of D'Aronco's exposition work, that it was visibly ephemeral. Partly for reasons of cost and time, the exposition was not built after the manner of fairs. Instead of covering frames with monumentalizing plaster, D'Aronco made buildings with canvas and wood skins, more like elaborate tents than the "palaces" typical of Chicago and Paris. In order to signify the themes and provide visual stimulation, he relied on color, a bizarre range of antennae, heraldic banners, and electric lighting.<sup>4</sup> The result was a group of buildings defined by visual characteristics that were at best accessory to the real stuff of architecture, both as defined by the academy and by the rationalist tradition that celebrated the iron and glass buildings of nineteenth-century expositions.

Freni and Varnier stress this in their monograph on D'Aronco, seeing his appreciation of the ephemeral building as the most truly modern and even functionalist aspect of his work:

Therefore the most revolutionary innovation, as well as the least understood, is that of having made evident the provisional nature of the pavilions."

And they even go so far as to describe them in quasi-futurist terms:

"The buildings of D'Aronco are realized in original form by means of two fundamental and little used instruments: color and movement. (Freni 1983, 51)

This aspect of D'Aronco's work made a great impression, and there is no reason to see the buildings as unsuccessful. In previewing them, a writer for the Turin newspaper *La Stampa* caught the novelty in D'Aronco's temporarily constituted style and celebrated its capacity for pure visual stimulation:

Our eye, habituated to the monotonous grey and white of common construction, finds recreation in that pleasant polychromy, in the brilliance of gold and in pure colors against the clear background of the sky. (La Stampa 1902)



While this writer was clearly doing PR, his words speak to something important in the architecture, a something largely missing from reactions by professional critics, who interpreted the architecture not as a *style* for a particular event but as a claimant to be *the* style of modern Italy. While more conservative critics decried D'Aronco's work for lacking a clear continuity with Italy's best traditions, even a relatively sympathetic critic like the young architect Vittorio Pica, in his book length resume of the exposition, could only offer this in D'Aronco's defense:

Raimondo D'Aronco, at the next occasion, being able to work with greater consideration, will, I am persuaded, do much more and much better: he will know how to be more balanced in construction and more sober in ornamentation and, still doing his part for the spirit of cosmopolitanism, he will strive to be more original, remaining within the most Italian conception and workmanship.<sup>1</sup>(Pica 1902, 24)

Pica makes nearly impossible demands for the semantic performance of an architecture that is at once Italian and modern. In a sense these are inverted in recent historical writing. Where Pica seeks the style that does everything at once, historical accounts of D'Aronco try to situate him in an increasingly profligate lexicon of stylistic labels. In a highly sophisticated example, Rossana Bossaglia's brief essay on "Il rapporto di D'Aronco con il Liberty Italiano," expertly explores all the usual avenues of influence and resemblance, only to conclude that it is more useful to situate D'Aronco's work in something like Goldhagen's discursive field.

D'Aronco's appearance in Turin is framed then within a broad and vital panorama of Italian modernist efforts. (Bossaglia 1982, 12)

This conclusion is based both on the geographic range of D'Aronco's work and his absence from Italy during the beginnings of "stile Liberty," "stile floreale," or "arte nova," but also on the unique characteristics of his exposition buildings, which Bossaglia (though less positively than Freni and Varnier) attributes partly to their ephemeral character.

[D'Aronco's work] presents a peculiar character and is marked by a fresh extravagance that was in direct ratio of the specific use for these paper mache constructions. (in Quargnal 1982, 12)

D'Aronco's work not only failed to meet the stylistic expectations of its professional audience, it also tends to confound stylistic categorization today. One might reasonably conclude from this that "style" is simply the wrong word to use in interpreting it, and yet D'Aronco's buildings most definitely exhibit a coherent set of visual traits. In fact, given that one architect did the master plan and the majority of the buildings, the Turin Decorative Arts exposition showed a high degree of visual consistency. If this isn't a style, what is? And if it is a style, then what does a style actually do that is not captured in the term's conventional use? A clue may come from the discussion of the exposition in the second volume of Terry Kirk's *The Architecture of Modern Italy*, in which he concludes:

The clamorous debut of Art Nouveau in Italy triggered a seminal debate in which at least one thing was clear: innovative international modernism and classical national tradition were set in tense opposition. (Kirk 2005, 18)

He suggests that D'Aronco's buildings had no influence except to set a precedent of "extreme liberty." It might be more useful, however, to reflect on them as the setting for the debate itself. Going back to the discussion that started with Goldhagen and SHoP above, we could see the Italian design scene in 1902 as a kind of network of actors that included not only a couple of generations of practicing architects and their students, but also educational institutions, local and foreign publications, and collectors and potential patrons. Energized by a number of "tense oppositions," the actors within this network could come together among D'Aronco's buildings, using them to advance their positions or rally their teams. Identifying D'Aronco's as not-the-right-style seems to have been an important part of this process, but it could not happen if it didn't have the semantic stability that we associate with a style.

In this context “style” is understood as a material stabilization of controversies, as a set of visual traits that increase the density of connections between objects, technologies, and stories about social groupings. D’Aronco’s work may not have been durable or imitable, and it may have had only a negative relationship to his contemporaries’ efforts to construct a narrative about authenticity to the modern, but it served to provide a stable basis for those efforts for a few months in physical form and maybe a year or two in the press. It may be that what D’Aronco found by “having made evident the provisional nature of the pavilions” is actually structural to the work of creating semantic capacity that styles do, particularly in the exposition context.

It should be said that the 1902 exposition was relatively small and had an unusually restricted group of participants. The more common situation for an architect acting within the exposition context has been a commission for a single building to be inserted in a rapidly evolving master plan, a sort of fast-forward version of what architects face when designing “permanent” buildings. It might be helpful, then, to look very briefly at exposition buildings by two architects far more famous than D’Aronco, Le Corbusier’ Philips Pavilion for Expo 58 in Brussels and Mies’ Barcelona Pavilion of 1929.

Le Corbusier contributed to three expositions, and in each case he took a different approach to his role as an actor in the exposition network. In 1925 he built the Pavillon de l’Esprit Nouveau as an irritant but adopted the predominant mode of habitat display found in the displays of the major Parisian interior designers. For the 1937 Paris exposition, he took a page out of D’Aronco’s book and created an evidently ephemeral tent (the Pavillon des Temps Nouveaux). In 1958, Corbusier appears as, of all things, a model collaborator, delegating substantially to Iannis Xenakis, Philips acoustics experts, and to composer Edgar Varèse, to produce a thin-shelled tensile structure with a geometry that has little precedent in Corbusier’s work. His most “authorial” contribution to the project was the montage projected inside the shell of the building and timed to Varèse’s *Poème Électronique*. The resulting building fits uncomfortably into a monographic view of Corbusier’s work.<sup>5</sup> It fit rather well, however, into the Brussels Expo, in which it stood out as one of a handful of truly experimental buildings that spoke to the official theme “Building a World for Modern Man” in a way that might engage both the public and the design community, which was underwhelmed by the “atomic” style constituted by the expo organizers. (Devos 2005)

The Barcelona Pavilion is another case entirely. As the exposition structure that fits most centrally into the conventional stylistic narrative of modernism, it is usually presented as absolute architecture with no reference to its (very limited) program or to the exposition in which it briefly stood before going on to a rich afterlife in photography and theory. Its role as textbook example and theoretical *topos* allows it to transcend its ephemeral beginnings--Whatever style the Barcelona Pavilion is it cannot be called “short lived”--but only at the cost of doing so in splendid isolation.. To the degree that interpretations look beyond the pavilion as architecture about architecture, they relate it to the political and cultural situation in Berlin, where it was designed, not in Barcelona. All of this is understandable, given the limited program of the building and its seemingly complete lack of engagement with the architecture of the exposition or the urban planning intention behind it. In the context of this investigation, it is worth asking if Mies’ project can be understood differently, or at all, within the network of the Barcelona Exposition and the revivalist stylistic investments made by its organizers. However, it’s a difficult question to answer fully, given the state of the literature on the architecture of the Barcelona Exposition, which even in Spain is dominated by discussion of Mies’ pavilion. It may present a kind of limit case, in which the building is—partly by design and partly through the efforts of critics and historians—unable to participate in its surroundings. It allows us to say a great deal about the question of style in general, but perhaps very little about how styles provided semantic material for networked groupings in Barcelona in 1929.

Since this is only a preliminary exploration of a difficult problem in historiography and theory, it’s perhaps best to conclude with a few issues that require further study. While the case of D’Aronco seems to fit quite well with the idea of a style as a material stabilization of controversy, it remains to be seen if the same holds true in the larger expositions, in which

design is not the only controversy and in which the designed material is less homogeneous. A brief look at the Brussels examples suggests that, true to the body of actor-network theory that inspired this study, each case will generate its own variant set of rules and definitions. The case of the Barcelona Pavilion reminds us that any group of stylistic markers that can be identified in twentieth century architecture must also be interpreted in relation to the omnipresent question of modernism as *the* style of the age. While the relevant materials are, in the Turin example, sufficiently manageable to make those connections, this may not always be the case. Finally, there is no doubt a good deal of theoretical work to do be done to derive value from this way of looking at “style” for contemporary practitioners like SHoP, who feel an urgent need to cross the word out. A starting point might be, following D’Aronco, in the possibility of linking the technical exigencies of contemporary production to groupings of visual markers that create semantic capacity. Would there be significant possibilities for meaning and relevance in a more deliberate approach to this, one that accepted the limited half-life of the resulting stylistic formations?

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<sup>1</sup> This sentence doesn’t do full justice either to Goldhagen’s argument or to the writers (Giedion, Pevsner, Gropius et. al.) she is summarizing. The main point is that most of them had considerable discomfort with calling the new architecture a “style,” yet each provided material for the definition of a modernist style in order both to speak the language of their audience and to satisfy the requirements a historicist definition of style as related to *Zeitgeist* which Goldhagen attributes primarily to Woelfflin. (Goldhagen 2005, 146)

<sup>2</sup> Like most expositions, the 1925 Art Deco exposition exhibits a considerable gap between the intentions of its organizers and the highly varied assemblage that appeared on the ground. It was a series of interior designers and their employers who organized the clearest expressions of a new luxury style in the octagonal pavilions of the department stores that anchored the corners of Esplanade des Invalides. (Troy 1991)

<sup>3</sup> This is a gloss on the basic ideas of actor-network theory as articulated by Bruno Latour. This research derives from a larger project looking at the history of exposition architecture partly through this methodology. (Latour 2005)

<sup>4</sup> D’Aronco’s approach to the ephemeral had no impact even on the next exposition in Turin, in 1911, which consisted of eclectic buildings surfaced in the plaster staff of the White City.

<sup>5</sup> For example, William Curtis’ excellent monograph devotes only a few sentences to the Philips Pavilion, commenting on the technical investigation involved. (Curtis 1986, 214)

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# Testing and evaluating sustainable design practices

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**ABSTRACT:** This paper presents an in-progress design research conducted by teachers and students of Chalmers University of Technology (Sweden) and the University of Houston (USA), in the form of a Habitation Laboratory (HabLab) (Nystrom, et al. 2000) design studio and in connection with a Sustainable Living Lab project.

The 'HSB Sustainable Living Lab', is a collaborative effort between the largest Swedish co-operative housing association, HSB, and Johanneberg Science Park, and will be built in 2014 as a student housing, located on Chalmers main campus<sup>1</sup>. Its location offers a unique opportunity to merge research, education and outreach.

A 400 m<sup>2</sup> three-story building will accommodate 25-30 students and guest researchers. Student units are designed to be flexible and adaptable to possible layout adjustments and changes throughout a ten-year building permit timeframe. The structure will also include additional facilities such as an exhibition area, a common laundry room and various meeting zones.

The paper identifies and investigates experiments in sustainable design education through the use of a design studio as the first stage within the larger "Sustainable Living Lab" research and building environment project. The goal of the educational initiative is implementing practice and construction experience into the learning process by combining hands-on approaches with theoretical development in trans-disciplinary real-life contexts, where design serves as a link between practices and disciplines. This is argued to be essential in the shaping of future responsible architectural practices.

Possible applications of lessons learned for the design of future environments is a key inquiry. The project objectives are: developing participatory and user-centered design research methodologies and measures, as well as studying how sustainable innovations are applied and perceived in the living environments of everyday life.

**KEYWORDS:** Trans-disciplinary research, sustainability, design, practice

## INTRODUCTION

This paper discusses approaches to test and evaluate responsible architectural and living practices related to a HabLab studio, with both educational and practical potential. The discussion is built upon examining an on-going study within an inter- and trans-disciplinary research development with the involvement of engineering, architectural and design researchers. The project is at its initial stage when potential structure, timeframe and level of multi-disciplinarity are still under investigation. Exploration of project potential at this early stage of the development is argued to be important to better define the project's goals and objectives, as well as the means of how they can be achieved.

The goal of the HabLab initiative is to explore new building and construction ideas and concepts, new materials implementation, design solutions testing, developing new technologies and adapting products and systems innovations to a local context culturally, economically and socially (Nystrom, et al. 2000). An educational aspect of the project, in the form of a design studio, is concentrated on developing and supporting sustainable living practices. An architectural input is focused on the definition of a sustainable living environment

and design practice, exploring students' interactions in the design process, construction and use of housing units while efficiently optimizing consumption of energy and other resources.

Important design considerations of the project include:

- Implementing research and empirical experience into design practice;
- Optimizing research, design and testing processes;
- Investigating industry needs and demands;
- Outlining possible project involvement benefits for investors, industry and academia.

Educational engagement of the project will include *Building Functions Analysis* studies in a full-scale laboratory in the form of on-campus student housing. The emphasis will be given to the role of designers and design education in facilitating academic methodologies, offering benefits of hands-on learning and real-time experimenting to students. The discussed research and educational approach mainly concerns full-scale research house studies (sustainable living environments) with an integrated instant design reviewing process. Uninterrupted feed-back by users is essential for optimizing design considerations and for advancing research in the test environment.

The paper also briefly discusses a critical interpretation of social, economic and environmental sustainability of contemporary design processes, moving towards a changing professional role and discourse within and between disciplines. It is recognized that the introduction of collaborative processes that promotes critical reflection is vital to applying sustainable practices to everyday life. There is however, a lack of effective communication between "users" (or clients) and "professionals" (Architects). Shaping those links by providing research in design and learning through building opportunities, along with creating new advanced outreach prospects for architects, are key steps towards new sustainable architectural practices. Applications analysis should be examined not only as final results but with an emphasis on human factors, systems and elements' relationships and inter-dependability in the context of the whole process. Based on the knowledge gained, a design and planning process is proposed to optimize sustainability approaches being put into practice.

## 1.0 CONCEPTS AND HYPOTHESES

Social, cultural, and even political aspects have to be addressed in the overall planning and throughout a design process. These present a high degree of design functionality, with a tendency to demand an adaptation from inhabitants to the technology. These aspects of human being correspond to multiple facets of sustainability and of course to sustainable design and planning in architectural practice. Sustainability as a definition was first mentioned in the very well-known Brundtland commission report in 1987:

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

It contains two key concepts:

- the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and
- the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.

(Brundtland 1987)

The adoption of sustainable practices and strategies remains a main challenge, with slow structural changes in mainstream society, including the building industry, as well as several psychological barriers (Gifford 2011). Imposing a sustainably adapted environment on inhabitants without connecting it to their social and psychological background may create resistive behavioural patterns. People tend to refuse to accept new environmental conditions if they are not properly informed before those conditions are introduced to them and become part of their life (Steg, van den Berg and de Groot 2012).

The three major theories for enabling sustainable practices into the built environment are to be tested and evaluated throughout the execution of the project include:

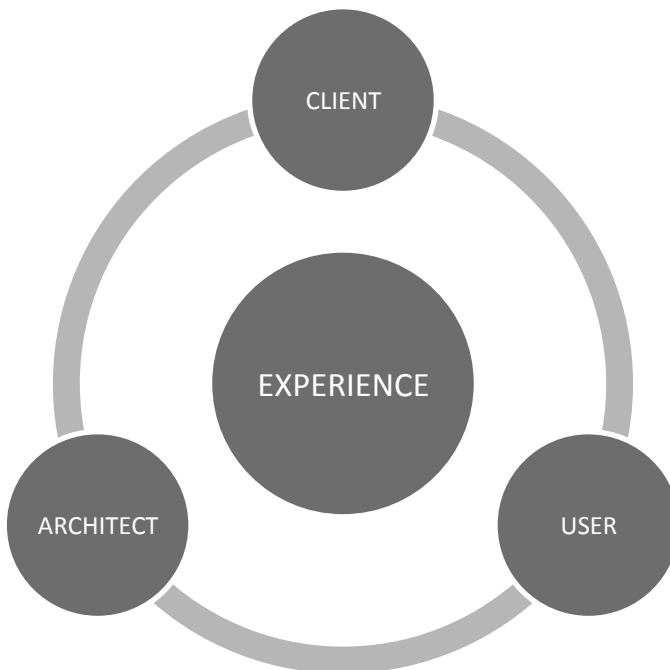
- Improving design practices: experiencing all stages of designing, building and living would help future designers and architects to implement sustainable practices more successfully;
- Shaping sustainable lifestyles: the built environment may influence personal and group lifestyle towards sustainable living;
- Applying advanced technologies: application of advanced technologies into design solutions facilitates awareness of essential and unnecessary living demands and helps to shape sustainable strategies.

### 1.1. Improving design practices

There are two common values for architecture as a discipline: the use of the system of elements of the project, and design itself (Benjamin 2001). The first value implies a purpose of offering the user/client profits from the practical advantage and planned effect of the system. The second value is to deliver design with the deliberate effect and results that it provides the user/client with anticipated practical advantages. This may include: functionality of systems and interior arrangements, cost effectiveness and aesthetics. The final product – design of a home or other types of residential facilities cannot be considered as a successful experience unless the design also satisfies client’s needs or expectations.

Architecture is interdisciplinary by its nature and the architects’ main role is to make sure all elements of the project receive the appropriate amount of attention and apply that knowledge to the design. The architect can be considered as an “attending physician, who, though using the expertise of the physiologist, radiotherapist, or bacteriologist, is the only person who can actually undertake the treatment of a case” (Fathy 1986). This means that an architect should be able to summarize knowledge, experience, and expertise and apply it to the design process.

This participatory architectural and design process is to be implemented into the studio course, where students will experience all of its instances: as a client, an architect and a user (Fig. 1). A regular feedback during the design, build and living in the designed units is an important element of the process when students evaluate their decisions and see if those decisions offer benefits (or not) for their everyday life.



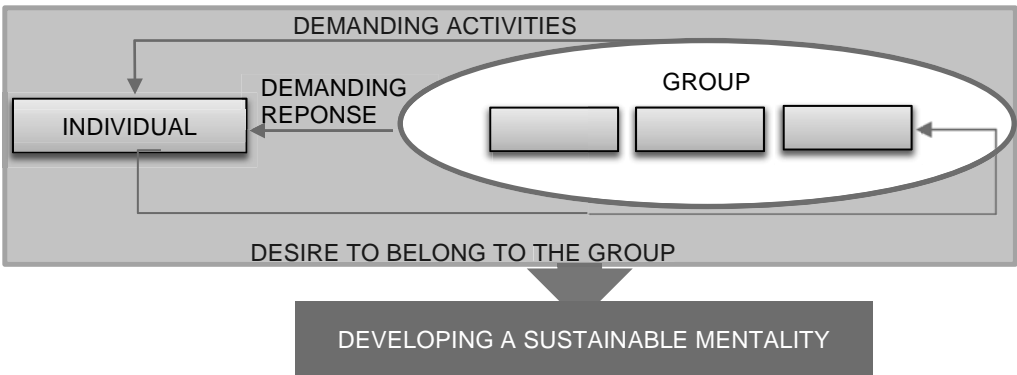
**Figure 1:** Collaborative efforts provide inclusive experience.

**1.2. Shaping sustainable lifestyle**

One of the major goals of connecting educational and built environments is to produce knowledge to advance and shape new sustainable lifestyles. Several strategies can be used in order to achieve that: information distribution, goal orienting, individual or group commitment obtaining, feedback on individual or group performance. But some psychological theories emphasize that informative techniques are not very effective if used alone (Staats, Wit and Midden 1996). Therefore a combination of strategies tend to be more effective in promoting sustainable behavior.

Discussions with students during preliminary workshop sessions that are described in this paper in the “Methods and approaches” section, confirmed that a “*combination of strategies*” theory exists, and revealed the importance of personal awareness of individual and group sustainable actions. Students also emphasized that proactive, and even demanding behavior, should play a positive role in pushing individuals to join a sustainable lifestyle that was promoted by their roommates.

An Important part in the process of shaping a sustainable lifestyle is creating a collaborative strategy towards optimized resources utilization. Implementing advanced technology in design affords a means for informing and coordinating residents’ responsible efforts, helping people to make conservative choices to become a part of their everyday routine (Fig. 2). Figure 2 depicts the basic level of essential relationships between an individual and a group, some of them may be present periodically while others belong to common attributes of human behavior.



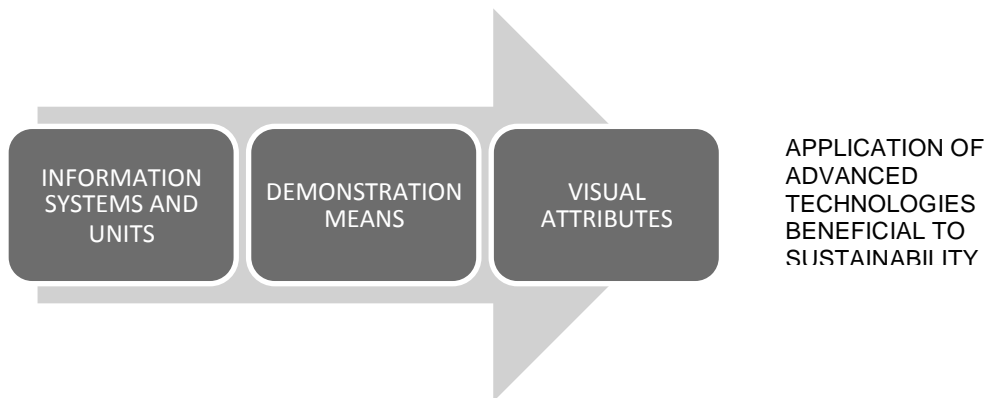
**Figure 2:** Individual and group relationships shaping sustainable behaviour.

It is important to consider a possible influence of human error or undesirable behavior, therefore relaying information about successful sustainable practices back to residents is also fundamental.

**1.3. Applying advanced technologies**

The idea of the Living Lab research project is to create an adaptable design of student housing units for testing new science and technology. The structure has to be flexible and intelligent enough to be able to accommodate various technological innovations in the building envelope and engineering systems and to implement sustainable principles into the project. An important part of the project process is analyzing and revising design solutions throughout the testing and building stages. Students’ involvement will include input on their everyday activities and usage of available spaces and resources; and testing living qualities of facilities after they are built. This approach presents hands-on learning opportunity for students and teachers, encouraging them to work together as a team to achieve the most optimized design and technological solutions.

The transdisciplinary nature of the project affords productive cooperation and almost instant application and testing of new materials, techniques and technologies both from industries and in cooperation with research teams within Chalmers University. The design will incorporate adjustability and will also provide opportunities for testing of experimental structural elements and technological innovations. A combination of these measures aims to provide a versatile platform for hands-on research and real-time applications of sustainable practices and technologies as well as evaluation of their performance throughout the lifespan of the structure (Fig.3).



**Figure 3:** Application of advanced technologies that are beneficial to sustainable development.

## 2.0. METHODS AND APPROACHES

In his "Designerly ways of knowing" Nigel Cross compares scientific, humanistic and designer problem solving approaches (Cross 1982). It can be helpful for identifying areas of cross-disciplinary between architecture, engineering, social and psychological studies. In discussion of Lawson's studies of design behavior Cross concludes that: "These experiments suggest that scientists problem-solve by analysis, whereas designers problem-solve by synthesis."

An ultimate goal of any design process depends on the successful definition of a design research problem, which always lays in finding a proper "translation from individual, organizational and social needs to physical artefacts" (Hillier and Leaman 1976). An applied testing and evaluating research approach is based on the collection of data from students' surveys, professionals' interviews, workshops and the construction and testing of design settings. The initial process is split into two stages: collecting data to make design assumptions; and testing and evaluating their implementation into design. Evolutionally, that will develop into proposing collective ways of implementing new design and living approaches into practice.

### 2.1. Data collection

In preparation for the studies, empirical data on students' daily living activities has been collected and analysed through a series of workshops and surveys in the form of activity diaries at the Architectural department of Chalmers University of Technology and the College of Architecture of the University of Houston (overall n=19). Preliminary data from student diaries at both universities were collected in December 2012 followed by workshops organized at Chalmers University in December 2012 and May 2013. Collected qualitative data on students' needs, activities and energy and resources requirements have been cross-analysed in regards to both current functional understanding and in a modified and/or extreme situation. A discussion of human factor conditions (physical, organizational or behavioural prerequisites) forms the starting point for student projects exploring alternative configurations for amelioration and optimization of living functions from a residential quality perspective as well as the radical reduction of energy- and resource consumption (Table 1). Table 1 represents classification of functions and activities based on personal preferences in sharing spaces and things while performing them. The particular inquiry of shared or private use is deemed relevant in the



context of energy and material resources, where a more sustainable living approach is to go towards smart collaborative uses of space and various home goods. It is recognized that personal perceptions related to this depends on geographical locations, cultural and religious beliefs, age and social status; and those conditions may alter the results.

The participating students demonstrated differential understanding and presumptions of collective and private values. For example, even though students belonged to the same age group and had relatively similar disciplinary background, their demand for privacy diverged, most likely based on cultural and social specifics and housing situation. This was further underpinned at two workshops held with respondents at Chalmers only.

Collected data are not quantitative but rather based on students' qualitative impressions and recognition. It resulted in the functional breakdown of student housing according to: 1) Grouping of activities and human functions; 2) Levels of private or shared use of space and resources 3) Defined or perceived corresponding spatial, energy and resource requirements.

**Table 1:** Basic functions and activities related to acceptance of sharing.

<i>Sharing \ Activity</i>	<i>Sleeping</i>	<i>Eating</i>	<i>Housekeeping/ cooking</i>	<i>Studying</i>	<i>Hygiene</i>	<i>Recreation</i>
<i>Collective (sharing activity and resources)</i>	No	Yes	Yes	Yes	Not likely	Yes
<i>Individual/ sharing resources</i>	Maybe	Maybe	Maybe	Yes	Not likely	Maybe
<i>Private/ not sharing at all</i>	Yes	Not likely	Maybe	Not likely	Yes	Not likely

**2.2. Design assumptions**

Students' surveys of daily activities and usage of spaces and places are used to make initial design assumptions that lead to developing a facility program. This stage also incorporates a participatory approach with inputs from clients, designers and future residents.

This stage of the project includes identification and classification of elements of the structure by their flexibility characteristics (if they can be replaced or modified with new features for testing alternative design solutions during the course of the project development) (Table 2):

- Elements of building envelope that are subject to modifications;
- Transformable elements of interior architecture;
- Upgradable equipment and engineering devices;
- Elements of building envelope that are stationary;
- Interior components that are fixed in place;
- Equipment and engineering elements that is not upgradable and cannot be replaced.

**Table 2:** Classification of building elements.

<i>Elements \ Characteristics</i>	<i>Building Envelope</i>	<i>Interior Architecture</i>	<i>Equipment/ Engineering</i>
<i>Fixed</i>	<i>Foundation, roofing (support structure), insulation, external walls.</i>	<i>Some kitchen and bathroom utilities and fixtures, fire place, stairs</i>	<i>Plumbing, air ducts, mechanical equipment, power sources</i>

<i>Adjustable/ Replaceable</i>	<i>Doors, windows, glazing</i>	<i>Internal walls, flooring &amp; ceiling finishing, sound insulation, lighting</i>	<i>Electrical, lighting, communication &amp; control systems</i>
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These assumptions lead to suggestive design where technological improvements may be tested and define up to what extend they can be implemented into living environments.

### 2.3. Study design

A proposed design studio will be project-oriented and scheduled accordingly. The table 3 below summarizes some of the issues that have to be resolved before the semester starts, for example, a criteria for students selection process has to be established. It will be necessary though that a mixed group of students involved in design process will be residents of the unit. Students will have to conduct research of design solutions for sustainable housing, implement them in their studio project – a unit within the larger Living Lab– test them and propose and apply design adjustments during the course of living in the unit. It is suggested that each studio project will be a -semester-by-semester endeavour and each consecutive year a new group of students will evaluate previous design and repeat the process.

Expected learning outcome after completion of the studio would include:

- Knowledge gained
  - understanding of essential human needs in context of enhancing sustainable practices
  - better understanding of relationships between social, cultural, other personal background and physical environment.
  - collecting knowledge about sustainable technological innovations and their integration into housing design.
  - learning about technology transfer from non-housing related disciplines and how they can be implemented into design practices.
- Adopted skills
  - ability to define potential problems of technological integration
  - ability to explain their design solutions between disciplines and efficiently perform teamwork with them.
  - be able to handle, classify and document large amounts of information
  - demonstrate ability to transform information and data into knowledge
  - work with the whole design process from problem definition, analysis and synthesis including design solution/proposals.
  - be able to visualize and communicate ideas and solutions.
  - understand systems analysis as a design tool.

### CONCLUSION

Anticipated outcomes of the proposed research as part of the design studio and in connection with the Living Lab project are expected to be beneficial for students, researchers and industry. An emphasis is given to sustainable practices to stimulate responsible lifestyles among inhabitants and therefore shape future living environments. The radical reduction of residential energy and resource consumption may be achieved by a combination of strategies including relaying information to residents about the benefits of sustainable strategies and processes in context of spatial and material conditions. Cognitive and social strategies among residents as well as designers in creating or upholding sustainable living environments should be further explored. An iterative *Research By Design* and *Design With Users* processes can be developed and further studied by creation of a studio within the overall Living Lab housing structure where students are designers, builders, as well as residents.

Experiencing from the 'inside' and mapping such experiences based on spatial, social, economic and time requirements is essential for creating consistent sustainable practices (Yaneva 2011). A participatory design process can provide a foundation for responsible living and the recognition that sustainable practices are economic and environmental benefits.

The table below illustrates categorizing and summarizing the method applied to analyzing some of the issues that were discussed during students' workshops and that have to be included into the Living Lab project process. The method is based on a user-centred approach, mapping individual and joint activities and home functions (Table 3). Some of the issues will have to be addressed and solved before the programming stage of the project. For example, financial, legal and other official permissions and agreements should be obtained prior to students' signing-in process and before the beginning of the semester when this studio project will be conducted.

**Table 3:** Classification of design tasks.

<i>Issues</i>		<i>Issues</i>	
<i>Student involvement</i>	<i>Who do we want to attract?</i>	<i>Structure/building</i>	<i>Envelop elements testing: what, how, when</i>
	<i>Only students or are friends also allowed?</i>		<i>Including spaces for lounging for the whole building</i>
	<i>Criteria for grouping people who will be living there</i>		<i>Measure impact changing envelope elements on heating/cooling</i>
	<i>Co-gender groups or mixed</i>		<i>How much change/not change in surroundings</i>
	<i>Mixed ages or different year students allowed?</i>		<i>What's changing with the environment? (e.g. Fire codes)</i>
<i>Organizational</i>	<i>Type of rental contract (timing, aligning with students' needs)</i>	<i>Layout</i>	<i>Living room wasted space? If the kitchen shared – is there need for a living room?</i>
	<i>Maintenance: who does what?</i>		<i>Kitchen is the "core" of home?</i>
	<i>Insurance</i>		<i>Neutral spaces are needed for meetings</i>
	<i>Rules and regulations</i>		<i>Multifunctional spaces: cooking/eating, library, something else?</i>
	<i>Security</i>		<i>Changeable interior walls and interior blocks</i>
<i>Social</i>	<i>Living with friends: groups up to 24 / strangers: no more than 4</i>	<i>Lifestyle</i>	<i>What to share and how?</i>
	<i>Accessible place to socialize</i>		<i>Recycling or sharing</i>
	<i>Creating positive and sustainable dominant living practices</i>		<i>Challenge laziness</i>

Future development of the project proposes expansion of research in different contexts possibly outside of Sweden and involving faculty and students from the University of Houston (Houston, Texas) and Universities of Bondo and Maseno (Kenya) where next stages of project development may be performed and tested by local students. This international context would bring more levels of understanding of human behavior in relation to built environment and

involvement of international architectural students and researches would facilitate improvement of design practices. It will give students an opportunity to:

- Synthesize professional experience from different settings;
- Learn and integrate innovative solutions into diverse design projects;
- Test proposed sustainable design approaches in different cultural, social and climate conditions;
- Optimize sustainable design practices for better and faster applications in various environments.

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<sup>1</sup> <http://suslab.eu/partners/chalmers-th/hsb-living-lab/>

Our increased awareness of the multiplicity of the deep and broad connections between mental, physical and metaphysical constructs leads us to rethink the autonomy and insularity of disciplinary structure.

Considering that the formation, naming development, and institutionalization of disciplines have, and have had, pragmatic, political and instrumental purposes, it now appears that such applications are also limiting in a world demanding more interconnectivities and transactions.

In the conference, we investigate: why is a new transformed structure of thinking and practice emerging now? What forms should a restructured knowledge and praxis take in the re-disciplining of architecture? What benefits might arise from such new constellations of thought and action? What might we lose, or forget? What is the impact for the future profession and body of architecture?

