HP Smith Courts
Detailed Engineering Evaluation Report

BU 0677-001 EQ2 - Block A Quantitative
BU 0677-003 EQ2 - Block B Quantitative
BU 0677-004 EQ2 - Block C Qualitative
BU 0677-002 EQ2 - Residents' Lounge Qualitative

Prepared for Christchurch City Council (Client)

By Beca Carter Hollings & Ferner Ltd (Beca)

5 August 2014

Revision History

Revision Nº	Prepared By	Description	Date
A	Andrew Franklin	Draft for CCC review	12 April 2013
B	Andrew Franklin	Final	20 April 2013
C	Hollie Friesen	Revised Draft for Precast Panel Connection Inspections	9 May 2014
D	Hollie Friesen Zahid Hanif	Updated Draft for CCC Review: Additional Damage Block B	20 June 2014
E	Zahid Hanif	Major changes after Rev C highlighted with a sidebar. Commentary on Level and Verticality Survey added. Implications of damage expanded due to further damage revealed during Opus inspection. Other minor changes to report structure.	4 July 2014
F	Zahid Hanif	Final Issue	5 August 2014

Document Acceptance

Action	Name	Signed	Date
Prepared by	Zahid Hanif		5 August 2014
Reviewed by	David Whittaker		5 August 2014
Approved by	David Whittaker		5 August 2014
on behalf of	Beca Carter Hollings & Ferner Ltd		

HP Smith Courts
BU 0677 EQ2

Detailed Engineering Evaluation
Qualitative and Quantitative Report – SUMMARY
Version 1

Address
56 Avalon St
Richmond
Christchurch

Background

This report has been updated to take into account inspections carried out on the 7 October 2013, 21 November 2013 and 28 May 2014.

This is a summary of the Qualitative and Quantitative Assessment reports for the building structures located at 56 Avalon Street, Richmond, Christchurch and is based on the document '*Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury – Part 2 Evaluation Procedure*' (draft) issued by the Engineering Advisory Group (EAG) on 19 July 2011.

The format and content of this report follows a template provided by Christchurch City Council (CCC), which is based on the EAG document.

A set of architectural drawings by Beechy Duder Constructions Ltd dated 1983 and structural drawings by Warren R Lewis dated 1984 were made available.

Block A and Block B

Block A and Block B are two storey buildings built in 1985 with an approximate internal floor area of 400m^2 each. Each block comprises four ground floor and four first floor residential units. The primary structural system is precast reinforced concrete tilt panels. The roof consists of chip coated metal tiles on timber battens, timber beams and timber trusses. The first floor is 175mm thick reinforced concrete slab. Calculations have been undertaken as part of the Quantitative Assessment.

Block C

Block C is a single storey building built in 1985 with an approximate floor area of 80m^2 internally. The block consists of two units separated by a precast reinforced concrete firewall. The primary structural systems comprise GIB-lined, timber-framed walls with concrete masonry block veneer cladding and a precast reinforced concrete tilt panel. The roof consists of chip coated metal tiles on timber battens, timber beams and timber trusses. No calculations were carried out as part of the qualitative assessment.

Residents' Lounge

Residents' Lounge is a single storey building built in 1985 with an approximate internal floor area of 63m^2. The primary structural system comprises GIB lined, timber-framed walls with concrete masonry block veneer and timber weatherboard cladding. The roof consists of chip coated metal tiles on timber battens, timber beams and timber trusses. No calculations were carried out as part of the qualitative assessment.

Key Damage Observed

Visual inspections on 12 December 2012, and follow up inspections of some precast panel connections on 7 October 2013, 21 November 2013 and 28 May 2014, indicate the buildings have suffered minor earthquake damage except for Units 11/12 (Block B) which has suffered significant earthquake damage to first floor slab-wall connections. The key damage observed includes:

Block A

- Cracking to precast reinforced concrete walls.
- Cracking and separation of internal wall and ceiling linings.
- Tilt / residual displacement of precast reinforced concrete wall.

Block B

- Cracking to precast reinforced concrete walls.
- Cracking and separation of internal wall and ceiling linings.
- Tilt / residual displacement of precast reinforced concrete wall.
- Buckled timber weatherboard cladding.
- Failure of first floor slab to wall cast-in inserts for main dividing wall (between units 11/12 and 13/14), 12mm gap observed.

Block C

- Horizontal cracks to the mortar joints of concrete masonry block veneer along the length of the rear wall.
- Possible minor differential settlement of building and settlement of external ground.

Residents' Lounge

- Minor separation of ceiling lining and cornice.
- Horizontal cracks to the mortar joints of the concrete masonry block veneer.

Level and Verticality Survey

A level and verticality survey was undertaken on 26 November 2013. Refer to Appendix F for drawings. The verticality survey date indicates the walls are tilting predominantly towards the west. Precast wall panels are found to be tilting both in-plane and out of plane. The tilting of the precast walls is consistent with the trend in floor levels. Variation in floor levels exceeds 0.5% slope (1 in 200) in many single units. In Block B, the western precast wall has a maximum of 46 mm tilt out of plane.

Additional Damage found during Intrusive Investigation

Opus carried out some intrusive investigations on 14 May 2014 and additional damage was found in Block B. The precast wall dividing units 11/12 and 13/14 has separated from the concrete slab at level 1 of Units 11/12; the connection between these elements has failed. As a result Block B was closed; follow up inspections in Block A of the same area show no damage. Refer to Appendix G for full site report by Opus.

Review of the Level and Verticality survey indicates that tilt and differential settlement of Block B is likely to be damage caused by the earthquakes.

Critical Structural Weaknesses (CSW)

The following Critical Structural Weaknesses have been identified:

- Site characteristics, due to liquefaction potential.
- Connections of first floor slab to precast wall panels are considered CSW due to brittle failure of connections in Units 11/12 and vulnerability to differential settlement.
- Damaged first floor slab of Units 11/12 (Block B) is a collapse hazard due to the damaged connections and loss of support..

Indicative Building Strength

Block A (From Quantitative Assessment)

The building has been assessed to have an indicative seismic capacity of 35%NBS using the New Zealand Society for Earthquake Engineering (NZSEE) Detailed Assessment guideline ‘Assessment and Improvement of the Structural Performance of Buildings in Earthquakes’ (AISPBE), 2006, and is therefore Earthquake Risk and classified as Seismic Grade C.

The structural damage observed is predominantly minor and the seismic capacity is not considered to have significantly diminished from its pre-earthquake level.

Our assessment has identified the structural components that have governed/limited the buildings’ seismic performance, and their potential failure mechanisms, are as follows:

- Ground floor precast concrete wall in-plane loading in the longitudinal direction, 35%NBS, governed by tension reinforcement.
- Foundations in the transverse directions, 35%NBS, governed by overturning.
- Precast panel connections to foundations, 35%NBS, based on weld details observed during intrusive investigations.
- Precast panel connection to level 1 slab, 35%NBS, based on down-rating for the brittle mechanism and differential settlement.

Block B (From Quantitative Assessment)

The building has been assessed to have a seismic capacity of less than 10*%NBS* governed by the residual capacity of the damaged connection between precast wall and first floor slab in Units 11/12 and is therefore considered as Earthquake Prone and classified as Seismic Grade E.

The first floor slab in Units 11-12 Block B has damaged connections to the supporting walls and as a result this is considered a collapse hazard and to be earthquake prone. This connection along the main dividing wall has failed in a brittle manner, most likely when subjected to the differential settlement between the two parts of the block on either side of this main dividing wall.

Our assessment has identified the structural components that have governed/limited the buildings’ seismic performance, and their potential failure mechanisms, are as follows:

- Failure of the connection between precast wall and first floor slab in Units 11/12 along the main dividing wall. The first floor slab is connected to multiple precast walls and the residual capacity of the damaged slab-wall connection is assessed to be less than 10%*NBS*.
- Ground floor precast concrete wall in-plane loading in the longitudinal direction, 35%*NBS*, governed by tension reinforcement.
- Foundations in the transverse directions, 35%*NBS*, governed by overturning.
- Precast panel connections to foundations, 35%*NBS*, based on weld details observed during intrusive investigations.
- Precast panel connection to level 1 slab, 35%NBS, based on down-rating for the brittle mechanism and differential settlement.

Block C (From Qualitative Assessment)

The Block C building has been assessed to have a seismic capacity of 50%*NBS* using the NZSEE Initial Evaluation Procedure (IEP) and is therefore classified as Earthquake Risk and Seismic Grade C.

Residents’ Lounge (From Qualitative Assessment)

The Residents’ Lounge building has been assessed to have a seismic capacity of 83% NBS using the NZSEE Initial Evaluation Procedure (IEP) and is therefore not classified as Earthquake Risk and Seismic Grade A.

Recommendations

In order for the owner to make an informed decision about the on-going use and occupancy of their building the following information is presented in line with the Department of Building and Housing document ‘Guidance for engineers assessing the seismic performance of non-residential and multi-unit residential buildings in greater Christchurch’, June 2012.

We have given due consideration to observed damage and Level and Verticality Survey while commenting on the occupancy of the buildings.

Block A

The building is considered to be earthquake risk, having a quantitatively assessed capacity between 34% and 67%*NBS*. The risk of collapse of an earthquake risk building is considered to be 5 to 10 times greater than that of an equivalent new building.

No significant damage or hazards were identified to seismic or gravity load resisting system that would reduce its ability to resist further loads.

It is recommended that:

- No restriction on use or occupancy is necessary.
- A full damage assessment is carried out for insurance purposes.
  - The results of the verticality and level survey should be considered further in relation to the damage investigations and observations. These results are considered likely to have resulted from earthquake settlement of the building. Further investigation as part of a damage inspection should be carried out to determine if this movement recorded has caused damage to the structure, that may be hidden, that has not yet been identified.
- Strengthening of first floor slab to precast wall panel connection is strongly recommended.

Block B

The building has been assessed to have a seismic capacity of less than 10%*NBS* governed by the residual capacity of the damaged/failed connection between precast wall and first floor slab in Units 11/12.

The damaged first floor slab in Units 11-12 Block B is considered a collapse hazard and earthquake prone. This connection has failed in a brittle manner, most likely when subjected to the differential settlement between the two parts of the block on either side of this main dividing wall.

Out of level and tilt indicated by the survey is consistent with the structural damage to the building including separation of first floor from wall and is considered to be caused by the earthquakes.

The building has suffered damage to the seismic and gravity load resisting system that is sufficient to impair or significantly reduce the ability to resist further loads. It is in a condition under which further deterioration may be expected in future aftershocks. The building should be repaired as soon as possible.

It is recommended that:

- The building is not occupied until the damage has been repaired.
- The damaged connection between the precast wall panel and the first floor slab in Units 11/12 is repaired.
- Strengthening of first floor slab to precast wall panel connection in all units is strongly recommended.
- A full damage assessment is carried out for insurance purposes.
  - The results of the verticality and level survey should be considered further in relation to the damage investigations and observations. The measured tilt and differential settlement are considered likely to have resulted from earthquake shaking. Further investigation as part of a damage inspection should be carried out to determine if this movement recorded has caused additional damage to the structure, that may be hidden, and not yet identified.

Block C

The building is considered to be earthquake risk, having a quantitatively assessed capacity of between 34% and 67%*NBS*. The risk of collapse of an earthquake risk building is considered to be 5 to 10 times greater than that of an equivalent new building.

No significant damage or hazards were identified to the seismic or gravity load resisting system that would reduce its ability to resist further loads.

It is recommended that:

- No restriction on use or occupancy is necessary.

- A full damage assessment is carried out for insurance purposes.
    - The results of level survey should be considered further in relation to the damage investigations and observations to determine significance and extent of any settlement of the building.
- Intrusive investigation is carried out to determine whether the concrete masonry block veneer has ties to the timber framing.

Residents' Lounge

The Residents' Lounge is not considered to be potentially earthquake risk or potentially earthquake prone, having a qualitatively assessed capacity greater than 67*%NBS*. The risk of collapse of an earthquake risk building is considered to be 1 to 2 times greater than that of an equivalent new building.

No significant damage or hazards were identified to the seismic or gravity load resisting system that would reduce its ability to resist further loads.

It is recommended that:

- No restriction on use or occupancy is necessary.
- A full damage assessment is carried out for insurance purposes.
    - The results of level survey should be considered further in relation to the damage investigations and observations to determine significance and extent of any settlement of the building.
- Intrusive investigation is carried out to determine whether the concrete masonry block veneer has ties to the timber framing.

Damage Reinstatement

According to the recent CCC Instructions to Engineers document (16 October 2012), Council's insurance provides for repairing damaged elements to a condition substantially as new. We suggest you consult further with your insurance advisor.

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Appendices

1 Background

This report has been updated to take into account inspections carried out on the 7 October 2013, 21 November 2013 and 28 May 2014.

Beca Carter Hollings & Ferner Ltd (Beca) has been engaged by Christchurch City Council (CCC) to undertake either a Qualitative or Quantitative Detailed Engineering Evaluation (DEE) of the four buildings at HP Smith Courts, 56 Avalon St, Richmond, Christchurch.

This report is a Qualitative DEE of Block C and the Residents' Lounge building structures and a Quantitative DEE of Block A and Block B building structures, and is based on the document 'Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury – Part 2 Evaluation Procedure' (draft) issued by the Engineering Advisory Group (EAG) on 19 July 2011.

A Qualitative DEE involves inspections of the building, a desktop review of existing structural and geotechnical information, including existing drawings and calculations, if available and an assessment of the level of seismic capacity against current code using the Initial Evaluation Procedure (IEP).

A Quantitative DEE involves analytical calculations of the building's strength and may involve material testing, geotechnical testing and intrusive investigation.

The purpose of these assessments is to determine the likely building performance and damage patterns, to identify any potential Critical Structural Weaknesses (CSW) or collapse hazards, and to make an assessment of the likely building strength in terms of percentage of New Building Standard (%NBS).

A set of architectural and structural drawings was made available and has been used in our assessment of the buildings. The building descriptions below are based on a review of the drawings and our visual inspections.

The format and content of this report follows a template provided by CCC, which is based on the EAG document.

2 Compliance

This section contains a brief summary of the requirements of the various statutes and authorities that control activities in relation to buildings in Christchurch at present.

2.1 Canterbury Earthquake Recovery Authority (CERA)

CERA was established on 28 March 2011 to take control of the recovery of Christchurch using powers established by the Canterbury Earthquake Recovery Act enacted on 18 April 2011. This act gives the Chief Executive Officer of CERA wide powers in relation to building safety, demolition and repair. Two relevant sections are:

Section 38 – Works

This section outlines a process in which the chief executive can give notice that a building is to be demolished and if the owner does not carry out the demolition, the chief executive can commission the demolition and recover the costs from the owner or by placing a charge on the owners' land.

Section 51 – Requiring Structural Survey

This section enables the chief executive to require a building owner, insurer or mortgagee carry out a full structural survey before the building is re-occupied.

We understand that CERA will require a detailed engineering evaluation to be carried out for all buildings (other than those exempt from the Earthquake Prone Building definition in the Building Act). It is understood that CERA is adopting the Detailed Engineering Evaluation Procedure document (draft) issued by the Engineering Advisory Group on 19 July 2011, which sets out a methodology for both qualitative and quantitative assessments. We understand this report will be used in response to CERA Section 51.

The qualitative assessment includes a thorough visual inspection of the building coupled with a desktop review of available documentation such as drawings, specifications and IEP's. The quantitative assessment involves analytical calculation of the building's strength and may require non-destructive or destructive material testing, geotechnical testing and intrusive investigation.

It is anticipated that factors determining the extent of evaluation and strengthening level required will include:

- The importance level and occupancy of the building.
- The placard status that was assigned during the state of emergency following the 22 February 2011 earthquake.
- The age and structural type of the building.
- Consideration of any Critical Structural Weaknesses.
- The extent of any earthquake damage.

2.2 Building Act

Several sections of the Building Act are relevant when considering structural requirements:

Section 112 – Alterations

This section requires that an existing building complies with the relevant sections of the Building Code to at least the extent that it did prior to any alteration. This effectively means that a building cannot be weakened as a result of an alteration (including partial demolition).

Section 115 – Change of Use

This section requires that the territorial authority (in this case Christchurch City Council (CCC)) be satisfied that the building with a new use complies with the relevant sections of the Building Code 'as near as is reasonably practicable'. Regarding seismic capacity 'as near as reasonably practicable' has previously been interpreted by CCC as achieving a minimum of 67%NBS however where practical achieving 100%NBS is desirable. The New Zealand Society for Earthquake Engineering (NZSEE) recommend a minimum of 67%NBS.

Section 121 – Dangerous Buildings

The definition of dangerous building in the Act was extended by the Canterbury Earthquake (Building Act) Order 2010, and it now defines a building as dangerous if:

- In the ordinary course of events (excluding the occurrence of an earthquake), the building is likely to cause injury or death or damage to other property; or
- In the event of fire, injury or death to any persons in the building or on other property is likely because of fire hazard or the occupancy of the building; or

- There is a risk that the building could collapse or otherwise cause injury or death as a result of earthquake shaking that is less than a ‘moderate earthquake’ (refer to Section 122 below); or
- There is a risk that that other property could collapse or otherwise cause injury or death; or
- A territorial authority has not been able to undertake an inspection to determine whether the building is dangerous.

Section 122 – Earthquake Prone Buildings

This section defines a building as earthquake prone if its ultimate capacity would be exceeded in a ‘moderate earthquake’ and it would be likely to collapse causing injury or death, or damage to other property. A moderate earthquake is defined by the building regulations as one that would generate ground shaking 33% of the shaking used to design an equivalent new building.

Section 124 – Powers of Territorial Authorities

This section gives the territorial authority the power to require strengthening work within specified timeframes or to close and prevent occupancy to any building defined as dangerous or earthquake prone.

Section 131 – Earthquake Prone Building Policy

This section requires the territorial authority to adopt a specific policy for earthquake prone, dangerous and insanitary buildings.

2.3 Christchurch City Council Policy

Christchurch City Council adopted their Earthquake Prone, Dangerous and Insanitary Building Policy in 2006. This policy was amended immediately following the Darfield Earthquake of the 4th September 2010.

The 2010 amendment includes the following:

- A process for identifying, categorising and prioritising Earthquake Prone Buildings, commencing on 1 July 2012;
- A strengthening target level of 67% of a new building for buildings that are Earthquake Prone;
- A timeframe of 15-30 years for Earthquake Prone Buildings to be strengthened; and,
- Repair works for buildings damaged by earthquakes will be required to comply with the above.

The council has stated their willingness to consider retrofit proposals on a case by case basis, considering the economic impact of such a retrofit.

It is understood that any building with a capacity of less than 33%NBS (including consideration of Critical Structural Weaknesses) will need to be strengthened to a target of 67%NBS of new building standard as recommended by the Policy.

If strengthening works are undertaken, a building consent will be required. A requirement of the consent will require upgrade of the building to comply ‘as near as is reasonably practicable’ with:

- The accessibility requirements of the Building Code.
- The fire requirements of the Building Code. This is likely to require a fire report to be submitted with the building consent application.

2.4 Building Code

The building code outlines performance standards for buildings and the Building Act requires that all new buildings comply with this code. Compliance Documents published by The Department of Building and Housing can be used to demonstrate compliance with the Building Code.

On 19 May 2011, Compliance Document B1: Structure was amended to include increased seismic design requirements for Canterbury as follows:

a. Hazard Factor increased from 0.22 to 0.3 (36% increase in the basic seismic design load)

b. Serviceability Return Period Factor increased from 0.25 to 0.33 (80% increase in the serviceability design loads when combined with the Hazard Factor increase)

The increase in the above factors has resulted in a reduction in the level of compliance of an existing building relative to a new building despite the capacity of the existing building not changing.

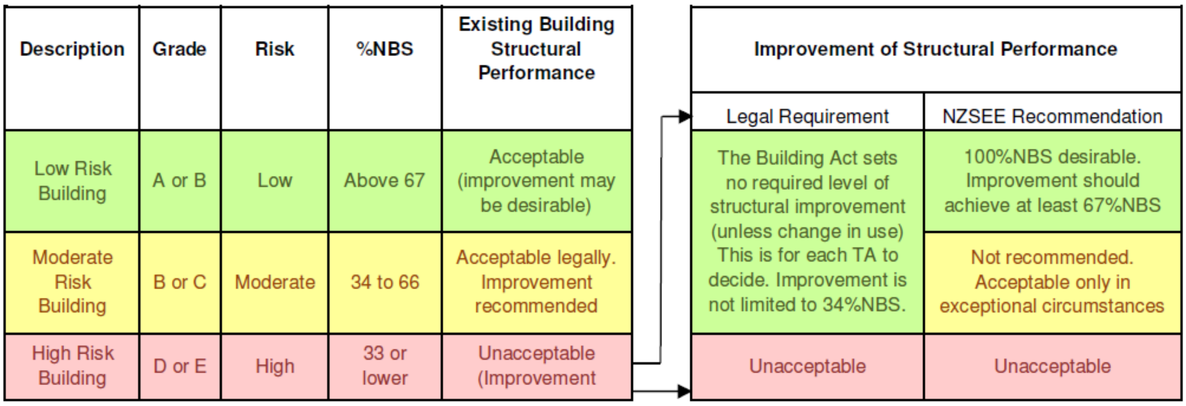
3 Earthquake Resistance Standards

For this assessment, the building's Ultimate Limit State earthquake resistance is compared with the current New Zealand Building Code requirements for a new building constructed on the site. This is expressed as a percentage of New Building Standard (%NBS). The new building standard load requirements have been determined in accordance with the current earthquake loading standard (NZS 1170.5:2004 Structural design actions - Earthquake actions - New Zealand).

No consideration has been given at this stage to checking the level of compliance against the increased Serviceability Limit State requirements.

The likely ultimate capacity of this building has been derived in accordance with the New Zealand Society for Earthquake Engineering (NZSEE) guidelines 'Assessment and Improvement of the Structural Performance of Buildings in Earthquakes' (AISPBE), 2006. These guidelines provide an Initial Evaluation Procedure that assesses a building's capacity based on a comparison of loading codes from when the building was designed and currently. It is a quick high-level procedure that can be used when undertaking a Qualitative analysis of a building. The guidelines also provide guidance on calculating a modified Ultimate Limit State capacity of the building which is much more accurate and can be used when undertaking a Quantitative analysis.

The New Zealand Society for Earthquake Engineering has proposed a way for classifying earthquake risk for existing buildings in terms of %NBS and this is shown in Figure 3.1 below.



Description	Grade	Risk	%NBS	Existing Building Structural Performance	Improvement of Structural Performance	
					Legal Requirement	NZSEE Recommendation
Low Risk Building	A or B	Low	Above 67	Acceptable (improvement may be desirable)	The Building Act sets no required level of structural improvement (unless change in use) This is for each TA to decide. Improvement is not limited to 34%NBS.	100%NBS desirable. Improvement should achieve at least 67%NBS
Moderate Risk Building	B or C	Moderate	34 to 66	Acceptable legally. Improvement recommended		Not recommended. Acceptable only in exceptional circumstances
High Risk Building	D or E	High	33 or lower	Unacceptable (Improvement	Unacceptable	Unacceptable

Figure 3.1: NZSEE Risk Classifications Extracted from Table 2.2 of the NZSEE 2006 AISPBE Guidelines

Table 3.1 below compares the percentage NBS to the relative risk of the building failing in a seismic event with a 10% risk of exceedance in 50 years (i.e. on average 0.2% in any year). It is noted that the current seismic risk in Christchurch results in a 6% risk of exceedance in the next year.

Table 3.1: %NBS Compared to Relative Risk of Failure

Building Grade	Percentage of New Building Standard (*%NBS*)	Approx. Risk Relative to a New Building
A+	>100	<1
A	81-100	1-2 times
B	67-80	2-5 times
C	34-66	5-10 times
D	20-33	10-25 times
E	<20	>25 times

4 Building Description

4.1 General

Summary information about the buildings are given in the following tables:

Table 4.1: Building Summary Information – Block A and Block B

Item	Details	Comment
Building name	HP Smith Courts - Block A - Block B	
Street Address	56 Avalon St, Richmond.	
Age	27 years. 1985 construction, 1984 design.	From information received from CCC.
Description	Two-storey, stand-alone residential unit block.	
Building Footprint / Floor Area	Internal floor area ≈ 400m^2 Building footprint ≈ 200m^2 Overall dimensions ≈ 7.7m x 26m in plan.	
No. of storeys / basements	2 storeys / No basement.	
Occupancy / use	Residential.	Importance Level 2.
Construction	Precast reinforced concrete tilt panels. First floor slab is 175mm thick reinforced concrete cast in situ.timber frame and truss roof with metal tiles.	Based on the drawings: Precast reinforced concrete wall panels typical reinforcing is H12@400EW OR 663 Mesh. With D16 trimmer bars around the openings. Typical slab reinforcing is D12@150 in the longitudinal direction and D12@200 in the transverse direction.
Gravity load resisting system	Gravity loads from the roof structure and first floor slab are supported by the precast reinforced concrete walls and transferred into the concrete perimeter strip foundation walls and prestressed concrete driven piles. Gravity loads from the ground floor slab are transferred directly into the foundations.	

Item	Details	Comment
Seismic load resisting system	Lateral loads in each direction are resisted by precast reinforced concrete tilt panels and transferred through to the perimeter strip footings and prestressed concrete driven piles. The first floor precast reinforced panel positioned above the stairs is assumed to transfer lateral loads to the stair tilt panels, causing local out of plane forces. Lateral loads acting along the roof structure are supported by out of plane action of the roof trusses, and transferred through the GIB ceiling linings into the longitudinal precast reinforced concrete tilt panels.	
Foundation system	Slab on grade and internal ground beam between units, and prestressed concrete driven piles.	
Stair system	Timber treads and stringers with concrete landing.	
Other notable features	Precast concrete cladding panel at first floor level between the units over the stairwell is supported of the transverse walls. Precast panel base connections are cast in plate welded to an angle cast into the foundation at each end and the middle of the panel. The precast panels are connected into the 1st floor slab using cast in threaded inserts and D12@400 starter bars.	Based on the drawings.
External works	Paving on western side of Block A and the Northern side of Block B. Concrete paths surrounding building.	
Construction information	Architectural and structural drawings (Beechy Duder Construction Ltd, 1983 (architectural), Warren R Lewis, 1984 (structural). Site inspection.	
Likely design standard	NZS 4203:1976.	Inferred from age of building.
Heritage status	No known heritage status.	
Other		

Table 4.2: Building Summary Information – Block C

Item	Details	Comment
Building name	HP Smith Courts - Block C.	
Street Address	56 Avalon St, Richmond.	
Age	27 years. 1985 construction, 1984 design.	From information received from CCC.
Description	Single storey, stand-alone residential block.	
Building Footprint / Floor Area	Internal floor area = $80m^2$ Building footprint = $93m^2$ Overall dimensions = 7.7m x 12.1m in plan.	
No. of storeys / basements	1 storey / No basement.	
Occupancy / use	Residential.	Importance Level 2.
Construction	GIB lined and timber framed walls with concrete masonry block veneer and timber weatherboard cladding. Precast reinforced concrete tilt panel across the structure separating the two units. Timber frame and truss roof with metal tiles.	Predominantly concrete block veneer cladding. Timber weatherboard cladding is only above windows and along terrace at front of building.
Gravity load resisting system	Gravity loads from the roof structure are supported by the timber framed walls and transferred into the foundations. Gravity loads from the superstructure are transferred directly into the foundations.	
Seismic load resisting system	Lateral loads acting across the structure (north-south) are predominantly resisted by the precast reinforced concrete tilt panel, as well as the timber framed walls and their associated linings. Lateral loads acting along the structure (east-west) are resisted by the timber framed walls and their associated linings.	
Foundation system	Slab on grade and internal ground beam between units with prestressed concrete driven piles.	
Stair system	N/A	
Other notable features		
External works	Paving on northern side. Concrete paths on northern, eastern and southern sides.	
Construction information	Architectural and structural drawings (Beechy Duder Construction Ltd, 1983 (architectural), Warren R Lewis, 1984 (structural).	

Item	Details	Comment
	Site inspection.	
Likely design standard	NZS 4203:1976.	Inferred from age of building.
Heritage status	No heritage status.	
Other		

Table 4.3: Building Summary Information – Residents' Lounge

Item	Details	Comment
Building name	HP Smith Courts - Residents' Lounge.	
Street Address	56 Avalon St, Richmond.	
Age	27 years. 1985 construction, 1984 design.	From information received from CCC.
Description	Single storey, stand-alone building.	
Building Footprint / Floor Area	Internal footprint = $63m^2$ 9m x 7m in plan.	
No. of storeys / basements	1 storey / No basement.	
Occupancy / use	Lounge.	Importance Level 2.
Construction	Timber framed walls with GIB linings and concrete masonry block veneer and timber weatherboard cladding. Timber frame and truss roof with metal tiles.	Concrete masonry block veneer cladding on northern, southern and eastern sides with timber weatherboard cladding above windows. Timber weatherboard cladding on western side.
Gravity load resisting system	Gravity loads from the roof structure are supported by the timber framed walls and transferred into the foundations. Gravity loads from the superstructure are transferred directly into the foundations.	
Seismic load resisting system	Lateral loads acting across the structure (east-west) are resisted by the timber framed walls and their associated linings, as well as cut in timber diagonal bracing in the north, south and east walls, and a plywood panel on the west wall. Lateral loads acting along the structure (north-south) are resisted by the timber framed walls and their associated linings.	Cut in timber bracing is shown on drawings but was not visible during our site inspection as it was concealed.
Foundation system	Slab on grade with prestressed concrete driven piles under ground beams.	
Stair system	N/A	
Other notable features	Terrace and concrete ramp on western side.	
External works	Paving on western side. Concrete paths surrounding building.	
Construction information	Architectural and structural drawings (Beechy Duder	

Item	Details	Comment
	Construction Ltd, 1983 (architectural), Warren R Lewis, 1984 (structural). Site inspection.	
Likely design standard	NZS 4203:1976	Inferred from age of building.
Heritage status	No known heritage status.	
Other		

4.2 Structural 'Hot-spots'

Areas in which damage may be expected to occur from earthquake shaking are outlined below:

Block A and Block B

- Connections between precast concrete walls, floor and roof typically.
- Out of plane restraint to the base of precast panels.

Block C and Residents' Lounge

- Connections between walls, floor and roof typically.
- Lateral restraint of block veneer cladding.

'Hot-spots' are areas that have the potential to be a Critical Structural Weakness (CSW) and are reviewed as part of the following assessment.

5 Site Investigations

5.1 Previous Assessments

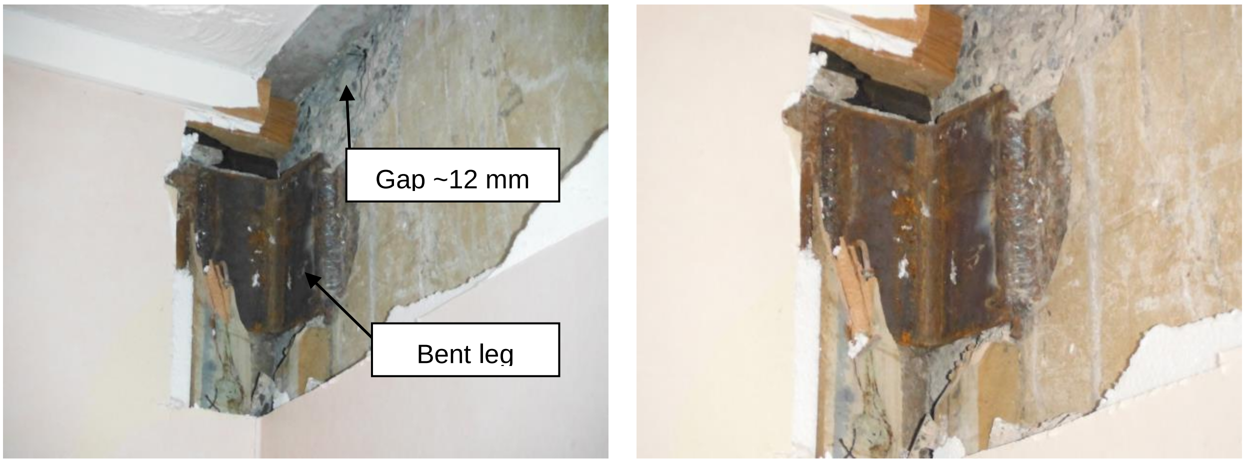
Block A and Block B have a documented Level 2 Rapid Assessment Form from the September 2010 earthquake and Block A and Block C have a documented Level 1 Rapid Assessment Form from the February 2011 earthquake, however it is assumed that all buildings on the site were inspected after each major earthquake (refer to Appendix D).

5.2 Damage Inspections and Intrusive Investigations

Visual inspections as part of this assessment for all the 4 No. buildings were undertaken on 13 December 2012 to build a picture of the damage the buildings have sustained.

Intrusive investigations were carried out on 7 October 2013 and 21 November 2013 to inspect the precast panel to foundation weld plate connections. These inspections were limited to unit 11 (Block B) as it was unoccupied at the time. A total of 5 connections (out of 7 at ground floor) were inspected. Generally the construction of the welded connection detail was not as indicated on the available design drawings (Appendix B). The assessed seismic capacity has been revised based on the site observations (Appendix E), and this report reissued to capture the updated results.

Opus carried out intrusive investigations on Block A and Block B on 14 May 2014. Refer to Appendix G for Opus site reports. The main dividing wall in Block B was found to have pulled apart from the level 1 floor slab with damage observed to the connections between the precast wall and the reinforced concrete floor slab. Beca carried out a further damage inspection on 28 May 2014 to investigate the panel connection to the first floor slab in Unit 11 and a gap of approximately 12 mm was found between the slab and precast wall. The leg of the wall to wall steel angle connection have also been found to be bent to approximately 105 degrees, indicating bending of the leg by approximately 15 degrees. Figure 5.1 shows the subject slab-wall connection.



(a) Spalling of concrete around connection

(b) Close-up of (a)

Figure 5.1: Precast wall to 1st floor slab connection (Unit 11, Block B)

This connection has failed in a brittle manner, most likely when subjected to the differential settlement between the two parts of the block on either side of this main dividing wall. The floor slab is therefore considered to be a collapse hazard.

5.3 Floor Level and Vertical Survey

A Level and Verticality Survey was undertaken on 26 November 2013 by Beca. Both Level and Verticality Surveys were carried out for Block A and Block B and Level Surveys only were carried out for Block C and the Residents' Lounge (Appendix F).

The construction type of Block A, Block B and Block C does not readily fit under any of the building types as given in the of MBIE document "*Repairing and rebuilding houses affected by the Canterbury earthquakes*" owing to different floor and foundation construction methods. The construction type of Block C and the Residents' Lounge closely approximates to that of 'Type C House'. For the sake of comparison of foundation levels with MBIE guidelines, all the buildings are treated as to be 'Type C House'.

Block A, Block B and Block C have been treated as multiple residential buildings and the Residents' Lounge as a single unit.

For Block A, Block B and Block C the *Building Assessment Criteria* (section 18.2) for 'Type C House' (TC2), as given in Table 18.2 of *Part E: Repairing and rebuilding multi-unit residential buildings* of the MBIE's afore-mentioned publication, has been applied. For the sake of comparison of floor levels, we have treated each unit as *Single Unit* and block of 4 units as one *Building*.

For the Residents' Lounge, the foundation assessment criteria for 'Type C House' (TC2), as given in Table 2.2 of *Part A: Technical Guidance* of the MBIE's afore-mentioned publication, has been applied.

CERA residential red zone and Department of Building & Housing (DBH) technical categories maps zone this site as foundation technical category 2 (TC2).

The results of floor level survey are summarised in Tables 5.1 to 5.4.

Table 5.1: Floor slope analysis – Block A (Units 1-8)

Unit	Max Floor Level Difference in a *Single Unit* mm	Max Floor Slope in a *Single Unit*	Comparison with MBIE Guideline	Max Floor Level Difference in a *Building* mm	Max Floor Slope in a *Building*	Comparison with MBIE Guideline
1	10	1 in 170	Floor slope exceeds 1 in 200. MBIE guideline implies foundation re-levelling is required.	At GF: 22 At 1st Fl: 26	At GF: 1 in 260	For the slope along the whole building < 0.5% (1 in 200), no foundation re-level is indicated.
2	18	1 in 170	Floor slope exceeds 1 in 200. MBIE guideline implies foundation re-levelling is required.			
3	20	1 in 215	For the variation in floor level < 50 mm and floor slope < 1 in 200. MBIE guideline indicates foundation re-levelling is not required.			
4	22	1 in 140	Floor slope exceeds 1 in 200. MBIE guideline implies foundation re-levelling is required.			
5	14	1 in 355	For the variation in floor level < 50 mm and floor slope < 1 in 200. MBIE guideline indicates foundation re-levelling is not required.	At GF: 20 At 1st Fl: 20	At GF: 1 in 1090	For the slope along the whole building < 0.5% (1 in 200), no foundation re-level is indicated.
6	18	1 in 250	For the variation in floor level < 50 mm and floor slope < 1 in 200. MBIE guideline indicates foundation re-levelling is not required.			
7	18	1 in 500	For the variation in floor level < 50 mm and floor slope < 1 in 200. MBIE guideline indicates foundation re-levelling is not required.			
8	18	1 in 195	Floor slope exceeds 1 in 200. MBIE guideline implies foundation re-levelling is required.			

Table 5.2: Floor slope analysis – Block B (Units 9-16)

Unit	Max Floor Level Difference in a *Single Unit* mm	Max Floor Slope in a *Single Unit*	Comparison with MBIE Guideline	Max Floor Level Difference in a *Building* mm	Max Floor Slope in a *Building*	Comparison with MBIE Guideline
9	20	1 in 370	For the variation in floor level < 50 mm and floor slope < 1 in 200, MBIE guideline indicates foundation re-levelling is not required.	At GF: 37 At 1st Fl: 34	At GF: 1 in 300	For the slope along the whole building < 0.5% (1 in 200), no foundation re-level is indicated.
10	18	1 in 210	For the variation in floor level < 50 mm and floor slope < 1 in 200, MBIE guideline indicates foundation re-levelling is not required.			
11	30	1 in 165	Floor slope exceeds 1 in 200. MBIE guideline implies foundation re-levelling is required.			
12	34	1 in 130	Floor slope exceeds 1 in 200. MBIE guideline implies foundation re-levelling is required.			
13	48	1 in 120	Floor slope exceeds 1 in 200. MBIE guideline implies foundation re-levelling is required.	At GF: 97 At 1st Fl: 88	At GF: 1 in 140	For the slope along the whole building > 0.5% (1 in 200) and floor level variation > 50mm (and <150 mm), criteria of foundation re-level/repair is indicated.
14	56	1 in 105	For the variation in floor level >50mm and <150mm within a single unit, MBIE guideline indicates foundation re-level/repair.			
15	60	1 in 115	For the variation in floor level >50mm and <150mm and floor slope > 1 in 200 within a single unit, MBIE guideline indicates foundation re-level/repair.			
16	44	1 in 110	Floor slope exceeds 1 in 200. MBIE guideline implies foundation re-levelling is required.			

Table 5.3: Floor slope analysis – Block C (Units 17-18)

Unit	Max Floor Level Difference in a *Single Unit* mm	Max Floor Slope in a *Single Unit*	Comparison with MBIE Guideline	Max Floor Level Difference in a *Building* mm	Max Floor Slope in a *Building*	Comparison with MBIE Guideline
17	36	1 in 180	Floor slope exceeds 1 in 200. MBIE guideline implies foundation re-levelling is required.	44	1 in 165	For the slope along the whole building > 0.5% (1 in 200), foundation re-level/repair is indicated.
18	44	1 in 110	Floor slope exceeds 1 in 200. MBIE guideline implies foundation re-levelling is required.			

Table 5.4: Floor slope analysis – Residents' Lounge

Unit	Max Floor Level Difference in a *Single Unit* mm	Max Floor Slope in a *Single Unit*	Comparison with MBIE Guideline
-	16	1 in 210	For Vertical differential settlement <50 mm and floor slope less than 1 in 200 between any two points >2 m apart, no structural repair to foundation is required.

The following summary has been deduced from the Verticality survey:

Block A

- The verticality survey was carried out on the gable walls and party walls.
- The verticality survey data indicates the walls are tilting predominantly towards the west.
- Precast wall panels were found to be tilting both in-plane and out of plane.
- For the *Building* comprising of Units 1-4, the northern precast wall has a maximum of 11 mm tilt out of plane and 9 mm tilt in-plane.
- For the *Building* comprising of Units 5-8, the southern precast wall has a maximum of 14 mm tilt out of plane and 8 mm tilt in-plane.
- The tilting of the precast walls is consistent with floor slope.

Block B

- The verticality survey was carried out on the gable walls and party walls.
- The verticality survey data indicates the walls are tilting predominantly towards the west.
- Precast wall panels are found to be tilting both in-plane and out of plane.
- For the *Building* comprising of Units 9-12, the eastern precast wall has a maximum of 29 mm tilt out of plane and 10 mm tilt in-plane.
- For the *Building* comprising of Units 13-16, the western precast wall has a maximum of 46 mm tilt out of plane and 19 mm tilt in-plane.
- The party wall between Units 11-12 & 13-14 has a maximum of 25 mm tilt out of plane and 19 mm tilt in-plane.
- The tilting of the precast walls is consistent with floor slope.

Block C and Residents' Lounge

- No Verticality Survey was carried out on either Block C or the Residents' Lounge.

6 Damage Assessment

6.1 Damage Summary

No detailed damage assessment has been carried out. The tables below provide a summary of damage observed during our inspections and its Qualitatively assessed severity. Refer to Appendix A for photographs.

Table 6.1: Damage Summary – Block A

Damage type	Unknown	Minor	Moderate	Major	Comment
Settlement of foundations			✓		Possible differential settlement, observed internal doors now swinging. Level survey carried out to confirm.
Tilt of building	✓				Tilt of building as evident through verticality survey (refer to section 5.3).
Liquefaction		✓			None observed during visual inspection. The aerial reconnaissance on 24 February 2011 indicates the extent was minor to moderate.
Settlement of external ground		✓			Settlement of paving at front of building evident.
Lateral spread / ground cracks	✓				None observed during visual inspection.
Frame					N/A
Precast concrete walls		✓			Cracking of 0.1mm to precast reinforced concrete panels, predominantly propagating from window corners, typically on most panels, viewed external side only, internal faces and connections are lined and were not inspected.
Cracking to concrete floors	✓				Unknown as concrete floors were concealed.
Bracing					N/A
Precast flooring seating					N/A
Stairs					None observed during visual inspection.
Cladding / envelope					None observed during visual inspection.
Internal fit out		✓			Minor cracking and separation of wall and ceiling linings.
Building services	✓				No inspection of services was carried out.
PC Panel to 1st floor slab connection					None observed by Opus intrusive investigation of limited number of connections.

Table 6.2: Damage Summary – Block B

Damage type	Unknown	Minor	Moderate	Major	Comment
Settlement of foundations			✓		None observed during visual inspection. Level survey indicates settlement worse at the western end of the block.
Tilt of building			✓		Verticality survey results indicates residual tilt of the walls, worse at the western end (refer to section 5.3).
Liquefaction		✓			None observed during visual inspection. The aerial reconnaissance on 24 February 2011 indicates the extent was minor to moderate.
Settlement of external ground		✓			Settlement of pavement at rear of building evident.
Lateral spread / ground cracks	✓				None observed during visual inspection.
Frame					NA
Precast concrete walls		✓			Cracking of up to 0.4mm to precast reinforced concrete panels, generally propagating from window corners. Viewed external side only, internal faces are lined and were not inspected.
Cracking to concrete floors	✓				Unknown as concrete floors were concealed.
Bracing					N/A
Flooring seating				✓	Loss of first floor slab seating on to precast wall in Unit 11/12.
Stairs					None observed during visual inspection.
Cladding / envelope		✓			Buckled timber weatherboards.
Internal fit out		✓			Minor cracking and separation of wall and ceiling linings.
Building services	✓				No inspection of services was carried out.
PC wall to 1st floor slab connections				✓	Failure of slab to wall cast-in inserts along main dividing wall (between units 11/12 and 13/14), 12 mm gap observed between slab edge and the wall.

Table 6.3: Damage Summary – Block C

Damage type	Unknown	Minor	Moderate	Major	Comment
Settlement of foundations		✓			Differential settlement believed to have occurred due to vertical separation between structure and surrounding paving. Level survey carried out confirms.
Tilt of building		✓			Tilt of building not visible but structure is assumed to be tilted due to settlement. Verticality survey may be required to confirm tilting of the walls.
Liquefaction		✓			None observed during visual inspection. The aerial reconnaissance on 24 February 2011 indicates the extent was minor to moderate.
Settlement of external ground	✓				Possible settlement of paving at front terrace.
Lateral spread / ground cracks					None observed.
Frame	✓				Unknown as timber frame was concealed.
Concrete / masonry walls	✓				Unknown as precast reinforced concrete tilt panel was concealed.
Cracking to concrete floors	✓				Unknown as concrete floors were concealed.
Bracing		✓			Wall linings (GIB) cracking at lining interfaces.
Precast flooring seating					N/A
Stairs					N/A
Cladding / envelope			✓		Moderate mortar cracking to concrete block veneer was observed.
Internal fit out					No damage to internal linings was observed.
Building services	✓				No inspection of services was carried out.
Other					

Table 6.4: Damage Summary – Residents' Lounge

Damage type	Unknown	Minor	Moderate	Major	Comment
Settlement of foundations		✓			None observed during visual inspection. Level survey indicated minor only.
Tilt of building	✓				None observed during visual inspection. Verticality survey may be required to confirm.
Liquefaction		✓			None observed during visual inspection. The aerial reconnaissance on 24 February 2011 indicates the extent was minor to moderate.
Settlement of external ground		✓			Settlement of pavement at rear of building evident.
Lateral spread / ground cracks					None observed during visual inspection.
Frame	✓				Unknown as timber frame was concealed.
Precast concrete walls					N/A
Cracking to concrete floors	✓				Unknown as concrete floors were concealed.
Bracing	✓				No damage to ply bracing observed during visual inspection. Inspection of diagonal metal bracing was not possible as it was concealed by cladding.
Precast flooring seating					N/A
Stairs					N/A
Cladding / envelope		✓			Minor cracking to concrete block veneer mortar was observed.
Internal fit out		✓			Minor separation of ceiling lining and cornice.
Building services	✓				No inspection of services was carried out.
Other					

6.2 Surrounding Buildings

The HP Smith Courts site comprises five structures. Block A and Block B are two storey buildings while Block C and the Residents' Lounge are single storey buildings (and the fifth building is a privately owned single storey structure to the west of Block B).

Due to the separation between the four stand-alone buildings that make up HP Smith Courts, and the surrounding buildings, the buildings are not affected by neighbouring buildings during an earthquake.

6.3 Residual Displacements and General Observations

A Level and Verticality Survey was carried out, refer to Appendix F for drawings and 5.2 above for discussion of results.

Block A

No evidence of permanent differential settlement or displacement was observed during our visual inspection; however a global settlement survey has revealed some movement that could not be identified by brief visual inspection alone.

Block B

The centre transverse precast reinforced concrete panel has been visibly displaced and is currently tilted to the west. It was not clear however from the visual inspection if the overall building had any permanent settlement or displacements. A global settlement survey has revealed movement that could be described as damage under insurance entitlement.

Block C

There is potentially some evidence of differential settlement of the building due to the vertical separation of the terrace paving and timber column on the northern side (refer to Photo 27 and Photo 28 in Appendix A). Cracking of the masonry mortar to the blockwork cladding immediately adjacent to the vertical separation also suggests differential settlement has occurred. It was unclear from our inspection whether the building structure, the terrace paving or both have settled. A global settlement survey has confirmed some movement, and is recommended these results be reviewed as part of the full damage assessment for insurance entitlement.

Residents' Lounge

No evidence of permanent differential settlement or displacements was observed during our visual inspection, however a global settlement survey has revealed some movements that could not be identified by brief visual inspection alone.

6.4 Implication of Damage

The Level and Verticality Survey indicates that the floors are sloping and walls are tilting. In many *Single Units*, the floor slope exceeds 0.5% (1 in 200) and according to MBIE guidelines, floor re-level/repair is typically indicated.

The connection (Fig. 5.1) between floor slab and precast wall has failed in a brittle manner leaving a gap of approximately 12 mm between the slab and the precast wall, most likely when subjected to the differential settlement between the two parts of the block on either side of this main dividing wall. It is considered the slab is a collapse hazard due to the damaged connection.

Out of level and tilt indicated by the survey is consistent with the structural damage to the Block B including separation of first floor from wall.

We have received an intrusive investigation report for Block A carried out by Opus (Appendix G). It is stated in the Opus report that wall-slab connections in Block A were not investigated as there was no other sign of significant damage in that area. As Block A has experienced little differential settlement compared to Block B, it is likely that the wall-slab connections may not have been damaged. However, to account for their brittle behaviour and vulnerability to differential settlement these connections (undamaged) across the site have had their *%NBS* score down-rated.

For Block C and the Residents' Lounge no significant damage or hazards were identified to the seismic or gravity load resisting system that would reduce its ability to resist further loads.

7 Generic Issues

Block A and Block B

The following generic issues referred to in Appendix A of the EAG guideline document have been identified as applicable to Block A and Block B:

- Mesh reinforcement in ground floor slabs making it prone to non-ductile failure.
- Precast tilt panels - Brittle panel connections and cracked panels at the connections.
- Precast tilt panels - Hard-drawn wire mesh reinforcement or inadequate reinforcement making panels prone to non-ductile face loading failure.

The connection between precast tilt panels and 1st floor slab in Units 11/12 (Block B) have failed in a brittle manner.

Block C

The following generic issues referred to in Appendix A of the EAG guideline document have been identified as applicable to the Block C building:

- Precast tilt panels - Hard-drawn wire mesh reinforcement or inadequate reinforcement making panels prone to non-ductile face loading failure.

Residents' Lounge

None of the generic issues referred to in Appendix A of the EAG guideline document are applicable to the Residents' Lounge building, however generic issues for timber construction include:

- Connections between roof/ceiling diaphragms, walls and foundation slab generally.

8 Geotechnical Consideration

No specific geotechnical information is currently available for this site; however the CERA residential red zone and Department of Building & Housing (DBH) technical categories maps zone this site as foundation technical category 2 (TC2).

The definition of TC2 is minor to moderate land damage from liquefaction is possible in future large earthquakes. Lightweight construction or enhanced foundations are likely to be required such as enhanced concrete raft foundations (i.e. stiffer floor slabs that tie the structure together).

During the inspection, no significant damage to the surrounding ground was noted. However, based on the floor levels (differential settlement), site characteristics are considered to be 'significant' and the IEP score has been adjusted accordingly.

9 Survey

A Level and Verticality Survey has been carried out on 26 November 2013, refer to Appendix F for Drawings, as there was some evidence of settlement or displacement observed during the visual inspections. The results have been discussed in 5.3 above.

10 Initial Capacity Assessment (Residents' Lounge and Block C)

10.1 *%NBS* Assessment

Residents' Lounge and Block C had their seismic capacities assessed using the Initial Evaluation Procedure based on the information available. The buildings' capacities are expressed as a percentage of New Building Standard (*%NBS*) and is in the order of that shown below in Table 10.1. A factor of 1.35 has been selected for the F factor, which takes into consideration the residential construction type and minor effects from site characteristics. These capacities are subject to confirmation by a quantitative analysis which is more detailed. The post-damage capacity is considered to be the same as the original capacity.

Table 10.1: Indicative Building Capacities – Residents' Lounge

System	Direction	Seismic Performance in *%NBS*	Notes
Timber Frame and Steel Brace	Longitudinal	83	NZSEE Initial Evaluation Procedure. IL 2, Z=0.3.
Timber Frame and Steel Brace	Transverse	83	NZSEE Initial Evaluation Procedure. IL 2, Z=0.3.

Table 10.2: Indicative Building Capacities – Block C

System	Direction	Seismic Performance in *%NBS*	Notes
Timber Frame	Longitudinal	83	NZSEE Initial Evaluation Procedure. IL 2, Z=0.3.
Precast reinforced concrete tilt panels	Transverse	50	NZSEE Initial Evaluation Procedure. IL 2, Z=0.3.

10.2 Critical Structural Weaknesses

The following Critical Structural Weakness was identified:

- Site characteristics, due to liquefaction potential.

10.3 Seismic Parameters

The seismic design parameters based on current design requirements from NZS1170:2004 and the NZBC clause B1 for this building are:

- Site soil class: D – NZS 1170.5:2004, Clause 3.1.3, Soft Soil
- Site hazard factor, Z = 0.3 – NZBC, Clause B1 Structure, Amendment 11 effective from 19 May 2011
- Return period factor Ru = 1 – NZS 1170.5:2004, Table 3.5, Importance level 2 structure with a 50 year design life.
- Near fault factor N(T,D) = 1 – NZS 1170.5:2004, Clause 3.1.6, Distance more than 20 km from fault line.

10.4 Expected Structural Ductility Factor

Block C

The precast reinforced concrete tilt panels across the structure has been assumed to have a ductility factor of 1.25 for the IEP assessment, while the timber framed walls along the structure have been assumed to have a ductility factor of 2.0.

Residents' Lounge

The timber framed walls in both directions have been assumed to have a ductility factor of 2.0 for the IEP assessment.

10.5 Discussion of results

Block C

Based on the IEP results Block C is considered Earthquake Risk and seismic grade C as the IEP result is between 34% and 67%NBS. This assessment is qualitative and based on the NZSEE IEP only.

Residents' Lounge

Based on the IEP results the Residents' Lounge is not considered to be Earthquake Risk with a seismic grade A as the IEP result is greater than 80*%NBS*. This assessment is qualitative and based on the NZSEE IEP only.

11 Detailed Seismic Capacity Assessment (Block A and Block B)

11.1 Assessment Methodology

Block A and Block B have had their seismic capacities assessed using the Detailed Assessment Procedures in the NZSEE 2006 AISPBE guidelines, based on the drawings and site measurements.

Block A has suffered minor damage. The post-damage capacities are not considered to have been significantly diminished from their original capacities.

Block B has suffered moderate damage except for Units 11/12 which have suffered major damage. The post-damage capacities are considered to have diminished from their original capacities.

11.2 Assumptions

The following assumptions were used in our quantitative assessment:

- Reinforcing steel yield strength, fy = 275 MPa (assumed from age)
- Mesh reinforcing yield strength, fy = 485 MPa (assumed from age)
- Concrete compressive strength, f'c = 20 MPa (assumed from age)
- All walls act in their primary axes only, except for forces induced due to self-weight only.
- Soil ultimate bearing pressure, fb = 240 MPa (including ϕ = 0.8 for overstrength actions) (due to the presence of driven piles spaced along the length of the strip footings, the ground is assumed to act as 'good ground' as per NZS 3604).

11.3 Critical Structural Weaknesses (CSW)

The following Critical Structural Weaknesses were identified:

- Site characteristics due to liquefaction potential.
  - The site characteristics have been identified as a potential CSW. Liquefaction is considered a CSW however no specific liquefaction penalty has been imposed in this quantitative assessment.
- All connections between the first floor slab and the precast wall panels are considered CSW due to brittle failure of connections in Units 11/12 and vulnerability to differential settlement.
  - To account for their brittle behaviour and vulnerability to differential settlement, these connections (undamaged) across the site have had their *%NBS* score down-rated.

11.4 Seismic Parameters

The seismic design parameters based on current design requirements from NZS 1170.5:2004 and the NZBC clause B1 for Block B and Block C are:

- Site soil class: D – NZS 1170.5:2004, Clause 3.1.3, Soft Soil
- Site hazard factor, Z = 0.3 – NZBC, Clause B1 Structure, Amendment 11 effective from 19 May 2011
- Return period factor Ru = 1 – NZS 1170.5:2004, Table 3.5, Importance Level 2 structure with a 50 year design life.
- Near fault factor N(T,D) = 1 – NZS 1170.5:2004, Clause 3.1.6, Distance more than 20 km from fault line.

11.5 Results of Seismic Assessment

Block A

The results of our quantitative assessment indicate the building has a seismic capacity of 35*%NBS*. Table 11.1 presents the evaluated seismic capacity in terms of *%NBS* of the individual structural systems in each building direction.

Block B

The results of our quantitative assessment indicate the building has a seismic capacity of less than 10*%NBS*. Table 11.2 presents the evaluated seismic capacity in terms of *%NBS* of the individual structural systems in each building direction.

Table 11.1: Summary of Seismic Assessment of Structural Systems – Block A (Units 1-8)

Item	Loading Direction	Ductility, μ Note 1,2	Seismic Capacity	Notes
Overall *%NBS* adopted from DEE	**Both**	**1.0**	**35*%NBS*** Note 3	**Governed by the capacity of the connection between first floor slab and precast panels.**
Ground Floor precast panels in-plane	Transverse	1.0	>100 65	Shear capacity Flexural capacity
Ground Floor precast panels in-plane	Longitudinal	1.0	35	Strut and tie solution
Ground Floor precast panels out-of-plane	Both Transverse	1.0	>100 44	Shear capacity Flexural capacity Parts loading
First Floor precast panels in-plane	Transverse	1.0	>100 60	Shear capacity Flexural capacity
First Floor precast panels in-plane	Longitudinal	1.0	>100 71	Shear capacity Flexural capacity
First Floor precast panels out-of-plane	Both Transverse	1.0	>100 36	Shear capacity Flexural capacity Parts loading
Foundations	Transverse	1.0	35	Bearing /Overturning
Foundations	Longitudinal	1.0	38	Bearing/Overturning
Precast panel connection to foundations	Both	1.0	35 35	Horizontal weld shear Vertical weld shear (revised capacity based on site observations following intrusive investigations).
First floor slab to precast wall connection	Both	1.0	35 Note 4	brittle behaviour of the connection based on damaged connection in Units 11/12 Block B, vulnerable to differential settlement.
Precast cladding panel at first floor level (over stairwell) connection to return walls	Longitudinal	1.0	>100	

Notes:

1. Ductility factors are in accordance with values recommended in the NZSEE 2006 AISPBE guidelines.
2. The precast panel drawings indicate that the panel reinforcing can be either H12@400 each way or 663 Mesh. As the hard drawn wire mesh is typically brittle in behaviour μ=1.0 has been adopted. If it can be shown that mesh was not used then μ=1.25 could be adopted, and the *%NBS* in the above table would increase slightly, however, the grade of the building is unlikely to

improve as the governing item is the bearing pressure, which will still have a ductility of 1.0, regardless of wall reinforcement.

3. Overall *%NBS* is governed by the lowest *%NBS* of any structural component in the building.
4. The connections between first floor slab and precast walls in Block A are found undamaged. But similar connections are found damaged/failed in Block B (Units 11/12) and this failure is a concrete cone failure and is considered brittle. Therefore the connections in Block A which are in their undamaged state have been down-rated to 35*%NBS* to account for potential brittle behaviour of the connections and the vulnerability to differential settlement.

Table 11.2: Summary of Seismic Assessment of Structural Systems – Block B (Units 9-16)Note 5

Item	Loading Direction	Ductility, μ Note 1,2	Seismic Capacity	Notes
Overall *%NBS* adopted from DEE	**Both**	**1.0**	**<10*%NBS*** Note 3	**Governed by the residual capacity of the connection between first floor slab and precast wall in Units 11/12.**
Ground Floor precast panels in-plane	Transverse	1.0	>100 65	Shear capacity Flexural capacity
Ground Floor precast panels in-plane	Longitudinal	1.0	35	Strut and tie solution
Ground Floor precast panels out-of-plane	Both Transverse	1.0	>100 44	Shear capacity Flexural capacity Parts loading
First Floor precast panels in-plane	Transverse	1.0	>100 60	Shear capacity Flexural capacity
First Floor precast panels in-plane	Longitudinal	1.0	>100 71	Shear capacity Flexural capacity
First Floor precast panels out-of-plane	Both Transverse	1.0	>100 36	Shear capacity Flexural capacity Parts loading
Foundations	Transverse	1.0	35	Bearing /Overturning
Foundations	Longitudinal	1.0	38	Bearing/Overturning
Precast panel connection to foundations	Both	1.0	35 35	Horizontal weld shear Vertical weld shear (revised capacity based on site observations following intrusive investigations).
First floor slab to precast wall connection	Both	1.0	<10 Note 4	Cast-in inserts brittle failure in Units 11/12, vulnerable to differential settlement. The first floor slab is connected to multiple precast walls and the residual capacity of the slab-wall connection is assessed to be less than 10%*NBS*. Note 5 35%*NBS* except for failed connections in Units 11/12.
Precast cladding panel at first floor level (over stairwell) connection to return walls	Longitudinal	1.0	>100	

Notes:

1. Ductility factors are in accordance with values recommended in the NZSEE 2006 AISPBE guidelines.
2. The precast panel drawings indicate that the panel reinforcing can be either H12@400 each way or 663 Mesh. As the hard drawn wire mesh is typically brittle in behaviour μ=1.0 has been adopted. If it can be shown that mesh was not used then μ=1.25 could be adopted, and the *%NBS* in the above table would increase slightly, however, the grade of the building is unlikely to improve as the governing item is the bearing pressure, which will still have a ductility of 1.0, regardless of wall reinforcement.
3. Overall *%NBS* is governed by the lowest *%NBS* of any structural component in the building.
4. The connection (cast-in inserts in the first floor slab) between floor slab and precast wall panel has failed in Units 11/12 Block B along the main dividing wall. The movement of this wall is consistent with the residual tilt of the walls and floor levels which indicate differential settlement between the two halves of the building either side of this wall. This failure is a concrete cone failure and is considered brittle. Similar connections are found in Block A and rest of the Block B. The connections which are in their undamaged state have been down-rated to 35*%NBS* to account for potential brittle failure of the connection and the vulnerability to differential settlement.

5. The first floor slab in Units 11-12 Block B is considered a collapse hazard and to be earthquake prone. This connection has failed in a brittle manner, most likely when subjected to the differential settlement between the two parts of the block on either side of this main dividing wall.

11.6 Discussion of results

The key findings of the assessment are as follows:

Block A

The overall seismic capacity is governed by the longitudinal precast concrete walls at 35*%NBS*, the transverse foundations at 35*%NBS*, the precast panel to foundation connections at 35*%NBS* (based on the weld details observed during intrusive investigations), and the precast panel to first floor slab connections at 35*%NBS*.

Based on the results of our Quantitative Assessment, Block A (Units 1-8) is considered Earthquake Risk as the seismic capacity was assessed to be between 34% and 67*%NBS*, and is classified as Seismic Grade C.

Block B

The building has been assessed to have a seismic capacity of less than 10*%NBS* governed by the residual capacity of the connection between precast wall and first floor slab in Units 11/12.

The building is considered to be Earthquake Prone as the seismic capacity was assessed to be less than 34*%NBS*, and is classified as Seismic Grade E.

The 1st floor slab in Units 11-12 Block B is considered a collapse hazard and to be earthquake prone. This connection along the main dividing wall has failed in a brittle manner, most likely when subjected to the differential settlement between the two parts of the block on either side of this main dividing wall.

12 Recommendations

12.1 Occupancy

In order for the owner to make an informed decision about the on-going use and occupancy of their buildings the following information is presented in line with the Department of Building and Housing document '*Guidance for engineers assessing the seismic performance of non-residential and multi-unit residential buildings in greater Christchurch*', June 2012.

We have given due consideration to the observed damage and the Level and Verticality Survey while commenting on the occupancy of the buildings.

Block A

The building is considered to be Earthquake Risk, having a quantitatively assessed seismic capacity between 34% and 67%*NBS*. The risk of collapse of an earthquake risk building is considered to be 5 to 10 times greater than that of an equivalent new building.

A Level and Verticality Survey has been completed; this identified some variations in level and verticality which are likely to be in excess of what would be considered as construction tolerances, however, there are no obvious signs of damage or distress to the structure observed as part of this DEE inspection.

No significant damage or hazards were identified to the seismic or gravity load resisting system that would reduce its ability to resist further loads and therefore **no restrictions on use or occupancy are recommended**.

Block B

The building is considered to be Earthquake Prone, having a quantitatively assessed seismic capacity (<10%*NBS*) being less than 34%*NBS*. The risk of collapse of a building with a seismic capacity of less than 10%*NBS* is considered to be greater than 25 times than that of an equivalent new building.

The building has suffered damage to the seismic or gravity load resisting system that is sufficient to impair or significantly reduce the ability to resist further loads. It is in a condition under which further deterioration may be expected during future aftershocks. The building should be repaired as soon as possible.

The 1st floor slab in Units 11-12 Block B is considered a collapse hazard and to be earthquake prone. This connection has failed in a brittle manner, most likely when subjected to the differential settlement between the two parts of the block on either side of this main dividing wall.

It is recommended that the building is not occupied until the damage has been repaired.

Block C

The building is considered to be Earthquake Risk, having a Qualitatively assessed capacity between 34% and 67%*NBS*. The risk of collapse of an earthquake risk building is considered to be 5 to 10 times greater than that of an equivalent new building.

A Level and Verticality Survey has been completed; this identified some variations in level and verticality which are likely to be in excess of what would be considered as construction tolerances, however, there are no obvious signs of damage or distress to the structure observed as part of this DEE inspection.

No significant damage or hazards were identified to the seismic or gravity load resisting system that would reduce its ability to resist further loads and therefore **no restrictions on use or occupancy are recommended**.

Residents' Lounge

The Residents' Lounge is not considered to be potentially earthquake risk or potentially earthquake prone, having a Qualitatively assessed capacity greater than 67%NBS. The risk of collapse of an earthquake risk building is considered to be 1 to 2 times greater than that of an equivalent new building.

No significant damage or hazards were identified to the seismic or gravity load resisting system that would reduce its ability to resist further loads and therefore **no restrictions on use or occupancy are recommended**.

12.2 Further Investigations, Survey or Geotechnical Work

Block A

- A full damage assessment is carried out for insurance purposes.
  - The results of the verticality and level survey should be considered further in relation to the damage investigations and observations. These results are considered likely to have resulted from earthquake settlement of the building. Further investigation as part of a damage inspection should be carried out to determine if this movement recorded has caused damage to the structure, that may be hidden, that has not yet been identified.
- Strengthening of first floor slab to precast wall panel connection is strongly recommended.

Block B

- The damaged connection between the precast wall panel and the first floor slab is repaired.
- Strengthening of first floor slab to precast wall panel connection is strongly recommended.
- A full damage assessment is carried out for insurance purposes.
  - The results of the verticality and level survey should be considered further in relation to the damage investigations and observations. These results are considered likely to have resulted from earthquake settlement of the building. Further investigation as part of a damage inspection should be carried out to determine if this movement recorded has caused damage to the structure, that may be hidden, that has not yet been identified.

Block C

- A full damage assessment is carried out for insurance purposes.
  - The results of level survey should be considered further in relation to the damage investigations and observations to determine significance and extent of any settlement of the building.
- Intrusive investigation is carried out to determine whether the concrete masonry block veneer has ties to the timber framing.

Residents' Lounge

- A full damage assessment is carried out for insurance purposes.
  - The results of level survey should be considered further in relation to the damage investigations and observations to determine significance and extent of any settlement of the building.
- Intrusive investigation is carried out to determine whether the concrete masonry block veneer has ties to the timber framing.

12.3 Damage Reinstatement

According to the recent CCC Instructions to Engineers document (16 October 2012), Council's insurance provides for repairing damaged elements to a condition substantially as new. We suggest you consult further with your insurance advisor.

13 Design Features Report

Repairs will be required to return the damaged portions to an as new condition. Strengthening of the first floor slab to precast wall panels is strongly recommended for Block B. No new load paths are expected.

Improvements to remove the CSW of the precast wall to first floor slab connections would likely consist of bolting angles to the walls at the underside of the slab to provide seating to the floor in the event the connection fails.

The repairs and strengthening to be carried out should be documented in a design features report and the work will need a building consent.

14 Limitations

The following limitations apply to this engagement:

- Beca and its employees and agents are not able to give any warranty or guarantee that all defects, damage, conditions or qualities have been identified.
- Inspections are primarily limited to visible structural components. Appropriate locations for invasive inspection, if required, will be based on damage patterns observed in visible elements, and review of the construction drawings and structural system. As such, there will be concealed structural elements that will not be directly inspected.
- The inspections are limited to building structural components only.
- Inspection of building services, pipework, pavement, and fire safety systems etc. is excluded from the scope of this report.
- Inspection of the glazing system, linings, carpets, claddings, finishes, suspended ceilings, partitions, tenant fit-out, or the general water tightness envelope is excluded from the scope of this report.
- The assessment of the lateral load capacity of the building is limited by the completeness and accuracy of the drawings provided. Assumptions have been made in respect of the geotechnical conditions at the site and any aspects or material properties not clear on the drawings. Where these assumptions are considered material to the outcome further investigations may be recommended. It is noted the assessment has not been exhaustive, our analysis and calculations have focused on representative areas only to determine the level of provision made.

At this stage we have not undertaken any checks of the gravity system, wind load capacity, or foundations.

- The information in this report provides a snapshot of building damage at the time the detailed inspection was carried out. Additional inspections required as a result of significant aftershocks are outside the scope of this work.

This report is of defined scope and is for reliance by CCC only, and only for this commission. Beca should be consulted where any question regarding the interpretation or completeness of our inspection or reporting arises.

Appendix A

Photographs

Figure 1: Site Plan (North is to top of page).

Photo 1: External view of Block A from north-west.

Photo 2: External view of Residents' Lounge from west.

Photo 3: External view of Block B from north-west.

Photo 4: External view of Block C from north-east.

Photo 5: External view of rear of Block A from north-east. Details are typical for Block B also.

Photo 6: Side elevation of Block B. Detail is typical for both ends of Block A and Block B. (0.1mm crack width)

Photo 7: Precast concrete wall panel at rear of Block A.

Damage Description: Cracking of precast reinforced concrete panel. (0.1mm crack width)

Photo 8: Precast concrete wall panel at rear of Block A.

Damage Description: Cracking of precast reinforced concrete panel. (0.1mm crack width)

Photo 9: Typical paving at front of Block A and Block B.

Damage Description: Settlement of external ground/paving.

Photo 10: Precast concrete wall panel at end of Block B.

Damage Description: Cracking of precast reinforced concrete panel (diagonal from balcony - 0.1mm crack width)

Photo 11: Precast concrete wall panel at end of Block B.

Damage Description: Cracking of precast reinforced concrete panel. (0.1mm crack width)

Photo 12: Precast reinforced concrete panel beneath stairs in Block B.

Damage Description: Cracking of precast reinforced concrete panel. (0.4mm crack width)

Photo 13: Precast reinforced concrete panel beneath stairs in Block B. (Transverse wall)

Damage Description: Cracking of precast reinforced concrete panel. (0.4mm crack width)

Photo 14: Typical pavement surrounding all buildings.

Damage Description: Cracking of external pavement.

Photo 15: External pavement at rear of Residents' Lounge

Damage Description: Differential settlement of external ground.

Photo 16: Rear porch entrance and pavement (typical for Block A, Block B and Block C).

Damage Description: Settlement of external paving.

Photo 17: Internal wall linings, typical for all buildings.

Damage Description: Cracking of wall linings.

Photo 18: Typical internal wall and ceiling linings.

Damage Description: Separation of wall and ceiling linings.

Photo 19: Internal wall linings.

Damage Description: Cracking of internal wall lining.

Photo 20: Centre precast concrete wall panel of Block B (view from south).

Damage Description: Tilt and residual movement of precast reinforced concrete wall.

Photo 21: Centre precast concrete wall panel of Block B (view from north).

Damage Description: Tilt and residual movement of precast reinforced concrete wall.

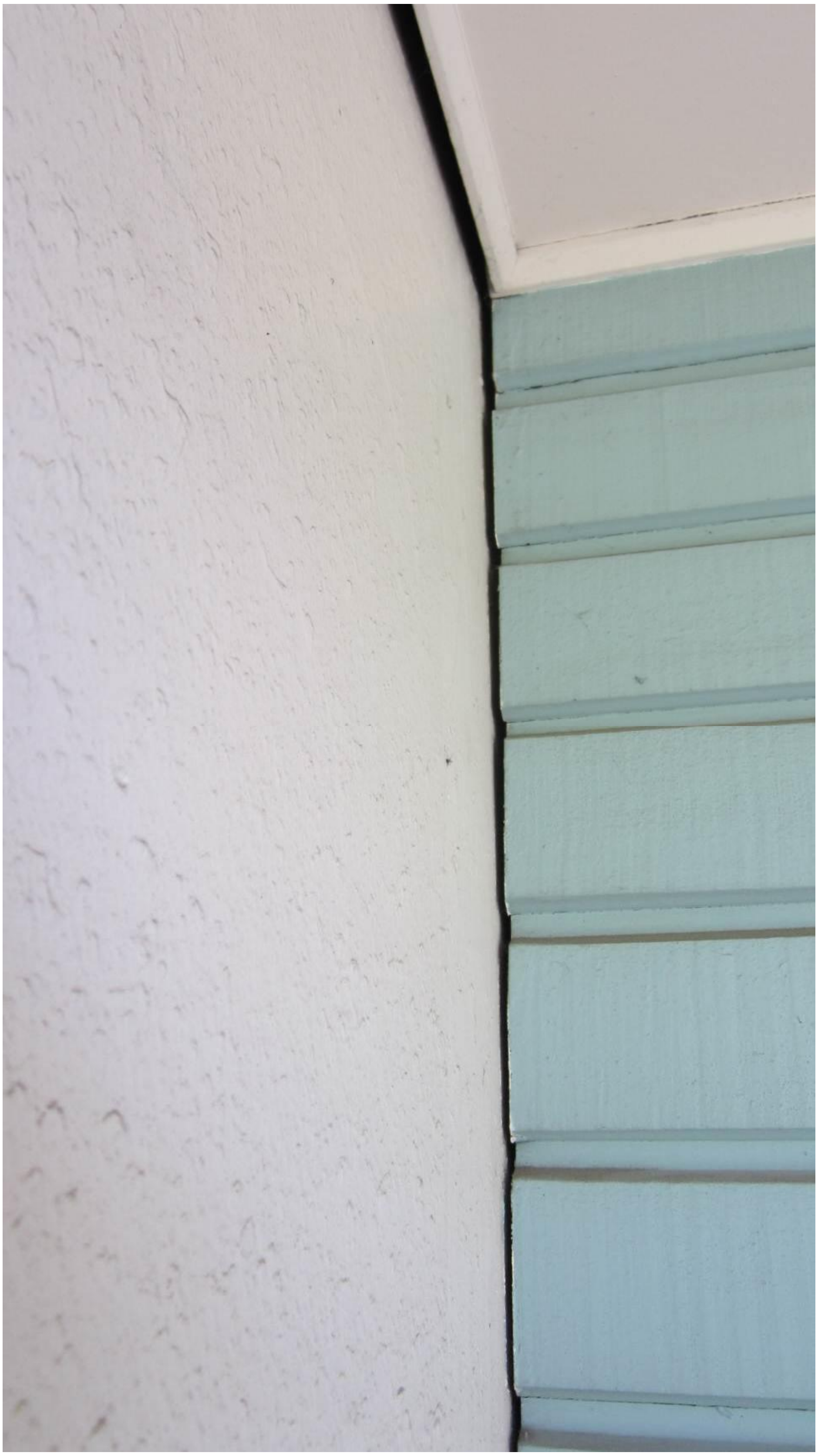


Photo 22: Centre precast concrete wall panel of Block B (view from north).

Damage Description: Tilt and residual movement of precast reinforced concrete wall.

Photo 23: Timber wall cladding on Block B.

Damage Description: Buckled timber weatherboards due to movement of precast reinforced concrete walls.

Photo 24: Timber wall cladding on Block B.

Damage Description: Buckled timber weatherboards due to movement of precast reinforced concrete walls.

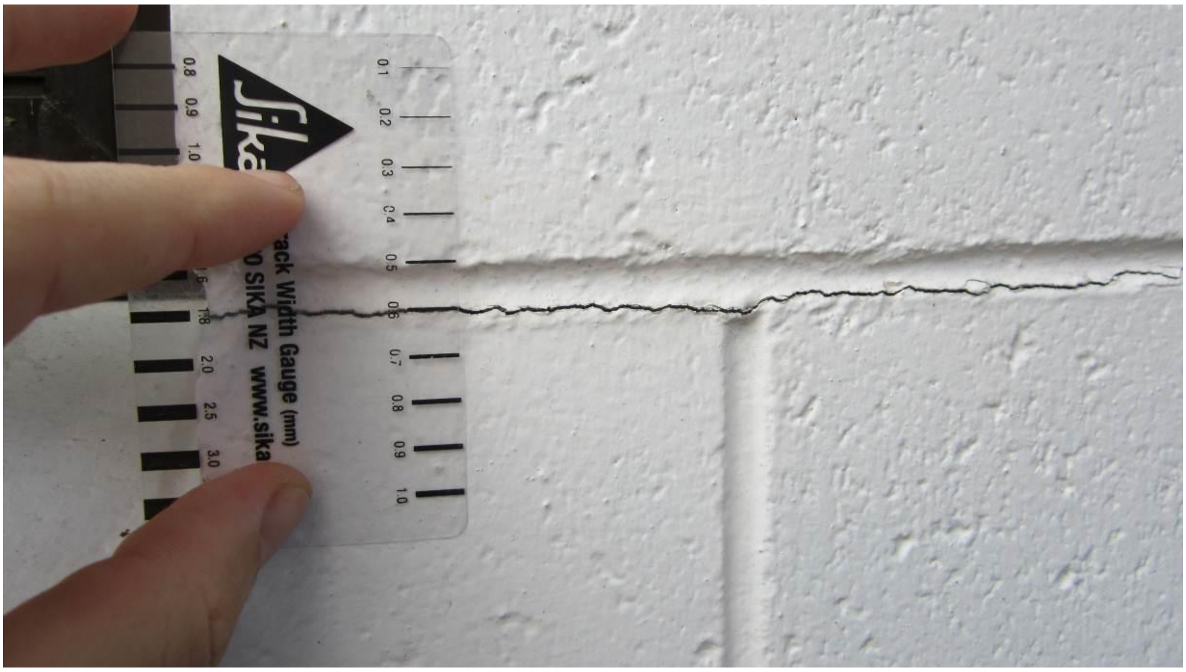


Photo 25: External concrete masonry block veneer of Block C.

Damage Description: Cracking in concrete masonry block veneer mortar.

Photo 26: External concrete masonry block veneer of Block C.

Damage Description: Cracking in concrete masonry block veneer mortar.

Photo 27: External concrete masonry block veneer at front terrace of Block C.

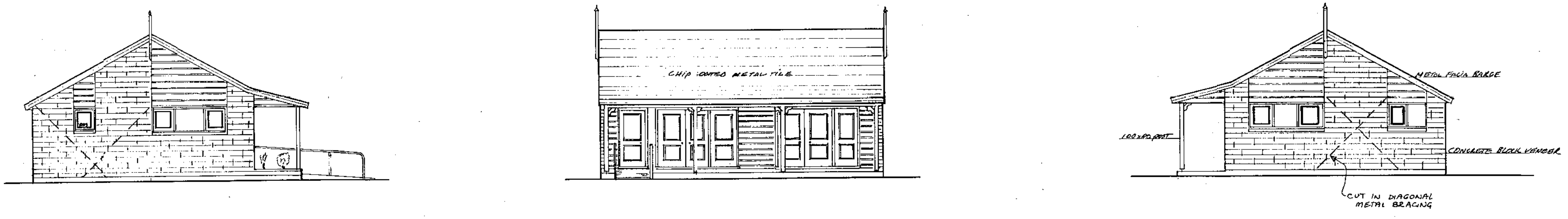
Damage Description: Cracking in concrete masonry block mortar and vertical separation of paving and timber column indicates tilt of building / differential settlement.

Photo 28: External concrete masonry block veneer at front terrace of Block C.

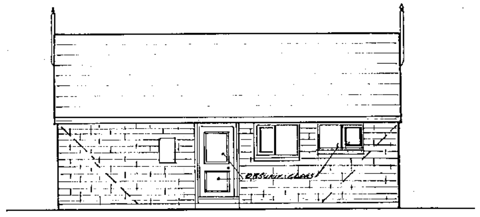
Damage Description: 1.4mm crack in concrete masonry block mortar.

Appendix B

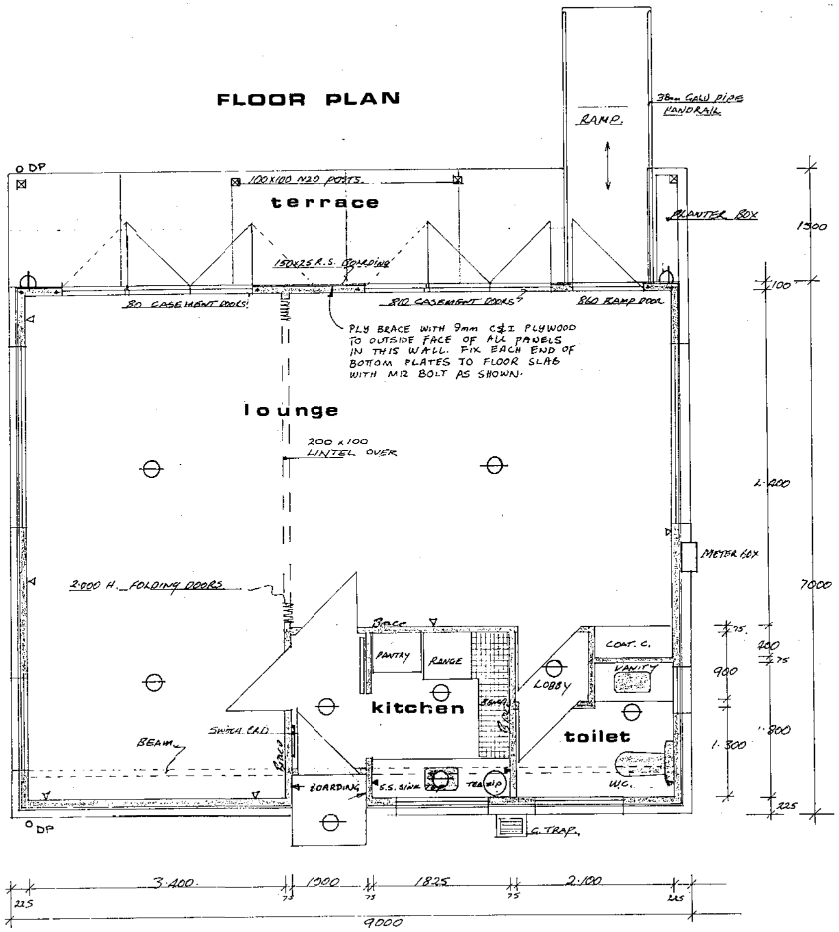
Existing Drawings



ELEVATIONS

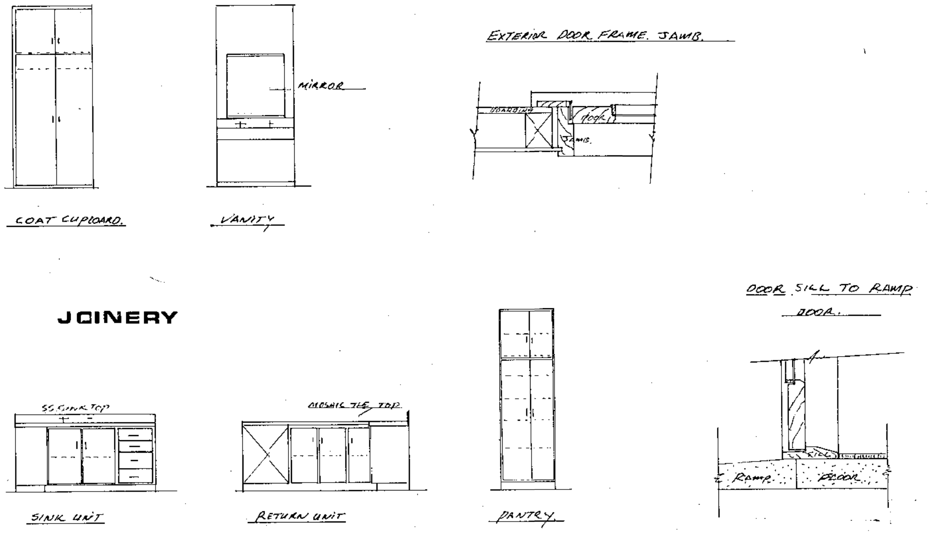


FLOOR PLAN



84-65
sheet 3

JOINERY



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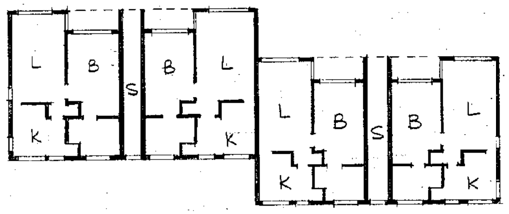
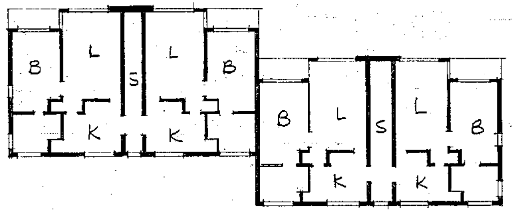
TWO STOREY UNITS

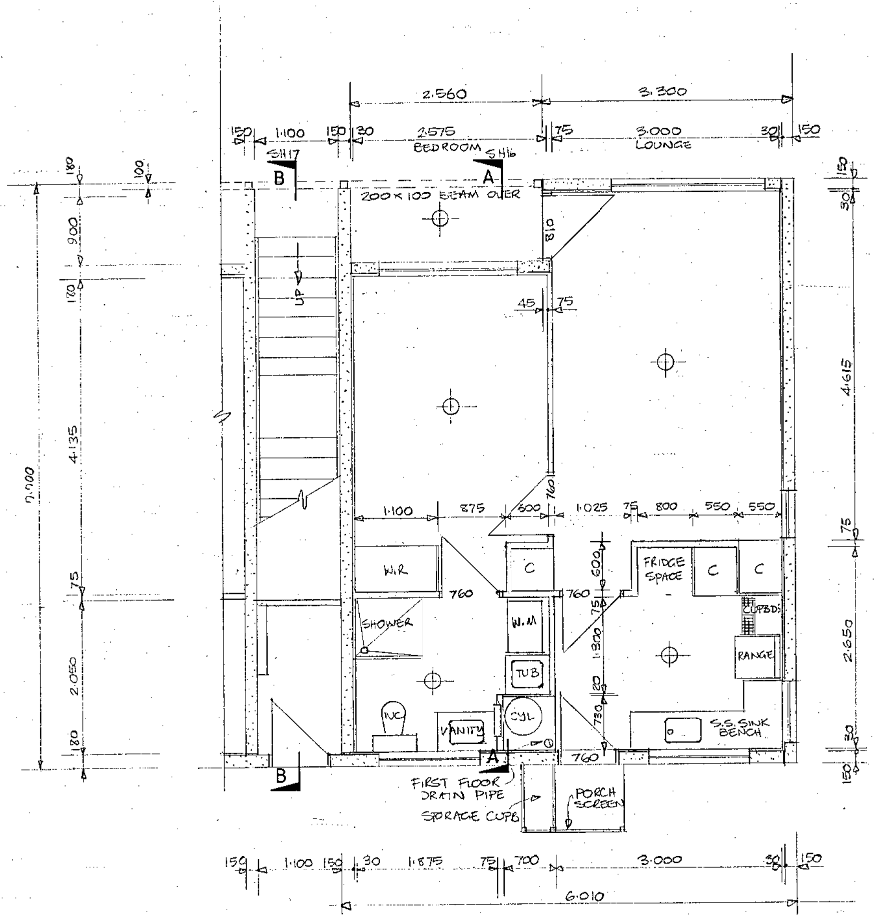
UNITS 1 - 16



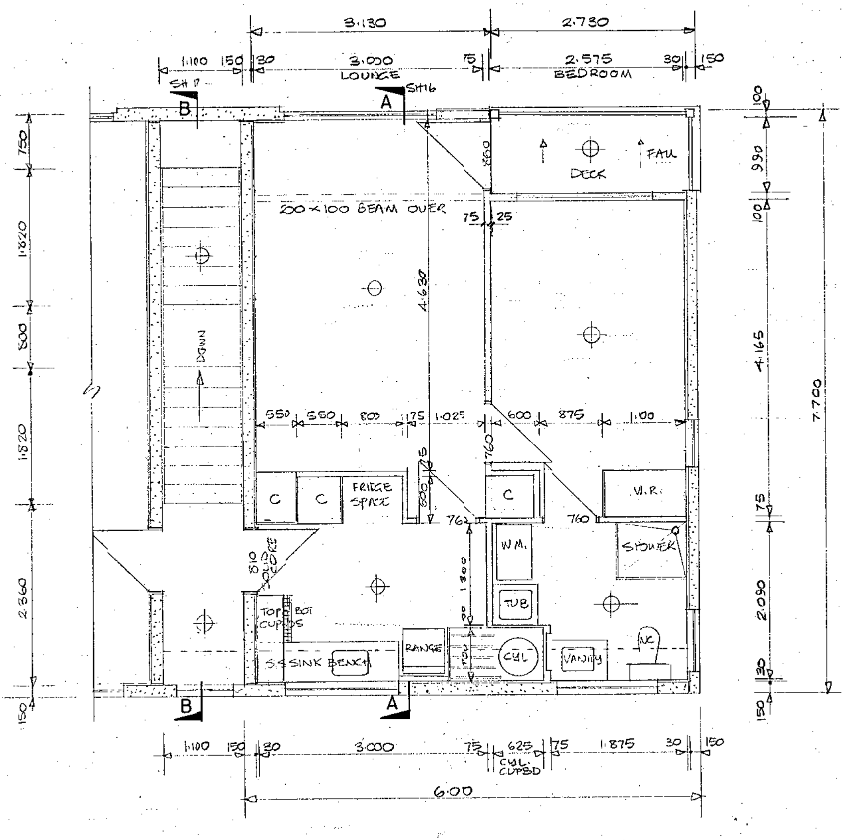
GROUND FLOOR BLOCK PLAN



FIRST FLOOR BLOCI PLAN



TYPICAL GROUND FLOOR PLAN
SEE SHEETS 16 & 17 FOR SECTIONS



TYPICAL FIRST FLOCR PLAN
SEE SHEETS 16 & 17 FOR SECTIONS

3

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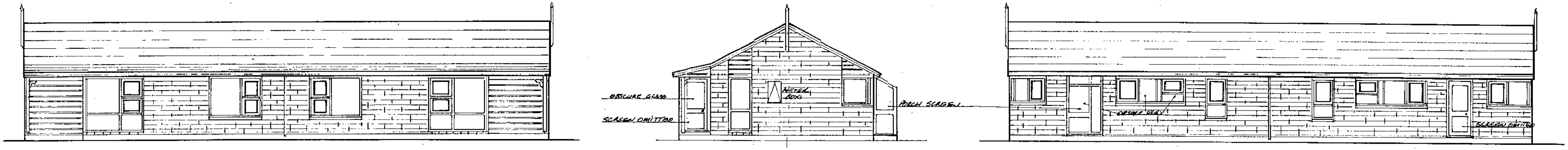
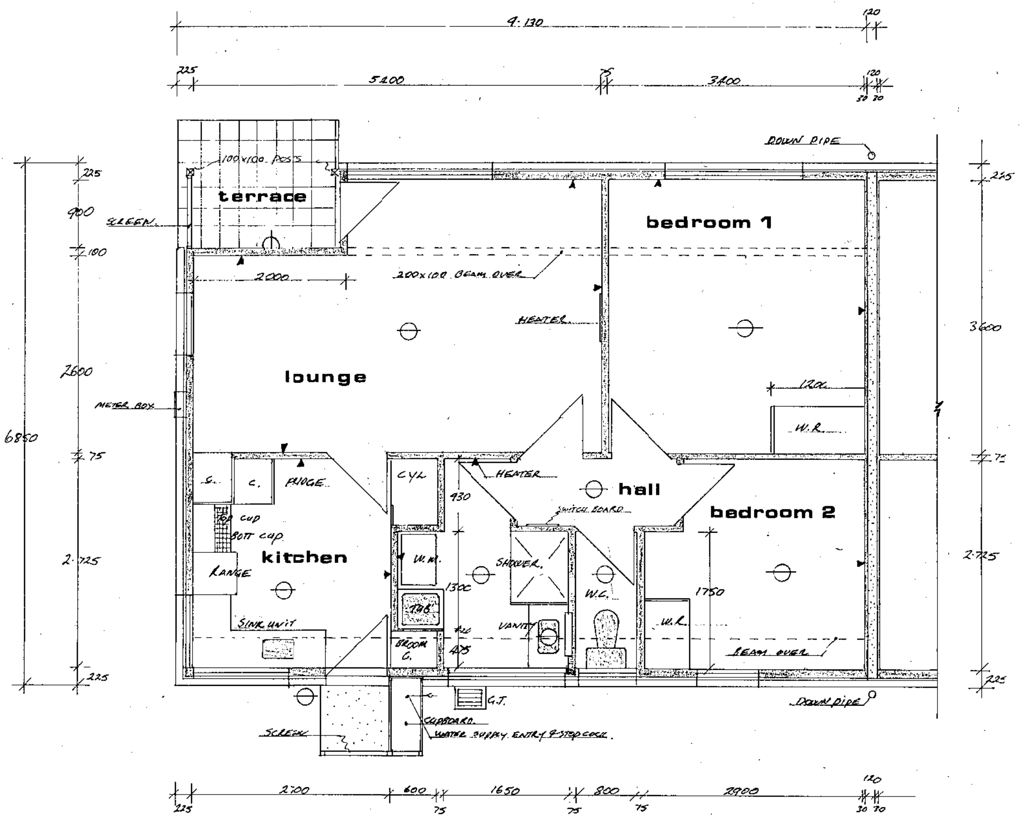
TWO BEDROOM UNITS

UNITS 19 - 20



ELEVATIONS

FLOOR PLAN



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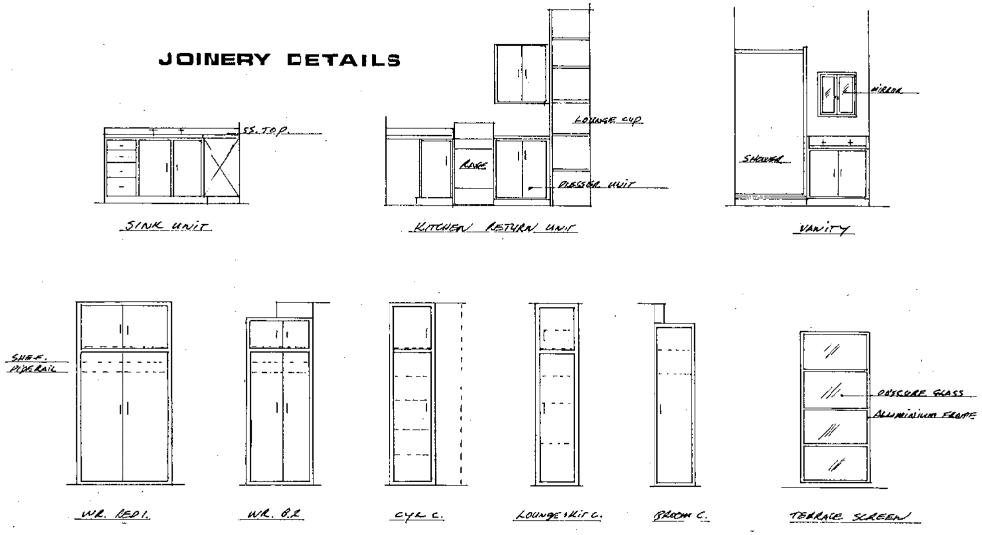

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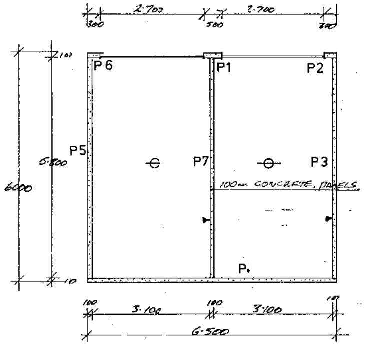
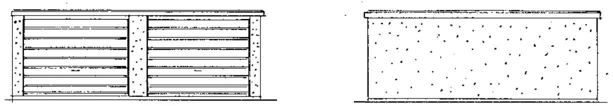


floor plan



elevations

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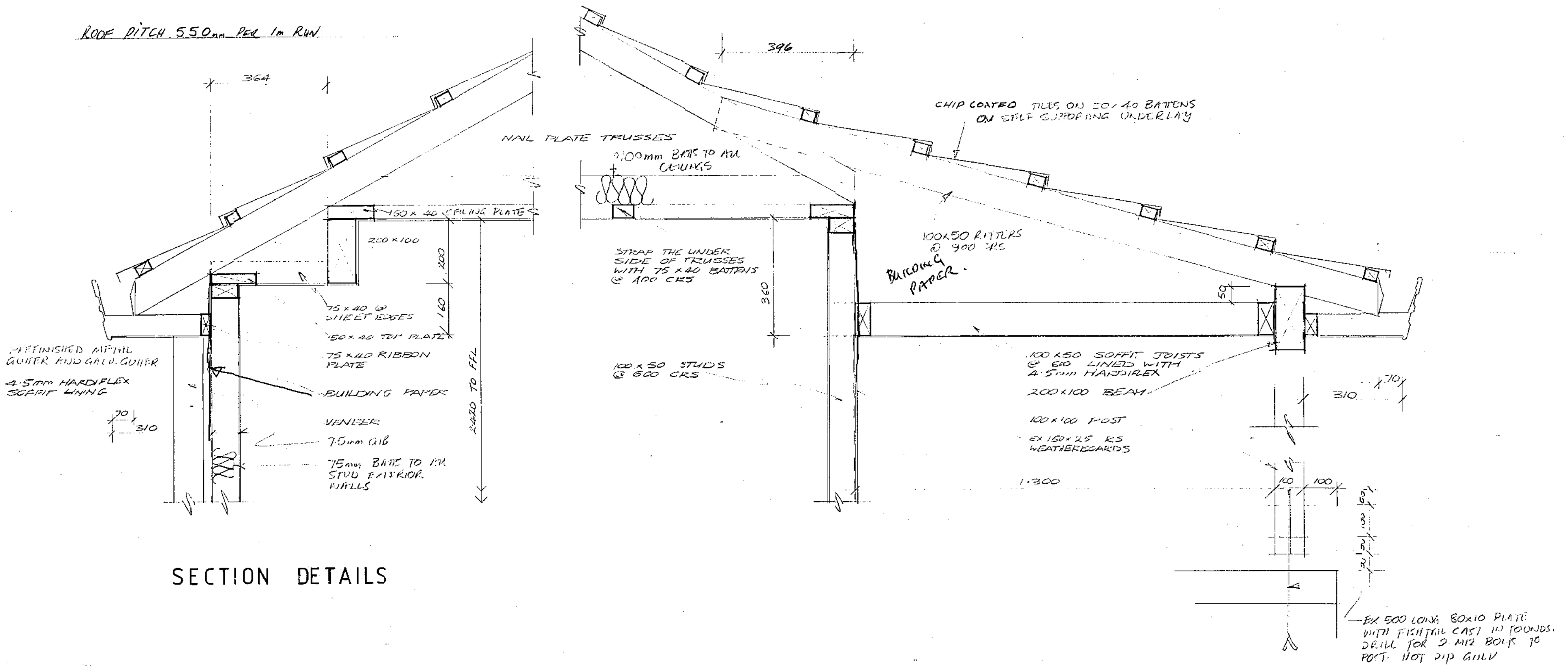
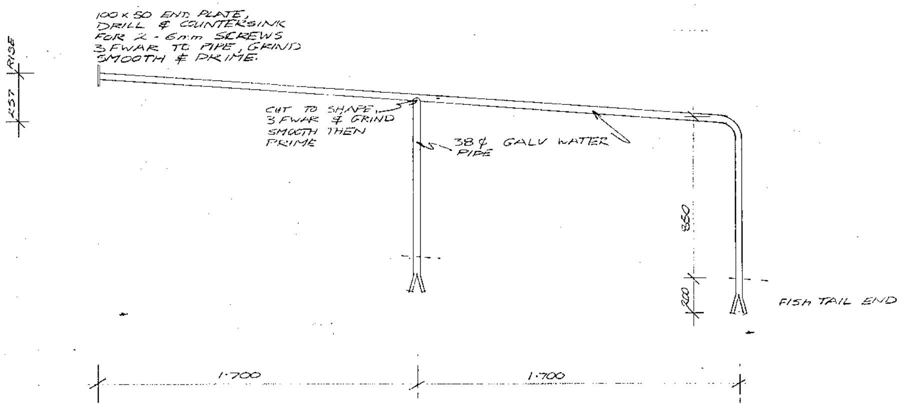


SECTION DETAILS

RESIDENTS LOJNGE



HANDRAILS

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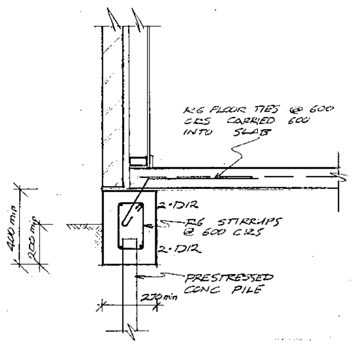

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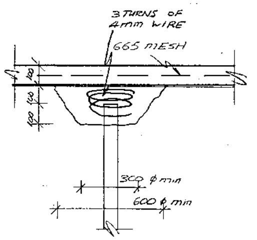

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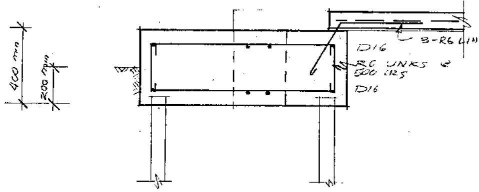

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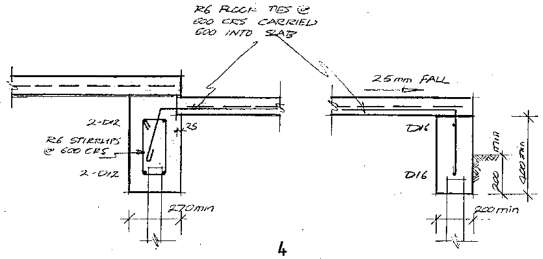

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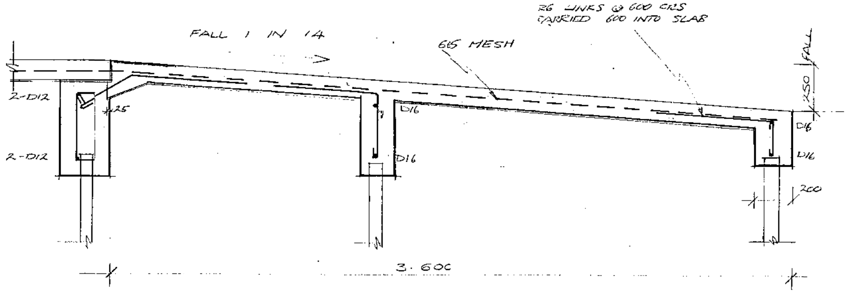

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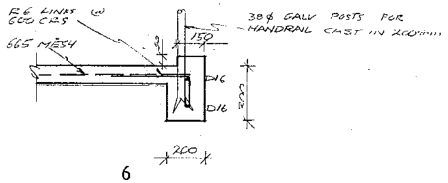

6

RESIDENTS LOUNGE

SEE SHEET 2 FOR POSITION OF DETAILS & PILE PLAN

1

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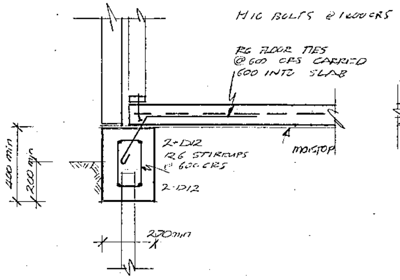

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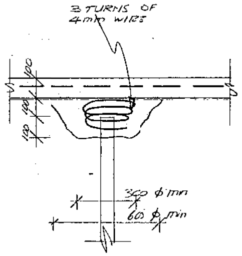

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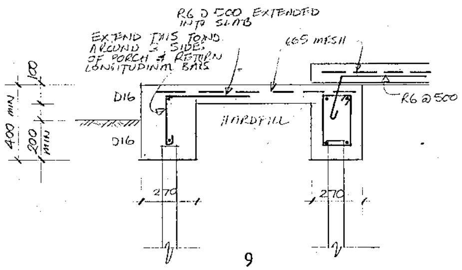

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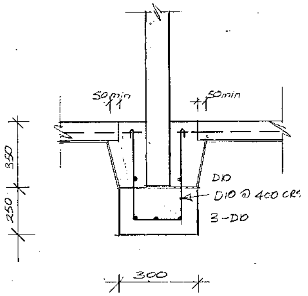

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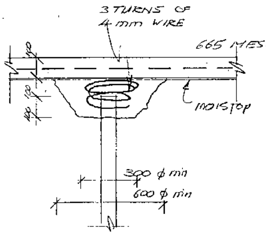

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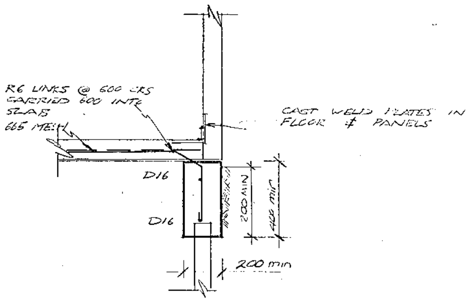

12

SEE SHEET 2 FOR POSITION OF DETAILS AND PILING PLAN.

UNITS 19-20 2

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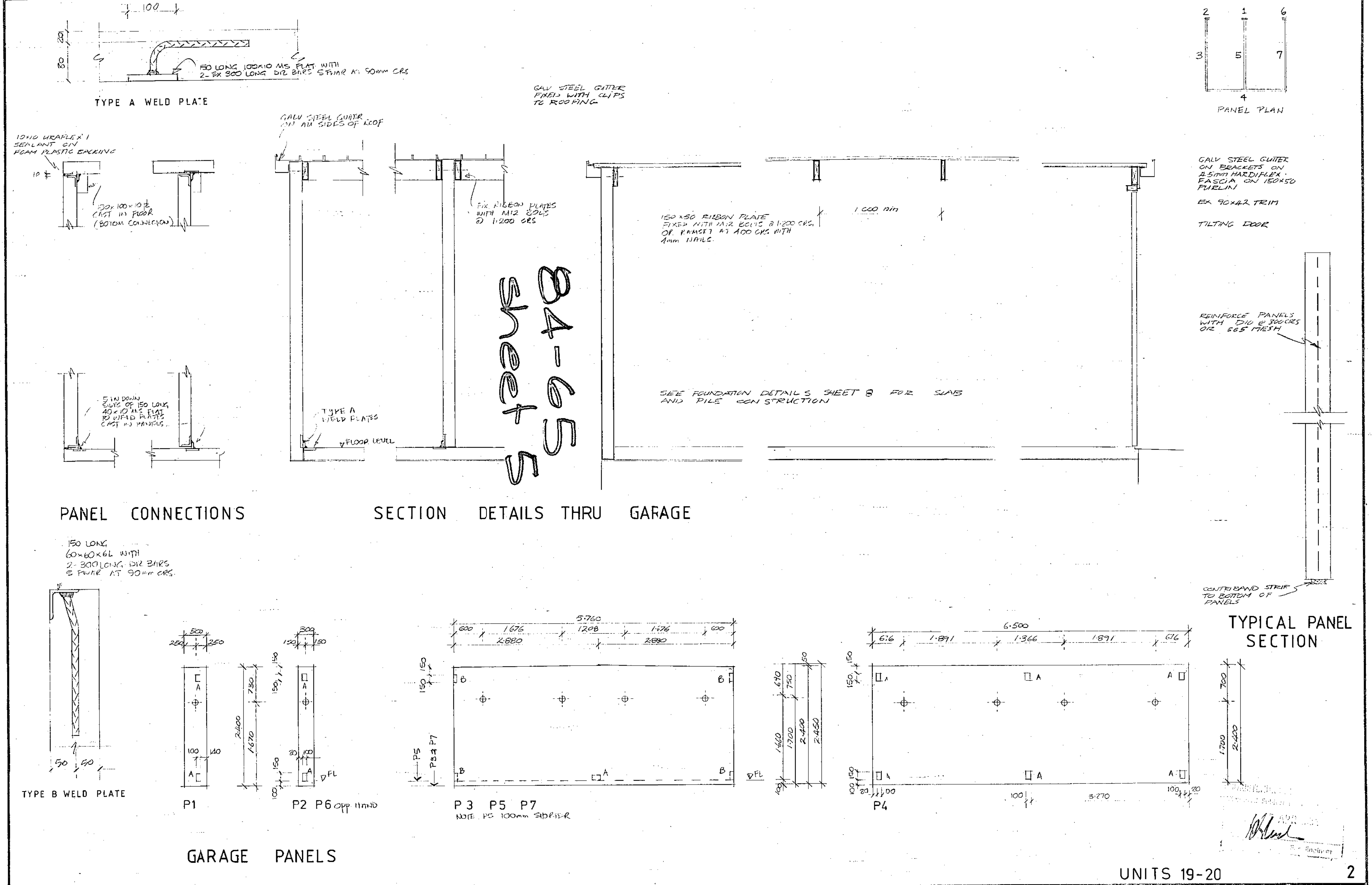

UNITS 19-20 2

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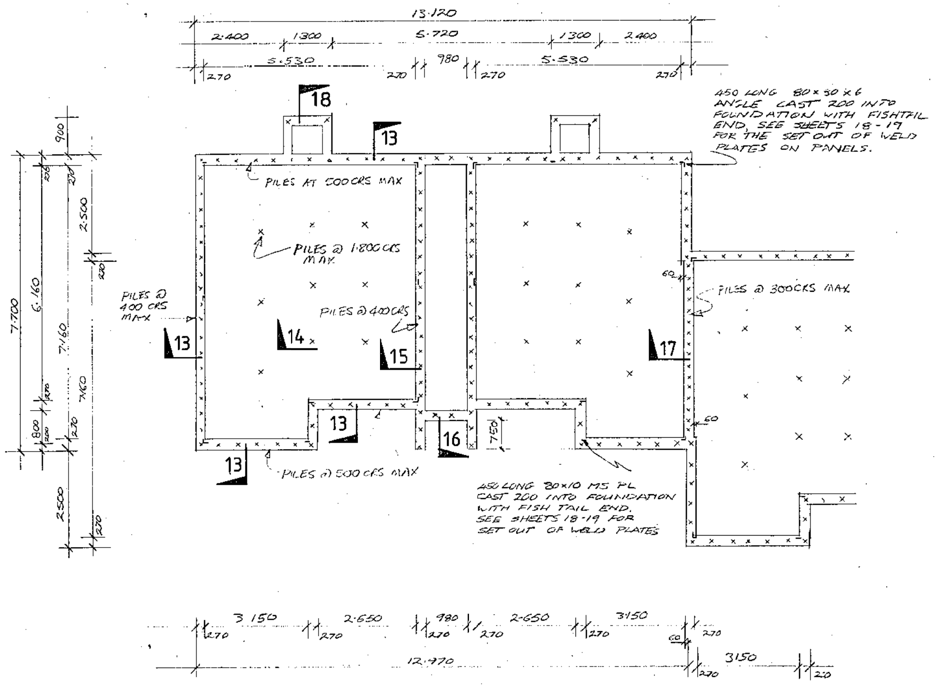
CONTRACT 3
SEE SHEET 13 FOR DETAILS.

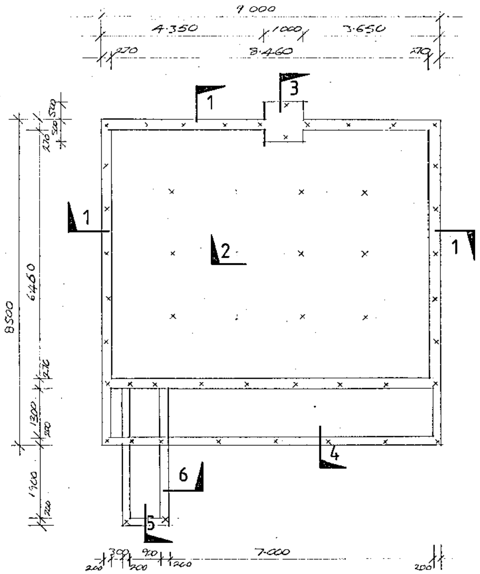


FOUNDATION & PILE PLAN
FOR UNITS 1 - 16

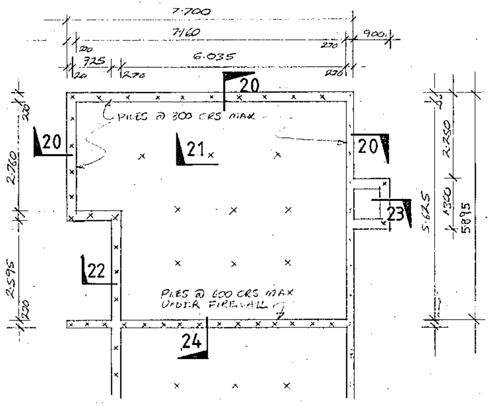
PILING NOTES

1. X MARKS THE POSITION OF EACH PRESTRESSED CONCRETE 92×75mm PILE REINFORCED WITH 4-4mm STRANDS.
2. PILES SHALL BE DRIVEN WITH A 200 KG HAMMER DROPPED 500mm TO A SET OF 16mm FOR 4 BLOWS IN ALL AREAS EXCEPT UNITS 17 & 18 WHERE A SET OF 25mm FOR 4 BLOWS SHALL BE ACHIEVED.
3. THE PILE DRIVER IS REQUIRED TO DRIVE ANY FURTHER TEST PILES REQUIRED TO DETERMINE PILE LENGTHS. ALL SUCH TEST PILES SHALL BE POSITIONED AND DRIVEN SO THEY FORM PART OF THE FOUNDATION.
4. PILE CENTRES ARE SHOWN AS MAXIMUM BUT ALL PILES SHALL BE EVENLY DISTRIBUTED ALONG FOUNDATION BEAMS AND UNDER FLOORS.

CONTRACT 1
SEE SHEET 5 FOR DETAILS.

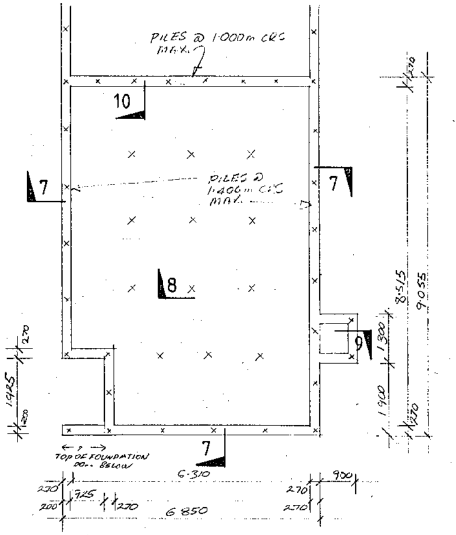


FOUNDATION & PILE PLAN
FOR RESIDENT'S LOUNGE

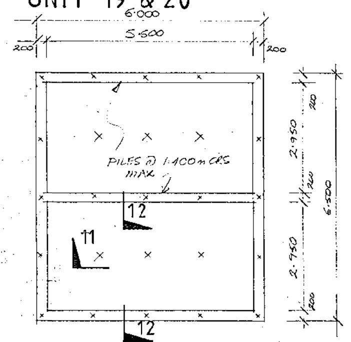


FOUNDATION & PILE PLAN
FOR UNITS 17 & 18
SEE NOTE 2 RE. PILE SETS

CONTRACT 2
SEE SHEET 8 FOR DETAILS.



FOUNDATION & PILE PLAN
FOR UNIT 19 & 20



FOUNDATION & PILE PLAN
FOR GARAGES FOR UNITS 19 & 20

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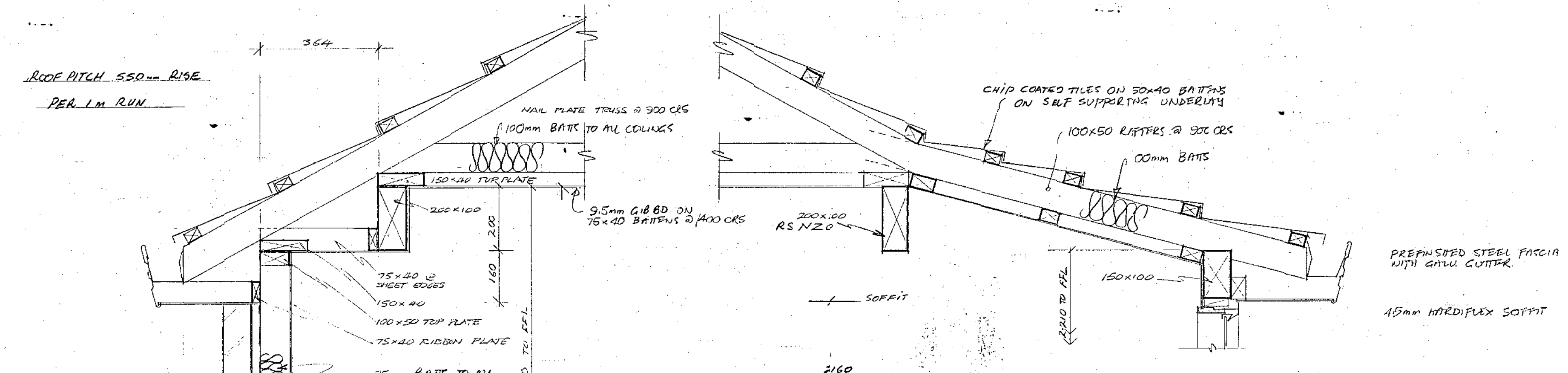
183 HEREFORD STREET
P.O. BOX 13-282
PHONE 64320

AVALON STREET ELDERLY PERSONS HOUSING DEVELOPMENT FOR C.C.C.

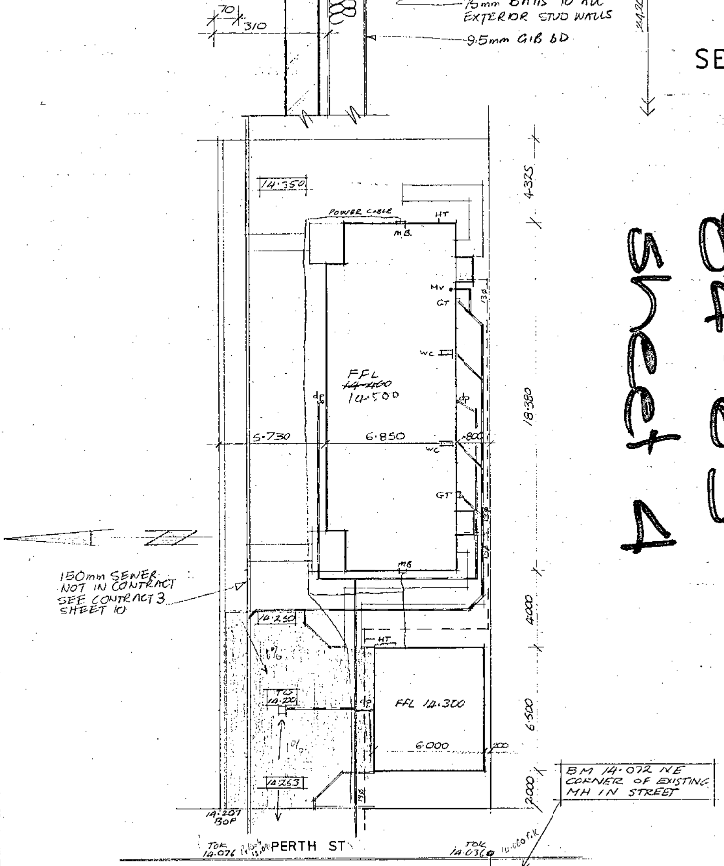
DSN.	SG
DRN.	SJC
TRCD.	SJC
CKD	
DATE	12/83

ISSUE	SCALES	FILE	DRAWING
Q	1:100	1926	2

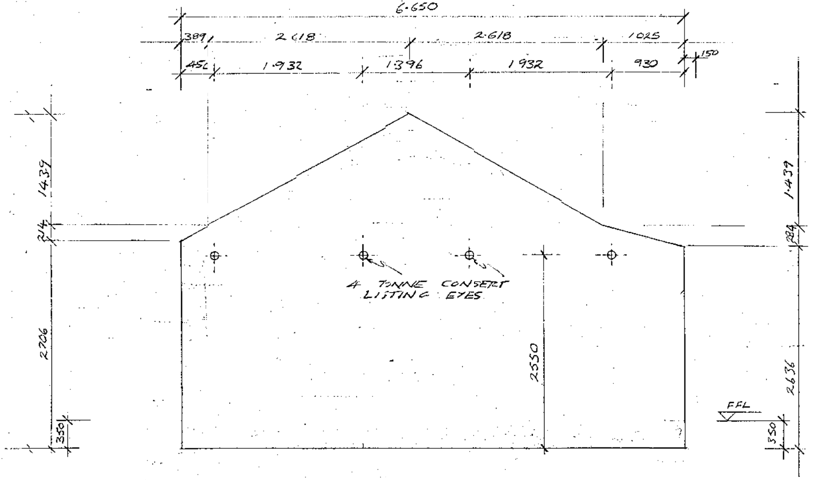
CONTRACTOR SHALL VERIFY ALL DIMENSIONS BEFORE STARTING WORK



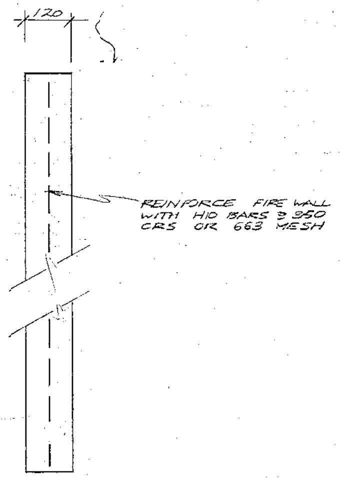
SECTION DETAILS



84-65
sheet 4



FIRE WALL PANEL



SECTION THRU PANEL

UNITS 19-20

2

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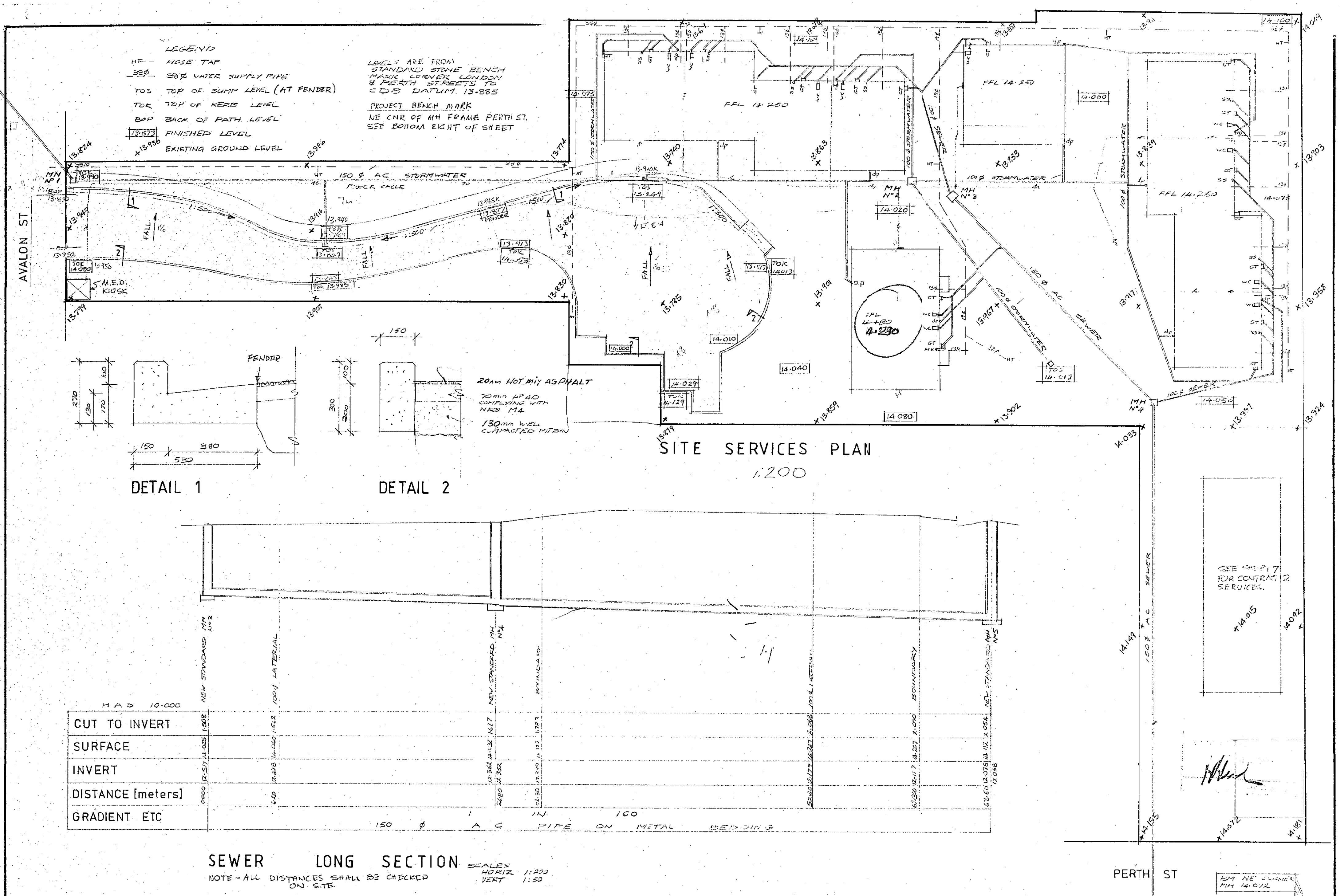
P.O. BOX 13·282
PHONE 64320

AVALON STREET ELDERLY PERSONS HOUSING DEVELOPMENT FOR C.C.C.

	ISSUE	SCALES	FILE	DRAWING
DSN. SB DRN. SJC TRCD. SJC CKD DATE 12/83	G	1:50 1:10 1:200	1926	7

CONTRACTOR SHALL VERIFY ALL DIMENSIONS BEFORE STARTING WORK



SITE SERVICES PLAN

1:200

DETAIL 1

DETAIL 2

	NEW STANDARD MH No3	100φ LATERAL	NEW STANDARD MH No4	BOUNDARY	100φ LATERAL	BOUNDARY	NEW STANDARD MH No5
CUT TO INVERT	1.508	1.562	1.677	1.783	2.068	2.090	2.054
SURFACE	14.025	14.040	14.032	14.122	14.247	14.207	14.112
INVERT	12.517	12.478	12.362 12.352	12.339	12.179	12.117	12.078 12.058
DISTANCE [meters]	0000	6.20	24.80	26.90	52.40	62.30	68.60
GRADIENT ETC	1 IN 160 150 φ A C PIPE ON METAL BEDDING						

HAD 10.000

SEWER LONG SECTION

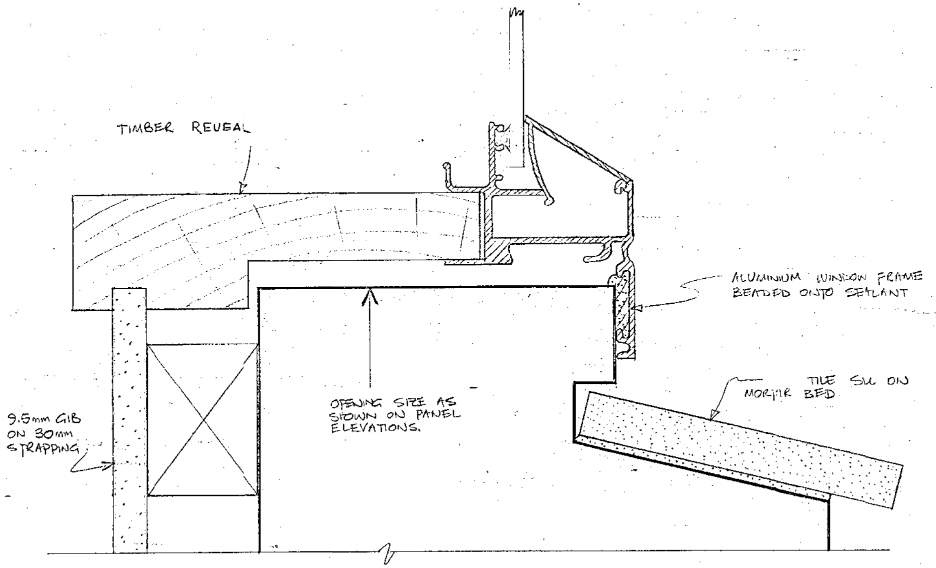
SCALES HORIZ 1:200 VERT 1:50

NOTE - ALL DISTANCES SHALL BE CHECKED ON SITE

BEECHEY DUDER CONSTRUCTION LTD. CHRISTCHURCH P.O. BOX 25081 TELEPHONE 525590

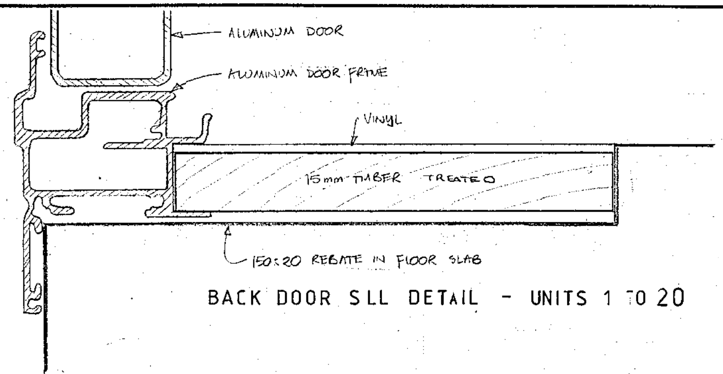
3

AVALON STREET ELDERLY PERSONS HOUSING DEVELOPMENT FOR C.C.C.	SCALES 1 : 1 : 1 :	DRAWN BY	DATE 16 FEB 1984	SHEET NUMBER 10 Q

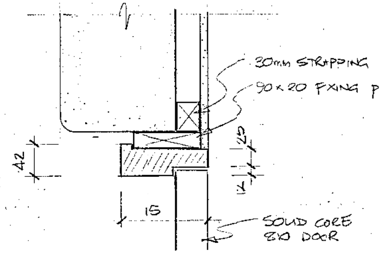


WINDOW SILL DETAIL - UNITS 1 TO 16

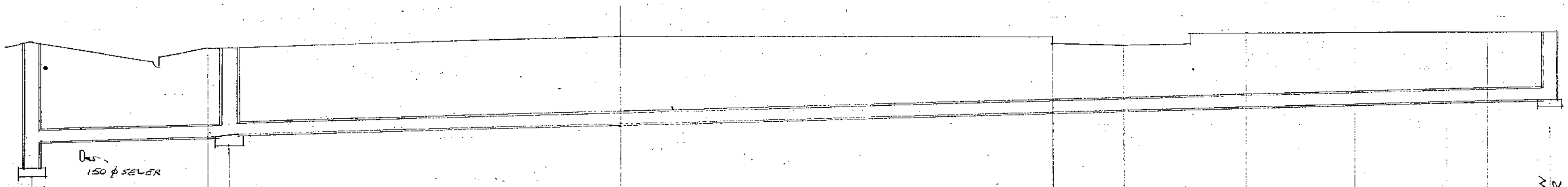
SCALE 1:1



BACK DOOR SILL DETAIL - UNITS 1 TO 20



FIRST FLOOR FIRE DOOR
HEAD AND JANB



	EXISTING MH	BOUNDARY	NEW STANDARD MN No1	100 φ LATERAIL	100 φ LATERAL	100 φ LATERAIL	100 φ LATERAIL	100 φ LATERIAL	100 φ LATERIAL	100 φ LATERIAL	NEW STANDARD MN No2
CUT TO INVERT	1.341	1.248	1.233	1.017	[illegible]	.877	.988	.965	.935	.935	.920
SURFACE	13.931	13.900	13.900	13.800	[illegible]	13.849	14.003	14.017	14.029	14.033	14.040
INVERT	12.590	12.651	12.657 12.667	12.780	[illegible]	12.972	13.015	13.052	13.084	13.098	13.119
DISTANCE [meters]		9.800	10.800	32.400	56.400	59.600	66.600	72.500	77.600	79.800	83.200
GRADES ETC	150 φ 1 IN 160 AC PIPE ON METAL BEDDING										

STORMWATER LONG SECTION

SCALES
HORIZ 1:200
VERT 1:50

3

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PHONE 64 320

AVALON STREET ELDERLY PERSONS HOUSING DEVELOPMENT FOR C.C.C.

DSN. SJC
DRN. SJC
TRCD. SJC
CKD
DATE 1/84

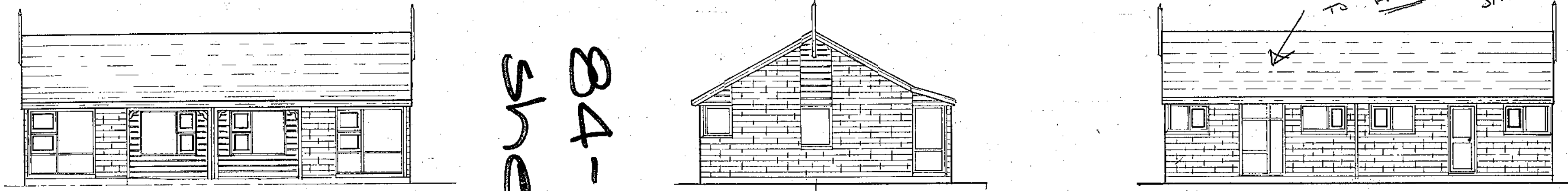
ISSUE	SCALES	FILE	DRAWING
Q	1:200 1:50 1:5	1926	11

CONTRACTOR SHALL VERIFY ALL DIMENSIONS BEFORE STARTING WORK

2 SINGLE STOREY UNITS

INVALID'S UNITS 17·18

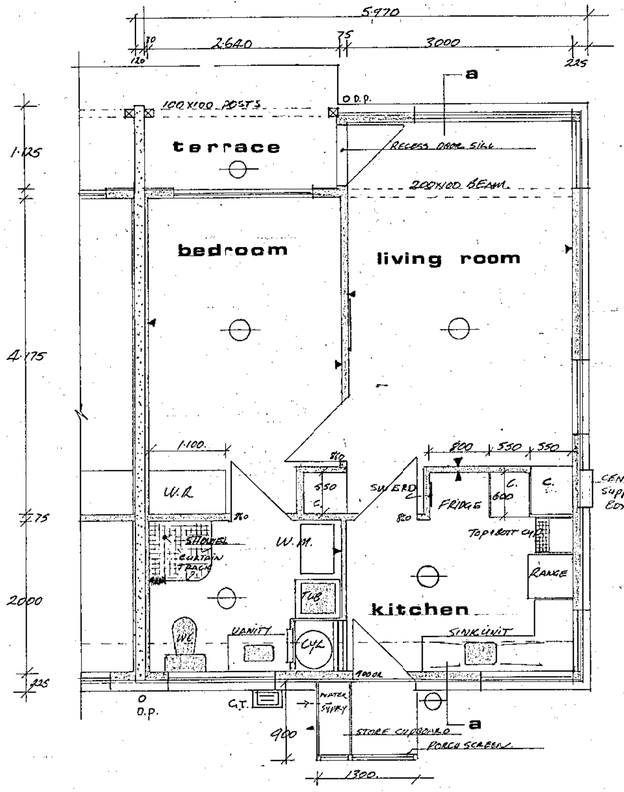
84-65
sheet 6



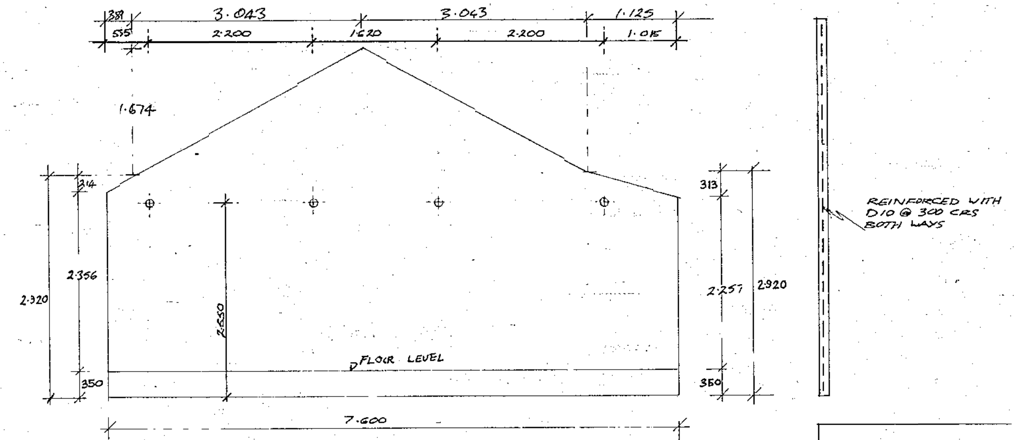
Ventilation required to all roof spaces

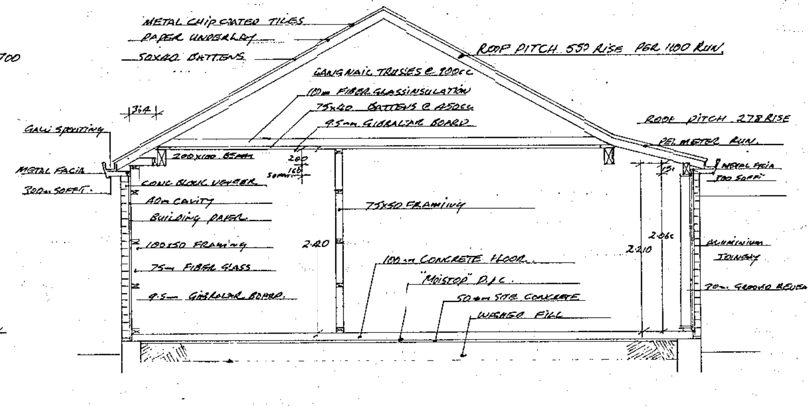
ELEVATIONS

FLOOR PLANS

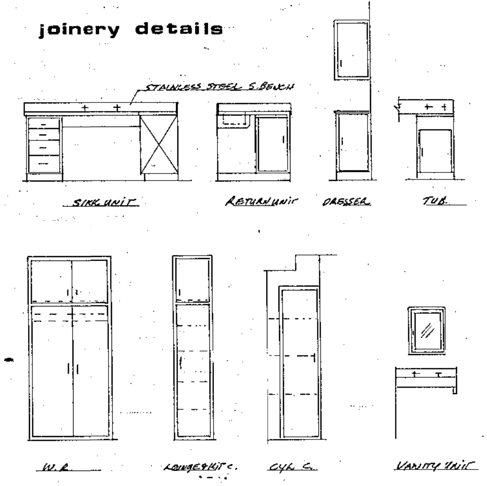


FIRE WALL DETAILS





CROSS SECTION a-a



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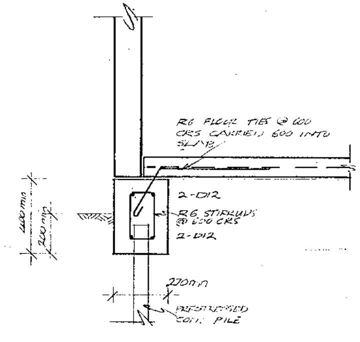
3

AVALON STREET ELDERLY PERSONS HOUSING DEVELOPMENT FOR C.C.C	SCALES 1:100 1:50 1:	DRAWN BY	DATE dec83	SHEET NUMBER 12 Q

UNITS 1 - 16



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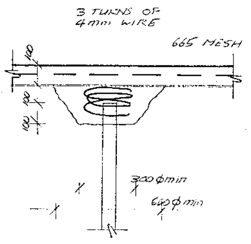

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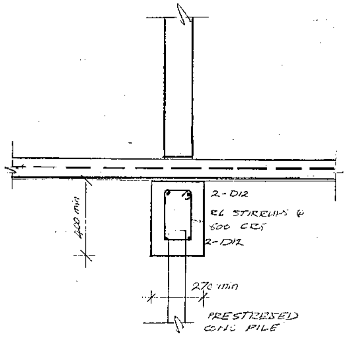

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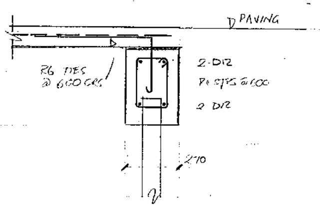

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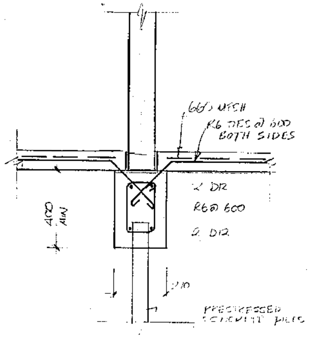

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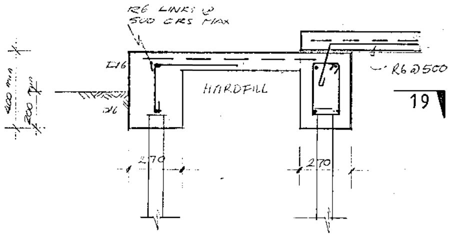
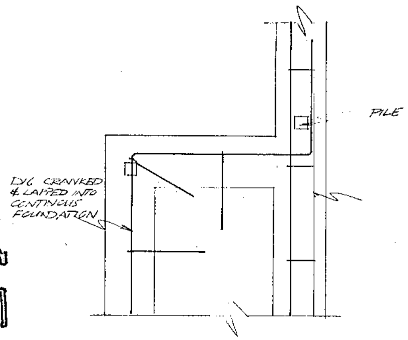


18

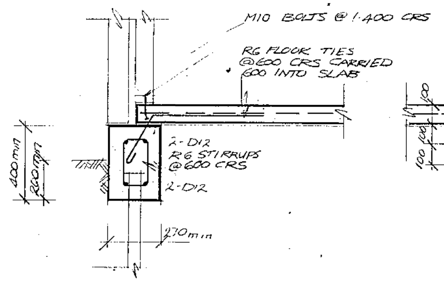
84 - ~~56~~ 65
Sheet 7



19

TWO STOREY FOUNDATION DETAILS - SEE SHEET 2 FOR POSITIONS

UNITS 17 - 18



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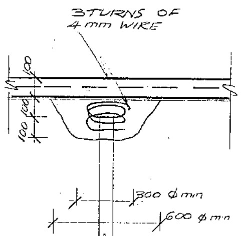

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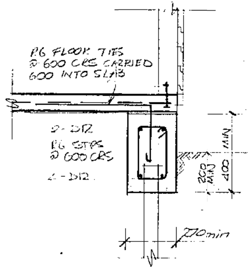

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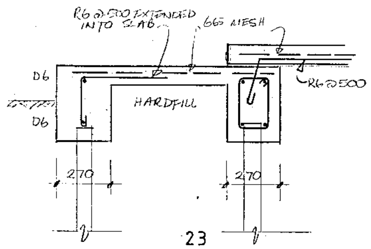

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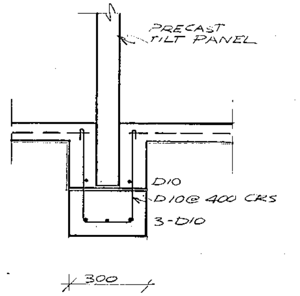

24

SINGLE STOREY FOUNDATION DETAILS - SEE SHEET 2 FOR POSITIONS

3

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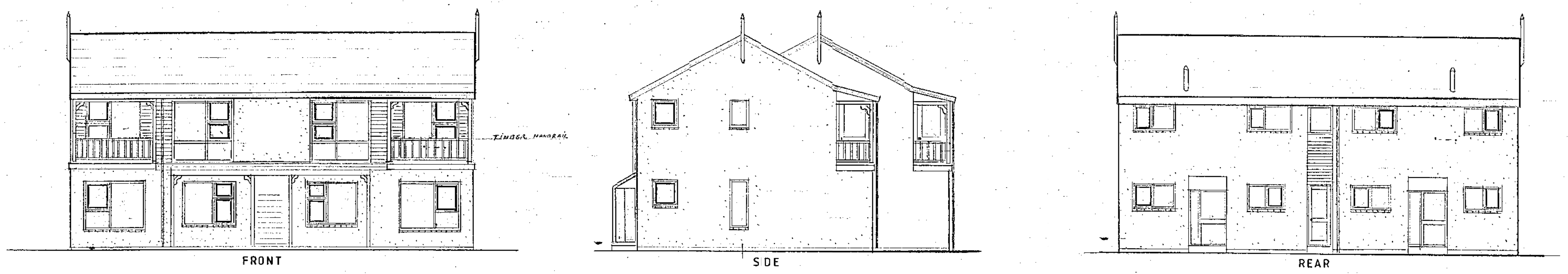
PHONE 64320

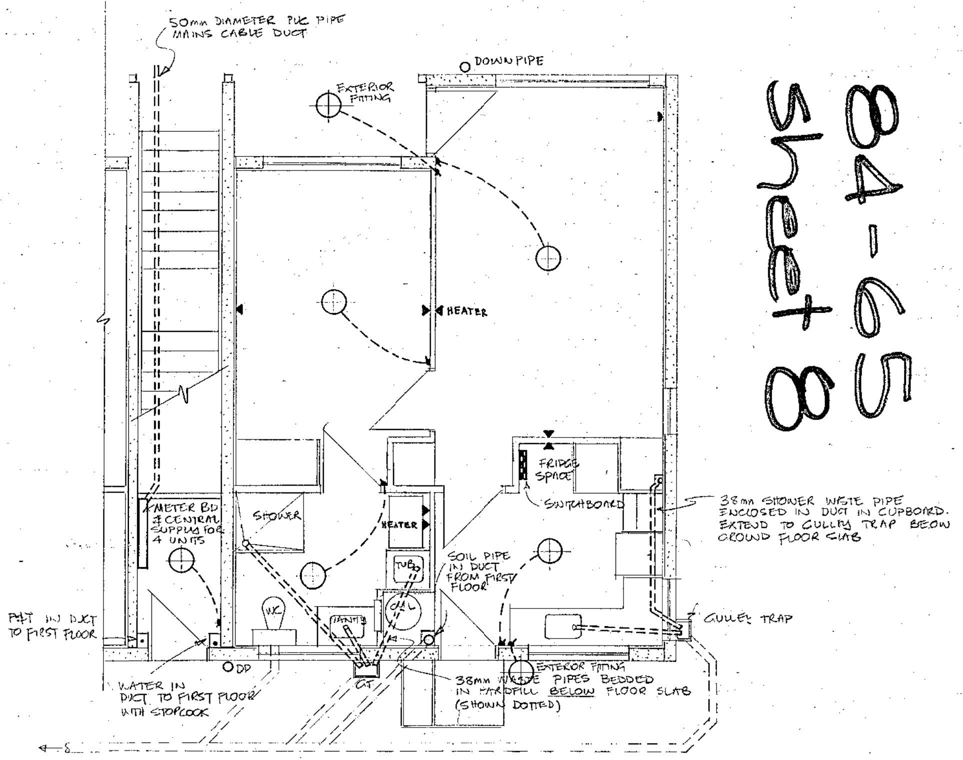
AVALON STREET ELDERLY PERSONS HOUSING DEVELOPMENT FOR C.C.C.

	ISSUE	SCALES	FILE	DRAWING
DSN. SB DRN. S.C TRCD. SJC CKD DATE 11/83	G	1:20	1926	13

CONTRACTOR SHALL VERIFY ALL DIMENSIONS BEFORE STARTING WORK

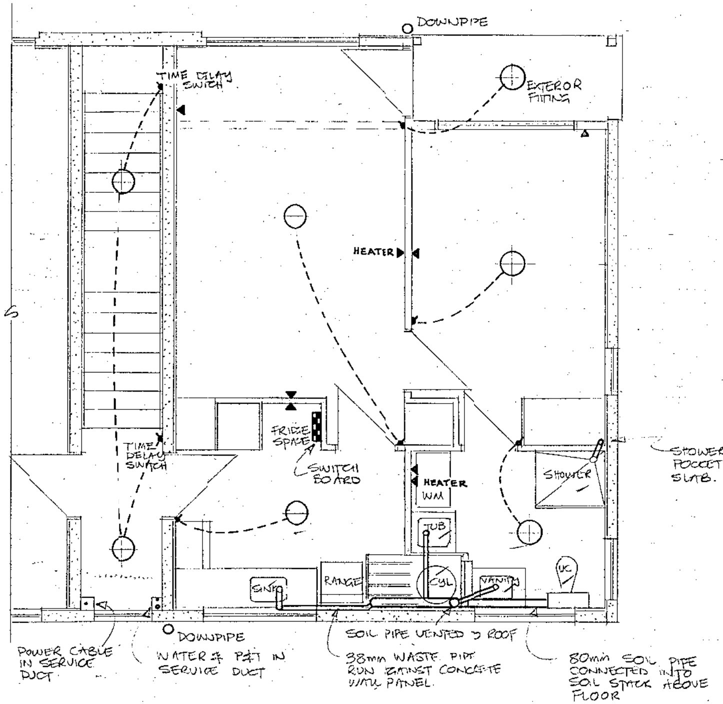


ELEVATIONS



84-65
sheet 8

GROUND FLOOR SERVICES



FIRST FLOOR SERVICES

⊕ INCANDESCENT LAMP HOLDER
◂ LIGHT SWITCH
◂ POWER POINT

UNITS 1 – 16

3

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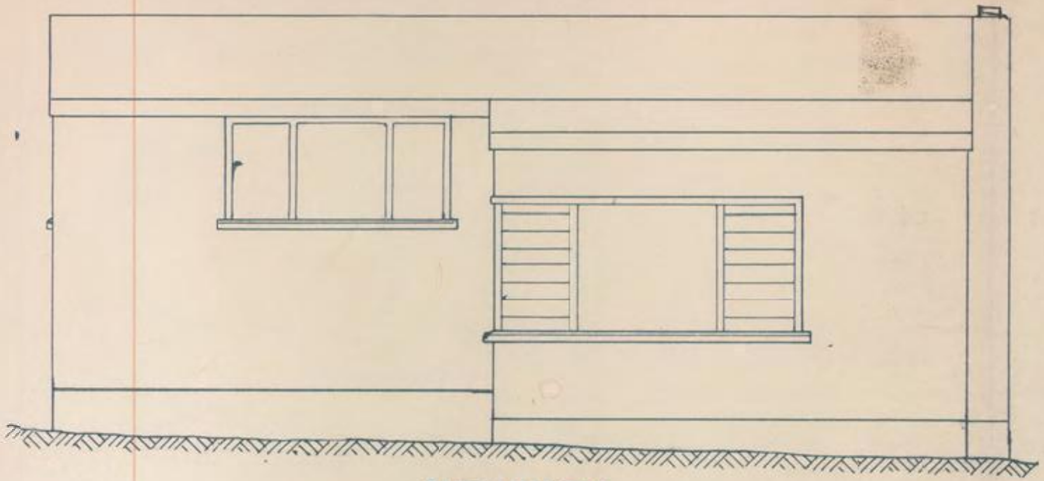
AVALON STREET ELDERLY PERSONS HOUSING DEVELOPMENT FOR C.C.C.

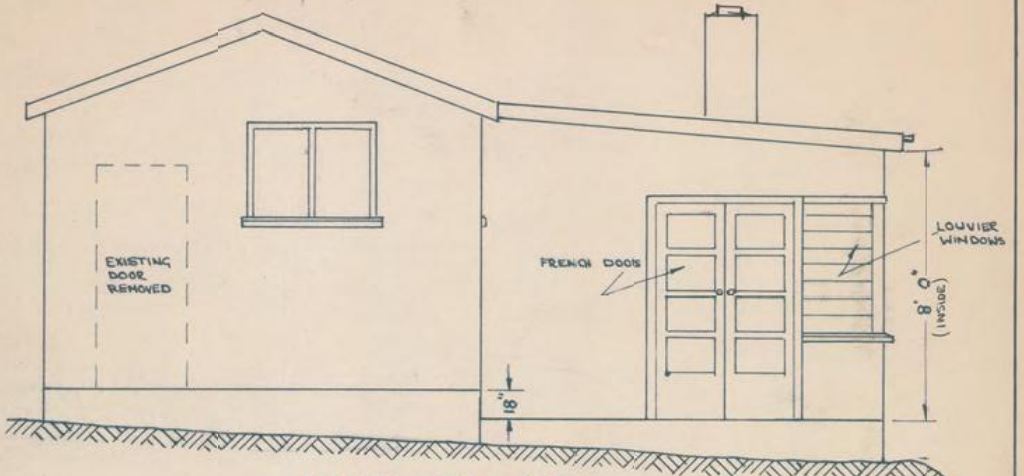
DSN. M.D.
DRN. M.D.
TRCD. S.B.
CKD W.L.
DATE JAN 8+

ISSUE	SCALES	FILE	DRAWING
Q	1:50 1:100	1926	15

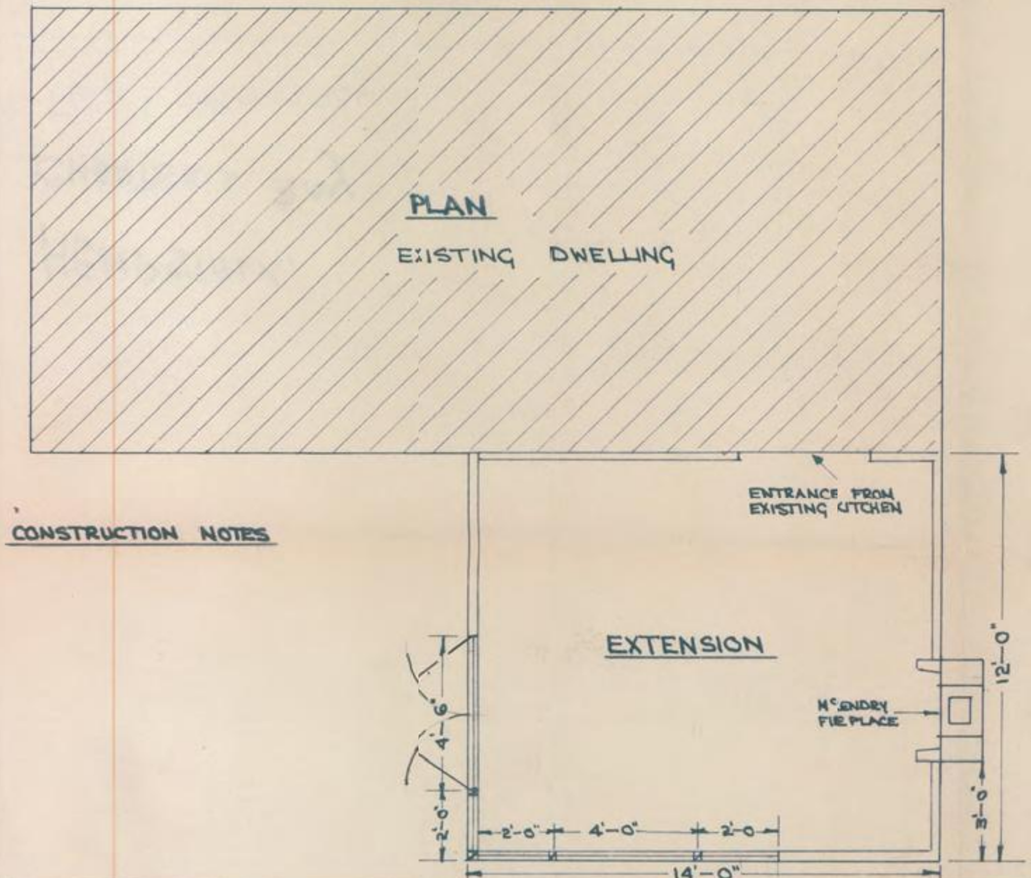
CONTRACTOR SHALL VERIFY ALL DIMENSIONS BEFORE STARTING WORK



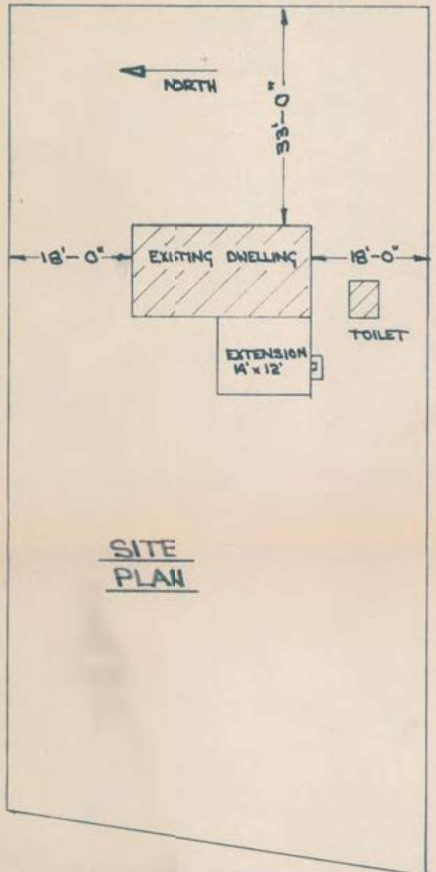
ELEVATION

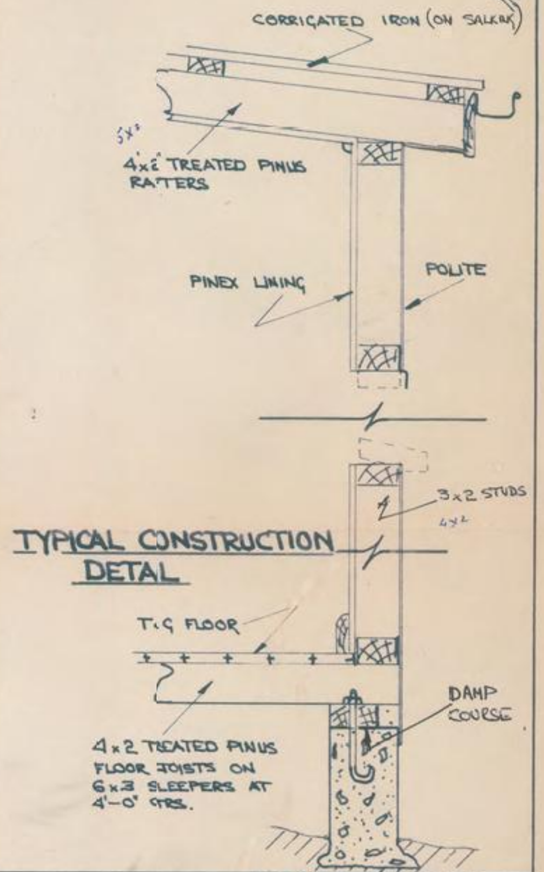


NORTH END VIEW



CONSTRUCTION NOTES





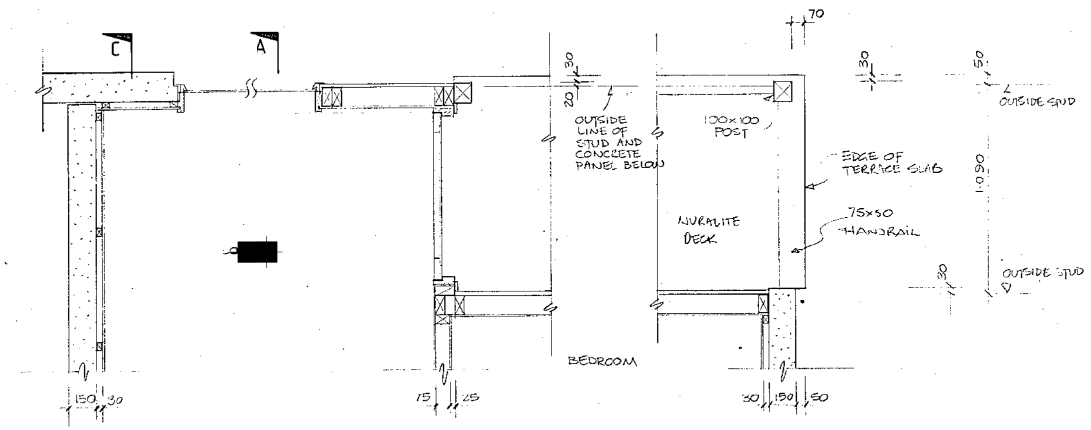
TYPICAL CONSTRUCTION DETAL

PROPOSED EXTENSION TO DWELLING OWNED BY MR. AND MRS. T.B. HEMPSTALK

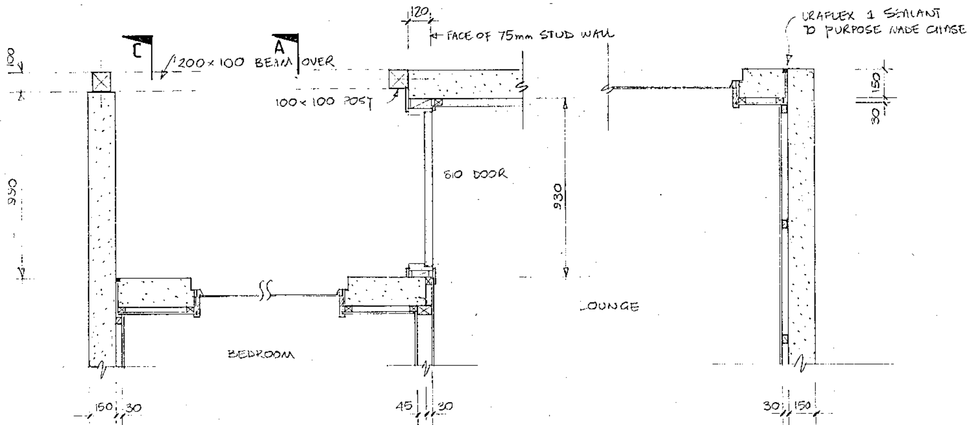
LOT 2 DP14262

SCALE	DATE
¼ FULL SIZE	27-3-67
DRAWN BY T.D.H.	No

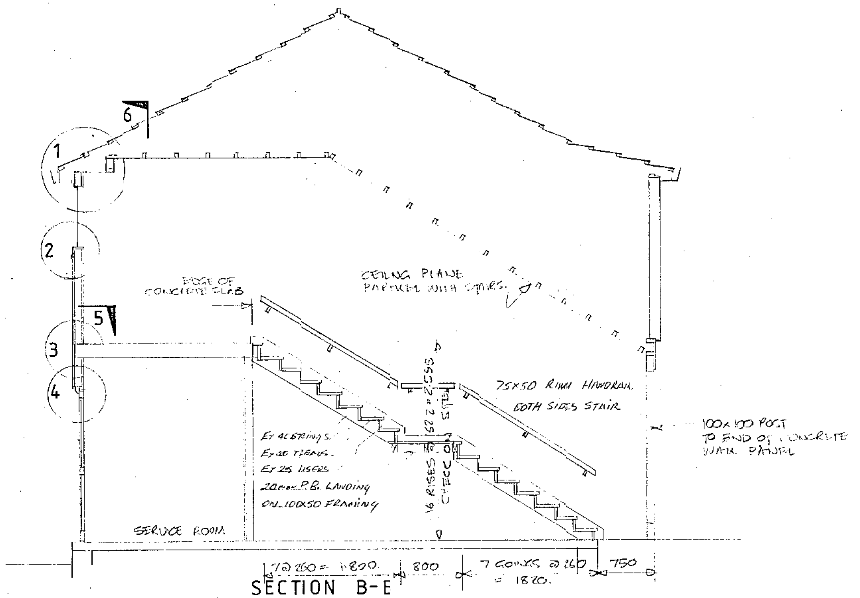
PT RS 1494



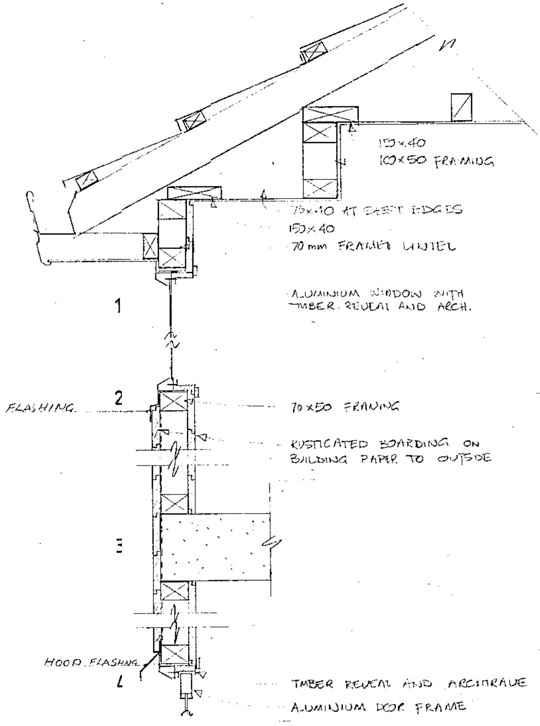
PLAN – FIRST FLOOR AT FRONT

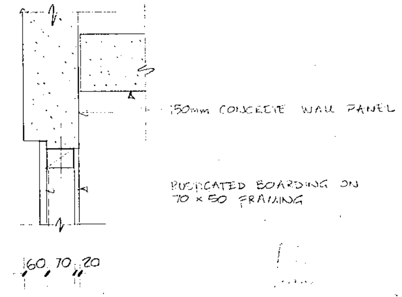


PLAN – GROUND FLOOR AT FRONT



SECTION B-E





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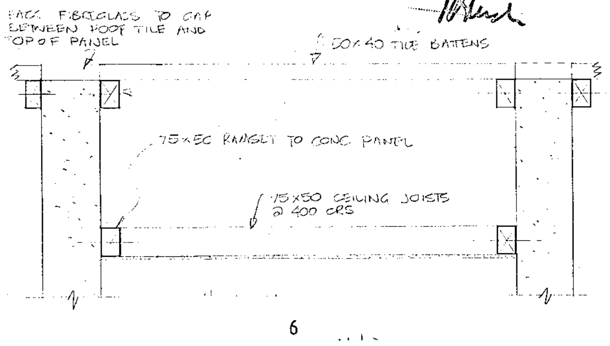

6

84-65
sheet 9

UNITS 1 - 16

3

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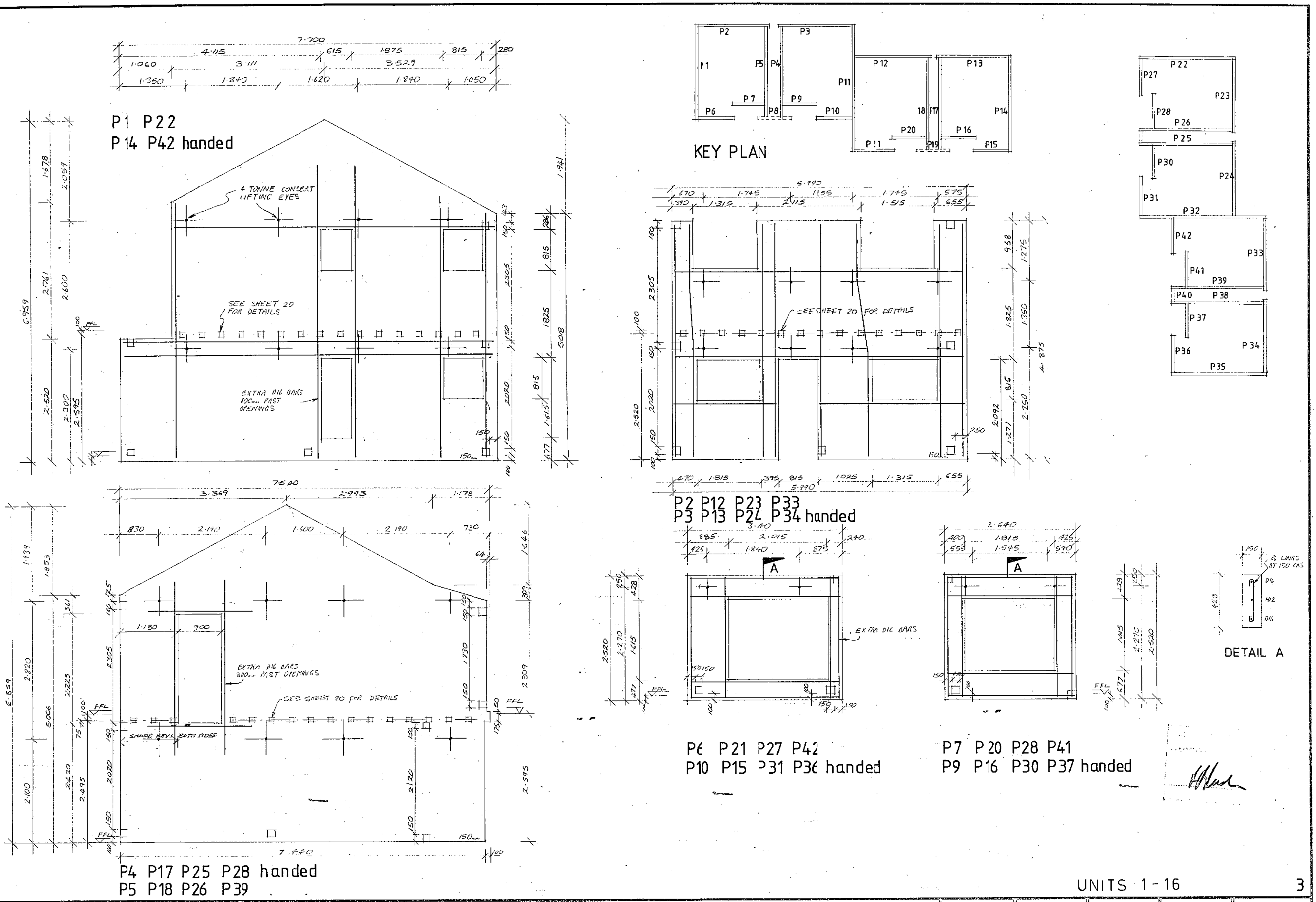
P.O. BOX 13·282
PHONE 64 320

AVALON STREET ELDERLY PERSONS HOUSING DEVELOPMENT FOR C.C.C.

DSN. M.D.
DRN. S.B.
TRCD. S.B.
CKD W.L.
DATE JAN 84

ISSUE	SCALES	FILE	DRAWING
Q	1:50 1:20 1:10	1926	17

CONTRACTOR SHALL VERIFY ALL DIMENSIONS BEFORE STARTING WORK



UNITS 1 - 16

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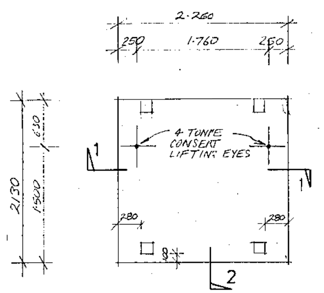
AVALON STREET ELDERLY PERSONS HOUSING DEVELOPMENT FOR C.C.C.

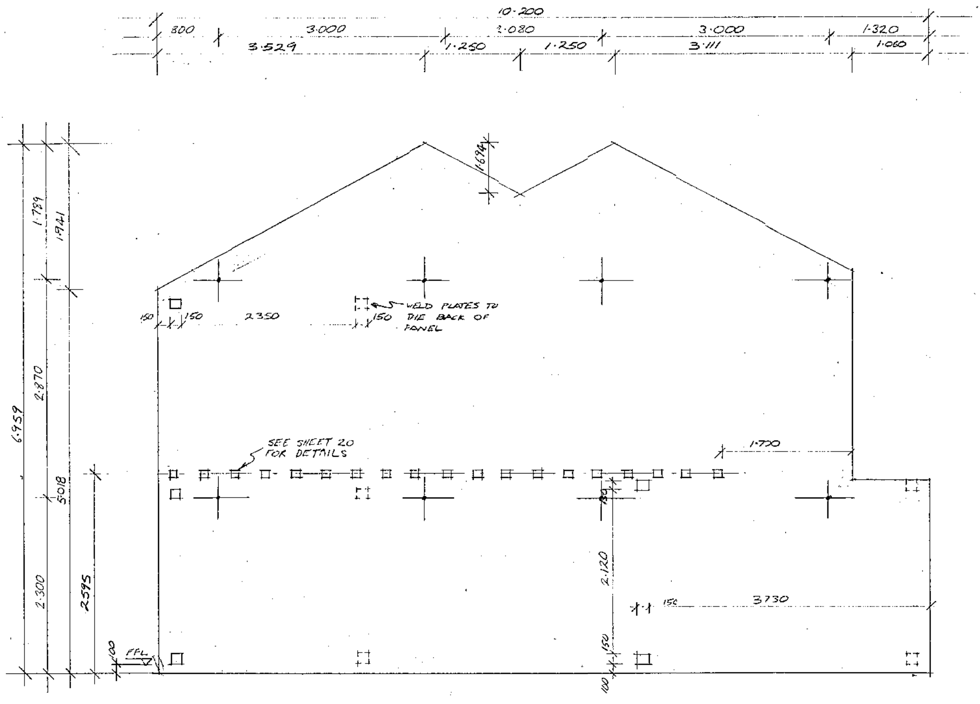
DSN. SE
DRN. SJ
TRCD. SJ
CKD S.B
DATE 1/84

ISSUE	SCALES	FILE	DRAWING
Q	1:50 1:20	1926	18

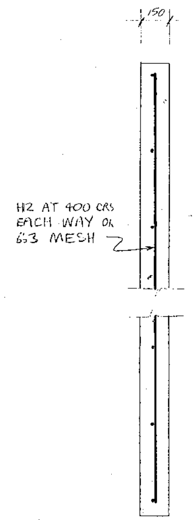
CONTRACTOR SHALL VERIFY ALL DIMENSIONS BEFORE STARTING WORK



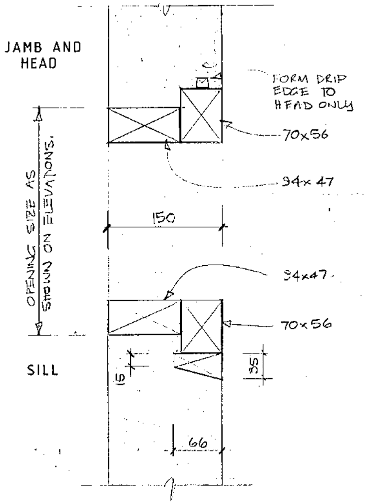
P8 P19 P29 P40



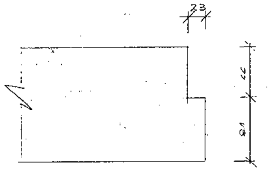
P 11
P 32 handed



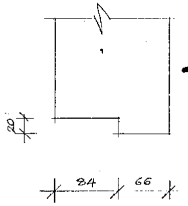
TYPICAL SECTION THROUGH PANEL



WINDOW BOXING

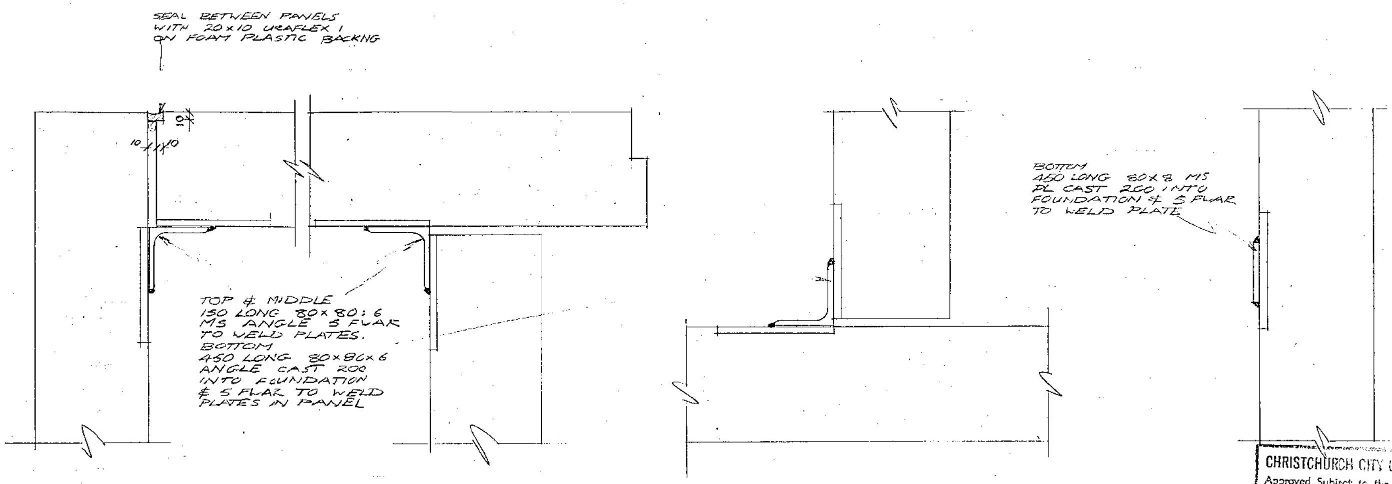


DETAIL 1



DETAIL 2

84-65
Sheet 10



PANEL CONNECTION DETAILS

CHRISTCHURCH CITY COUNCIL
Approved Subject to the Endorsement
APR 1984
For Engineer

UNITS 1 - 16

3

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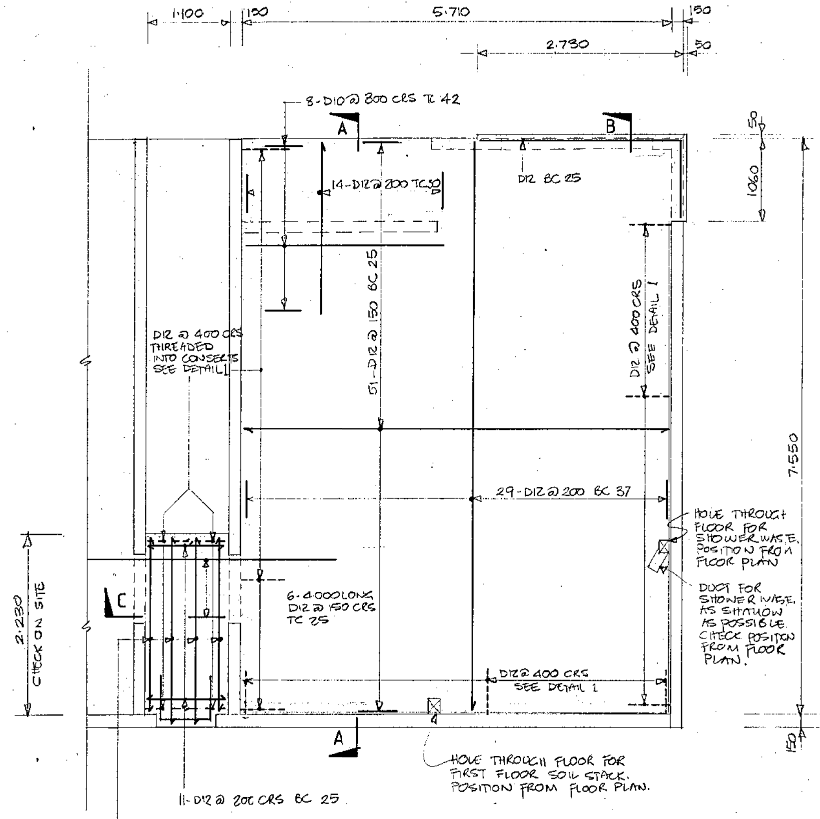
AVALON STREET ELDERLY PERSONS HOUSING DEVELOPMENT FOR C.C.C.

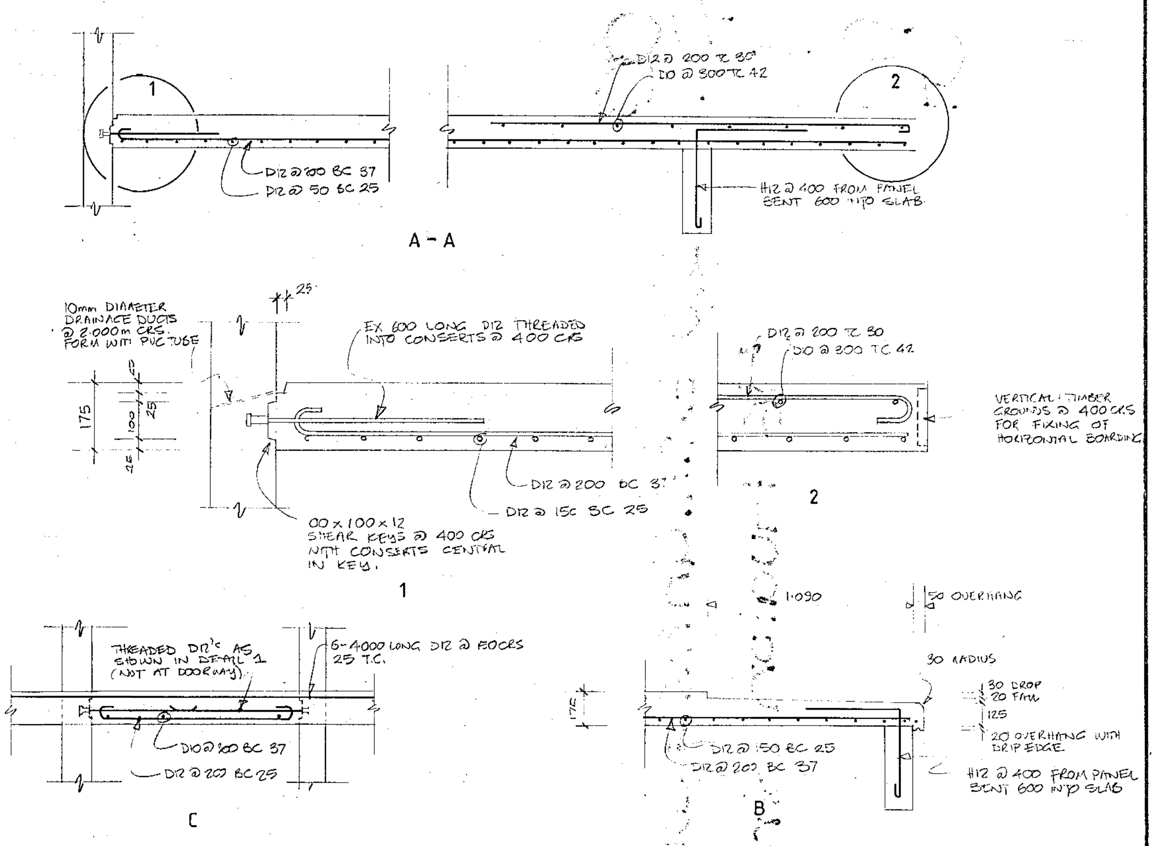
	ISSUE	SCALES	FILE	DRAWING
DSN. SB DRN. SJC TRCD. SJC CKD. SB DATE 1/84	Q	1:50 1:20 1:10 1:5	1926	19

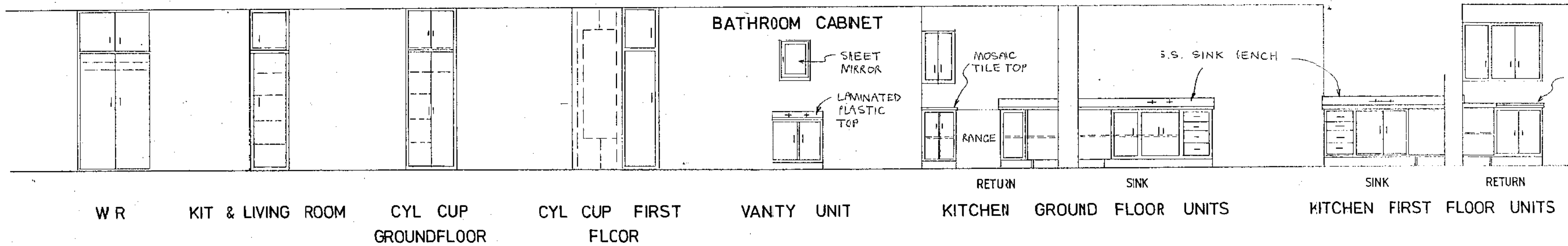
CONTRACTOR SHALL VERIFY ALL DIMENSIONS BEFORE STARTING WORK



TYPICAL FIRST FLOOR SLAB PLAN

4-OFF AS SHOWN
4-OFF OPPOSITE HAND





CHRISTCHURCH CI
Approved Subject to
APR 1984
For Engineer

JOINERY DETAILS UNITS 1 - 16

UNITS 1 - 16

3

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AVALON STREET ELDERLY PERSONS HOUSING DEVELOPMENT FOR C.C.C.

DSN. S.B DRN. S.B TRCD. S.B CKD. W.L DATE JAN 84	ISSUE	SCALES	FILE	DRAWING
	Q	1:50 1:20 1:10	1926	20

CONTRACTOR SHALL VERIFY ALL DIMENSIONS BEFORE STARTING WORK

Appendix C

CERA DEE Summary Data

Detailed Engineering Evaluation Summary Data

V1.11

Location

Building Name: Block A

Unit No: Street

Building Address: 56 Avalon St, Richmond

Legal Description: HP Smith Courts

Degrees Min Sec

GPS south:

GPS east:

Building Unique Identifier (CCC): PRO 0677-001

Reviewer: David Whittaker

CPEng No: 123089

Company: Beca

Company project number: 5323355

Company phone number: 643663521

Date of submission: 5/08/2014

Inspection Date: 12/12/2012

Revision: F

Is there a full report with this summary? yes

Site

Site slope: flat

Soil type:

Site Class (to NZS1170.5): D

Proximity to waterway (m, if <100m):

Proximity to clifftop (m, if < 100m):

Proximity to cliff base (m,if <100m):

Max retaining height (m):

Soil Profile (if available): Unknown.

If Ground improvement on site, describe:

Approx site elevation (m):

Building

No. of storeys above ground: 2 single storey = 1

Ground floor split? no

Storeys below ground 0

Foundation type: other (describe)

Building height (m): 7.00

Floor footprint area (approx): 200

Age of Building (years): 27

Ground floor elevation (Absolute) (m):

Ground floor elevation above ground (m):

if Foundation type is other, describe: Raft slab with prestressed concrete driven piles.

height from ground to level of uppermost seismic mass (for IEP only) (m): 5.6

Date of design: 1976-1992

Strengthening present? no

Use (ground floor): multi-unit residentia

Use (upper floors): multi-unit residentia

Use notes (if required):

Importance level (to NZS1170.5): IL2

If so, when (year)?

And what load level (%g)?

Brief strengthening description:

Gravity Structure

Gravity System: load bearing walls

Roof: timber truss

Floors: concrete flat slab

Beams: timber

Columns: timber

Walls: load bearing concrete

truss depth, purlin type and cladding: 2.1m deep truss with timber battens and chipcoated tiles.

slab thickness (mm): 175 first floor, 100 ground floor.

type: One 200 x 100 longitudinal beam

typical dimensions (mm x mm): 100 x 100, only along front

#N/A

Lateral load resisting structure

Lateral system along: concrete shear wall

Ductility assumed, μ: 1.25

Period along: 0.40 0.11 from parameters in sheet

Total deflection (ULS) (mm):

maximum interstorey deflection (ULS) (mm):

Note: Define along and across in detailed report!

enter wall data in "IEP period calcs" worksheet for period calculation: Some timber framing in first floor

estimate or calculation? estimated

estimate or calculation?

estimate or calculation?

Lateral system across: concrete shear wall

Ductility assumed, μ: 1.25

Period across: 0.40 0.10 from parameters in sheet

Total deflection (ULS) (mm):

maximum interstorey deflection (ULS) (mm):

enter wall data in "IEP period calcs" worksheet for period calculation: Precast panels.

estimate or calculation? estimated

estimate or calculation?

estimate or calculation?

Separations:

north (mm): leave blank if not relevant

east (mm):

south (mm):

west (mm):

Non-structural elements

Stairs: timber

Wall cladding: exposed structure

Roof Cladding: Heavy tiles

Glazing: aluminium frames

Ceilings: fibrous plaster, fixed

Services(list):

describe supports: Timber stringers, concrete landing.

describe: Some timber weatherboards.

describe: Chipcoated tiles.

9.5mm gib board lining.

Available documentation

Architectural: partial

Structural: partial

Mechanical: none

Electrical: none

Geotech report: none

original designer name/date: Beechy Duder Constructions, 1983

original designer name/date: Warren R Lewis, 1983.

original designer name/date:

original designer name/date:

original designer name/date:

Damage

Site:

(refer DEE Table 4-2)

Site performance: Good

Settlement: 0-25mm

Differential settlement: 1:250-1:150

Liquefaction: none apparent

Lateral Spread: none apparent

Differential lateral spread: none apparent

Ground cracks: none apparent

Damage to area: slight

Describe damage: Minor cracking of linings and precast panels.

notes (if applicable): Floor level survey

notes (if applicable): Floor level survey

notes (if applicable): Verticality survey suggests walls are tilting.

notes (if applicable):

notes (if applicable):

notes (if applicable):

notes (if applicable): Movement of structure evident.

Building:

Current Placard Status: green

Along Damage ratio: 0%

Describe (summary): Minor structural damage.

Describe how damage ratio arrived at: Minor structural damage.

Across Damage ratio: 0%

Describe (summary): Minor structural damage.

$$Damage\_Ratio = \frac{(\%NBS\,(before) - \%NBS\,(after))}{\%NBS\,(before)}$$

Diaphragms Damage?: no

Describe:

CSWs: Damage?: yes

Describe: first floor slab to wall connections in Units 11/12 due to brittle behaviour observed in Block B, and site characteristics due to liquefaction potential

Pounding: Damage?: no

Describe:

Non-structural: Damage?: no

Describe:

Recommendations

Level of repair/strengthening required: minor structural

Building Consent required: no

Interim occupancy recommendations: full occupancy

Describe: Repair cracks in linings and precast panels.

Describe:

Describe:

Along Assessed %NBS before e'quakes: 35% 0% %NBS from IEP below

Assessed %NBS after e'quakes: 35%

If IEP not used, please detail assessment methodology: Quantitative calculations - force based

Across Assessed %NBS before e'quakes: 35% 0% %NBS from IEP below

Assessed %NBS after e'quakes: 35%

IEP **Use of this method is not mandatory - more detailed analysis may give a different answer, which would take precedence. Do not fill in fields if not using IEP.**

Period of design of building (from above): 1976-1992

h_n from above: 5.6m

Seismic Zone, if designed between 1965 and 1992: B

not required for this age of building

not required for this age of building

	along	across
Period (from above):	0.4	0.4
(%NBS)nom from Fig 3.3:		

Note:1 for specifically design public buildings, to the code of the day: pre-1965 = 1.25; 1965-1976, Zone A =1.33; 1965-1976, Zone B = 1.2; all else 1.0	1.00
Note 2: for RC buildings designed between 1976-1984, use 1.2	1.2
Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (1.0)	1.0

	along	across
Final (%NBS)$_{nom}$:	**0%**	**0%**

2.2 Near Fault Scaling Factor

Near Fault scaling factor, from NZS1170.5, cl 3.1.6: 1.00

	along	across
Near Fault scaling factor (1/N(T,D), **Factor A**:	1	1

2.3 Hazard Scaling Factor

Hazard factor Z for site from AS1170.5, Table 3.3: 0.30

Z_{1992}, from NZS4203:1992: 0.8

Hazard scaling factor, **Factor B:** 3.333333333

2.4 Return Period Scaling Factor

Building Importance level (from above): 2

Return Period Scaling factor from Table 3.1, **Factor C**: 1.00

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)	1.25	1.25
Ductility scaling factor: =1 from 1976 onwards; or =k_μ, if pre-1976, fromTable 3.3:	1.00	1.00
Ductiity Scaling Factor, **Factor D**:	1.00	1.00

2.6 Structural Performance Scaling Factor:

Sp:	0.925	0.925
Structural Performance Scaling Factor **Factor E**:	1.081081081	1.081081081

2.7 Baseline %NBS, (NBS%)$_b$ = (%NBS)$_{nom}$ x A x B x C x D x E **%NBS$_b$:**	**0%**	**0%**

Global Critical Structural Weaknesses: (refer to NZSEE IEP Table 3.4)

3.1. Plan Irregularity, factor A:	insignificant	1
3.2. Vertical irregularity, Factor B:	insignificant	1
3.3. Short columns, Factor C:	insignificant	1

3.4. Pounding potential

Pounding effect D1, from Table to right: 1.0

Height Difference effect D2, from Table to right: 1.0

Therefore, Factor D: 1

Table for selection of D1	Severe	Significant	Insignificant/none
Separation	0<sep<.005H	.005<sep<.01H	Sep>.01H
Alignment of floors within 20% of H	**0.7**	**0.8**	**1**
Alignment of floors not within 20% of H	**0.4**	**0.7**	**0.8**

Table for Selection of D2	Severe	Significant	Insignificant/none
Separation	0<sep<.005H	.005<sep<.01H	Sep>.01H
Height difference > 4 storeys	0.4	0.7	1
Height difference 2 to 4 storeys	0.7	0.9	1
Height difference < 2 storeys	1	1	1

3.5. Site Characteristics	significant	0.7

3.6. Other factors, Factor F

	Along	Across
For ≤ 3 storeys, max value =2.5, otherwise max valule =1.5, no minimum	1.0	1.0
Rationale for choice of F factor, if not 1		

Detail Critical Structural Weaknesses: (refer to DEE Procedure section 6)

List any: Liquefaction potential. Refer also section 6.3.1 of DEE for discussion of F factor modification for other critical structural weaknesses

3.7. Overall Performance Achievement ratio (PAR)	**0.70**	**0.70**
4.3 PAR x (%NBS)b: PAR x Baselline %NBS:	**0%**	**0%**
4.4 Percentage New Building Standard (%NBS), (before)		**0%**

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name: Block B
Unit No: Street
Building Address: 56 Avalon St, Richmond
Legal Description: HP Smith Courts
Degrees Min Sec
GPS south:
GPS east:
Building Unique Identifier (CCC): PRO 0677-003

Reviewer: David Whittaker
CPEng No: 123089
Company: Beca
Company project number: 5323355
Company phone number: 643663521
Date of submission: 5/08/2014
Inspection Date: 12/12/2012
Revision: F
Is there a full report with this summary? yes

Site

Site slope: flat
Soil type:
Site Class (to NZS1170.5): D
Proximity to waterway (m, if <100m):
Proximity to clifftop (m, if < 100m):
Proximity to cliff base (m,if <100m):

Max retaining height (m):
Soil Profile (if available): Unknown.
If Ground improvement on site, describe:
Approx site elevation (m):

Building

No. of storeys above ground: 2 single storey = 1
Ground floor split? no
Storeys below ground 0
Foundation type: other (describe)
Building height (m): 7.00
Floor footprint area (approx): 200
Age of Building (years): 27

Ground floor elevation (Absolute) (m):
Ground floor elevation above ground (m):
if Foundation type is other, describe: Raft slab with prestressed concrete driven piles.
height from ground to level of uppermost seismic mass (for IEP only) (m): 5.6
Date of design: 1976-1992

Strengthening present? no
If so, when (year)?
And what load level (%g)?
Brief strengthening description:

Use (ground floor): multi-unit residential
Use (upper floors): multi-unit residential
Use notes (if required):
Importance level (to NZS1170.5): IL2

Gravity Structure

Gravity System: load bearing walls
Roof: timber truss — truss depth, purlin type and cladding: 2.1m deep truss with timber battens and chipcoated tiles.
Floors: concrete flat slab — slab thickness (mm): 175 first floor, 100 ground floor.
Beams: timber — type: One 200 x 100 longitudinal beam.
Columns: timber — typical dimensions (mm x mm): 100 x 100, only along front.
Walls: load bearing concrete — #N/A:

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along: concrete shear wall
enter wall data in "IEP period calcs" worksheet for period calculation: Some timber framing in first floor.
Ductility assumed, μ: 1.25
Period along: 0.40 0.11 from parameters in sheet — estimate or calculation? estimated
Total deflection (ULS) (mm): — estimate or calculation?
maximum interstorey deflection (ULS) (mm): — estimate or calculation?

Lateral system across: concrete shear wall
enter wall data in "IEP period calcs" worksheet for period calculation: Precast panels.
Ductility assumed, μ: 1.25
Period across: 0.40 0.10 from parameters in sheet — estimate or calculation? estimated
Total deflection (ULS) (mm): — estimate or calculation?
maximum interstorey deflection (ULS) (mm): — estimate or calculation?

Separations:

north (mm): leave blank if not relevant
east (mm):
south (mm):
west (mm):

Non-structural elements

Stairs: timber — describe supports: Timber stringers, concrete landing.
Wall cladding: exposed structure — describe: Some timber weatherboards.
Roof Cladding: Heavy tiles — describe: Chipcoated tiles.
Glazing: aluminium frames
Ceilings: fibrous plaster, fixed — 9.5mm gib board lining.
Services(list):

Available documentation

Architectural: partial — original designer name/date: Beechy Duder Constructions, 1983.
Structural: partial — original designer name/date: Warren R Lewis, 1983
Mechanical: none — original designer name/date: Floor level and verticality survey by Beca
Electrical: none — original designer name/date:
Geotech report: none — original designer name/date:

Damage

Site:
(refer DEE Table 4-2)

Site performance: moderate — Describe damage: Minor cracking of linings and precast panels. Failed first floor slab to precast wall connections in Units 11/12.

Settlement: 25-100m — notes (if applicable): Floor level survey
Differential settlement: 1:250-1:150 — notes (if applicable): Floor level survey
Liquefaction: none apparent — notes (if applicable): Verticality survey suggests walls are tilting.
Lateral Spread: none apparent — notes (if applicable):
Differential lateral spread: none apparent — notes (if applicable):
Ground cracks: none apparent — notes (if applicable):
Damage to area: slight — notes (if applicable): Movement of structure evident.

Building:

Current Placard Status: green

Along
Damage ratio: 20% — Describe how damage ratio arrived at: failed first floor slab to wall connections, differential settlement
Describe (summary): major structural damage.

Across
Damage ratio: 20%
Describe (summary): major structural damage.

$$Damage\_Ratio = \frac{(\%NBS(before) - \%NBS(after))}{\%NBS(before)}$$

Diaphragms — Damage?: yes — Describe: brittle failure of first floor slab to wall connections in Units 11/12
CSWs: — Damage?: yes — Describe: first floor slab to wall connections in Units 11/12, and site characteristics due to liquefaction potential
Pounding: — Damage?: no — Describe:
Non-structural: — Damage?: no — Describe:

Recommendations

Level of repair/strengthening required: significant structural and strengthening — Describe: Repair cracks in linings and precast panels.
Building Consent required: yes — Describe: strengthen undamaged first floor slab-wall connections
Interim occupancy recommendations: do not occupy — Describe: repair damaged first floor slab-wall connection (Units 11/12), re-level GF slab

Along
Assessed %NBS before e'quakes: 10% 0% %NBS from IEP below
Assessed %NBS after e'quakes: 8%

If IEP not used, please detail assessment methodology: Quantitative calculations - force based, <10%NBS due to damaged/failed connection of first floor slab with precast walls.

Across
Assessed %NBS before e'quakes: 10% 0% %NBS from IEP below
Assessed %NBS after e'quakes: 8%

IEP **Use of this method is not mandatory - more detailed analysis may give a different answer, which would take precedence. Do not fill in fields if not using IEP.**

Period of design of building (from above): 1976-1992

h_n from above: 5.6m

Seismic Zone, if designed between 1965 and 1992: B

not required for this age of building

not required for this age of building

	along	across
Period (from above):	0.4	0.4
(%NBS)nom from Fig 3.3:		

Note:1 for specifically design public buildings, to the code of the day: pre-1965 = 1.25; 1965-1976, Zone A =1.33; 1965-1976, Zone B = 1.2; all else 1.0	1.00
Note 2: for RC buildings designed between 1976-1984, use 1.2	1.2
Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (1.0)	1.0

	along	across
Final $(\%NBS)_{nom}$:	**0%**	**0%**

2.2 Near Fault Scaling Factor

Near Fault scaling factor, from NZS1170.5, cl 3.1.6: 1.00

	along	across
Near Fault scaling factor (1/N(T,D), **Factor A**:	1	1

2.3 Hazard Scaling Factor

Hazard factor Z for site from AS1170.5, Table 3.3: 0.30

Z_{1992}, from NZS4203:1992: 0.8

Hazard scaling factor, **Factor B:** 3.333333333

2.4 Return Period Scaling Factor

Building Importance level (from above): 2

Return Period Scaling factor from Table 3.1, **Factor C**: 1.00

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)	1.25	1.25
Ductility scaling factor: =1 from 1976 onwards; or =kμ, if pre-1976, fromTable 3.3:	1.00	1.00
Ductiity Scaling Factor, **Factor D**:	1.00	1.00

2.6 Structural Performance Scaling Factor:

Sp:	0.925	0.925
Structural Performance Scaling Factor **Factor E**:	1.081081081	1.081081081

2.7 Baseline %NBS, $(NBS\%)_b = (\%NBS)_{nom}$ x A x B x C x D x E **$\%NBS_b$:**	**0%**	**0%**

Global Critical Structural Weaknesses: (refer to NZSEE IEP Table 3.4)

3.1. Plan Irregularity, factor A: insignificant 1

3.2. Vertical irregularity, Factor B: insignificant 1

3.3. Short columns, Factor C: insignificant 1

3.4. Pounding potential

Pounding effect D1, from Table to right 1.0

Height Difference effect D2, from Table to right 1.0

Therefore, Factor D: 1

3.5. Site Characteristics significant 0.7

Table for selection of D1	Severe	Significant	Insignificant/none
Separation	0<sep<.005H	.005<sep<.01H	Sep>.01H
Alignment of floors within 20% of H	**0.7**	**0.8**	**1**
Alignment of floors not within 20% of H	**0.4**	**0.7**	**0.8**

Table for Selection of D2	Severe	Significant	Insignificant/none
Separation	0<sep<.005H	.005<sep<.01H	Sep>.01H
Height difference > 4 storeys	0.4	0.7	1
Height difference 2 to 4 storeys	0.7	0.9	1
Height difference < 2 storeys	1	1	1

3.6. Other factors, Factor F

	Along	Across
For ≤ 3 storeys, max value =2.5, otherwise max valule =1.5, no minimum	1.0	1.0
Rationale for choice of F factor, if not 1		

Detail Critical Structural Weaknesses: (refer to DEE Procedure section 6)

List any: Liquefaction potential

Refer also section 6.3.1 of DEE for discussion of F factor modification for other critical structural weaknesses

3.7. Overall Performance Achievement ratio (PAR)	**0.70**	**0.70**
4.3 PAR x (%NBS)b: PAR x Baselline %NBS:	**0%**	**0%**

4.4 Percentage New Building Standard (%NBS), (before) **0%**

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name: Block C
Unit No: Street
Building Address: 56 Avalon St, Richmond
Legal Description: HP Smith Courts
Degrees Min Sec
GPS south:
GPS east:
Building Unique Identifier (CCC): PRO 0677-004

Reviewer: David Whittaker
CPEng No: 123089
Company: Beca
Company project number: 5323355
Company phone number: 643663521
Date of submission: 5/08/2014
Inspection Date: 12/12/2012
Revision: F
Is there a full report with this summary? yes

Site

Site slope: flat
Soil type:
Site Class (to NZS1170.5): D
Proximity to waterway (m, if <100m):
Proximity to clifftop (m, if < 100m):
Proximity to cliff base (m,if <100m):

Max retaining height (m):
Soil Profile (if available): Unknown.
If Ground improvement on site, describe:
Approx site elevation (m):

Building

No. of storeys above ground: 1 single storey = 1
Ground floor split? no
Storeys below ground 0
Foundation type: other (describe)
Building height (m): 4.60
Floor footprint area (approx): 93
Age of Building (years): 27

Ground floor elevation (Absolute) (m):
Ground floor elevation above ground (m):
if Foundation type is other, describe: Raft slab with prestressed concrete driven piles.
height from ground to level of uppermost seismic mass (for IEP only) (m): 3.5
Date of design: 1976-1992

Strengthening present? no
Use (ground floor): multi-unit residentia
Use (upper floors): multi-unit residentia
Use notes (if required):
Importance level (to NZS1170.5): IL2

If so, when (year)?
And what load level (%g)?
Brief strengthening description

Gravity Structure

Gravity System: load bearing walls
Roof: timber truss
Floors: concrete flat slab
Beams:
Columns:
Walls:

truss depth, purlin type and cladding 2.1m deep truss with timber battens and chipcoated tiles.
slab thickness (mm) 100

Lateral load resisting structure

Lateral system along: lightweight timber framed walls
Ductility assumed, μ: 2.00
Period along: 0.40 0.00
Total deflection (ULS) (mm):
maximum interstorey deflection (ULS) (mm):

Note: Define along and across in detailed report!

Timber frame with block veneer.
note typical wall length (m)
estimate or calculation? estimated
estimate or calculation?
estimate or calculation?

Lateral system across: other (note)
Ductility assumed, μ: 1.25
Period across: 0.40 0.00
Total deflection (ULS) (mm):
maximum interstorey deflection (ULS) (mm):

describe system Timber frame with block veneer typically and precast concrete firewall between units.
estimate or calculation? estimated
estimate or calculation?
estimate or calculation?

Separations:

north (mm):
east (mm):
south (mm):
west (mm):

leave blank if not relevant

Non-structural elements

Stairs:
Wall cladding: other heavy
Roof Cladding: Heavy tiles
Glazing: aluminium frames
Ceilings: fibrous plaster, fixed
Services(list):

describe Block veneer and timber weatherboard.
describe Chipcoated tiles.
9.5mm gib board lining.

Available documentation

Architectural partial
Structural partial
Mechanical none
Electrical none
Geotech report none

original designer name/date Beechey Duder Construction, 1983
original designer name/date Warren R Lewis, 1983
original designer name/date
original designer name/date
original designer name/date

Damage

Site:
(refer DEE Table 4-2)

Site performance: Good
Settlement: none observed
Differential settlement: 0-1:350
Liquefaction: none apparent
Lateral Spread: none apparent
Differential lateral spread: none apparent
Ground cracks: none apparent
Damage to area: slight

Describe damage: Mortar cracking of blockwork veneer.
notes (if applicable):
notes (if applicable): Gap between pavement and footing suggests building ha
notes (if applicable):
notes (if applicable):
notes (if applicable):
notes (if applicable):
notes (if applicable): Movement of structure evident.

Building:

Current Placard Status: green

Along Damage ratio: 0%
Describe (summary): Minor structural damage.

Describe how damage ratio arrived at: Minor structural damage.

Across Damage ratio: 0%
Describe (summary): Minor structural damage.

$$Damage\_Ratio = \frac{(\%NBS\,(before) - \%NBS\,(after))}{\%NBS\,(before)}$$

Diaphragms Damage?: no Describe:
CSWs: Damage?: no Describe:
Pounding: Damage?: no Describe:
Non-structural: Damage?: yes Describe: Mortar cracking of blockwork veneer.

Recommendations

Level of repair/strengthening required: minor structural
Building Consent required: no
Interim occupancy recommendations: full occupancy

Describe: Repair mortar cracking.
Describe:
Describe:

Along Assessed %NBS before e'quakes: 83% 83% %NBS from IEP below
Assessed %NBS after e'quakes: 83%

If IEP not used, please detail assessment methodology:

Across Assessed %NBS before e'quakes: 50% 50% %NBS from IEP below
Assessed %NBS after e'quakes: 50%

IEP **Use of this method is not mandatory - more detailed analysis may give a different answer, which would take precedence. Do not fill in fields if not using IEP.**

Period of design of building (from above): 1976-1992

h_n from above: 3.5m

Seismic Zone, if designed between 1965 and 1992: B

not required for this age of building

not required for this age of building

	along	across
Period (from above):	0.4	0.4
(%NBS)nom from Fig 3.3:	16.5%	16.5%

Note:1 for specifically design public buildings, to the code of the day: pre-1965 = 1.25; 1965-1976, Zone A =1.33; 1965-1976, Zone B = 1.2; all else 1.0: 1.00

Note 2: for RC buildings designed between 1976-1984, use 1.2: 1.0

Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (1.0): 1.0

	along	across
Final (%NBS)$_{nom}$:	**17%**	**17%**

2.2 Near Fault Scaling Factor

Near Fault scaling factor, from NZS1170.5, cl 3.1.6: 1.00

	along	across
Near Fault scaling factor (1/N(T,D), **Factor A**:	1	1

2.3 Hazard Scaling Factor

Hazard factor Z for site from AS1170.5, Table 3.3: 0.30

Z_{1992}, from NZS4203:1992: 0.8

Hazard scaling factor, **Factor B:** 3.333333333

2.4 Return Period Scaling Factor

Building Importance level (from above): 2

Return Period Scaling factor from Table 3.1, **Factor C**: 1.00

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)	2.00	1.25
Ductility scaling factor: =1 from 1976 onwards; or =k_μ, if pre-1976, fromTable 3.3:	1.00	1.00
Ductiity Scaling Factor, **Factor D**:	1.00	1.00

2.6 Structural Performance Scaling Factor:

Sp:	0.700	0.925
Structural Performance Scaling Factor **Factor E**:	1.428571429	1.081081081

2.7 Baseline %NBS, (NBS%)$_b$ = (%NBS)$_{nom}$ x A x B x C x D x E **%NBS$_b$:**	**79%**	**60%**

Global Critical Structural Weaknesses: (refer to NZSEE IEP Table 3.4)

3.1. Plan Irregularity, factor A: insignificant 1

3.2. Vertical irregularity, Factor B: insignificant 1

3.3. Short columns, Factor C: insignificant 1

3.4. Pounding potential

Pounding effect D1, from Table to right 1.0

Height Difference effect D2, from Table to right 1.0

Therefore, Factor D: 1

Table for selection of D1	Severe	Significant	Insignificant/none
Separation	0<sep<.005H	.005<sep<.01H	Sep>.01H
Alignment of floors within 20% of H	**0.7**	**0.8**	**1**
Alignment of floors not within 20% of H	**0.4**	**0.7**	**0.8**

Table for Selection of D2	Severe	Significant	Insignificant/none
Separation	0<sep<.005H	.005<sep<.01H	Sep>.01H
Height difference > 4 storeys	0.4	0.7	1
Height difference 2 to 4 storeys	0.7	0.9	1
Height difference < 2 storeys	1	1	1

3.5. Site Characteristics significant 0.7

3.6. Other factors, Factor F

	Along	Across
For ≤ 3 storeys, max value =2.5, otherwise max valule =1.5, no minimum	1.5	1.2
Rationale for choice of F factor, if not 1	Single storey timber structure, minor damage.	RC wall designed between 1976-1984.

Detail Critical Structural Weaknesses: (refer to DEE Procedure section 6)

List any: Liquefaction potential. Refer also section 6.3.1 of DEE for discussion of F factor modification for other critical structural weaknesses

3.7. Overall Performance Achievement ratio (PAR)	**1.05**	**0.84**
4.3 PAR x (%NBS)b: PAR x Baselline %NBS:	**83%**	**50%**
4.4 Percentage New Building Standard (%NBS), (before)		**50%**

Detailed Engineering Evaluation Summary Data

V1.11

Location

Building Name: Residents' Lounge
Unit No: Street
Building Address: 56 Avalon St, Richmond
Legal Description: HP Smith Courts
Degrees Min Sec
GPS south:
GPS east:
Building Unique Identifier (CCC): PRO 0677-002

Reviewer: David Whittaker
CPEng No: 123089
Company: Beca
Company project number: 5323355
Company phone number: 643663521
Date of submission: 5/08/2014
Inspection Date: 12/12/2012
Revision: F
Is there a full report with this summary? yes

Site

Site slope: flat
Soil type:
Site Class (to NZS1170.5): D
Proximity to waterway (m, if <100m):
Proximity to clifftop (m, if < 100m):
Proximity to cliff base (m,if <100m):

Max retaining height (m):
Soil Profile (if available): Unknown.
If Ground improvement on site, describe:
Approx site elevation (m):

Building

No. of storeys above ground: 1
single storey = 1
Ground floor split? no
Storeys below ground 0
Foundation type: other (describe)
Building height (m): 4.60
Floor footprint area (approx): 63
Age of Building (years): 27

Ground floor elevation (Absolute) (m):
Ground floor elevation above ground (m):
if Foundation type is other, describe: Raft slab with prestressed concrete driven piles.
height from ground to level of uppermost seismic mass (for IEP only) (m): 3.5
Date of design: 1976-1992

Strengthening present? no
If so, when (year)?
And what load level (%g)?
Brief strengthening description:

Use (ground floor): multi-unit residentia
Use (upper floors): multi-unit residentia
Use notes (if required):
Importance level (to NZS1170.5): IL2

Gravity Structure

Gravity System: load bearing walls
Roof: timber truss
truss depth, purlin type and cladding: 2.1m deep truss with timber battens and chipcoated tiles.
Floors: concrete flat slab
slab thickness (mm): 100
Beams:
Columns:
Walls:

Lateral load resisting structure

Lateral system along: lightweight timber framed walls
Note: Define along and across in detailed report!
Timber frame with block veneer.
Ductility assumed, μ: 2.00
note typical wall length (m)
Period along: 0.40 0.00
estimate or calculation? estimated
Total deflection (ULS) (mm):
estimate or calculation?
maximum interstorey deflection (ULS) (mm):
estimate or calculation?

Lateral system across: lightweight timber framed walls
Timber frame with block veneer.
Ductility assumed, μ: 2.00
note typical wall length (m)
Period across: 0.40 0.00
estimate or calculation? estimated
Total deflection (ULS) (mm):
estimate or calculation?
maximum interstorey deflection (ULS) (mm):
estimate or calculation?

Separations:

north (mm):
leave blank if not relevant
east (mm):
south (mm):
west (mm):

Non-structural elements

Stairs:
Wall cladding: other heavy
describe Block veneer and timber weatherboard.
Roof Cladding: Heavy tiles
describe Chipcoated tiles.
Glazing: aluminium frames
Ceilings: fibrous plaster, fixed
9.5mm gib board lining.
Services(list):

Available documentation

Architectural partial
original designer name/date Beechey Duder Construction, 1983
Structural partial
original designer name/date Warren R Lewis, 1983
Mechanical none
original designer name/date
Electrical none
original designer name/date
Geotech report none
original designer name/date

Damage

Site:
(refer DEE Table 4-2)

Site performance: Good
Describe damage: Minor separation of linings and mortar cracking.

Settlement: none observed
notes (if applicable):
Differential settlement: 0-1:350
notes (if applicable): Possibly, not visible to naked eye.
Liquefaction: none apparent
notes (if applicable):
Lateral Spread: none apparent
notes (if applicable):
Differential lateral spread: none apparent
notes (if applicable):
Ground cracks: none apparent
notes (if applicable):
Damage to area: slight
notes (if applicable): Movement of structure evident.

Building:

Current Placard Status: green

Along
Damage ratio: 0%
Describe how damage ratio arrived at: Minor structural damage.
Describe (summary): Minor structural damage.

Across
Damage ratio: 0%
Describe (summary): Minor structural damage.

$$Damage\_Ratio = \frac{(\%NBS\,(before) - \%NBS\,(after))}{\%NBS\,(before)}$$

Diaphragms
Damage?: no
Describe:

CSWs:
Damage?: no
Describe:

Pounding:
Damage?: no
Describe:

Non-structural:
Damage?: yes
Describe: Mortar cracking of blockwork veneer.

Recommendations

Level of repair/strengthening required: minor structural
Describe:
Building Consent required: no
Describe:
Interim occupancy recommendations: full occupancy
Describe:

Along
Assessed %NBS before e'quakes: 83%
83% %NBS from IEP below
If IEP not used, please detail assessment methodology:
Assessed %NBS after e'quakes: 83%

Across
Assessed %NBS before e'quakes: 83%
83% %NBS from IEP below
Assessed %NBS after e'quakes: 83%

IEP **Use of this method is not mandatory - more detailed analysis may give a different answer, which would take precedence. Do not fill in fields if not using IEP.**

Period of design of building (from above): 1976-1992

h_n from above: 3.5m

Seismic Zone, if designed between 1965 and 1992: B

not required for this age of building:

not required for this age of building:

	along	across
Period (from above):	0.4	0.4
(%NBS)nom from Fig 3.3:	16.5%	16.5%

Note:1 for specifically design public buildings, to the code of the day: pre-1965 = 1.25; 1965-1976, Zone A =1.33; 1965-1976, Zone B = 1.2; all else 1.0: 1.00

Note 2: for RC buildings designed between 1976-1984, use 1.2: 1.0

Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (1.0): 1.0

	along	across
Final $(\%NBS)_{nom}$:	**17%**	**17%**

2.2 Near Fault Scaling Factor

Near Fault scaling factor, from NZS1170.5, cl 3.1.6: 1.00

	along	across
Near Fault scaling factor (1/N(T,D), **Factor A**:	1	1

2.3 Hazard Scaling Factor

Hazard factor Z for site from AS1170.5, Table 3.3: 0.30

Z_{1992}, from NZS4203:1992: 0.8

Hazard scaling factor, **Factor B:** 3.333333333

2.4 Return Period Scaling Factor

Building Importance level (from above): 2

Return Period Scaling factor from Table 3.1, **Factor C**: 1.00

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)	2.00	2.00
Ductility scaling factor: =1 from 1976 onwards; or =k_{μ}, if pre-1976, fromTable 3.3:	1.00	1.00
Ductiity Scaling Factor, **Factor D**:	1.00	1.00

2.6 Structural Performance Scaling Factor:

Sp:	0.700	0.700
Structural Performance Scaling Factor **Factor E**:	1.428571429	1.428571429

2.7 Baseline %NBS, $(NBS\%)_b = (\%NBS)_{nom} \times A \times B \times C \times D \times E$ $\%NBS_b$:	**79%**	**79%**

Global Critical Structural Weaknesses: (refer to NZSEE IEP Table 3.4)

3.1. Plan Irregularity, factor A: insignificant 1

3.2. Vertical irregularity, Factor B: insignificant 1

3.3. Short columns, Factor C: insignificant 1

3.4. Pounding potential

Pounding effect D1, from Table to right: 1.0

Height Difference effect D2, from Table to right: 1.0

Therefore, Factor D: 1

Table for selection of D1	Severe	Significant	Insignificant/none
Separation	0<sep<.005H	.005<sep<.01H	Sep>.01H
Alignment of floors within 20% of H	**0.7**	**0.8**	**1**
Alignment of floors not within 20% of H	**0.4**	**0.7**	**0.8**

Table for Selection of D2	Severe	Significant	Insignificant/none
Separation	0<sep<.005H	.005<sep<.01H	Sep>.01H
Height difference > 4 storeys	0.4	0.7	1
Height difference 2 to 4 storeys	0.7	0.9	1
Height difference < 2 storeys	1	1	1

3.5. Site Characteristics significant 0.7

3.6. Other factors, Factor F

	Along	Across
For ≤ 3 storeys, max value =2.5, otherwise max valule =1.5, no minimum	1.5	1.5
Rationale for choice of F factor, if not 1	Single storey timber structure, minor damage.	Single storey timber structure, minor damage.

Detail Critical Structural Weaknesses: (refer to DEE Procedure section 6)

List any: Liquefaction potential. Refer also section 6.3.1 of DEE for discussion of F factor modification for other critical structural weaknesse

3.7. Overall Performance Achievement ratio (PAR)	**1.05**	**1.05**
4.3 PAR x (%NBS)b: PAR x Baselline %NBS:	**83%**	**83%**

4.4 Percentage New Building Standard (%NBS), (before) **83%**

Appendix D

Previous Reports and Assessments

Christchurch Eq. RAPID Assessment Form - LEVEL 1

Inspector Initials: YS.
Territorial Authority: Christchurch City

Date of Inspection: 260211
Time: 1100

Exterior Only ☑
Exterior and Interior ☐

Building Name
Short Name: Richmond / St Albans
Address: 56 Avalon St
GPS Co-ordinates: S° E°
Contact Name:
Contact Phone:
Storeys at and above ground level:
Below ground level:
Total gross floor area (m²):
Year built:
No of residential Units: 1-8 units in one building
Photo Taken: Yes [✓ No]

Type of Construction concrete & timber weather boards

☑ Timber frame
☐ Steel frame
☑ Tilt-up concrete
☐ Concrete frame
☐ RC frame with masonry infill
☐ Concrete shear wall
☐ Unreinforced masonry
☐ Reinforced masonry
☐ Confined masonry
☐ Other:

Primary Occupancy

☑ Dwelling
☐ Other residential
☐ Public assembly
☐ School
☐ Religious
☐ Commercial/ Offices
☐ Industrial
☐ Government
☐ Heritage Listed
☐ Other

Investigate the building for the conditions listed below:

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☑	☐	☐	
Building or storey leaning	☑	☐	☐	
Wall or other structural damage	☑	☐	☐	no signes of damage.
Overhead falling hazard	☑	☐	☐	
Ground movement, settlement, slips	☑	☐	☐	
Neighbouring building hazard	☑	☐	☐	
Other	☑	☐	☐	

Choose a posting based on the evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance.

INSPECTED *GREEN* ☑ **RESTRICTED USE** *YELLOW* ☐ **UNSAFE** *RED* ☐

Record any restriction on use or entry:

Further Action Recommended: no

Tick the boxes below only if further actions are recommended

☐ Barricades are needed (state location):
☐ Level 2 or detailed engineering evaluation recommended
  ☐ Structural ☐ Geotechnical ☐ Other:
☐ Other recommendations:

Estimated Overall Building Damage (Exclude Contents)

None ☑
0-1 % ☐
2-10 % ☐
11-30 % ☐
31-60 % ☐
61-99 % ☐
100 % ☐

Sign here on completion
YS. 260211 1100
Date & Time
ID

Inspection ID ________ *(Office Use Only)*

75008440

RES A28 3

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials: JWM
Territorial Authority: Christchurch City
Date: 10/9
Time:
Final Posting (e.g. UNSAFE): Green 1

Building Name
Short Name: H.P. Smith (18) units
Address: Peth St (2) units
to Avalon
GPS Co-ordinates: S° Richmond E°
Contact Name:
Contact Phone:
Storeys at and above ground level: Below ground level:
Total gross floor area (m²): Year built:
No of residential Units: 20
Photo Taken: Yes [✓ No]

Type of Construction
- ☑ Timber frame (brick veneer)
- ☐ Steel frame
- ☑ Tilt-up concrete
- ☐ Concrete frame
- ☐ RC frame with masonry infill
- ☐ Concrete shear wall
- ☐ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☐ Other:

Primary Occupancy
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☐ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☑	☐	☐	
Building or storey leaning	☑	☐	☐	
Wall or other structural damage	☑	☐	☐	
Overhead falling hazard	☑	☐	☐	
Ground movement, settlement, slips	☑	☐	☐	
Neighbouring building hazard	☑	☐	☐	
Electrical, gas, sewerage, water, hazmats	☑	☐	☐	

Record any existing placard on this building:

Existing Placard Type (e.g. UNSAFE):

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED *GREEN* [✓ G1] G2
RESTRICTED USE *YELLOW* Y1 Y2
UNSAFE *RED* R1 R2 R3

Record any restriction on use or entry:

~~Level 2 g1~~
~~BU 0675 001~~
BE 0677
BE 0675 Perth

Further Action Recommended:

Tick the boxes below only if further actions are recommended
- ☐ Barricades are needed (state location):
- ☐ Detailed engineering evaluation recommended
  - ☐ Structural
  - ☐ Geotechnical
  - ☐ Other:
- ☐ Other recommendations:

Estimated Overall Building Damage (Exclude Contents)

None	☑		
0-1 %	☐	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion
Date & Time
ID

Inspection ID: JWM10A28 *(Office Use Only)*

706793

Lot 2 DP 51292

RES A28 3

Structural Hazards/ Damage	Minor/None	Moderate	Severe	Comments
Foundations	☑	☐	☐	
Roofs, floors (vertical load)	☑	☐	☐	
Columns, pilasters, corbels	☐	☐	☐	
Diaphragms, horizontal bracing	☑	☐	☐	
Pre-cast connections	☐	☐	☐	
Beam	☐	☐	☐	did not inspect.
Non-structural Hazards / Damage				
Parapets, ~~ornamentation~~	☐	☐	☐	
Cladding, glazing	☑	☐	☐	
Ceilings, light fixtures	☐	☐	☐	
Interior walls, partitions	☐	☐	☐	
~~Elevators~~	☐	☐	☐	
Stairs/ Exits	☑	☐	☐	
Utilities (eg. gas, electricity, water)	☑	☐	☐	
Other	☐	☐	☐	
Geotechnical Hazards / Damage				
Slope failure, debris	☑	☐	☐	
Ground movement, fissures	☑	☐	☐	
Soil bulging, liquefaction	☑	☐	☐	

General Comment insignificant cracking at some window corners in concrete panels. small cracks along stairwell soffit at panel intersection.

Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	[✓ G1. Occupiable, no immediate further investigation required]	
		G2. Occupiable, repairs required	
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

Inspection ID: JWM10A28 *(Office Use Only)*

RES

A28

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.

Recommendations for Repair and Reconstruction or Demolition (Optional)

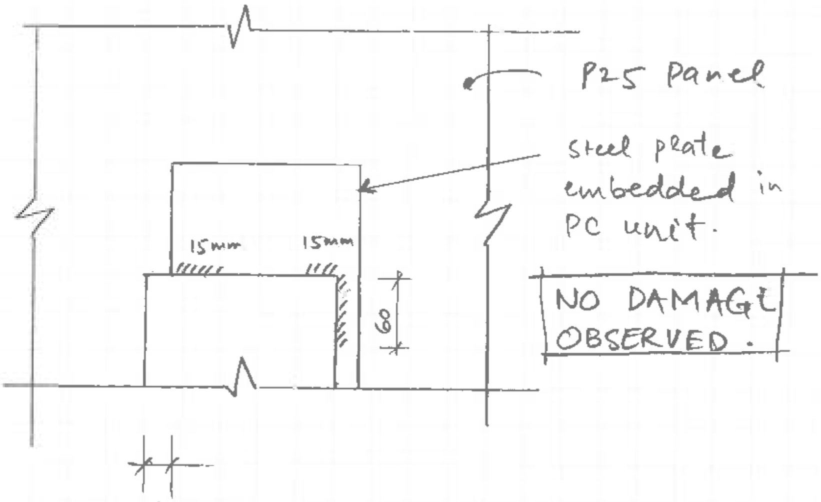
Appendix E

Intrusive Investigations

Beca

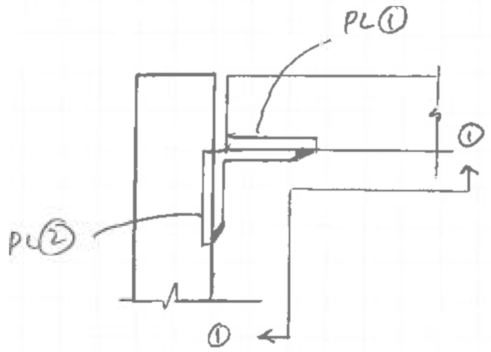
Calculation Sheet

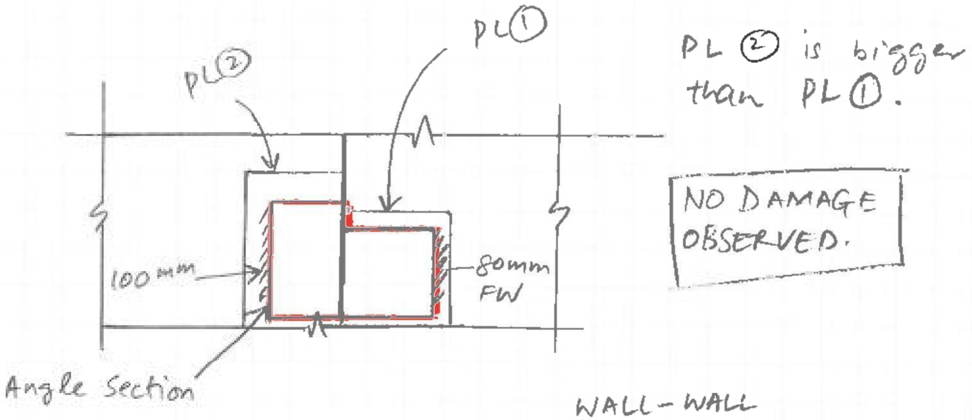
Job Number 5323355/155-158 Date 07-10-13
Job Name HP Smith Courts
Subject PC wall panel - foundation Connection.
By ZH Page No 1 of 1



indicates misalignment of PC unit during construction.

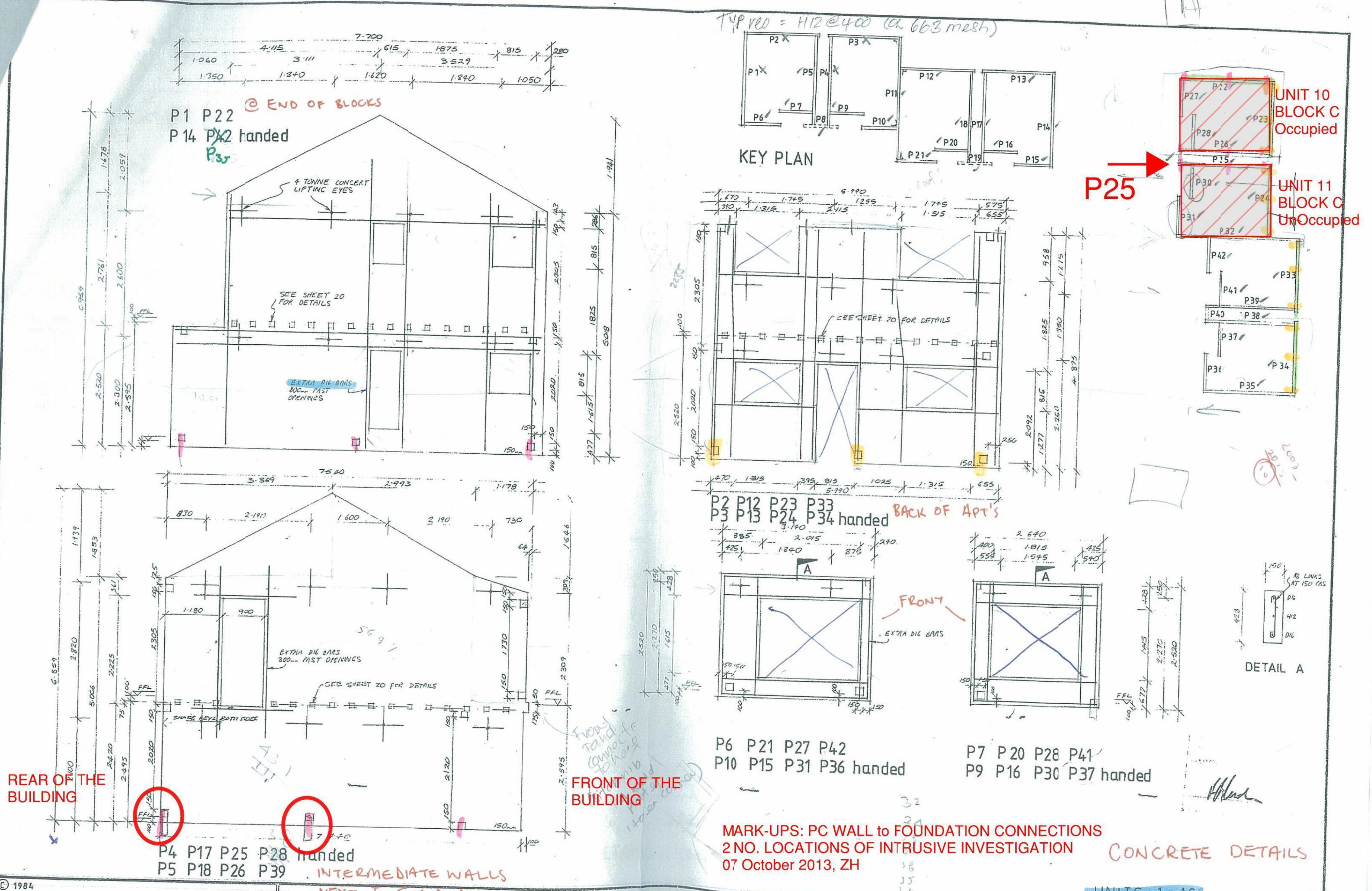
ELEVATION P25 PC UNIT
MIDDLE CONNECTION
BLOCK C UNIT 11





P25 PC UNIT: WALL-WALL Connection at REAR OF THE UNIT.
DEVELOPED ELEVATION 1-1
BLOCK C UNIT 11

Photos @ P:\532\5323355\HPSmith Courts\#155-#158 HPSmith Courts\131007 PC wall Connections - Intrusive investigation

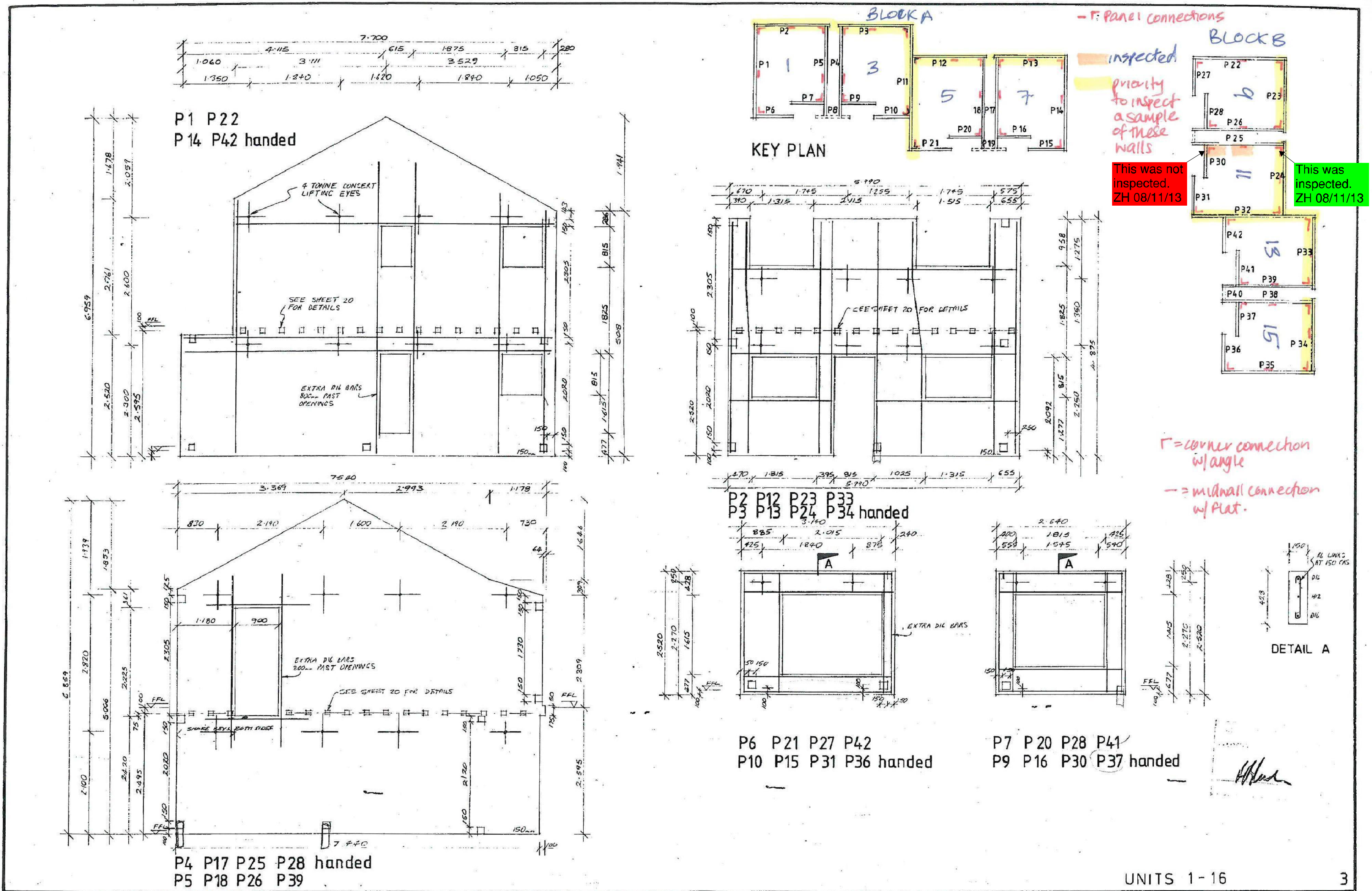


© 1984
WARREN R. LEWIS
REGISTERED CONSULTING ENGINEER
183 HEREFORD STREET
P.O. BOX 13·282
PHONE 64 320

AVALON STREET ELDERLY PERSONS HOUSING DEVELOPMENT FOR C.C.C.

DSN. S.B DRN. SJC TRCD. SJC CKD S.B. DATE 1/84	ISSUE	SCALES	FILE	DRAWING	3
	Q	1:50 1:20	1926	18	

CONTRACTOR SHALL VERIFY ALL DIMENSIONS



– ꓕ: Panel connections

inspected

priority to inspect a sample of these walls

This was not inspected. ZH 08/11/13

This was inspected. ZH 08/11/13

ꓕ = corner connection w/angle

— = midwall connection w/flat.

UNITS 1 - 16

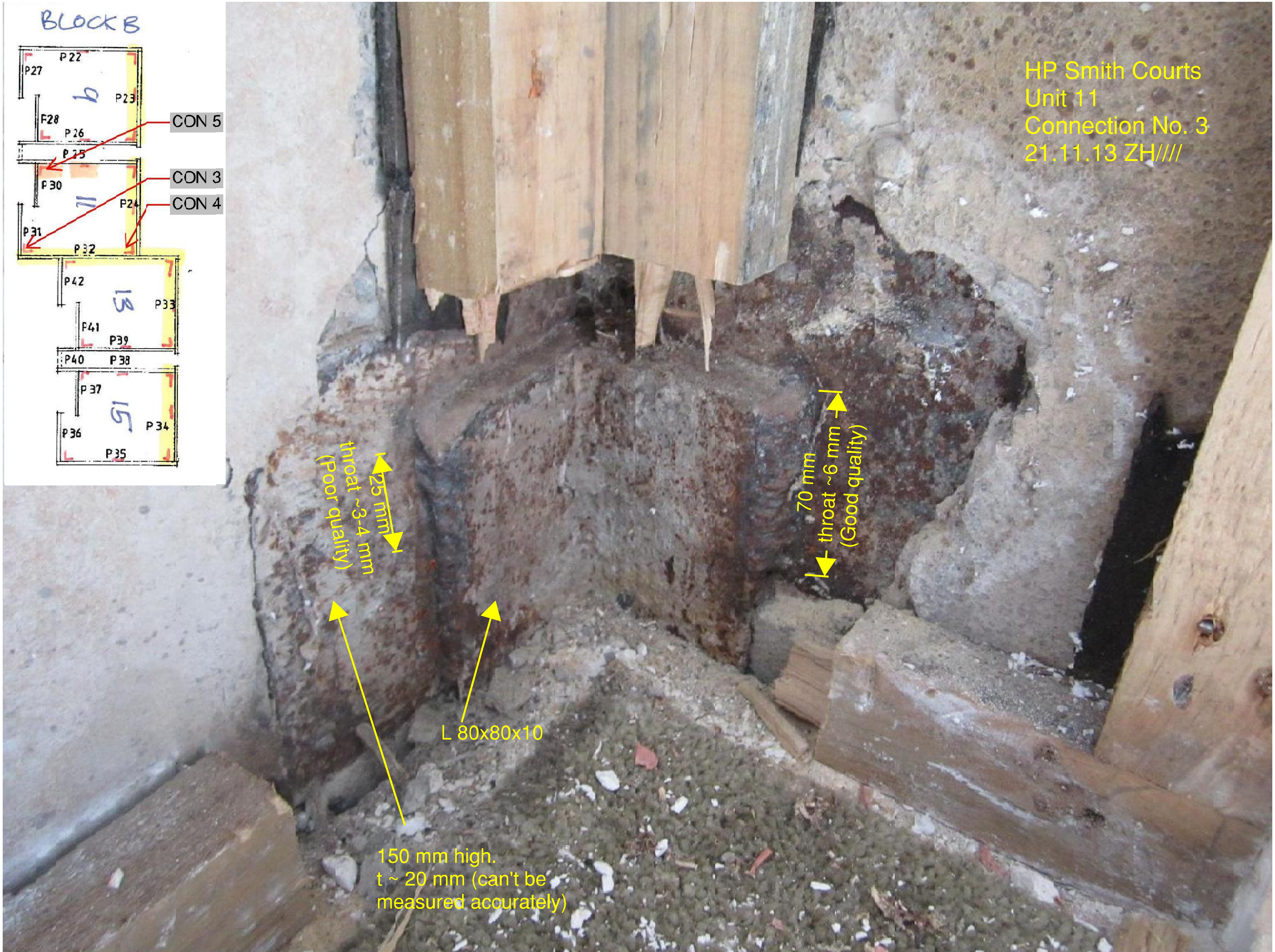
3

© 1984
WARREN R. LEWIS
REGISTERED CONSULTING ENGINEER
183 HEREFORD STREET
P.O. BOX 13 282
PHONE 64 320

AVALON STREET ELDERLY PERSONS HOUSING DEVELOPMENT FOR C.C.C.

	ISSUE	SCALES	FILE	DRAWING
DSN. SB DRN. SJC TRCD. SJC CKD S.B. DATE 1/84	Q	1:50 1:20	1926	18

CONTRACTOR SHALL VERIFY ALL DIMENSIONS BEFORE STARTING WORK


HP Smith Courts
Unit 11
Connection No. 3
21.11.13 ZH////
BLOCK B
P22
P27
P23
9
F28
P26
P25
CON 5
P30
11
P24
CON 3
CON 4
P31
P32
P42
13
P33
P41
P39
P40
P38
P37
15
P34
P36
P35
70 mm
throat ~6 mm
(Good quality)
25 mm
throat ~3-4 mm
(Poor quality)
L 80x80x10
150 mm high.
t ~ 20 mm (can't be
measured accurately)


HP Smith Courts
Unit 11
Connection No. 4
21.11.13 ZH////
Small welds
Small welds
L 80x80x10
50 mm
throat ~3-4 mm
(Poor quality)
70 mm
throat ~6 mm
(Good quality)
BLOCK B
CON 5
CON 3
CON 4
P22
P27
P23
9
F28
P26
P25
P30
11
P24
P31
P32
P42
13
P33
P41
P39
P40
P38
P37
15
P34
P36
P35

HP Smith Courts
Unit 11
Connection No. 5
21.11.13 ZH////
Extent of plate cast in wall
~200 mm long plate
80 mm
throat ~3 mm
80 mm
throat ~5-6 mm
~5 thick weld
~ 15 thick plate
(not sure what it's doing?
Plate
200x80x5
Not a weld
BLOCK B
P22
P27
9
P23
F28
P26
P25
P30
11
P24
P31
P32
P42
13
P33
P41
P39
P40
P38
P37
15
P34
P36
P35
CON 5
CON 3
CON 4

Appendix F

Verticality and Level Survey Drawings

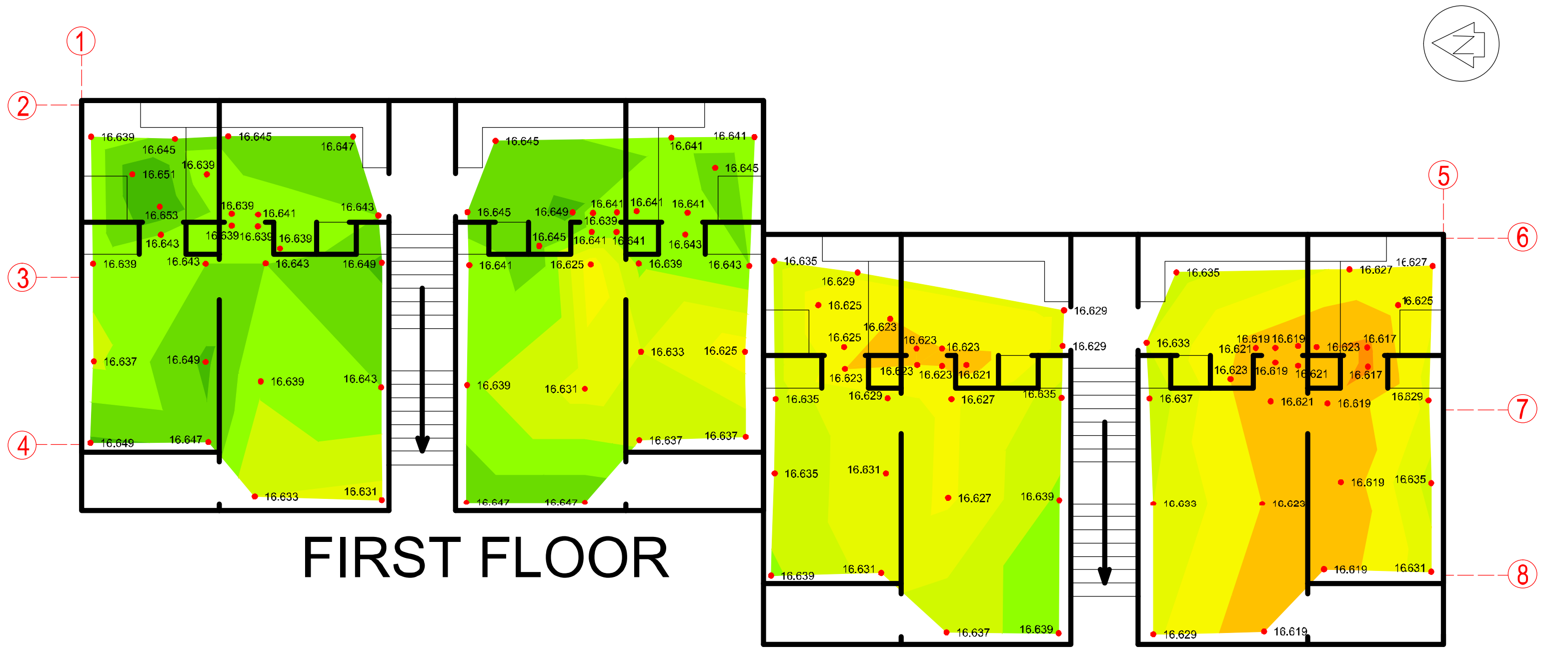
Drawing Plotted: 04 Dec 2013 10:50 a.m.

VERTICALITY 1		
Level	Direction	(mm)
Top	↓	9mm
Middle	↓	2mm
Base		0mm

VERTICALITY 2		
Level	Direction	(mm)
Top	→	3mm
Middle	→	4mm
Base		0mm

VERTICALITY 3		
Level	Direction	(mm)
Peak	→	11mm
Top	→	6mm
Middle		0mm
Base		0mm

VERTICALITY 4		
Level	Direction	(mm)
Top	→	3mm
Middle	←	3mm
Base		0mm



FIRST FLOOR

GROUND FLOOR

VERTICALITY 5		
Level	Direction	(mm)
Top	↓	8mm
Middle	↓	2mm
Base		0mm

VERTICALITY 6		
Level	Direction	(mm)
Top	→	10mm
Middle	→	7mm
Base		0mm

VERTICALITY 7		
Level	Direction	(mm)
Peak	→	14mm
Top	→	11mm
Middle	→	1mm
Base		0mm

VERTICALITY 8		
Level	Direction	(mm)
Top	→	2mm
Middle	←	3mm
Base		0mm

NOTES:
a) Levels are in terms of SCIRT/CCC benchmark EKJA with the CDD height of 13.21m. This height was transferred using a Topcon dumpy level which has a survey accuracy of +/- 3mm.
b) All floor levels have been observed using a Technidea zip level which has a survey accuracy of +/- 4mm.
c) All observation have been corrected for changes in floor covering and reduced as if they were observed on the lino flooring.
d) Verticality measurements were observed with a Leica 1205 Total Station which has a survey accuracy of +/- 4mm.

LEGEND

---- Denotes a change in floor covering or step.

→ Direction of arrow indicates the displacement of the top of the wall from vertical.

FLOOR CONTOUR LEGEND

🟩	0mm to -5mm
🟩	-5mm to -10mm
🟩	-10mm to -15mm
🟨	-15mm to -20mm
🟨	-20mm to -25mm
🟨	-25mm to -30mm
🟧	-30mm to -35mm
🟧	-35mm to -40mm
🟥	-40mm to -45mm
🟥	-45mm to -50mm

FLOOR LEVEL AND VERTICALITY SURVEY

APPROXIMATE SCALE 1:25@A3

FOR INFORMATION
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
A	FOR INFORMATION	XP	CB	CH	03/12/13

Drawing Originator:

Original Scale (A1) NTS	Surveyed	CB & LM	25/11/13
	Drawn	XP	03/12/13
Reduced Scale (A3) NTS	Verifier	CH	04/12/13
	Dwg Check	CB	04/12/13
	Approved For Issue*		Date

* Refer to Revision 1 for Original Signature

Client: CHRISTCHURCH CITY COUNCIL

Project: HP SMITH COURTS
CHCH EQ CCC BUILDINGS

Title: UNITS 1-8 BUILDING A
SHEET 1/4
BUILDING SURVEY

Discipline: SURVEY

Drawing No. 5323355-169-GS-001

Rev A

DO NOT SCALE

Source Application

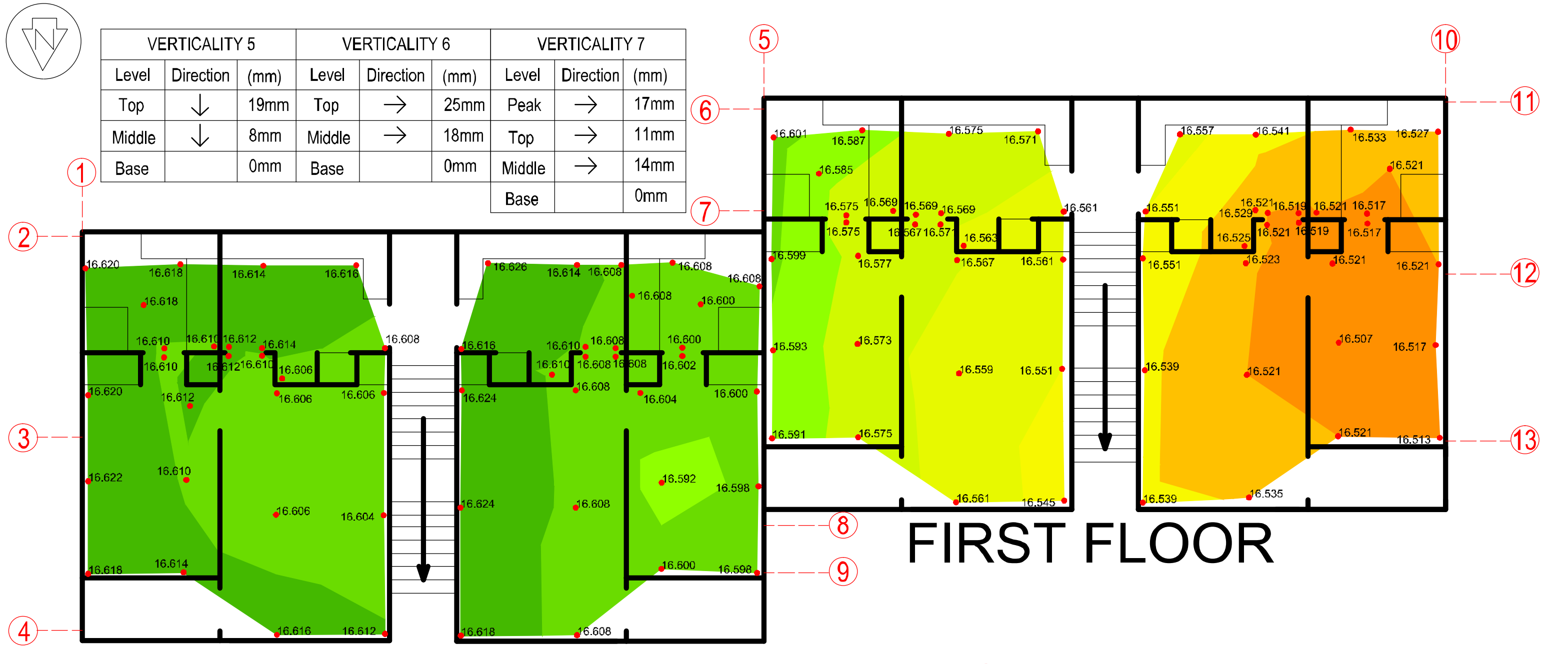
IF IN DOUBT ASK

Drawing Plotted: 04 Dec 2013 10:50 a.m.

VERTICALITY 5		
Level	Direction	(mm)
Top	↓	19mm
Middle	↓	8mm
Base		0mm

VERTICALITY 6		
Level	Direction	(mm)
Top	→	25mm
Middle	→	18mm
Base		0mm

VERTICALITY 7		
Level	Direction	(mm)
Peak	→	17mm
Top	→	11mm
Middle	→	14mm
Base		0mm



VERTICALITY 10		
Level	Direction	(mm)
Top	↓	19mm
Middle	↓	12mm
Base		0mm

VERTICALITY 11		
Level	Direction	(mm)
Top	→	40mm
Middle	→	29mm
Base		0mm

VERTICALITY 12		
Level	Direction	(mm)
Peak	→	46mm
Top	→	37mm
Middle	→	23mm
Base		0mm

VERTICALITY 13		
Level	Direction	(mm)
Top	→	34mm
Middle	→	8mm
Base		0mm

NOTES:

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b) All floor levels have been observed using a Technidea zip level which has a survey accuracy of +/- 4mm.

c) All observation have been corrected for changes in floor covering and reduced as if they were observed on the lino flooring.

d) Verticality measurements were observed with a Leica 1205 Total Station which has a survey accuracy of +/- 4mm.

LEGEND

- - - -	Denotes a change in floor covering or step.
→	Direction of arrow indicates the displacement of the top of the wall from vertical.

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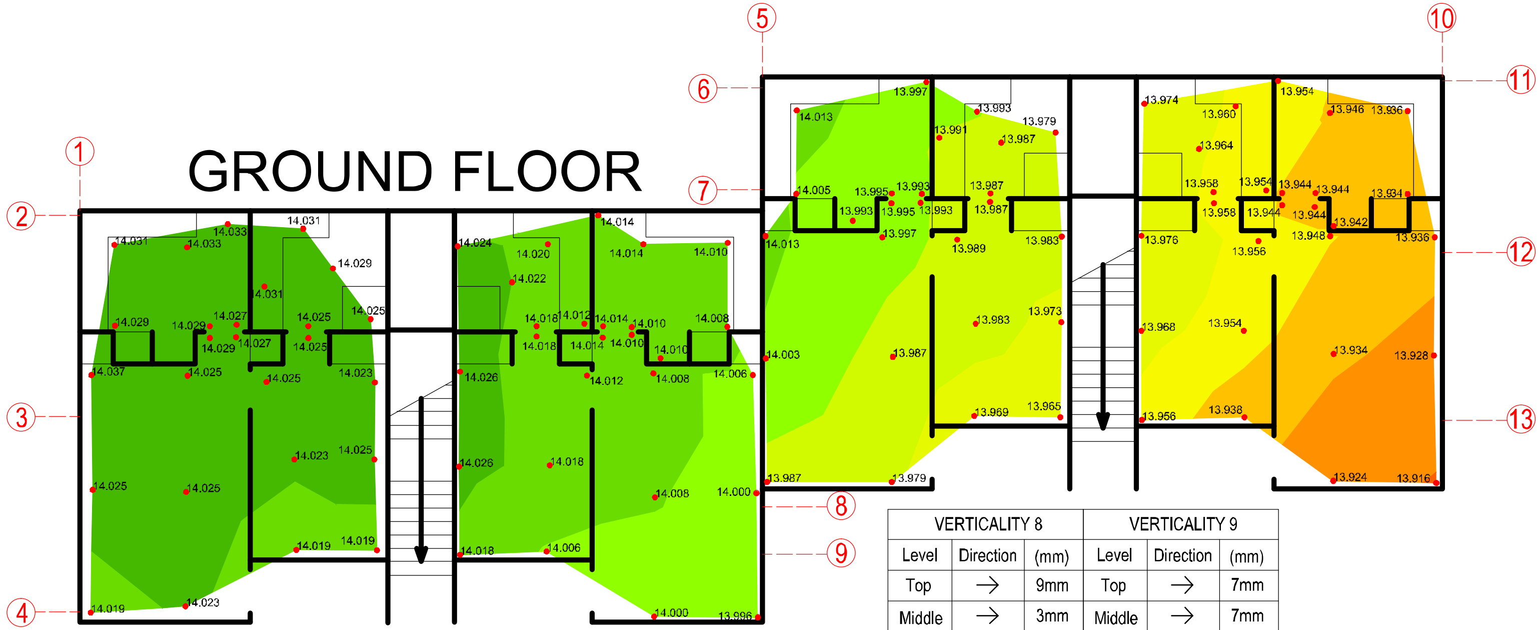
VERTICALITY 1		
Level	Direction	(mm)
Top	↓	10mm
Middle	↓	4mm
Base		0mm

VERTICALITY 2		
Level	Direction	(mm)
Top	→	28mm
Middle	→	19mm
Base		0mm

VERTICALITY 3		
Level	Direction	(mm)
Peak	→	29mm
Top	→	24mm
Middle	→	18mm
Base		0mm

VERTICALITY 4		
Level	Direction	(mm)
Top	→	28mm
Middle	→	8mm
Base		0mm



VERTICALITY 8		
Level	Direction	(mm)
Top	→	9mm
Middle	→	3mm
Base		0mm

VERTICALITY 9		
Level	Direction	(mm)
Top	→	7mm
Middle	→	7mm
Base		0mm

FLOOR CONTOUR LEGEND

🟩	0mm to -15mm
🟩	-15mm to -30mm
🟩	-30mm to -45mm
🟨	-45mm to -60mm
🟨	-60mm to -75mm
🟨	-75mm to -90mm
🟧	-90mm to -105mm
🟧	-105mm to -120mm
🟥	-120mm to -135mm
🟥	-135mm to -150mm

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FLOOR LEVEL AND VERTICALITY SURVEY

APPROXIMATE SCALE 1:25@A3

FOR INFORMATION
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
A	FOR INFORMATION	MA	CB	CH	03/12/13

Drawing Originator: Beca

Original Scale (A1) NTS	Surveyed	CB & LM	26/11/13
	Drawn	MA	03/12/13
Reduced Scale (A3) NTS	Verifier	CH	04/12/13
	Dwg Check	CB	04/12/13
	Approved For Issue*		Date

* Refer to Revision 1 for Original Signature

Client: CHRISTCHURCH CITY COUNCIL

Project: HP SMITH COURTS
CHCH EQ CCC BUILDINGS

Title: UNITS 9-16
SHEET 2/4
BUILDING SURVEY

Discipline: SURVEY

Drawing No. 5323355-169-GS-002 Rev A

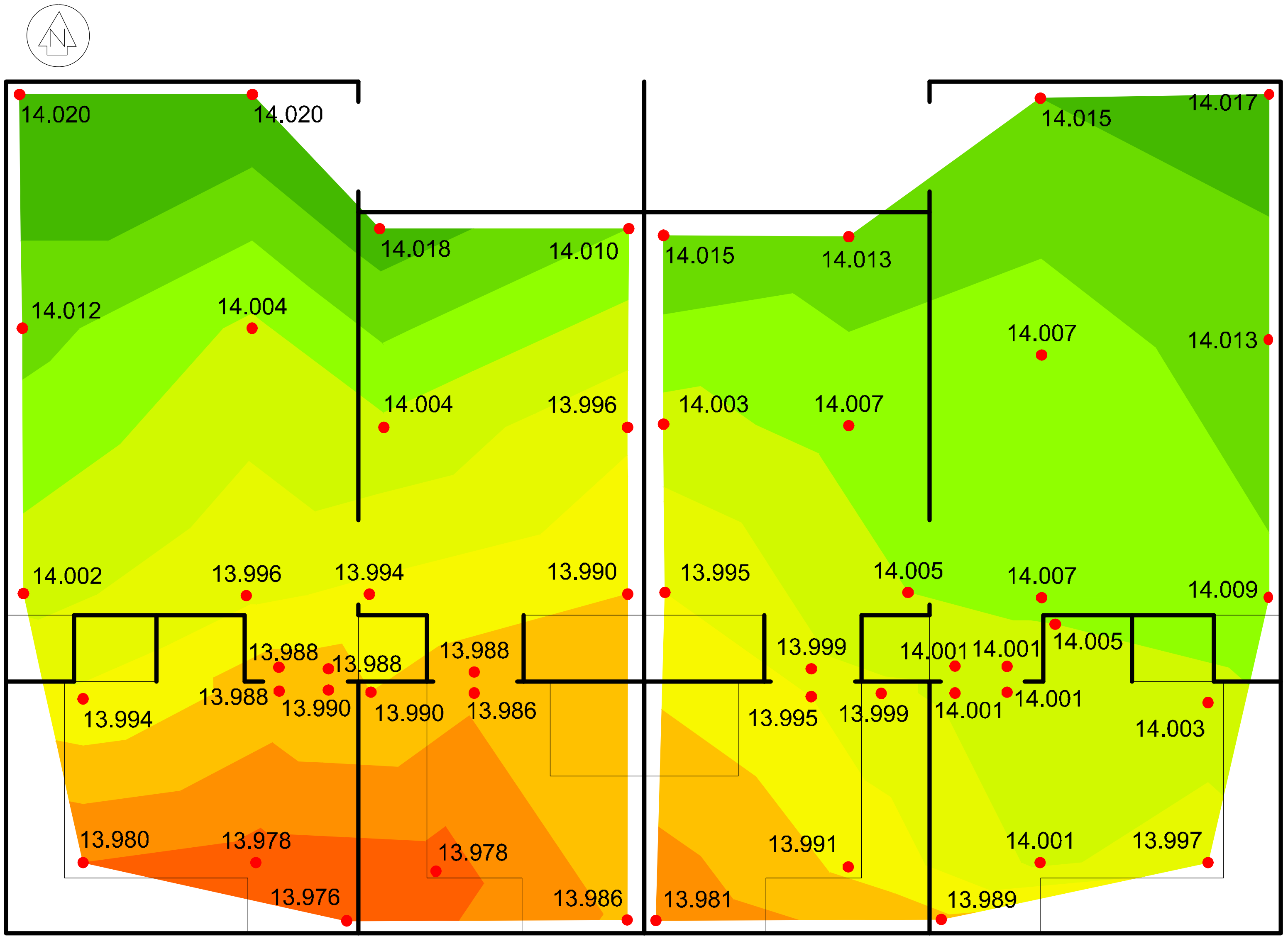
Document No. 5323355-169-GS-002.DWG

DO NOT SCALE

Source Application

IF IN DOUBT ASK

Drawing Plotted: 04 Dec 2013 10:51 a.m.



FLOOR LEVEL SURVEY

APPROXIMATE SCALE 1:10@A3

NOTES:

a) Levels are in terms of SCIRT/CCC benchmark EKJA with the CDD height of 13.21m. This height was transferred using a Topcon dumpy level which has a survey accuracy of +/- 3mm.

b) All floor levels have been observed using a Technidea zip level which has a survey accuracy of +/- 4mm.

c) All observation have been corrected for changes in floor covering and reduced as if they were observed on the lino flooring.

LEGEND

- - - - - Denotes a change in floor covering or step.

FLOOR CONTOUR LEGEND

🟩	0mm to -5mm
🟩	-5mm to -10mm
🟩	-10mm to -15mm
🟨	-15mm to -20mm
🟨	-20mm to -25mm
🟨	-25mm to -30mm
🟧	-30mm to -35mm
🟧	-35mm to -40mm
🟥	-40mm to -45mm
🟥	-45mm to -50mm

FOR INFORMATION
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
A	FOR INFORMATION	XP	CB	CH	03/12/13

Drawing Originator:
Beca

Original Scale (A1) NTS
Reduced Scale (A3) NTS

Surveyed	CB & LM	26/11/13	Approved For Issue*
Drawn	XP	03/12/13	
Verifier	CH	04/12/13	
Dwg Check	CB	04/12/13	Date

* Refer to Revision 1 for Original Signature

Client:
CHRISTCHURCH CITY COUNCIL

Project:
HP SMITH COURTS
CHCH EQ CCC BUILDINGS

Title:
UNIT 17 & 18
SHEET 3/4
BUILDING SURVEY

Discipline
SURVEY

Drawing No.
5323355-169-GS-003

Rev
A

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Source Application

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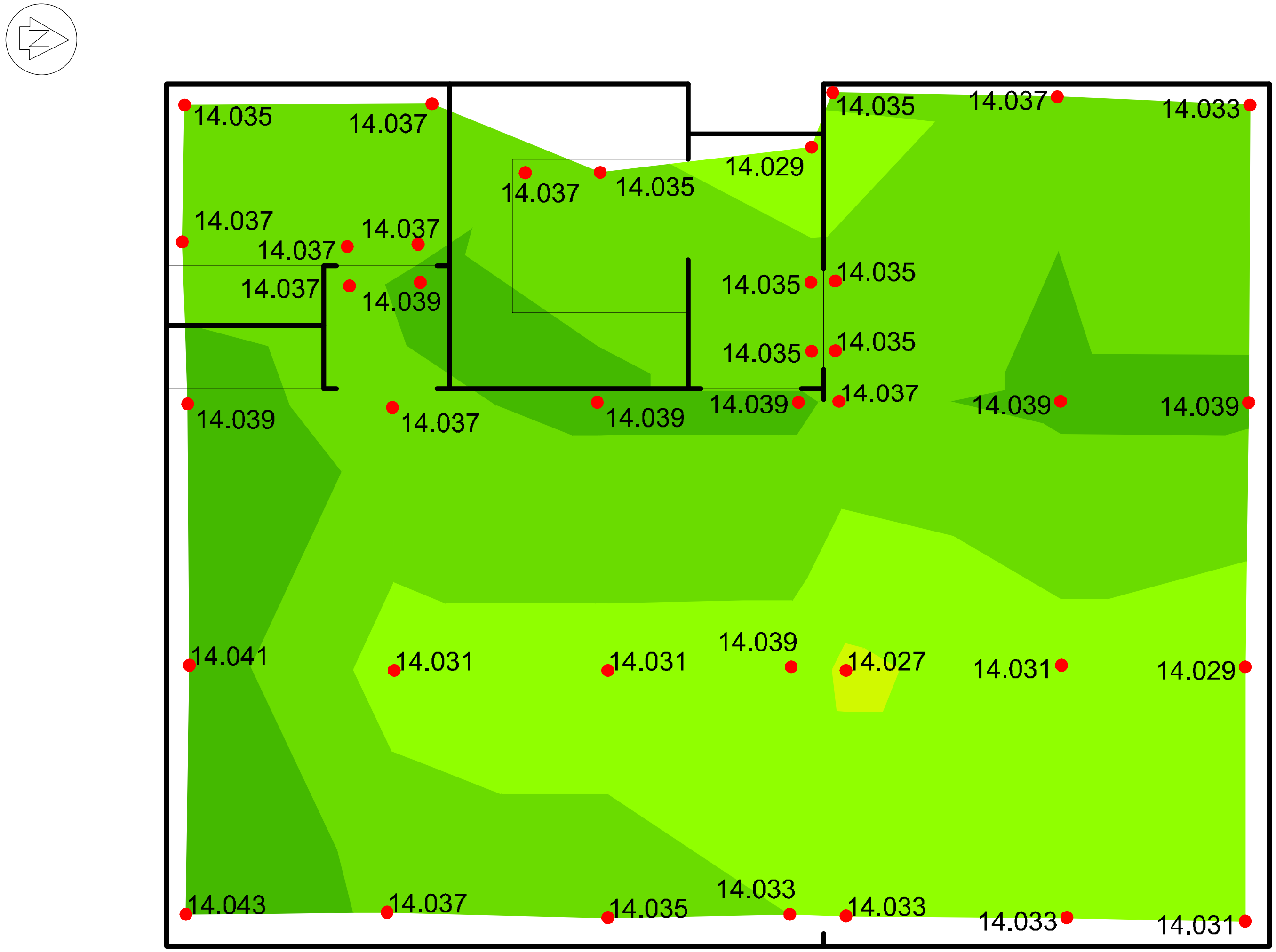
Document No. 5323355-169-GS-003.DWG



NOTES:
a) Levels are in terms of SCIRT/CCC benchmark EKJA with the CDD height of 13.21m. This height was transferred using a Topcon dumpy level which has a survey accuracy of +/- 3mm.
b) All floor levels have been observed using a Technidea zip level which has a survey accuracy of +/- 4mm.
c) All observation have been corrected for changes in floor covering and reduced as if they were observed on the lino flooring.

LEGEND

- - - - - Denotes a change in floor covering or step.

FLOOR CONTOUR LEGEND

🟩	0mm to -5mm
🟩	-5mm to -10mm
🟩	-10mm to -15mm
🟨	-15mm to -20mm
🟨	-20mm to -25mm
🟨	-25mm to -30mm
🟧	-30mm to -35mm
🟧	-35mm to -40mm
🟥	-40mm to -45mm
🟥	-45mm to -50mm

FLOOR LEVEL SURVEY

APPROXIMATE SCALE 1:10@A3

FOR INFORMATION
NOT FOR CONSTRUCTION

A	FOR INFORMATION	MA	CB	CH	03/12/13
No.	Revision	By	Chk	Appd	Date

Drawing Originator: Beca

Original Scale (A1) NTS	Surveyed	CB & LM	27/11/13	Approved For Issue*
	Drawn	XP	03/12/13	
Reduced Scale (A3) NTS	Verifier	CH	04/12/13	
	Dwg Check	CB	04/12/13	Date
	* Refer to Revision 1 for Original Signature			

Client: CHRISTCHURCH CITY COUNCIL

Project: HP SMITH COURTS
CHCH EQ CCC BUILDINGS

Title: RESIDENTIAL LOUNGE
SHEET 4/4
BUILDING SURVEY

Discipline: SURVEY

Drawing No. 5323355-169-GS-004

Rev A

DO NOT SCALE

Source Application

IF IN DOUBT ASK.

Appendix G

Opus Site Reports (Block A & Block B)

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Centre, Christchurch 8140
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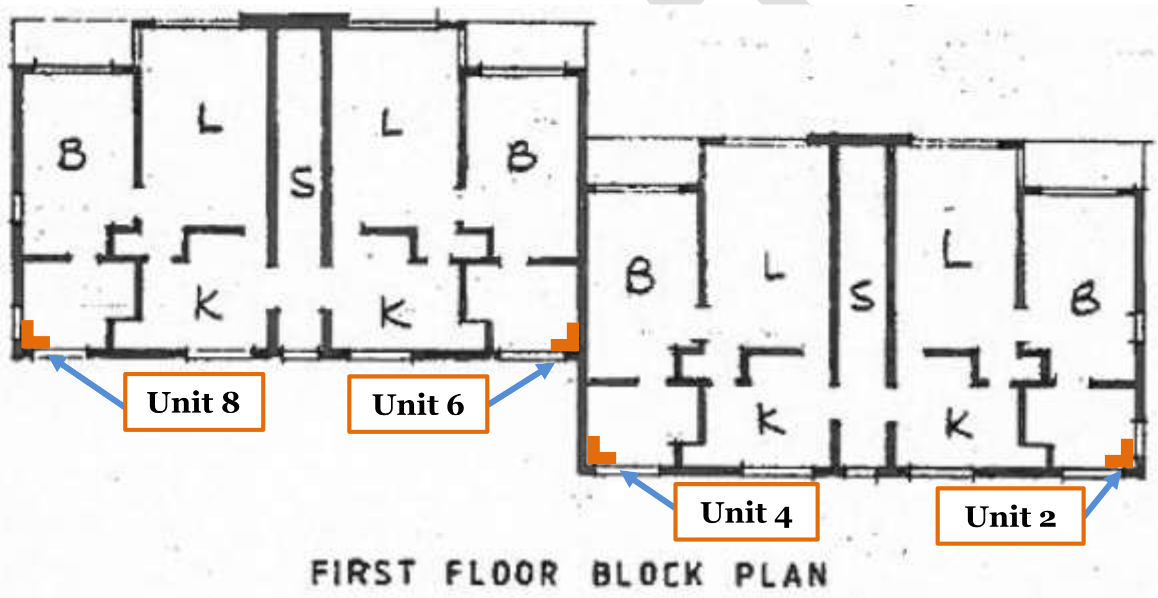
3 June 2014 revision 2

Christchurch City Council

HP Smith Courts Social Housing Inspection

The HP Smith Courts Social Housing complex was inspected by Opus International Consultants on Wednesday 14 May 2014.

The weld-plates were inspected on the first floor of Block A as shown on the diagram below:



The weld plates were found to all have at least two sides welded, refer to the photos below.

Unit 8 weld plate showing 2 welded sides

Unit 6 weld plate showing 2 welded sides

Unit 4 weld plate showing 3 welded sides

Unit 2 weld plate showing 2 welded sides

The drawing specifies that the weld is all round (implying at least 3 sides are welded). Block A has good contact between the cast in plate and the angle bracket. However the vertical alignment is such that only two sides of the bracket could be welded. In unit 4 the weld along the top was very small. There were no visible signs of damage in or around the weld plates.

The wall to slab connection in block A was not investigated as there was no other sign of significant damage in that area.

We would recommend that this information be given to Beca for them to re-assess the DEE. Opus has not undertaken any calculations. Investigations were undertaken to determine if the strength of the building had been significantly reduced due to earthquake damage or construction deficiencies.

Regards

MHalliday

Mary Ann Halliday

Senior Structural Engineer

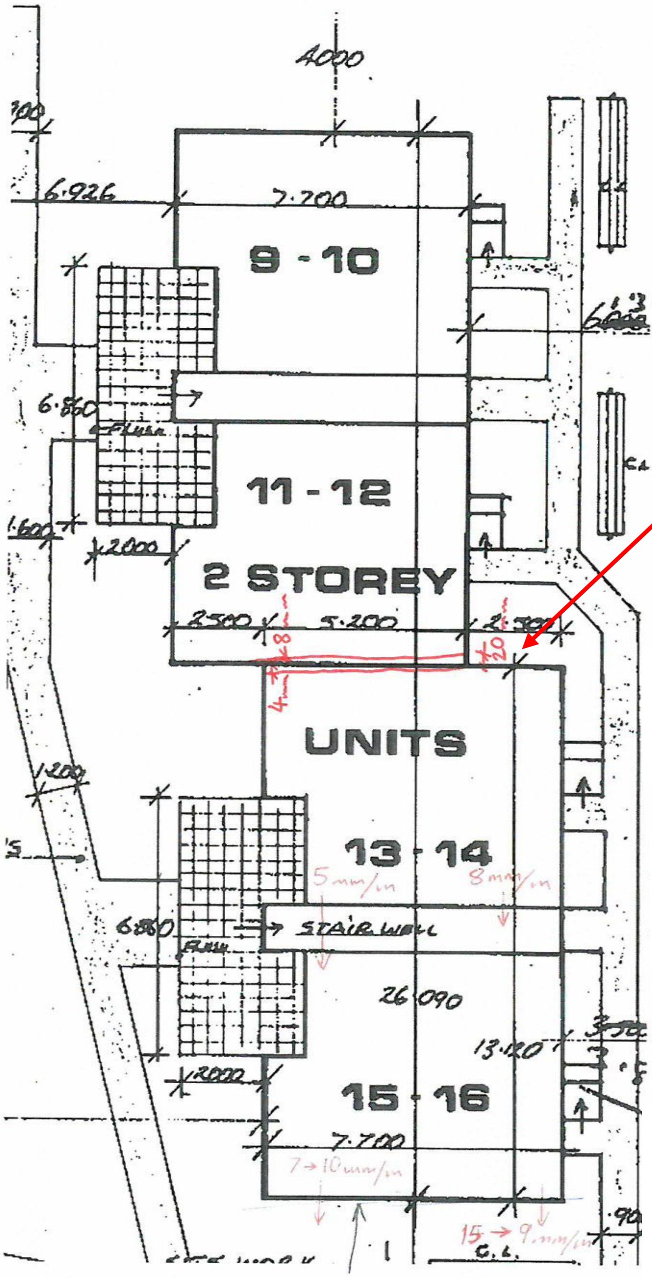
HP SMITH COURTS

28th March 2013

Opus has been engaged to undertake damage assessments on social housing buildings to inform the insurance claim for earthquake damage. Yesterday, I did an intrusive investigation at Block B, HP Smith housing complex. We have also reviewed the DEE written by Beca in April 2013 and the level and verticality survey done by Beca in November 2013.

A summary of our findings are:

- The weld plates have been deformed. What used to be a right angle is now about 105 degrees - refer to photo 3.
- The welds to the angles were not constructed as shown on the drawings - refer to photo 3.
- The deformation of the plates are considered to have compromised the strength of the welds.
- Half of the block (units 13, 14, 15 and 16) has rotated and pulled away from the rest of the block (both the floor levels and wall verticality show this) – refer to photo 4.
- There is a crack at first floor level in the tilt panel at the west of the block which appears to be getting worse – refer to photo 1.
- The tenant in unit 14 reports that she thinks the cracks in her unit are getting bigger.
- The in-situ concrete suspended floor in unit 12 has pulled away from the tilt slab wall supporting it by about 20mm at the south end. This tapers down to about 5mm at the other end of this wall – refer to photo 1, showing unit 11 which is below unit 12.
- This movement is also visible on the other side of the wall in unit 14. The gap between the wall and floor is now about 4mm.
- This gap is evident on the outside of the building and in the ceiling space.
- The floor to wall connection was detailed with Conserts and a shear key. The spalled concrete in this area suggests that they have failed. Typically these sorts of connections have not performed well in earthquakes.
- The wall panels may be reinforced with brittle mesh (two options were shown on the drawings).



Crack width between floor slab and precast concrete wall

Wall between units 11 & 13 See sheet

Measured by Opus with digital level

Measured with total station by Beca surveyor

See west wall elevation
Sheet 4

Sheet 2

Photo 1: Unit 11 First floor slab pulling away from the tilt slab intermediate wall

Photo 2: Unit 11 First floor slab pulling away from the tilt slab intermediate wall

Photo 3: Unit 11 Weld plate no longer 90 degrees

Photo 4: Units 13 & 14 moving away from units 11 & 12