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New Civil Engineer

NOVEMBER 2020

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New Civil Engineer

# AUTUMN PROMISES CAN SIGNAL WINDS OF CHANGE

**ROB HORGAN**
NEWS EDITOR

Autumn is here. Trees have started shedding their leaves, the Christmas countdown has begun and the promised second coronavirus wave has hit.

But while the weather may be dreary, and the Covid-19 challenge mounts by the day, the year is unlikely to end with a whimper as several key decisions are expected to be made by government before we can sing Auld Lang Syne (in groups of no more than six, of course).

Here are just a few big ticket items, the next few weeks and months should produce: the National Infrastructure Strategy; the Williams Rail Review; the government's Energy White Paper and its Heat Strategy.

All have been long awaited; all have been pushed into the ambiguous promised land of "autumn" – which we all understand to mean "some time before the end of the year".

Large parts of the Williams Review have, of course, already been shared and the overhaul of the UK's rail franchising system is underway.

But what the National Infrastructure Strategy will look like is still a mystery with little indication from government. Chancellor Rishi Sunak has repeated his promise to publish it this autumn, and he has added that cancelling the Budget will have no impact on the content of the infrastructure strategy – which on the face of it sounds like good news.

The government's Energy White Paper has also gained extra weight in the last few weeks, with the developments (or lack of) at the proposed Wylfa Newydd nuclear power plant.

First Hitachi backed out of the project following 18 months of unsuccessful talks with government about funding, and then the government postponed its planning decision once more – leaving Wylfa and the wider nuclear sector in limbo.

If you were to put two and two together, prime minister Boris Johnson's ambition – set out in his Conservative party conference speech – to power all UK homes with wind energy by 2030 looks to be the final nail in the coffin for nuclear. Big nuclear anyway, as small nuclear reactors do still to curry some political favour.

Away from policy, the government must also rule on planning applications for major schemes before the end of the year, including the Stonehenge Tunnel and the Hornsea Three windfarm.

And then there are the ongoing talks with Transport for London about a long-term funding plan or financing options for Crossrail – which has warned of a forced shut down without an additional £1.1bn.

An action plan on London's other headache – the Hammersmith Bridge – is also due in the coming weeks, with the taskforce already revealing that it is keen on a temporary ferry crossing of the Thames.

> **"Several key decisions are expected to be made by government before we can sing Auld Lang Syne (in groups of no more than six, of course)**

The country's biggest infrastructure projects are also set for a busy autumn, with court cases involving Heathrow and High Speed 2 promoter HS2 Ltd getting underway as this issue of *NCE* went to print.

Heathrow Airport Ltd heads to the Supreme Court in the hope that it can overturn a Court of Appeal decision which effectively blocked its expansion plans.

Meanwhile, HS2 Ltd faces Bechtel in the Technology & Construction Court to finally settle their long-running battle over the procurement of Old Oak Common Station.

The Department for Transport's (DfT's) £27bn RIS2 roads funding plan will also go before a judge in the coming months – with all eyes on the outcome of the Heathrow Supreme Court ruling. The case against RIS2 is largely built around the court's decision that the Airports National Policy Statement, which concludes Heathrow expansion was unlawful.

Following a year of great uncertainty, upcoming policy announcements and project decisions offer hope of clarity for 2021.

● *Rob Horgan is* New Civil Engineer*'s news editor*

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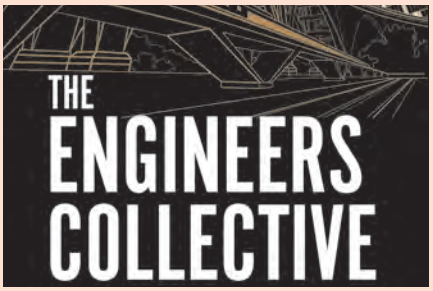
# Live!




### LISTEN: THE ENGINEERS COLLECTIVE

**NCE has released two new podcast episodes this month. Go to newcivilengineer.com/podcast to listen to the latest episodes and The Engineers Collective back catalogue**

### BOOK NOW

**NCE's Future of Transport event is a week of virtual content from 9 to 12 November. The event will explore the opportunities and critical projects in the airports, bridges, rail and road sectors. Visit https://transport.newcivilengineer.com for the speaker line up**

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# We need spending priorities for a sustainable future

How the government allocates and spends public funds is something that is discussed in offices, around dining tables, at the pub and, most importantly, within the walls of Westminster.

Decisions about what projects or programmes will be funded, and by how much, impact all areas of our lives – which is why the government's upcoming Comprehensive Spending Review is such a significant event. The outcome of this review, like its predecessors, will have a massive impact on the provision and quality of all public services, including the UK's infrastructure networks.

That is why the Institution's policy team has been working closely with

**"The outcome of this review, like its predecessors, will have a massive impact on the provision and quality of all public services, including the UK's infrastructure networks**

BY ART WE MASTER WHAT WOULD MASTER US

ICE members and industry leaders to put together a submission to the review. This will, we hope, encourage the government to include funding for core areas, which will improve the performance of the UK's infrastructure.

A key area we hope to see a focus on is jobs and skills. With unemployment continuing to rise as the Covid-19 pandemic continues, it is increasingly important that there is a plan for investing in job creation and skills development.

This is also particularly important when considered alongside the fast-approaching 2050 net zero target.

The UK's built environment sector is ready to play its part in transitioning to net zero, but doing so will require a radical transformation in the sorts of infrastructure networks that we build and how they are built.

The UK needs cleaner transport solutions and more renewable power and heat sources.

And, while the development of emerging technologies, such as carbon capture and energy storage, will create opportunities for change, it also creates a need for new skills. To co-ordinate this effort and to ensure that better project delivery is at the forefront of the economic recovery, it is essential that the government publishes an infrastructure skills plan that addresses and offers solutions for these challenges.

The UK is one of only a small number of countries to have legislated for a net zero emissions target. Although achieving it by 2050 will be challenging,

**"While the development of emerging technologies, such as carbon capture and energy storage, will create opportunities for change, it also creates a need for new skills**

the UK has an opportunity to lead the way in terms of developing the technologies across transport, power and heating – and those for abating emissions in heavy industry – that will be required not just here, but globally.

The government has many difficult policy and investment choices to make as it approaches the spending review. Decisions about the combination of technologies and approaches it will back to meet the target must be made quickly to allow industry time to react and deliver.

Let's not waste the opportunity of putting the UK at the forefront of the scientific and technological battle to mitigate the impacts of climate change and create a sustainable future that we can all enjoy.

**Send feedback on the Lighthouse to policy@ice.org.uk**

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# The Edit

THE BIGGEST STORIES OF THE MONTH
FROM NEWCIVILENGINEER.COM


## Crossrail 2 falls down TfL priority list in favour of Northern Line and Docklands Light Railway projects

**TRANSPORT**

Transport for London (TfL) cannot afford to build Crossrail 2 this decade, says its *Investment to get London and the UK moving again* report. The document sets out a revised list of project priorities for the next decade. It was released with board meeting agenda notes for 30 September as long term funding negotiations continue with the government. Priority schemes include the Docklands Light Railway extension to Thamesmead, south east London, plus the Camden Town Tube station and Northern line upgrades. The report says that major projects such as Crossrail 2 and the Bakerloo Line Extension will be unaffordable before 2030. "We are being realistic about what is affordable over the next decade," the report states. "Very large projects from the mayor's Transport Strategy, particularly Crossrail 2 and Bakerloo Line Extension, are still relevant and aligned to the Department for Transport's decarbonisation plan. However, given current affordability constraints, our immediate priority for these is safeguarding, although they are still likely to be needed in the future to support long term growth and modal shift in London." Board meeting papers also reveal that TfL has spent all of the £1.6bn emergency government grant it secured following a downturn in revenue caused by Covid-19 restrictions. As a result, TfL has stopped all new non-critical spend. It adds that a £2bn annual funding gap must be plugged and it is asking for £4.9bn to cover operating expenditure until the end of 2021/22.

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**KEY STAT**

**£4.9bn**
**Additional emergency funding sought by Transport for London to keep going until the end of 2021/22**

RAIL

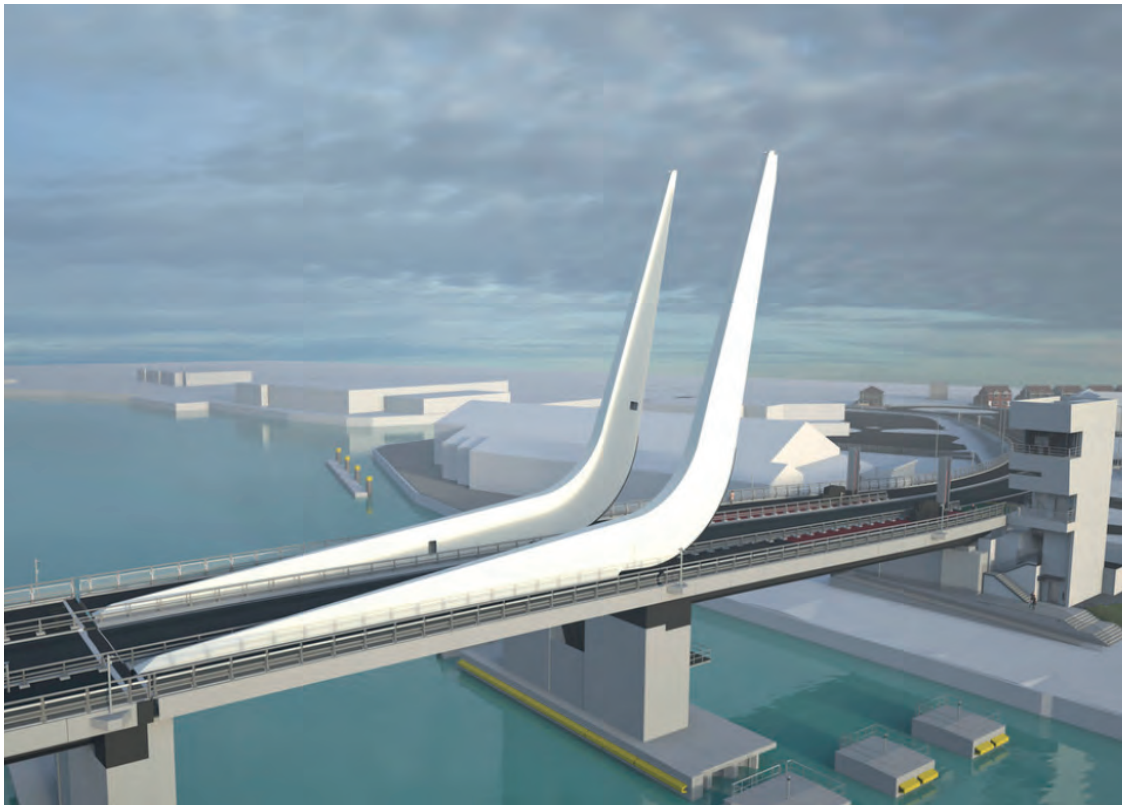
### CROSSRAIL FACES SHUT DOWN WITHOUT EXTRA £1.1BN

Crossrail Ltd will be forced to shut down unless the government releases an additional £1.1bn soon, Transport for London (TfL) board meeting agenda papers reveal. Crossrail announced this summer that it needs the additional funding to complete work on the Elizabeth line. "We are […] in discussions with Department for Transport in order to resolve the additional £1.1bn of funding that Crossrail Limited (CRL) have stated they need to complete the project, as this issue was deferred in the first half of the year," the papers state. "This is becoming an increasingly critical issue [..] CRL will soon have committed all of its funds within the current £14.964bn funding envelope."

STRUCTURES

### WSP FACES FLORIDA BRIDGE COLLAPSE LAWSUIT FOLLOWING BERGER TAKEOVER

WSP is embroiled in a lawsuit followibng the collapse of the Florida International University (FIU) bridge in 2018, despite not being involved in the project. Contractor Magnum Construction Management (MCM) has named WSP on its lawsuit against the Louis Berger Group, the company responsible for reviewing the bridge's design. WSP acquired Louis Berger Group after the bridge collapsed. MCM is attempting to recover costs paid to the university as part of a previous settlement. The FIU bridge in Miami-Dade County collapsed onto a live eight lane road on 15 March 2018, killing six people and injuring eight others. A National Transportation Safety Board report on the collapse published last year concluded that design calculation errors made by MCM's consultant Figg Bridge Engineers were ultimately to blame. But it says failures by independent design checker Louis Berger, the client, contractor and on-site construction supervisor also contributed to the disaster.



STRUCTURES

## LOWESTOFT BRIDGE CONTRACT

Farrans is to build Lowestoft's £76M Gull Wing, tilting bridge, after Bam Nuttall failed to agree a price with Suffolk County Council last year. The bridge will be Lowestoft's third crossing of Lake Lothing. A tender process was run over the summer and approval to appoint the contractor was granted by Suffolk County Council's Cabinet. Farrans' contract will begin later this year.

TRANSPORT

## VITAL LONDON ROUTES FACE CLOSURE WITHOUT £2BN REPAIR CASH

Key road bridges and tunnels in London face closure unless Transport for London (TfL) gets £2bn for its road renewals programme for the next 10 years. TfL says that the A40 Westway, Rotherhithe Tunnel and Gallows Corner Flyover need urgent repair cash. Speed and weight restrictions are already in place on all three routes. All three are part of TfL's Surface Transport Asset Renewals Programme.

ENERGY

## CUMBRIAN COAL MINE WINS PLANNING PERMISSION

Cumbria County Council has approved the planning application for the £165M Woodhouse coal mine in Cumbria. It is the first deep coal mine to receive planning permission in the UK for 30 years. The green light comes despite campaigns from environmentalists who fear that emissions from burning coking coal from the mine could stop the UK meeting its net zero target.

TRANSPORT

## NETWORK RAIL TO ASSESS UK TRANSPORT CONNECTIONS

Network Rail chair Sir Peter Hendy will lead an independent review of UK transport connections. It will assess the feasibility of a bridge or tunnel between Scotland and Northern Ireland. The review will look at how to boost transport infrastructure in Scotland, Wales, Northern Ireland and England via road, rail and air, and across the Irish Sea, as part of the Covid-19 recovery effort.

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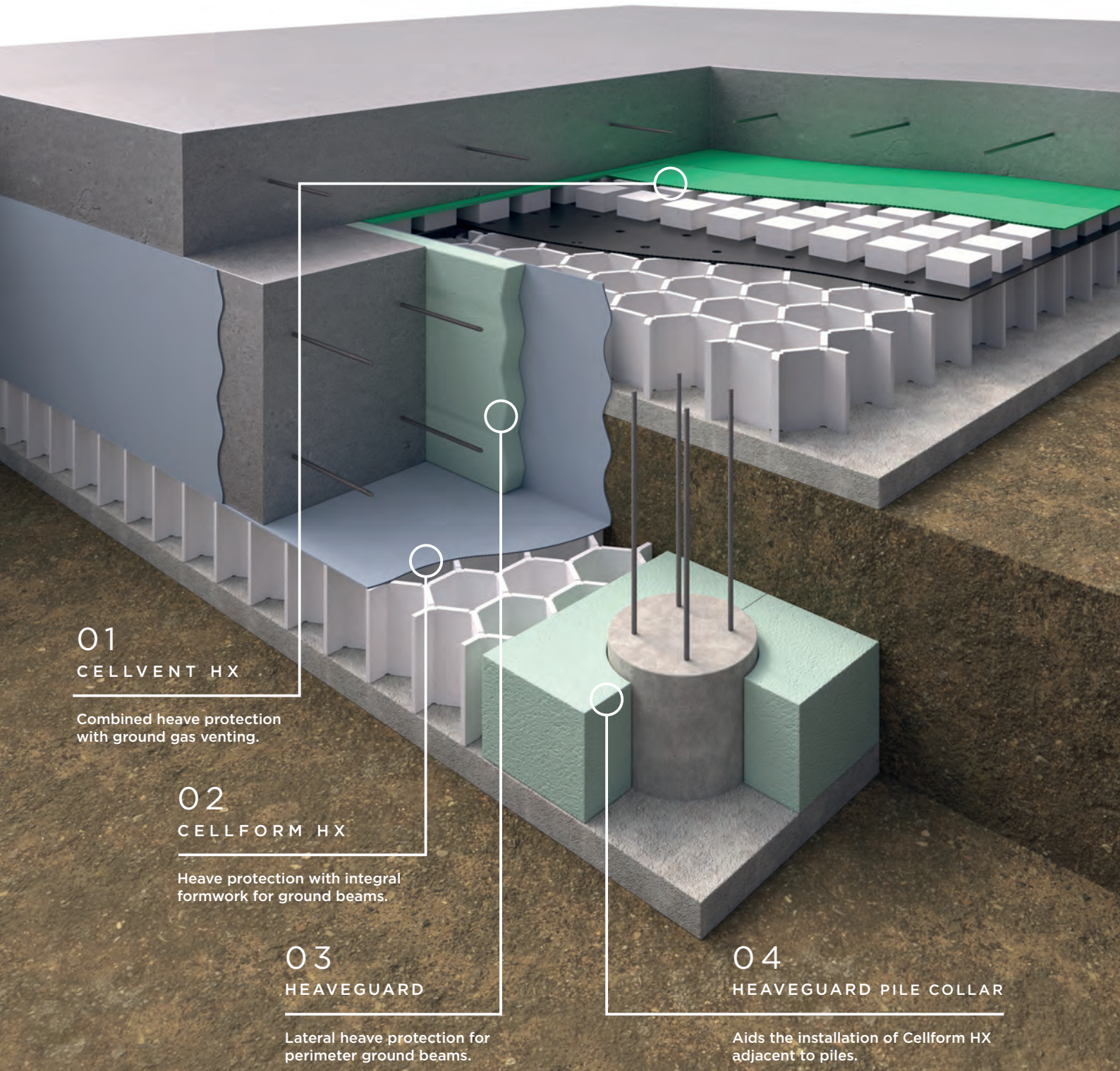

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# Inside Track

THE BIGGEST ISSUES OF THE MONTH EXPLORED

Cause for concern: Heathrow tunnel refurb

AVIATION

## Regulator and rivals' alarm at Heathrow spending

Airport operator reveals it spent more than £500M on its failed expansion bid and regulator expresses concern about tunnel refurb costs

BY ROB HORGAN

Rival airport expansion bidders and the aviation regulator have criticised the amounts Heathrow Airport Ltd (HAL) spent on its failed third runway expansion bid and on two tunnel refurbishment schemes.

HAL has been left with a £500M bill for its thwarted third runway expansion bid.

The Court of Appeal blocked the £14bn expansion programme in February due to climate change concerns, and in May the Civil Aviation Authority (CAA) said the plans were "unlikely" to re-start in the "short term".

It has emerged that HAL had already spent £504M on planning and early construction works at the time the project was halted.

According to the CAA's *Economic regulation of Heathrow: Policy update and consultation* report, the costs are broken down into £394M of planning (category B) and £110M of early construction (category C) costs.

Competing expansion bidder Heathrow West has also halted its expansion bid. Its bid costs are less than a tenth of HAL's, with Heathrow West chief executive Carlton Brown estimating total sunk costs to be less than £50M.

Final sunk costs are currently being agreed with the CAA.

"The amount HAL has spent really is a shocking amount of money," Brown told *NCE*.

"To put it into context, we expect our entire costs, including planning fees, legal fees and wind down fees, to come in below what HAL is proposing for wind down costs alone.

"The final sunk costs have yet to be finalised with the CAA, but I am confident that our spend will be less than £50M."

He added: "It is true that HAL have been doing their planning application for longer and got slightly further along, but that does not justify spending half a billion pounds before securing planning permission."

Brown estimates that Heathrow West's wind down costs will be less than £500,000, compared to HAL's £46M.

He added: "Every pound we spend is accounted for, because we run the expansion like a business.

"The way Heathrow is regulated means it is not penalised for spending large amounts of money and therefore it can spend inefficiently without consequence."

To cover the £500M expansion bill, HAL is expected to charge airlines more to operate at the airport.

Another rival expansion bidder, Heathrow Hub, now believes that its expansion plan to extend the north runway is the only financially viable option left open to the airport.

Heathrow Hub founder Jock Lowe claims that the group's runway extension scheme is "cheaper, greener and more sustainable" than third runway proposals put forward by HAL and Heathrow West.

He told *NCE* that Covid-19 economic pressures, a drop in passenger numbers and legal issues with building a third runway all strengthen the business case for Heathrow Hub's proposal.

"Now is the time to look again at this plan [to extend the runway]," Lowe said. "It's greener and cheaper than HAL's plans. It causes less disruption, and it makes better business and financial sense as it can be done incrementally."

Heathrow Hub's plan consists of three phases of expansion. The total cost of all three phases is £12.6bn, less than the estimated £37bn third runway proposal put forward by HAL.

But it is not just HAL's expansion costs which have come under scrutiny. A CAA economic performance review concludes that HAL has "wasted" money on two ongoing tunnel refurbishment schemes.

It adds that HAL acted "inefficiently" on refurbishments of a cargo tunnel and a road tunnel servicing its terminals.

The combined cost overrun of both schemes is estimated at £212.4M, although the CAA suggests that those costs could be inflated further by the time work is completed.

Conclusions made in the CAA's September 2020 *Economic regulation of Heathrow* paper draw on independent analysis by Arcadis and the Institute for Fiscal Studies.

Costs of refurbishing the cargo tunnel between Terminal 4 and the Central Terminal Area have soared by £152M, from its approved £44.9M budget to the current

estimated cost of £197M, the report reveals.

Meanwhile, the cost of upgrading the road tunnel linking Terminals 1, 2 and 3 has risen by £60.3M to £146.3M from an approved budget of £86M.

The CAA states that for the cargo tunnel "there is clear evidence that the actions of HAL may have directly contributed to wasted spending or lost benefits".

It adds: "The cargo tunnel project faced significant cost overruns of around 400% against the original budget and is now forecast to be completed during H7 [the next funding period starting in 2022].

"We consider that this has led to a loss of benefits to consumers because of late delivery […] We also consider that if the risk of cost increases had been better assessed at the beginning of the project, more efficient contractual terms (in terms of risk allocation) may have been obtained by HAL through its procurement process."

Design work for the project is now being undertaken by WSP, with Mace providing contractor input and Brydon Wood onboard to provide offsite and DFMA expertise (*NCE* last month).

They took over the project from Bam and Mott MacDonald which were initially involved in the scheme.

The CAA had complimented HAL for working to overcome poor contractor performance on the initial road tunnel work which was being carried out by Bam Nuttall with mechanical and electrical specialist VVB engineering.

The CAA report states that "Arcadis concluded that the project had been delivered efficiently to date, and HAL had, by and large, acted reasonably in trying to mitigate the contractor's poor performance".

It adds: "Arcadis found several examples of poor performance by HAL's contractor on this project, including continuing discovery of defects within works already completed."

But the CAA concluded that HAL is still ultimately "responsible for any inefficient management or delivery of projects by its contractors that increases cost or results in loss of benefit".

The CAA will now assess whether to remove costs associated with the tunnel refurbishments from HAL's Regulated Asset Base (RAB) – which effectively means HAL would have to pay for cost overruns, rather than charging airlines.

The decision will be taken after a further consultation round and once work on both projects is complete.

ENERGY

## Nuclear uncertainty

Developer pulls out of Wylfa project

BY ROB HORGAN

The UK's nuclear power sector has been left in limbo because of government indecision about the future of the £20bn Wylfa Newydd power plant on Anglesey.

The government has delayed its decision on the development consent order (DCO) application for a third time. Business, energy and industrial strategy secretary Alok Sharma was due to rule on the scheme at the end of September. But he has deferred his decision until the end of the year "to allow further information to be provided and considered".

Developer Horizon Nuclear Power Wylfa, requested the delay, asking for time to discuss the future of the project with its shareholders. Its parent company Hitachi had said it was withdrawing from the project after funding talks with ministers broke down.

A letter from Horizon Nuclear Power Wylfa chief executive Duncan Hawthorne adds: "Due to the recent change in circumstance, a short extension to the decision deadline would be beneficial to enable Horizon to work constructively with its key stakeholders to ascertain the options for the Wylfa Newydd DCO Project and secure its future, recognising the critical role nuclear power has to play in helping tackle the UK's energy needs, meet climate change targets and level up the economy through green growth and job creation."

The Planning Inspectorate filed its report to Sharma's office in July 2019. The government has delayed its decision three times, with a ruling originally scheduled for October last year. That deadline was adjusted to March this year but was further delayed because of the Covid-19 lockdown.

The DCO decision will be watched closely by EDF in particular, as the Planning Inspectorate is assessing its Sizewell C nuclear reactor plans, after an appeal for a judicial review of the scheme was thrown out by the High Court.

Energy & Climate Intelligence Unit analyst Jess Ralston told *NCE* that the ruling is likely to give an indication of the

government's long term thinking about nuclear projects.

"Policy decisions on nuclear power's future in Britain's energy mix are required urgently if the industry is to stay alive. The prime minister recently stated that there is a role for nuclear power in reaching net zero, but without clarity on funding it is hard to see how this will come to pass," said Ralston.

"Without long term direction and a signal for investors, the industry may not be economically viable in this decade and beyond, particularly as the investments are large and the planning stages long. More delays also mean more scrutiny in light of the ever falling cost of renewables along with developments in technologies needed to balance the grid at low cost.

"All eyes are on the upcoming energy White Paper, promised this autumn. Net zero is entirely feasible but an answer on the future energy mix is needed soon, with or without nuclear."

Other potential developers will also be keeping a close eye on the ruling. *NCE* understands that the DCO application could be taken on by a third party, should one be willing to step in. A new developer would be able to make minor changes to Horizon's DCO, but any major changes would require a new DCO application to be filed.

But Ralston added that cost overruns and delays to current nuclear projects such as Hinkley Point C and Sizewell C had

Wylfa: Planned new nuclear plant on hold

made investment in UK nuclear projects "unattractive". Twelve months ago, Hinkley Point C developers announced that the plant faced delays after costs rose by £2.9bn.

EDF's Sizewell C DCO application has also been hit by delays this year due to Covid-19 restrictions and legal challenges.

Ralston added: "When you look at the case for nuclear projects like Wylfa, they no longer stack up. Nuclear is not a financially attractive proposition for investment, especially when you put them next to renewable projects.

"Delays to other projects have also not helped. We've had delays at Hinkley and at Sizewell, which makes it harder to make the case for new projects."

Wylfa is the latest nuclear scheme to be canned in the UK. In the last few years, Japan's Toshiba dropped plans to build a new nuclear reactor at Moorside, Cumbria, while Hitachi scrapped plans for a plant at Oldbury-on-Severn in Gloucestershire.

Meanwhile, political backing for renewables is on the rise due to dramatic reductions in cost during the last decade, and prime minister Boris Johnson pledging to power all UK homes with wind energy by 2030. Across the board, the cost of renewables has fallen since 2010. Large scale solar power costs have fallen 47%, while onshore wind are down 40% and offshore wind 29%.

BUSINESS

# Covid hits on civils firms

Losses reflect tough year for sector

BY CATHERINE KENNEDY

The impact of the Covid-19 pandemic has been laid bare by a series of financial results recently released by construction and engineering firms.

Big name contractors Galliford Try, Kier, Costain and Amey have all reported losses.

All have felt the effects of forced site closures at the start of lockdown and the additional safety precautions required on reopening.

Fines and cost overruns on major projects have also contributed.

Galliford Try reported a pretax loss of £59.7M in the financial year to 30 June 2020. The firm said Covid-19 hit revenue and lowered site productivity.

But the firm's infrastructure division reported an improved performance, incurring a pre-exceptional operating loss of £1.8M, compared to a £5.5M loss in 2019 which was inflated by dispute costs.

Its order book stands at £3.2bn, a rise on the £2.9bn reported last year, and despite the economic disruption caused by the pandemic, the business reported good progress towards its strategic goals.

Chief executive Bill Hocking emphasised that Galliford Try had responded "rapidly and effectively" to the Covid-19 challenges, with working practices changing "significantly" through staggered shifts, increased welfare facilities and enhanced cleaning regimes.

Contractor Kier posted a pretax loss of £225M for the 12 months to 30 June, again due to challenging market conditions and Covid-19 costs.

It said the results reflect nine months of "good strategic progress" and three months affected by the pandemic.

Despite the losses for the whole company, Kier's infrastructure services division reported an operating profit of £9.4M on revenue of £1.5bn compared with an operating loss of £3.3M on revenue of £1.6bn the previous year, and the firm described its £7.9bn order book as "stable".

Kier chief executive Andrew Davies said the company had been trading "in line with expectations" up to 31 March 2020, before the pandemic reduced the amount of work the contractor could do, and costs increased.

He added that the management team is working to ensure the company is "well-placed" to benefit from expected increases in UK infrastructure investment.

Meanwhile, Costain recorded a pretax loss of £92.3M during the first half of this year after taking financial hits on two troubled contracts.

Results were impacted by a £45.4M charge on the A465 Heads of the Valleys road contract and a £49.3M charge on the Peterborough and Huntingdon gas compressor station programme.

Despite the challenges, the firm's chief executive Alex Vaughan said he was confident about future profit and margin growth with over £2bn of contracts and frameworks secured in the first half.

He also cited the government's drive to progress infrastructure investment to support the post-Covid recovery.

Amey reported a £217M loss for the year ending 31 December 2019 as the pandemic delayed attempts to sell its loss-making utilities and waste businesses.

Chief executive Amanda Fisher said Covid-19 had led to "significant business challenges".

However, in its remaining core business, the firm increased turnover from £1.5bn in 2018 to £1.9bn in 2019, while operating profit was £73.2M, compared to a £178.2M loss in 2018.

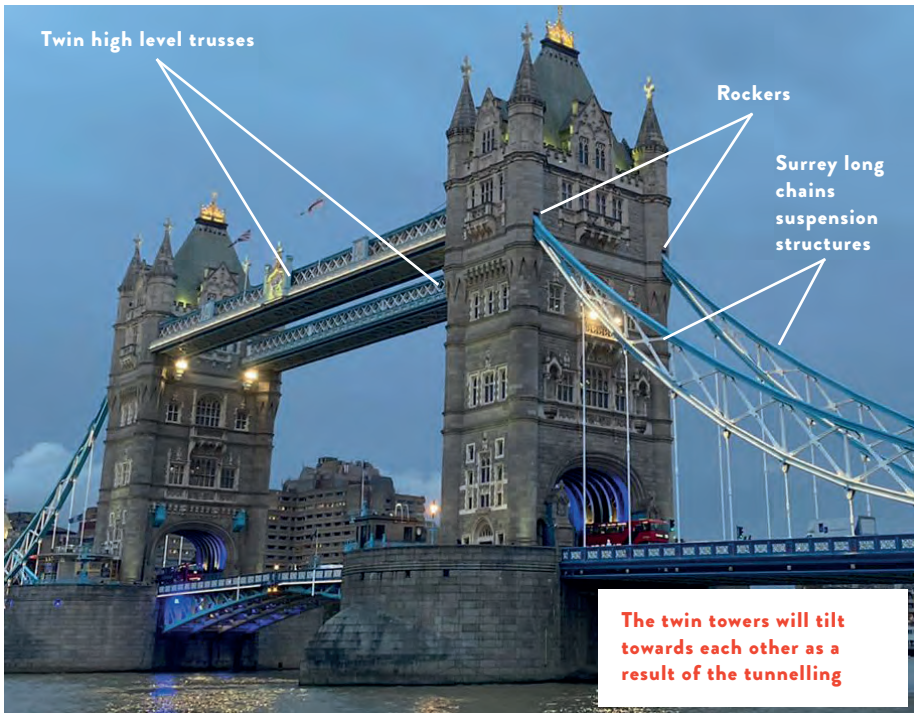
And despite "Covid-19 shocks", consultant Turner & Townsend's 2019/20 turnover rose from £639M to £744M. UK net revenue grew by 9% to £283M, while UK profits jumped from £29M to £36M year-on-year.

The firm's infrastructure division increased revenues by 15% to £206M, boosted by high profile jobs in Australasia.

Chairman Vincent Clancy said: "While we continue, like the rest of the industry, to feel the impact of Covid-19, our financial performance and business model stand us in good stead to withstand the economic aftershocks." He emphasised that there is now an "exciting opportunity to drive change and to build back better".

Glenigan economic director Allan Wilen said the recent results highlight that construction businesses were hard hit by the initial lockdown.

"Whilst industry activity has begun to recover, firms are now facing increased operating costs and the challenge of delivering projects with a reduced onsite workforce," he said.




The twin towers will tilt towards each other as a result of the tunnelling

STRUCTURES

# Tower Bridge braces for Tideway impact as TBMs prepare to pass beneath the landmark structure

Concerns work on super sewer could disturb bascule bridge

BY ROB HORGAN

Additional monitoring equipment has been installed at London's Tower Bridge to ensure tunnelling for London's Tideway sewer does not damage it, *NCE* can reveal.

The City of London Corporation – which owns the bridge – confirmed that Tideway has installed "invar barcodes" over the last few weeks, before Tideway's tunnel boring machine (TBM) passes beneath the 19th century bascule bridge.

The invar barcodes have been installed to detect any unexpected movement in the bridge during tunnelling.

TBM *Ursula* stopped beneath the *HMS Belfast* museum ship for three weeks, around 500m from Tower Bridge.

Tideway confirmed that it had stopped to allow general maintenance.

Concerns that tunnelling could disturb the structure were first raised in 2013 by Aecom. In its report – seen by *NCE* – Aecom concludes that tunnelling will cause Tower Bridge's piers to rotate very slightly towards each other.

But the report concludes that this would not cause lasting damage.

But chartered electrical engineer and author of the *Haynes Tower Bridge Operations Manual* John Smith has warned that more significant damage could occur.

Smith has aired his concerns with the City of London Corporation and Tideway, in a discussion paper that concludes that rusted rocker bearings [connecting the suspension structures to the twin high level trusses] will be unable to withstand the slight movements predicted by Aecom's modelling.

"At first sight, this does not appear to be a serious issue. If the rockers were working as designed, the suspension bridges could probably take this movement in their stride," a paper written by Smith states.

Smith is concerned that the movement of the towers will place extra loads on the twin high level trusses between them. He is also concerned that the movement will stretch the suspension structureswhich carry the side spans and their connections with the towers.

"As the rockers are believed to have seized, the consultants concluded that each of the two high level ties [twin girders between the two towers] will shorten by 24mm, reducing the tension in each tie from 897.2t to 234.9t."

It adds: "It is likely that these rockers have been seized for many years […] The movement of the tops of the towers will cause stretching of the two Surrey long chains [suspension structures] as the stiffening girders prevent the Surrey suspended span [south bank side span] from hogging.

"The Middlesex suspended span [north bank side span] may be capable of hogging if the bearings connecting the Middlesex long and short chains [north side suspension structures] are not seized. The stretching of the main chains will apply substantial additional horizontal load to the pinned joint linking each long chain to its high-level tie.

"The rocker assemblies [connecting the high level ties with the suspension structures] will thus be subjected to substantial horizontal forces which they were not designed to sustain."

Speaking to *NCE*, Smith added: "Perhaps I am being overly concerned but when I was reading over the Aecom report as part of my research [for the *Haynes Manual*] I couldn't help but think something had been overlooked.

"It might not seem like a massive thing, and it is not going to cause the bridge to collapse. That said, the cost and complexity of replacing damaged rockers would be extensive."

In March 2019, *Ursula* became the second TBM to be launched from a 45m deep shaft at Tideway's Kirtling Street site in Battersea. It is due to pass under Tower Bridge in the autumn.

A Tideway spokesperson added: "TBM *Ursula* has stopped for routine maintenance between London Bridge and Tower Bridge, and is expected to resume tunnelling soon, passing beneath Tower Bridge later in the autumn, and breaking through at Chambers Wharf in late 2020/ early 2021.

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The Interview

André Gibbs

PARTNER, ARGENT

BY NADINE BUDDOO

# Delivering sustainable urban regeneration projects

Delivering mixed-use developments which blend residential, commercial and leisure space is a considerable feat, particularly in densely populated urban areas. It is a challenge André Gibbs knows very well. In his role as a partner at real estate developer Argent, Gibbs has been involved with the delivery of the £6bn King's Cross regeneration scheme, north of London's King's Cross Station.

Gibbs was tasked with integrating land assembly, business planning, finance, infrastructure and sustainability into the construction and delivery of the scheme.

"Argent is best suited to large, complicated and difficult projects that provide opportunities to transform parts of a city," he says.

"Currently, our focus is very much on city building, which means we're not just involved in individual building projects but also considerable amounts of infrastructure and all of the planning and challenges around that."

Maintaining long term relationships across the supply chain has become a defining feature of Argent's approach. Gibbs explains that projects often span up to two decades, so it is important to ensure that lessons learned are carried from one development to the next.

Equally important is finding a balance between the benefits of long term relationships, while also encouraging fresh thinking.

"When you're working on a 15 to 20 year project, you don't want to always have to start from scratch with a completely new team," says Gibbs. "However, we're never closed to working with a new business or new suppliers."

> "Our focus is very much on city building, which means we're not just involved in individual building projects

## NEW FOCUS

As work at King's Cross draws to a close, Gibbs' focus has now pivoted to another of Argent's regeneration projects in the capital. The developer is delivering the £5bn Brent Cross Town project – formerly known as Brent Cross South – in partnership with Barnet Council. This 72.8ha town centre development is at the heart of the Brent Cross Cricklewood regeneration scheme. It covers three interrelated developments – Brent Cross Town; the new Brent Cross West Thameslink station; and the redevelopment of Brent Cross shopping centre and related infrastructure.

Brent Cross Town will deliver 3M.ft$^2$ of office space, 6,700 new homes, restaurants, sports facilities and student accommodation, all set around 20ha of parks and playing fields. The first office buildings are expected to open in 2024.

Gibbs is understandably proud of the success of the King's Cross development which has transformed an underused industrial site into a thriving part of the city. But he is at pains to point out that the Brent Cross project will not be a replica. "It's easy for people to say 'oh, you're going to do another King's Cross at Brent Cross', but that's absolutely not the case," he insists.

"We obviously hope the development will be just as successful as King's Cross in terms of the

Brent Cross Town will deliver office space, homes and restaurants, all set in around 20ha of parks and playing fields

contribution it makes to the area and local communities, while continuing to set a high bar for what regeneration and transformation of areas can do and should achieve. But we have to look at every single project within its context."

Gibbs says Argent is embedding sustainability into all its thinking, with a health and wellbeing agenda at the core of the development. The team is currently exploring how nature and sound can be integrated, for example.

The focus on sustainability is also shaping plans for the development's energy infrastructure. Argent is working with energy provider Vattenfall to manage the district heating network at the site. Gibbs says the decision to partner with Vattenfall, which is owned by the Swedish Government and has around 1.8M customers across Europe, was a logical step towards quickly achieving low to zero carbon solutions.

"Vattenfall's mission is to be fossil free in a generation," he adds. "That's the sort of partner we need to work with to bring about innovation."

This innovation is in the form of a combined heat and power system that operates at low temperatures and allows multiple sources of renewable heat.

"I think overall energy efficiency and multiple sources which allow you to adapt over time and use the best technology without having to change every building is a long term strategy that we embraced at King's Cross and will take us to another level at Brent Cross," he says.

**KEY FACTS**

**72.8ha**
**Size of Brent Cross Town development**

**£5bn**
**Cost of Brent Cross Town**

> **"There are a lot of challenges around how we ensure everything is connected into the wider area**

## LOCATION, LOCATION, LOCATION

This long-term, holistic thinking goes beyond the energy infrastructure for the development – it is also evident in the approach to design and construction on the project.

The site itself is well situated in terms of the surrounding highway infrastructure, Gibbs explains. However, a key focus for the project is connecting to this existing infrastructure and ensuring the highways continue to function and provide long term accessibility.

Barnet Council is working with Network Rail to deliver the new Thameslink station, which Gibbs says will help to address some issues concerning rail accessibility. "Due to its physical geography, there have been issues around accessibility because of the major highway infrastructure around the site," he says. "There are a lot of challenges around how we ensure everything is connected into the wider area. We've been tackling a lot of those engineering challenges."

As well as the complexities related to transport infrastructure, the site will require significant earthworks and remediation. Dealing with issues such as asbestos sheeting and demolitions will be a challenge, although these issues are not uncommon issues on brownfield sites.

The overall development will be delivered in phases, which means a cost-benefit analysis is carried out for every structure before construction can begin. Each decision to start building is market driven, explains Gibbs. This means it is vital for engineers and the wider supply chain to understand the economic drivers behind the project and the challenges Argent faces in allocating capital prudently.

"It's important for them to take the time to understand what we want, but if they don't understand why they're doing something then they need to ask us about it," says Gibbs.

"Obviously, we'd love everybody to be a clairvoyant but the second best thing is to be questioning and challenging."

There's a sense that Gibbs is keen to ensure his company's previous success does not engender a culture of complacency. He insists that constant improvement is required from the wider supply chain, but that sentiment is just as true for the organisation itself.

He adds: "The attitude must always be pushing ahead while maintaining enough to anchor on to ensure we're not just reckless risk takers." N

# Your View

LETTERS TO THE EDITOR
AND COMMENTS ONLINE

STRUCTURES

## WHY NOT USE A TOLL TO PAY FOR HAMMERSMITH BRIDGE REPAIRS?

I read with little sympathy about the wringing of hands at the inability of those responsible for maintaining the Hammersmith Bridge to find the £100M funding needed to repair it. I do not see it as a responsibility of the government. I do see that it is an historical monument and worthy of repair rather than replacement. The solution is blindingly obvious – borrow the funds and impose a toll on the use of the bridge to discharge the loan and build up a fund for future maintenance. If the bridge is that important a traffic route, the users should be glad to pay to have it restored.

Here in Cornwall, we built a bridge many years ago to link us with Plymouth and this was, and still is, funded by tolls.

**Steve Burstow (M), steveburstow@btinternet.com**

STRUCTURES

## GOVERNMENT SHOULD CALL TFL'S BLUFF

Transport for London (TfL) just can't admit that the deterioration of Hammersmith Bridge is down to its own mismanagement, since it has chosen to pour money down the drain of Crossrail and son of Crossrail [Crossrail 2] rather than spend it on maintenance as a good asset steward should (*NCE* last month). It just continually plays the game of blaming central government for its own mistakes in the hope (quite justified in the light of recent fiascos) that central government will come to the rescue with yet more taxpayers' money to pour down another black hole. It's about time government called its bluff and explained to the voters at the next mayoral election that the reason the bridge is still closed is down, fairly and squarely, to the current mayor and his incompetent TfL cronies.

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RAIL

## WON'T ELECTRIC CARS SUPERSEDE EAST-WEST RAIL?

Suggesting that there will be benefits from the East West railway sounds like wishful thinking. People will have transferred to electric cars powered by clean electricity long before construction of the railway is complete. The construction process and the manufacture of rail, rolling stock and equipment will emit large amounts of carbon, accelerating climate change. Better to act responsibly and divert current activity into clean power projects, and build the railway cleanly, if its viability can be demonstrated, as you breathe clean air in the new clean, climate-controlled planet that you will have helped to create.

**Rodney Bridle (F), rodney.bridle@damsafety.co.uk**
**Posted online on story headed East West Rail boss claims case for line is strengthened by Covid-19**

RAIL

## EAST-WEST RAIL IS JOINED UP THINKING

Something I think that's been missed out of this is that currently many rail journeys, East to West primarily but many others similar to this, involve a journey through a London interchange. These are often crowded, bustling places with a Tube journey between termini and taking hours longer than a direct route would. These events all increase actual exposure to potential infection and perceived exposure. Taking Oxford to Cambridge, that's a trip of 2.5 hours by rail at present using three operators. Sure, using an electric vehicle would be half an hour quicker and less exposure but I wouldn't risk doing those 136km in a Nissan Leaf. What about the return journey? There's a lot to be said for the defocusing of London when it comes to travel interchanges. South of London there's a rich web of interconnecting stations, but to the north, the concentric options are very limited indeed. Where they did survive the Beeching axe, these local connections were often curtailed leaving communities served by two stations that are miles apart.

**Grant Wray, trt1968@gmail.com**
**Posted online on story headed East West Rail boss claims case for line is strengthened by Covid-19**

MAJOR PROJECTS

## HOUSE BUILDING IS NOT THE SAME AS MAJOR PROJECTS

Crossrail: hugely complex

Not unlike those he castigates, Adrian Marsh (*Your View*, *NCE* last month), appears to have an attitude problem. His view is characteristic of that expressed by many who see the ailments of modern society in emotive and stereotypical ways. His comparison between private house building contracts and major infrastructure projects is not viable. Housebuilding is generally well understood and straightforward. However, major, and to a greater extent megaprojects (ie multibillion pound projects such as Crossrail) face many complex problems both in their planning and execution, as well as intense political scrutiny. The simplistic notion that the

MAIN POINT

# TACKLING HULL'S FLOODING PROBLEM

**Please excuse a slight touch of amusement in reading the article on Lagoon Hull in your September issue. It states: "In 2007 a massive downpour into saturated land led to surface water just pooling everywhere before it got to the drains".**

**I was employed as an external consultant to Hull in 2007. Initially I was to report on a variety of issues following this flooding. I went up to Hull to meet the job specification as provided by Hull officers. I stayed and worked there over many days, interviewed willing and receptive staff, and attended management meetings with the department responsible.**

**I was very surprised to find Hull had a most modern surface water system. All surface rain water as it ran off was collected and pumped off out to sea.**

**Unfortunately, as so often happened, municipal engineering good practice was forgotten and routine inspection and maintenance of the pumping stations was not up to scratch.**

**Worse, even, was that the standby pumping station had not recently been tested and did not kick in following this failure. The result was that over 24 hours of heavy rainfall, vast areas of Hull City built below the highway surface water level were flooded overnight and, of course, once in the very many houses affected was the devil of an expensive job to clean out, taking many months.**

**I walked a large area of the city to note the complete absence of any reasonable budget for systematic maintenance of the highway surface water system. I noted a client specification of 75,000 road gulleys to be emptied twice a year by the in-house direct labour organisation. This was unsurprisingly way beyond the capabilities of a single gulley emptier with a one-man crew even on a 55 hour week.**

**As a result, a large number of full depth highway gully pots had so much sediment that established vegetation was literally growing out from them. The many water courses I walked were filled in with dumped material to the extent that over many years very large trees had established themselves in some of them.**

**I noted that an emergency plan had purchased and stored 5,000 sand bags. This was not of much use if there was no sand or machinery available or a plan on how to fill them. I understood that their only use in 2007 could have been in the mopping up operations.**

**I supplied three comprehensive reports including a service profile totalling 75 pages. My final report had 25 detailed recommendations.**

**Although neither I personally nor the London-based recruitment agency which had employed me received any adverse comment or reaction to these reports, my initial very short-term introductory contract was not (as promised) extended.**

**Ah – history.**

Roger Khanna (M), rogerkhanna@gmail.com

difference in the successful management of private house building compared with public infrastructure is due to some innate incentive in the former as in "it is my money" rather than someone else's in the latter is simplistic in the extreme.

To give a little balance. I too have similar experience to Marsh over perhaps a longer period both as employee and as a self-employed consultant on several of the largest and most complex major infrastructure projects in the UK, including High Speed 1 and Crossrail. In my experience, the notion that those employed on these projects, be they direct employees or consultants, behave in the way he suggests is just not true and very insulting to those it addresses.

There is much research into delivering international megaprojects which highlights, and to some extent explains, the multitude of complex interfaces within them and why they are so difficult to control. Unfortunately, the research shows that nearly all fail to meet programme and budget to some extent, often to an alarming extent. In the league table of these projects, Crossrail is below the norm, as it stands, and is certainly unexceptional. Unfortunately, the way the almost inevitable delays and overspending were communicated and managed could, I think, have been better handled.

**Michael Robinson (M Ret), mrpar@btinternet.com**

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# Future of Water

As the impact of climate change puts increasing pressure on water supply and quality, this issue looks at sustainable solutions that could provide blueprints for future projects

# CONFLICTING PRIORITIES

Ministers have urged water companies to make environmental performance a top priority. But how can engineers help them achieve this? **Nadine Buddoo** reports.

Despite a period of significant challenges, water companies are being encouraged to use the Covid-19 pandemic as a springboard to improve their environmental performance.

But can the government's push for what it terms a "green economic recovery" from the coronavirus crisis provide an opportunity to ramp up delivery of the infrastructure projects and network upgrades that will support better environmental performance?

In September, environment minister Rebecca Pow acknowledged that the water industry had coped well under increased pressure during lockdown. But she made it clear that stronger action on environmental priorities is needed, especially with regard to storm overflows, chalk streams, water resources and leakage.

"Water companies need to take their environmental obligations seriously and this impetus must come from the top," Pow said. "Despite investment from the industry, the damage inflicted on our environment – our rivers, lakes, streams and the wildlife that rely on them – is still far too great.

**KEY FACTS**

**£800M**
**Amount earmarked by Anglian Water for environmental improvements in the next five years**

**20%**
**Anglian Water's pollution reduction for 2020**

"This country's green recovery from coronavirus can only happen if water companies step up and play their part."

Pow, representatives from Ofwat, the Environment Agency, Natural England, Water UK, the Consumer Council for Water and the Drinking Water Inspectorate, met with the chief executives of 15 water companies on 8 September to discuss what can be done to better protect the environment and safeguard the UK's water supply.

Speaking after the meeting, Environment Agency executive director of environment and business Harvey Bradshaw said: "Our water environment is precious and under huge and increasing pressure from a growing population and the climate emergency.

> **"This country's green recovery from coronavirus can only happen if water companies step up and play their part**

"Our environmental targets are ambitious and we are challenging water companies to go faster and further on environment, leakage and protecting supplies. Water companies have a key role to safeguard our water environment and we will regulate them as a modern regulator should; rewarding excellence and sanctioning behaviour that harms the environment. In this way, we will be working with them to drive up standards, including through our new taskforce on storm overflows.

"Everybody shares a crucial responsibility to protect the environment for future generations, and we will continue to work with all parties to deliver much-needed

Water companies are under pressure to improve the water environment

improvements."

On 2 October, the Environment Agency released its annual report on the environmental performance of England's water and sewerage companies in 2019. The report shows that four out of the nine companies are falling short of expected standards.

Each company is rated from one star (poor) to four star (industry leading), based on a range of measures including serious pollution incidents, pollution per kilometre of sewer pipes, and compliance with permits.

Anglian Water received a two star rating, meaning the company's environmental performance requires improvement.

Responding to the report, an Anglian Water spokesperson said the company was disappointed by the rating, but it has already implemented strategies which have already reduced pollution by 20% this year.

"We take every incident extremely seriously, and we have one goal – zero pollutions. We will innovate, collaborate and invest until we get there," the spokesperson added.

Despite the challenging performance review, Anglian Water head of environmental quality Lucinda Gilfoyle says the company is taking a firm stance on driving down leakage and maintaining its zero carbon commitments.

"We are fully committed to the government's green recovery approach and will play our part to make sure we deliver projects and initiatives that support this. We also have our own high quality standards to maintain and new metrics in the Environment Agency's Environmental Performance Assessment to meet so we are already focused on how we are going to deliver those moving forward," Gilfoyle says.

> **"We are challenging water companies to go faster and further on environment, leakage and protecting supplies**

"Our telemetry system that monitors our water and sewerage networks, our treatment works, and pumping stations enables us to keep a close eye on what our assets are doing but we are always keen to build on this."

The company is focused on the provision of additional monitoring to supplement its existing telemetry. The aim is to better understand whether assets are producing an adverse environmental impact, providing evidence that will shape investment priorities.

"We are also interested in working with in-catchment solutions and those that give us biodiversity net gain," Gilfoyle adds. "For example, solutions such as our ground-breaking Ingoldisthorpe wetland, in Norfolk, helps us treat final effluent but also support biodiversity simultaneously, or working with farmers and communities to prevent pollution at its source (*see box*)."

While the company has committed to investing more than £800M over the next five years to improve the environment, Gilfoyle welcomes more innovation from engineers and the wider supply chain that can deliver not just against quality standards but also provide wider benefits, such as biodiversity net gain or help to address issues at source.

It is this kind of innovative thinking that University of Reading professor of hydrology Hannah Cloke believes water companies and engineers alike must adopt in order to cope with the

> **Traditional methods of floodwater storage, like big concrete tanks, are not as effective as diverting water into the landscape**

demands of climate change.

"We're looking at a climate emergency. The climate is changing – as it gets hotter, heavy rain is more likely. We're going to see differences in rainfall patterns, and we've got increasing urbanisation which is increasing pressure on housing and infrastructure," Cloke explains.

"These are problems that are just going to get worse, so we need to change the way we're doing things.

"There's been a big push from the industry around issues such as leakages, for example, which is great. That's exactly the right thing to do but we have to go faster. We've got seriously ageing infrastructure – we've just got to go faster."

But the water industry should not just be concerned about ageing assets. Cloke believes some new infrastructure projects fail to focus on long term sustainability.

"I'm a big enthusiast of working with natural processes and using our natural landscapes to the best of our ability. Soil, for example, holds water well, so if we look after our soil it can help to alleviate flooding. It can also ensure that water is going down into the deep groundwater stores so that we can sustain chalk streams over periods where we do get less rainfall," she says.

"The landscape functions quite well until we start to interfere with it. Some of that is around urbanisation and making water runoff from our cities flow into the combined sewers quickly. Traditional methods of flood water storage, like big concrete tanks, are not as effective as diverting water into the landscape."

A more holistic approach to flooding, drought and water quality is needed, but that requires more joined-up thinking from all stakeholders, not least the engineers tasked with upgrading and maintaining water infrastructure.

"We have to think about everything holistically," adds Cloke. "We have to understand that whatever changes we make in one area, it will have an impact elsewhere. If we make a change in our headwater, it will have an impact further downstream. If we change our cities, it will change the runoff that goes into our rivers. It's all connected. The landscape is linked, but I worry that siloed decisions are made without really understanding that everything is connected." N

## CASE STUDY: RIVER INGOL WETLAND

**Anglian Water has delivered its first wetland treatment site, on the River Ingol – a spring-fed chalk stream – in west Norfolk. The company believes that the project's success will provide a blueprint for the delivery of dozens of similar sites across its network.**

The wetland treatment site at Ingoldisthorpe is described as the first of its kind in England and has been created in partnership with the Norfolk River Trust. The site works as a natural treatment plant for millions of litres of water each day.

The wetlands – formed by four interlinking shallow pools – are planted with approximately 25,000 native plants. The plants help to purify the water, filtering and sequestering nutrients.

Creating the four pools involved a major earthworks project, requiring a significant level of excavation from within the proposed areas where the pools were being built.

GPS technology was used to cut the pools to the required levels and allow the correct rate of water flow. The edges of each pool include gradually sloping banks, with significant variations in the alignment to produce an ideal wildlife habitat.

The final phase of the project involved installing a new feed to pipe the water supply from Anglian Water's recycling plant into the new River Ingol wetland.

Used but treated water is released into the river after it has filtered through the pools, significantly improving water quality in the river and helping to preserve the habitat for wildlife. Aside from its water filtration purpose, the wetland is also a biodiversity asset which attracts breeding birds, amphibians, bats and water voles.

Anglian Water is monitoring the wetland to see if it removes nutrients such as nitrates and other substances such as metals and microplastics, in addition to removing ammonia and phosphates.

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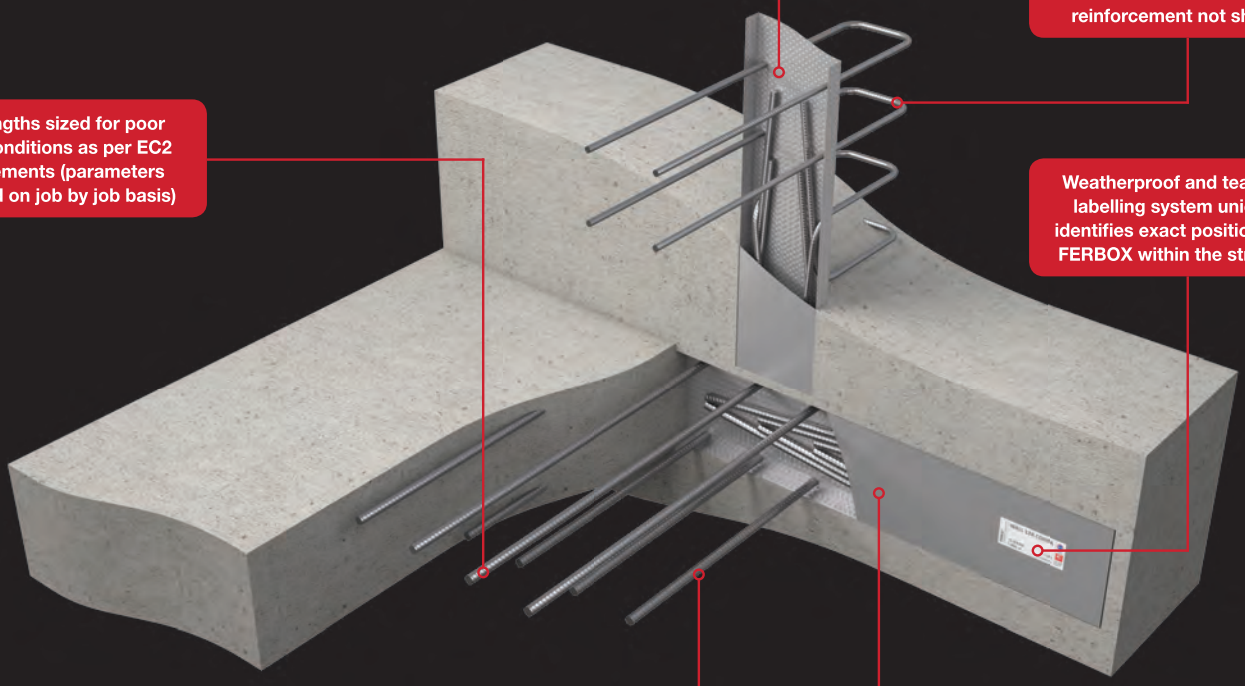


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# PROTECT AND SUPPLY

As the upgrade of Glenmore Dam draws to a close, **Nadine Buddoo** explores how the Canadian structure has evolved to help reduce flood risk, while increasing its water supply capacity.

## Future of Water

Canada's Glenmore Reservoir has become an important landmark in the city of Calgary, providing clean water, flood mitigation and a recreational setting for locals. The 3.8km² reservoir is formed by a concrete dam, which has been the focus of a C$81M (£46M) improvement project.

Approximately 320m long, Glenmore Dam is located on the Elbow River in south west Calgary. The structure was originally built in 1933 to supply drinking water and enable the city to cater for future population growth.

More than 85 years after the dam's construction, the city's population has increased by almost 1,500% to over 1.2M, significantly increasing water demand. But as well as the need to future proof the water supply, Calgary has also had a series of significant floods – in 1996, 2005 and 2013.

These have brought flood mitigation sharply into focus and led to the recent upgrade project which has the joint aim of increasing water storage capacity and improving flood mitigation capability.

The dam incorporates a bridge which runs along its crest providing a pedestrian and cycle route, and previously carried water and gas mains.

The work has focused on the stoplogs – flood gates – which are incorporated into the bridge structure. They can be raised or lowered to regulate water flows.

The original timber stoplogs were positioned below the dam's concrete crest and would be raised to slow water flow.

The refurbishment programme involves replacing the 28 original stoplogs with new steel ones which are taller. The new gates are 2.5m high

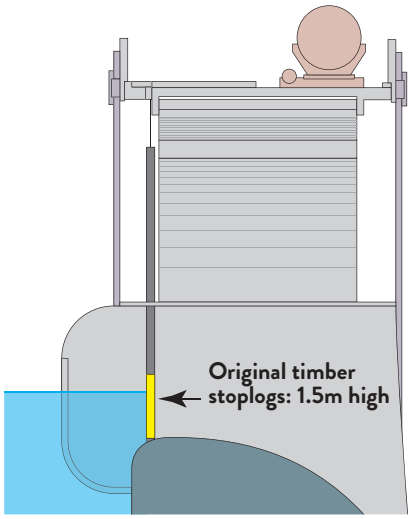
**KEY FACTS**

**£46M**
**Cost of Glenmore Dam refurb**

**320m**
**Length of Glenmore Dam**

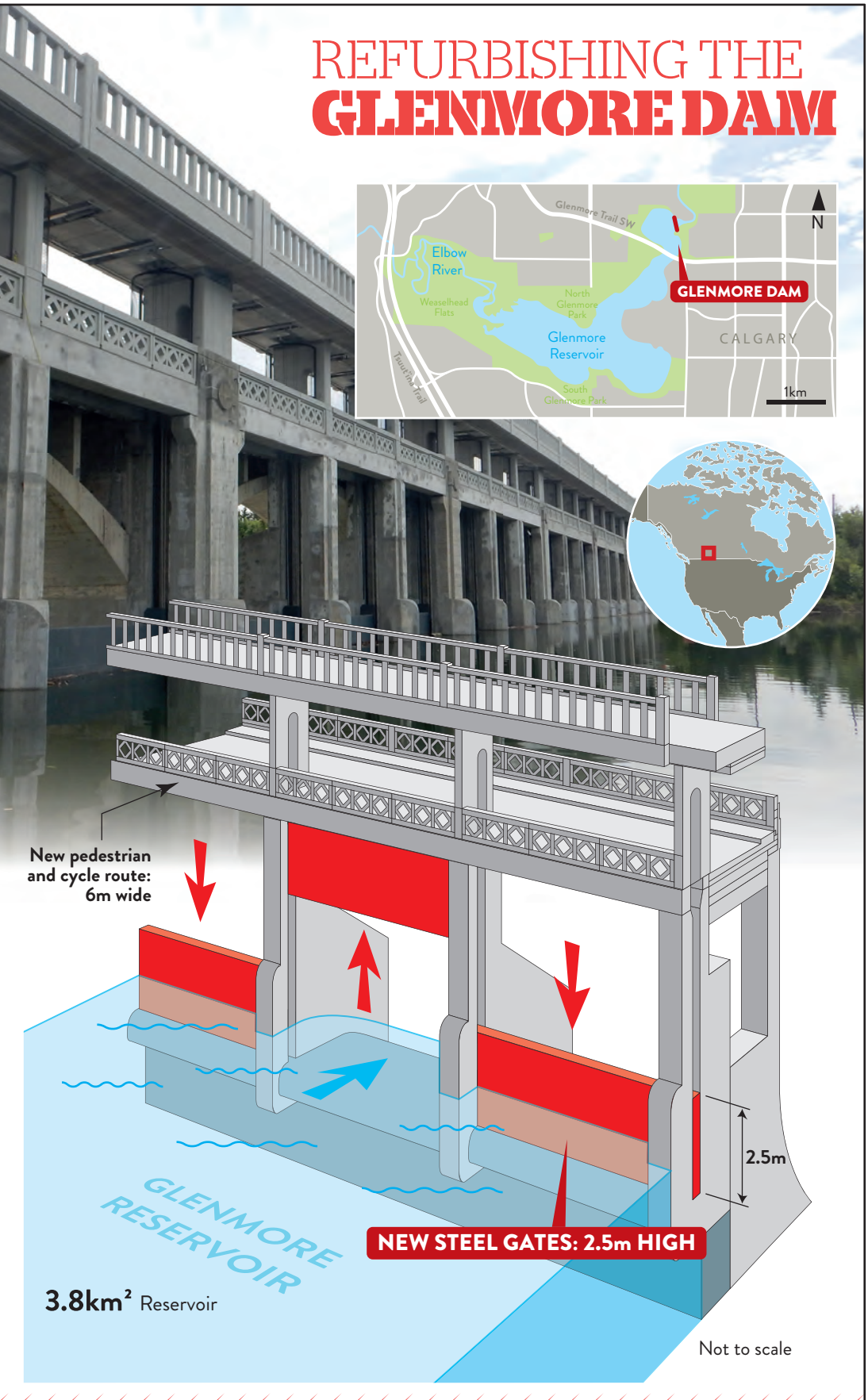
> **"The flood event in 2013 made us think about how we could get more out of the dam in terms of flood mitigation**

The dam with new stoplogs in position




ORIGINAL TIMBER GATES

# REFURBISHING THE GLENMORE DAM




**“The flashy nature of the geography doesn’t give you a lot of time before there’s runoff in the city**

– 1m taller than their predecessors. They are positioned above the crest and lowered to slow water flow.

City of Calgary project engineer Patrick Mackie has been involved with the upgrade project since 2011 when the design phase started. He explains that the 2013 flood impacted the direction of the project.

“It steered us in a slightly different mode,” he says. “The flood caused a lot of damage to critical infrastructure throughout the city. It focused everyone on the issue of flood mitigation.”

Downtown Calgary, north east of the dam, is the bustling retail and business heart of the city. Businesses and recreational venues in the area were severely affected by the flood, as were residential properties close to the river.

“Up to that point, the Glenmore Dam project was about water resilience,” says Mackie.

“The dam was initially built to retain water, so it always inherently had a bit of flood mitigation capability, but it was never built as such. The flood event in 2013 made us think about how we could get more out of the dam in terms of flood mitigation.”

As well as being on the Elbow River, the dam is bordered by the foothills of the Rocky Mountains to the west. After significant snow melt or a period of heavy rainfall – like that experienced in 2013 – it can take just 48 hours for water runoff to reach the city.

“The flashy nature of the geography doesn’t give you a lot of time before there’s runoff in the city,” says Mackie.

“In 2013, we experienced a fairly normal year for snow melt, but a significant rain event stalled over the mountains and dumped a huge amount of rainwater. Soon after, that water hit the river and then impacted the city.”

The City of Calgary appointed consultant Klohn Crippen Berger (KCB) to help design a solution that would meet all of the requirements associated with increasing water supply capacity and reducing flood risk, while respecting the architectural

> **Relocating the utilities has allowed us to free up the deck, so there are no services running across it**

heritage of the Depression era structure.

Construction to deliver the upgrade started in September 2017. The work is expected to extend the lifespan of the dam by 100 years. Minor clean-up work is still underway but the team expects everything to be completed within the next few weeks.

Initially, the upgrade design specified 1.5m high gates but this was increased to 2.5m as a means of boosting the reservoir's capacity and providing additional protection against runoff.

During normal operations, the reservoir's water level can be brought to 1.5m above the crest, which is the provincially regulated level. "We can't go any higher than that level. But the gates now allow us to keep the water at that 1.5m level for a longer duration through the year," Mackie says.

From May to July, the reservoir's water level is typically lowered in case of flooding. Then, in September to October when the river inflow is approaching its minimum level, but water demand remains high, the reservoir captures as much water as possible.

The new gates mean this water level can be maintained through the winter months. The steel barriers have also been designed to withstand the significant ice loading that can occur during winter, where sustained temperatures of -30°C are common.

"The [water level in the] reservoir isn't going to be any higher, per se. It's just going to be at its maximum level for longer periods," Mackie explains.

The new gates, along with the installation of a new independent hoist system above deck level to raise and lower the barrier, mean that high flow events can be better managed and the reservoir's storage capacity has increased by 10M.m$^3$.

The dam was originally built in the 1930s

KCB senior civil engineer Andrew Brunsdon says that retrofitting the structure posed some of the biggest challenges across the project.

"The as-built information is pretty sparse," he says. "Nothing is linear on the existing structure – a lot of the issues aren't evident until you peel the lid off."

Before work to install the new gates could begin, the team had to relocate the water and gas mains that ran along the bridge deck.

"That was quite a challenge. The solution was to tunnel beneath the Elbow River just in front of the dam," says Brunsdon. The tunnel would then house the relocated utility pipelines.

While Flatiron Contractors Canada was appointed for the main works programme, contractor Ward & Burke was brought in to relocate all the utilities through a 3m diameter tunnel beneath the river.

"It sounds simple, but it wasn't," says Brunsdon. "Relocating the utilities has allowed us to free up the deck, so there are no services running across it."

The 6m wide concrete bridge deck which runs above the crest of the dam has also been replaced. The relocation of the utilities means that the full width of the deck can now be used to improve access for cyclists and pedestrians.

"It's very rare to have public access on a dam," says Brunsdon.

"To have the public in and around industrial equipment is a real challenge.

"That's something Klohn and the City of Calgary have worked hard on – ensuring that it's a safe environment that functions as a dam but is also a wonderful public space."

Mackie admits that the team toyed with the idea of closing the bridge, but there were concerns that a complete closure would be a contentious decision as it forms part of a city-wide regional pathway network, providing a vital link between downtown Calgary and the south west of the city.

Despite the potential disruption associated with any major construction programme of this scale, Mackie says the project has been generally well received. "We don't get a lot of public pushback because obviously drinking water is so important and flood mitigation is also on the radar," he says.

"At the end of the day, when you commit to boosting the drinking water supply and protecting the city from some degree of flood damage, people are pretty open and accepting of that. There might be some short-term inconvenience, but there is overall long-term gain for everybody."

Following the extensive upgrade, the pathway across the deck was reopened to the public in September. Conclusion of the main works on site has given the team an opportunity to reflect on the delivery of the project.

With winter fast approaching, the upgraded dam will surely be put to the test. But Mackie acknowledges that the reservoir and dam were primarily constructed for water supply – not flood mitigation.

Analysis has shown that the new gates could potentially mitigate the effect of the 2005 flood, and while the barrier would also provide some protection against the level of flooding seen in 2013, it would not be capable of mitigating the risk completely.

Mackie adds: "You're never going to get 100% protection from all floods. The structure has its limits." N

# SALINE SOLUTION

A £2.1M scheme to improve the storage and transfer of fresh water is helping Halvergate Marshes adapt to climate change. **Nadine Buddoo** reports.

Halvergate Marshes is an environmentally designated area within the Broads National Park west of Yarmouth in Norfolk. Sprawling across 1,069ha, the land nestles between the Rivers Bure to the north and the Yare to the south. It is the UK's second largest area of grazing marsh.

The site is a freshwater system fed by rainwater and the river. It relies on fresh water being taken from the River Bure to water course known as the high level water carrier (HLC) and then to the marshes via a gravity feed when salinity levels are low.

Water from the River Bure enters the high level water carrier through the Stracey Arms control structure - an automated freshwater inlet located on the river. The existing 7.4km water carrier is located south of the river, feeding water to a drainage network across the marshes.

Building resilience to rising sea levels and low rainfall and creating new habitats and wetlands has been the focus of the recently completed second phase of work.

The scheme involved major earthworks to increase the capacity of the existing high level water carrier watercourse. An additional 4.7km HLC from east to west, was delivered across a three year construction programme which completed in May 2019.

Increasing storage and improving the ability to transfer fresh water across the Halvergate Marches was the key objective for the £2.1M project.

Essentially an internal ditch system, the network at Halvergate Marshes is managed by the Broads Internal Drainage Board, which is part of the Water Management Alliance (WMA). The WMA is a consortium of five drainage boards across Norfolk and Suffolk and provides support through engineers, ecologists and administrative assistance, for example.

> **"There was no major consultant or major contractor involved. It was primarily delivered by our own staff**

**Norfolk's Halvergate Marshes rely on fresh water taken from the River Bure**

The scheme was designed and delivered in-house by the WMA, with support from a small framework of contractors.

"There was no major consultant or major contractor involved. It was primarily delivered by our own staff," says WMA project director Matthew Philpot.

"There's a real danger of client organisations losing a lot of their skills because they don't deliver projects themselves. The WMA really tries to retain those skills in-house so that we have the capability to deliver projects if we need to."

## PROJECT FOCUS

Approximately 8km of clay embankment has been constructed to border the HLC extension and the newly established floodplain wetlands, allowing more water to be retained.

WMA operations engineer Paul George explains that the team has effectively created two water levels – the water stored in the HLC watercourse, and the drainage network across the marshes. Storing water at a higher level allows it to be more efficiently transferred to the drainage

> You've got a freshwater habitat sandwiched between saline tidal watercourses

network via the gravity feed.

"The storage is generally about 500mm higher than the lower drainage system," he says. "That gradient allows us to move water around the marsh network to wherever it's needed."

A total of six aqueducts have also been installed to help maintain low level drainage within the system.

Five new environmental scrapes – shallow depressions which seasonally retain water and are attractive to wildlife – have also been constructed.

As part of the project, two flood plain water meadows have been created across 35ha at the site, in addition 12 water control structures have been installed, including pumping stations.

Collectively, the new features at the site have created an additional 70,000m³ of freshwater storage – a much needed step toward tackling the pressing impact of climate change.

But as well as meeting current demand for freshwater, the project has been designed to anticipate future requirements. "We have slightly oversized culverts and pipes within the system so that if there's ever an option to tie into a larger scheme, for example, then it's relatively simple. The infrastructure is there," says George.

## WATER CHECKS

There are two main sources of fresh water at the site – rain water and the tidal rivers. The existing HLC was completed in 2006. It incorporates salinity probe sensors in the inlet structure to check that water is fresh enough before releasing it into the marsh area.

Salinity levels are dictated by tides pushing upstream and rainfall discharging downstream. But with the dual threat of flood and drought, the existing system did not have the capacity to future proof the site's water supply.


Climate change predictions show that the availability of fresh water will become less reliable due to higher tides and longer periods of drought.

"You've got a freshwater habitat sandwiched between saline tidal watercourses. The issue we have in maintaining this pristine freshwater habitat on such a scale is the fresh water availability," says George.

"With tidal conditions, sea level rise and climate change, there is more saline water heading up these watercourses so we're getting less fresh water coming down to dilute it, especially during the summer period where water scarcity is a real problem at the site.

"We can't get enough water, not only for the site of special scientific interest (SSSI) habitats but also for agricultural purposes like wet fencing and drinking water for cattle."

**The £2.1M project has created 70,000m³ of additional freshwater storage**

Philpot adds: "We've achieved our aim of transporting fresh water when it is available further into the marsh network, further towards the sea where the salinity conditions get worse. The new system also allows us to store more fresh water when it is available."

Based on current climate change forecasts, the project has a 50 year design life. But the team is keen to ensure that it remains proactive, rather than reactive to the water requirements at the site.

"We're looking at a range of other potential projects. It's really important to explore better ways of using the water, better ways of storing it and then maybe connecting into different systems," says Philpot. "There are lots of interesting options on the horizon."

Philpot also believes treating water as a scarce resource and managing it properly is a transferable principle that can and should be applied to other projects.

"With a bit of initiative and solid engineering knowledge, water [drainage] systems can really be fine tuned," he says. "I think other drainage boards and consultancies should see this as an exemplar project." N

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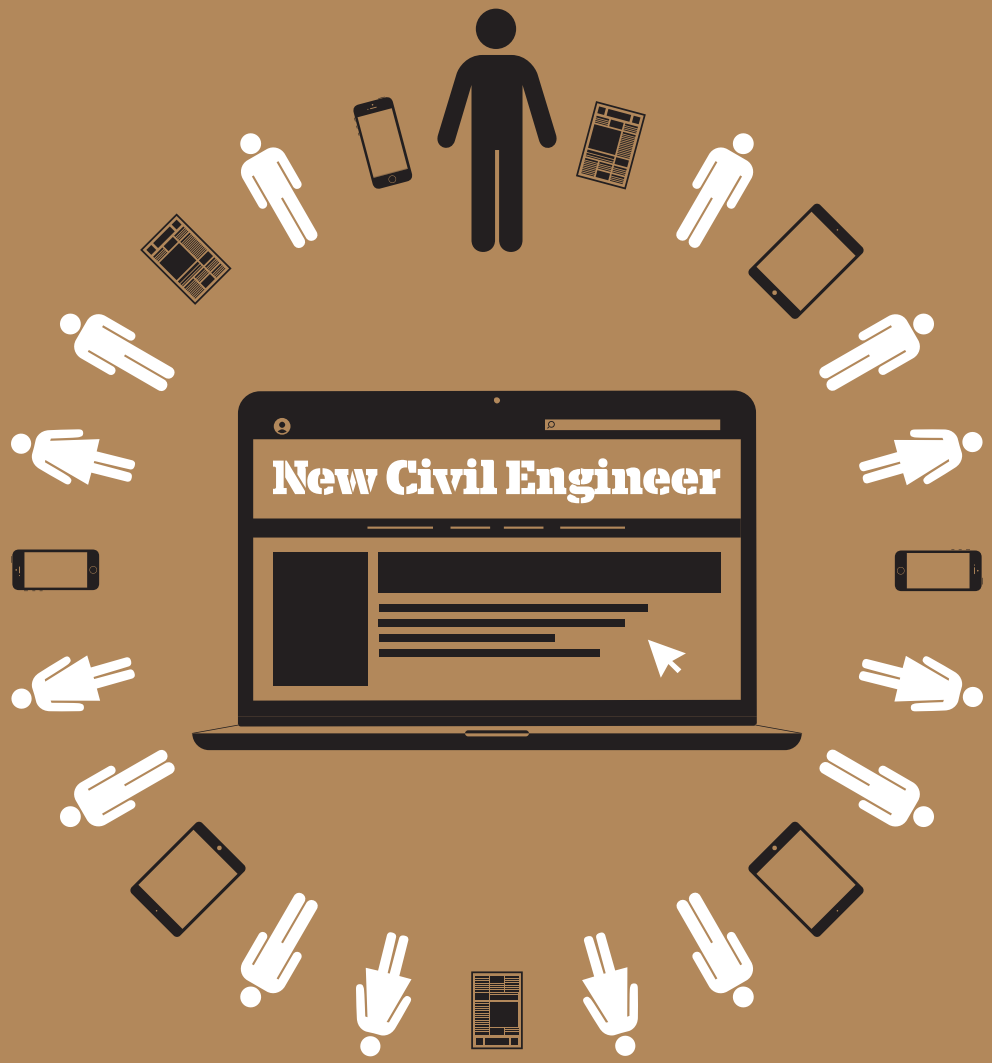


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# Innovative Thinking

NEW DESIGN CONCEPTS, INVENTIVE CONSTRUCTION METHODS AND FRESH IDEAS

Applying fresh thinking and innovative solutions is a common theme when it comes to delivering High Speed 2, tackling Covid-19 restrictions and adopting offsite construction

# GROUND CONTROL

Work on High Speed 2 is ramping up ahead of tunnelling on the first phase of the route. **Greg Pitcher** reports.

When tunnel boring machines (TBMs) *Florence* and *Cecilia* are launched next spring, the 2,000t German-built giants will work relentlessly and largely unseen for three years to create the UK's longest transport tunnel.

Named after local nursing and astronomy legends Florence Nightingale and Cecilia Payne-Gaposchkin, the Herrenknecht TBMs will create 16km of twin-bore passageway under Buckinghamshire's Chiltern Hills for High Speed 2 (HS2).

And like their namesakes, the bespoke machines will display elements of innovation working in challenging conditions.

Due to the length of the tunnel and the amount of time they will be underground, a huge amount of design effort has gone into making the TBMs as efficient and reliable as possible.

For a start, it will be the first time variable density TBMs have been used in the UK. This technology allows the machines to adapt to different ground conditions.

"There are two main types of conventional closed-faced tunnelling machine – slurry shield and earth pressure balance," explains James Reilly, TBM engineer at contracting consortium Align, which is responsible for the Chiltern Tunnel project as part of a £1.6bn package of works on phase one of HS2.

**KEY FACT**

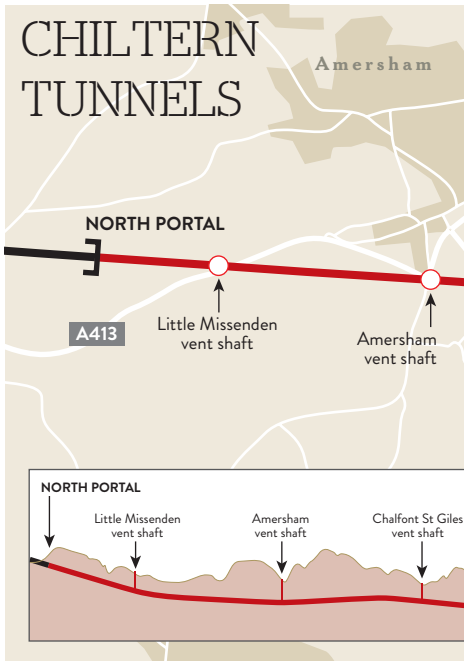
**2,000t**
**Weight of each TBM**

"Given the constraints we have – such as an aquifer underneath the tunnel and not being able to use certain chemicals – we are to use a variable density TBM, which uses both slurry and pressure balance technology."

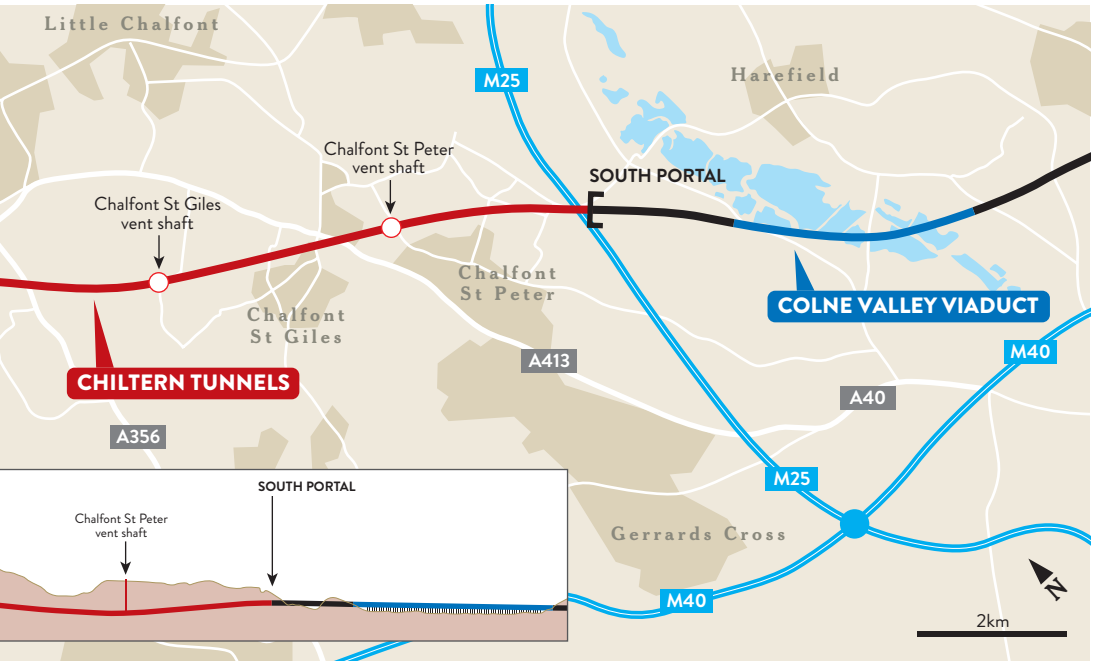
Align comprises Bouygues Travaux Publics, Sir Robert McAlpine and VolkerFitzpatrick. It has thought beyond normal constraints to maximise the efficiency of the TBMs.

"We have changed the design," says Reilly. "For example, grout used to

> **"We will have a grout plant on the TBM itself. This means we will not rely as much on logistics on the outside**



Levelling the sprawling, hilly and chalky South Portal site is a main focus of work in preparation for the TBMs' arrival




**"We have targets to meet so we cracked on with the plans as the Oakervee Review happened. We could not afford to pause**

fill the gaps between segments of the tunnel wall would usually be pumped to the TBM or brought on vehicles to the machine, but given the length of the tunnel this was not practical – so we will have a grout plant on the TBM itself. This means we will not rely as much on logistics on the outside."

The boring machines also feature robotic arms that will automatically screw in dowels to join concrete lining segments together as well as removing timber planks that separate these segments while they are transported.

"It removes a person from a hazardous area," says Reilly. "We've done a lot of development with the supplier to put the correct equipment on the TBM."

The TBMs will operate in a "continuous boring" mode that hasn't been used on site before.

"Usually you would excavate, stop, install a ring, continue excavating," says Reilly. "We are doing a form of continuous boring where segments can be installed as the TBM excavates. Align has been working very closely with its supplier to make sure it is working; we've had to change the interface with the cabin, the hardware, the programming and logic to make the system work."

*Florence* and *Cecilia* will arrive on site in parts this autumn and the team will undertake a six month building phase before launching them next spring. But before the machines' epic journey can begin, a similar effort has already been required from the engineering team preparing the ground along the tunnel alignment.

The consortium took over the South Portal site – which has its own access slip road between junctions 17 and 18 of the M25 – in September 2019 to prepare for tunnelling as well as construction of the 3km long Colne Valley Viaduct.

Levelling this sprawling, hilly, chalky site and ensuring everything is ready for *Florence* and *Cecilia* has required an unblinking focus,

**“When you launch a TBM forward, you have to bury the whole of the cutting head straight away, so you need vertical ground to press into**

especially in the face of a government-ordered Oakervee review of the entire HS2 project, closely followed by a global pandemic.

“The tunnel is on the critical path of phase one of HS2,” says Align construction director David Whiteford. “The decision was taken last year to order the TBMs.

“We have targets to meet so we cracked on with the plans as the Oakervee Review happened. We could not afford to pause as we are working to a tight plan that includes procuring buildings and processes.

The team is moving in the region of 850,000m$^3$ of chalky earth to create the right conditions to build a raft of construction facilities and to build and launch the TBMs.

Align South Portal construction director Mick O’Hare says the high water content of chalk means it can become unworkable after heavy rain.

“A big challenge was that chalk has an extremely high water content – up to 33% – so any more water makes it unworkable. We were therefore unable to move a lot of the material through the winter. We started at the beginning of April and we’ve done about 500,000m$^3$ over the summer.”

As the groundworks are delivered, the construction aspects of the project can begin. One major structure that the consortium has already created is a 17m high headwall for the boring machines to break through when they are launched. “When you launch a TBM forward, you have to bury the whole of the cutting head straight away, so you need vertical ground to press into,” says O’Hare.

Almost 700 reinforced polymer soil nails, each up to 20m long, were driven into the wall to stabilise it. A specialised rotary drill took up to two hours to create each bore hole before each nail could be installed.

“Building and nailing the headwall took seven months, starting in December 2019 and completing this June,” adds O’Hare.

All the precasting for this section of HS2 will be done on facilities that Align is purpose building on site.

“We’re creating three batching plants to produce all the concrete,” says Whiteford. “There will be tunnel segment and viaduct deck precast facilities.

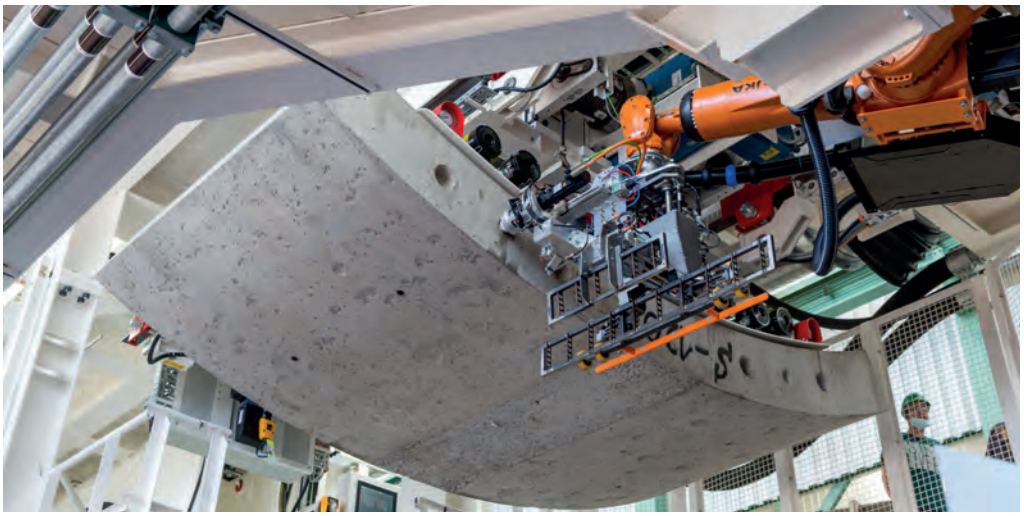
“We will also be processing 3M.m$^3$ of arisings from the tunnel and placing them into the recently quarried landscape. Water has to be added to the chalk at the face of the tunnel to slurrify it, then it can be pumped down the tunnel and we immediately squeeze the water out. The slurry treatment plant is a process in its own right. We have a facility to reuse as much of the water as possible.”

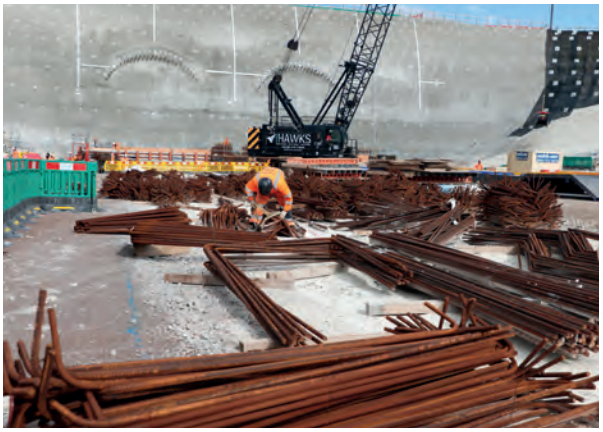
Digging the tunnel approach cutting and creating the reinforced concrete launch slab for the TBMs is another major project.

“It is a technically challenging reinforced concrete structure,” he says. “It’s only an 18m section and has 207t of steel due to the weight and thrust that will go through it when we launch.”

Designing the slab took 18 months of close collaboration between the Align team and its design joint venture Jacobs and Ingerop-Rendel. It is described by Whiteford as among the largest co-ordinations of permanent and temporary works he’s ever worked on.

As this issue of *NCE* went to press, work to build the launch slab was well underway ahead of the arrival of the TBM components. N







Top: A robotic arm will be used to position tunnel lining segments Bottom left: Work is underway to prepare for tunnelling to begin at HS2’s South Portal site Bottom right: TBM Florence is due to arrive on site in the autumn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# HEAT SPOTS

Thermal imaging could be rolled out further in response to the coronavirus pandemic. **Catherine Kennedy** reports.

At the beginning of this year, it would have been difficult to imagine a scenario in which London Underground and rail services operated at 4% capacity and airports saw 90% of flights grounded.

And yet here we are.

As this issue went to press, the UK was facing a growing list of local and regional lockdown measures imposed in response to rising Covid-19 infection rates. Indications that the virus will be present for some time mean attention is being focused on how to enable public life to remain functional.

Thermal imaging cameras for temperature readings – deployed across public spaces – could be part of the solution, according to Costain chief systems engineer Hazel Woodcock.

Costain has trialled and installed thermal imaging technology for several aviation sector clients – airports and airlines – for their passengers and cabin crew. The whole process from initial enquiry to installation now takes around three to four weeks.

A three-week trial with Swissport Western Europe at Birmingham International Airport, for example, involved positioning a thermal camera at a boarding gate.

This was used to pinpoint passenger temperatures, with the technology displaying elevated temperature readings on a monitor screen..

It is an approach, Woodcock says, that can be effectively used alongside other measures to make air passengers more comfortable and improve safety.

**KEY FACT**

**500mm to 1m**
**Range of site cameras used by Costain**

## CAMERAS

The cameras take thermal and visible light pictures – essentially two lenses are built into their bodies.

Costain proposition lead for elevated body temperature Rob Middleton explains: "The visible light camera is looking for where to measure – not face recognition but face identification – then that is directing the camera software as to which pixels on the thermal image correspond to the face."

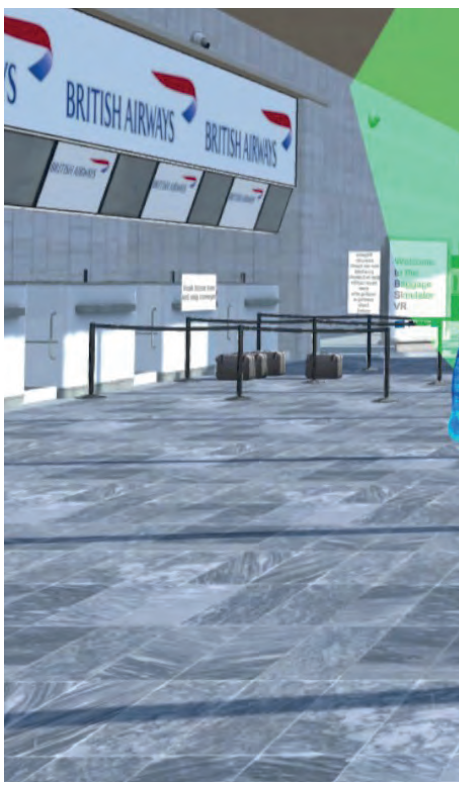
> **"For each pixel on the sensor, you can extract a temperature reading**

The best indicator of core body temperature generally comes from around the eyes, so the thermal imaging software focuses on this area.

"That's how you're looking specifically at people and not just going, 'oh there's somebody at 70°C over there' and it's just somebody holding a cup of coffee," Middleton adds. "For each pixel on the sensor, you can extract a temperature reading."

When it comes to locating the cameras, there is a range of options. As with the Birmingham Airport trial, they can be stationed at boarding gates to help provide confirmation that individual flights are clean. Equally, checks can be done as people move through an airport at established points, as the cameras can monitor multiple individuals up to 5m away at any one time.

If a high temperature is detected, rescreening is possible – false readings can be caused by warm weather or physical exertion– while in other cases a more robust medical examination may be necessary.



## CONSTRUCTION SITES

Costain has also deployed cameras across some project sites and offices. Lower specification cameras – used for one person at a time – are suitable in this context.

"Cameras we've installed at the airports are optimised for 2m to 5m working range," Middleton says.

"One of our site cameras is for a single person and it's got a range of 500mm to 1m so you basically stand right in front of it."

Similarly, contractor Bouygues UK has deployed thermal imaging cameras at 60% of its offices and on most projects.

Working with technology and software company Biosite – which also manages the firm's door entry systems and turnstiles – Bouygues trialled the technology at its 800-person Mount Pleasant site, a residential project in central London.

The technology became a minimum standard for Bouygues projects at the beginning of April and the contractor is in the process of rolling out the cameras to remaining sites.

"Within three weeks Biosite had gone from understanding what we were after to trialling an offering on one of our projects," says Bouygues UK HSQE director Dean Murphy.

After an electronic induction and initial registration on the system, those entering sites queue, while adhering to social distancing guidelines, then stand in front of the camera for a heat detection scan.

The site entry door opens automatically if a temperature reading is normal.

If someone has a high temperature, the door will not open and the monitor screen will go red. As experienced by Costain, false positives have occurred where people have cycled to the site, for example. In these cases, there is a cooling down area.

Once a person has cooled down, screening is repeated and if the high temperature persists access to the project is denied.

"We've found it takes less time to do that than having somebody with a thermometer," Murphy says.

"It's also more efficient because you're not paying for a person to do the tests – and we are reducing the risk for an individual manually taking temperatures. So, it's more efficient both in terms of process and business case."

Masks are also mandatory on Bouygues sites. "Initially the feedback was that 100% masks and thermal imaging is a bit draconian," Murphy says. "But after four to six weeks, the supply chain feedback was: 'we feel safer on your projects'."

Thermal imaging can detect potential Covid-19 carriers as they move around airports

> **"We can detect somebody with an elevated temperature and you just need imagination to work out where that's useful**

## WIDER ROLLOUT

Opportunities for a wider rollout of thermal imaging technology are "broad and varied", according to Woodcock.

"Beyond Covid, we can look at detecting people with seasonal flu or with the next thing that comes along. Anywhere you've got a high level of pedestrian traffic, you can see people going through so it would suit other transport methods."

The technology could also be used at hospital entrances, nursing homes, offices, shopping centres and sports venues.

"I could get really excited about the potential applications – it doesn't need to be constrained to Covid and airports," says Woodcock.

"We can detect somebody with an elevated temperature and you just need imagination to work out where that's useful."

Murphy also sees scope for the technology's deployment in public areas. But he adds that once rail and underground use rises again the numbers may make using it in those contexts challenging.

At the same time, he emphasises the importance of embracing new approaches.

"It's got to become the new norm until we get a vaccine. We've got to be more innovative with new solutions. It's a mindset thing," he says.

# TURNING POINTS

Schaeffler bearings have played a vital role in key civil engineering projects.

By using its expertise and experience as early as possible in the design stages of building and civil engineering projects, Schaeffler can help architects, structural engineers and main contractors to select the most suitable, cost effective bearing solution.

For large structures such as commercial buildings, bridges, dams, flood gates, sports stadiums and airports, the design of the supporting bearings is critical.

The surrounding structure can greatly influence the behaviour of the bearing and so it is important that the selection of the bearing is correct.

In the UK, Schaeffler has been involved in a number of prestigious building projects, including the London Eye, Wembley Stadium, the Lloyds of London Building, Wimbledon Centre Court's retractable roof and Tottenham Hotspur's new stadium. In all these cases, early involvement from Schaeffler was fundamental in ensuring that the correct bearing solution was selected.

## KEY STATS

**600mm**
**Outside diameter of London Eye bearings**

**194kg**
**Weight of London Eye bearings**

**50+ years**
**London Eye bearings' life expectancy**

### WHY IS EARLY INVOLVEMENT SO IMPORTANT?

Schaeffler UK technology centre manager Sally Sillis comments: "When sourcing bearings, various bearing design criteria need to be considered, including operational safety, load ratings, the life rating of the bearing and the lifecycle cost of the bearing, which includes maintenance and servicing costs.

"As a bearings supplier, we can use our expertise and experience to help select the most appropriate, cost effective bearing solution.

"When we are involved early in the design process, we can provide trusted advice, guidance and engineering support from our experienced application engineers. This can save significant time and costs for the contractor in terms of redesign or modification work later on, but it should also result in a more cost effective overall design of a building or structure," adds Sillis.

Many designers and main contractors will want a "fit-and-forget" bearing solution – one that is maintenance-free and guaranteed to last for the lifetime of the structure. Special coatings, materials or sealing arrangements can be provided to upgrade the bearing solution to one that will be fit for purpose for the expected lifetime of the project.

While this may mean higher initial costs, designers often follow this type of advice from the bearing supplier, particularly if the technical upgrade is justified and assures a longer bearing life.

The building or structure may also require the bearing to fulfil "special" duties. It may, for example, need to support several hundred tonnes in weight or withstand a harsh operating environment such as freezing temperatures, extreme heat, high humidity or high winds. In certain applications, the bearings may also need to be earthquake-proof.

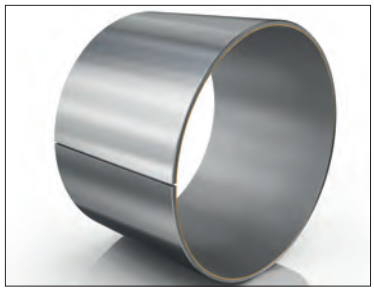
Sillis points out: "If the architect or main contractor specifies a bearing themselves, they tend to consider only the maximum loads and movements


**“When we are involved early in the design process, we can provide trusted advice, guidance and engineering support**

**For bridges, dams and floodgates, architects and structural engineers require a maintenance-free bearing solution that is guaranteed to last the lifetime of the structure**

on the bearing, which unfortunately does not provide a full picture of the application and invariably will lead to incorrect bearing selection, over-engineering or under-engineering.”

Sillis says that an experienced bearing supplier would also consider the minimum loads and movements on the bearing, as well as the type of movement and the available operating envelope. This is because if, for example, a bearing is heavily loaded but well within its load carrying capacity, that bearing may suffer from “stick-slip” – a spontaneous juddering motion that occurs when two surfaces within a bearing slide over each other, often causing loud grinding noises, which in most civil engineering projects would be unacceptable. This condition can be avoided by selecting the appropriate type and size of bearing and/or by applying special low friction coatings to bearing components and surfaces.



## BEARING TYPES AND EXAMPLES

The bearings themselves – which might be spherical plain bearings, cylindrical bushings, rod ends, or combination bearings – should be maintenance-free if possible. A ferris wheel or swing bridge, for example, will have little time to set aside for maintenance work to be carried out.

Schaeffler offers a comprehensive range of maintenance-free plain bearings. Innovative plain bearing materials are used, such as Elgoglide, Elgotex, and the metal-polymer composite E40. These PTFE-based plain bearing materials enable ultra-low coefficients of friction for spherical plain bearings and rod ends, while ensuring low wear and very long lifecycles. Maintenance-free plain bearings considerably reduce lubricant and maintenance costs as they do not require oil or grease, while also being environmentally friendly.

## SPHERICAL PLAIN BEARINGS

With more than 75 years of plain bearing expertise, Schaeffler is a market leader in the design and manufacture of spherical plain bearings. Durable and capable of supporting heavy loads, its bearings ensure reliable operation, even under harsh environmental conditions. The product range is also geared towards maintenance-free operation.

## SPHERICAL PLAIN BEARINGS WITH ELGOGLIDE

Elgoglide is a high performance, maintenance-free sliding material based on Teflon fabric. Suitable for dynamic loads at contact pressures ranging from 1MPa to 300MPa, bearings with this layer are particularly suitable for applications that require minimal friction.

Radial spherical plain bearings comprise inner and outer rings with maintenance-free sliding layers made from Elgoglide, PTFE composite or PTFE-bronze film. This means they are suitable for alternating dynamic loads.

Angular contact spherical plain bearings comprise inner and outer rings with Elgoglide. In addition to radial loads, they can also support high axial loads.

Axial spherical plain bearings comprise shaft locating and housing locating washers with Elgoglide.

## SPHERICAL PLAIN BEARINGS WITH PTFE SLIDING SURFACES

Schaeffler offers various PTFE-based sliding materials for specific applications. These include a PTFE composite material for compact radial spherical plain bearings for small envelopes with bore diameters as small as 6mm.

# EFFICIENT ACCESS

Fast Beam is a low disruption access system which maximises workspace.

VolkerLaser is the exclusive supplier of Fast Beam access technology to the UK market.

Fast Beam is a temporary works solution for bridge parapet repairs and maintenance operations.

VolkerLaser says Fast Beam, which is new to the UK market, is a unique, safe and extremely efficient bridge access system. From straight to curved bridges and platforms, it is designed to maximise working space and minimise traffic disturbance, while site teams undertake parapet repairs, maintenance, or construction.

The system replaces conventional scaffolding methods – reducing cost, time, manpower, and risk. Typically, 50m of Fast Beam can be installed by a five-person team, within an eight-hour shift, compared to traditional systems, which can take up to two weeks to install.

Traffic management can often be reduced to maintain traffic flow, meaning the impact and disruption to the travelling public is significantly minimised, by limiting the need for road closures or diversions. The system can also be used to provide a safe and secure pedestrian walkway or cycleway while bridge repair work is undertaken.

The system can be hydraulically adjusted up and down by up to 1m, either targeting specific individual access platforms, or adjusted as a complete unit. When lifted to the underside of a bridge deck, a water and debris tight seal is created, allowing secure hydro-demolition or concrete breakout works to the parapet to be undertaken.

When lowered, it provides operatives with a safe working platform and access to the underside of the deck edge for repair or maintenance works.


**Main picture: Fast Beam access technology Inset: VolkerLaser conducting the trial on the M5 Oldbury Viaduct**

Fast Beam can also be installed while the existing parapets are in place, making it an ideal solution for rail bridge repair works and highway maintenance.

The system has already been successfully used on a number of Highways England and Transport Scotland projects, with the technology winning an RTB Blue Star award from Highways England during a trial installation on the M5 Oldbury Viaduct.

During the trial, an independent health and safety inspection took place, specifically looking at the innovation initiative being used to replace traditional scaffolding.

As a result, the RTB Blue Star was subsequently awarded for innovation and good practice.

With UK exclusivity, and international agent agreements with Fast Beam in place, VolkerLaser is continually looking to improve and innovate, using building information modelling to fully design and explore the best access solutions via 3D design. This includes developing the system for the new build bridge market.

VolkerLaser claims to be one of the market leaders in the specialist construction sector, and recognises that to remain a specialist, new and innovative methods of work must be implemented. The company believes this innovation will change the way parapet repairs are undertaken across the UK, saving clients' money and reducing programme time.

# Innovation News

NEW INNOVATIONS THAT WILL TRANSFORM YOUR PROJECTS
NEWCIVILENGINEER.COM/INNOVATIVE-THINKING

STRUCTURES

## TOWERS FOR WORLD BEATING SUSPENSION BRIDGE FINISHED

The two 318m high towers for the 1915 Çanakkale suspension bridge in Turkey are now complete. The £1bn bridge, also known as the Çanakkale Strait Bridge, is being constructed in Çanakkale Province, north west Turkey. When complete, the central span will be the world's longest at 2,023m, beating the previous record holder, Japan's Akashi Kaikyo Bridge by 32m. The deck will carry six motorway lanes and two maintenance walkways. Construction started in March 2017 and is due to finish in just over 18 months, opening in March 2022. Designed by Cowi, the bridge is being constructed by a joint venture between Daelim, Limak, SK and Yapı Merkezi.

ROADS

## ARTIFICIAL INTELLIGENCE TOOL TO TACKLE POTHOLE WOES

Artificial intelligence is being deployed in Durham and Gwent to tackle pothole problems. Vehicle-mounted 3D cameras will patrol the streets in both areas, scanning the road surface for defects and reporting them. The technology is developed by GPC and is supported by the GovTech Catalyst funding pot, which encourages innovative solutions to public sector problems. In April, the Department of Transport ring-fenced £23M for councils to trial new pothole repair technologies.

STRUCTURES

## NETWORK RAIL TO DESIGN AND BUILD COMPOSITE BRIDGES

Network Rail plans to build composite footbridges at its stations, working with the National Composites Centre. The "Futura" concept footbridge, conceived and designed by Marks Barfield Architects, is being prototyped to show the benefits of using composites in new build and replacement structures at railway stations. Cowi engineering designer Ian Firth said: "High strength modern composite materials present huge opportunities for a new generation of bridges and structures."

STRUCTURES

## SKY POOL LIFTED INTO PLACE ON NINE ELMS DEVELOPMENT IN LONDON

London's Sky Pool has finally been lifted into place, five years after designs were first unveiled (*NCE* September 2016). The ambitious project is the first fully transparent swimming pool in the world to bridge two buildings 10 storeys up. It was initially due to be completed in 2018. No reason has been given for the delay. The 5m wide pool is 200t when full and spans 14m between two residential towers in the heart of the new American Embassy development in London. Structural engineer is Eckersley O'Callaghan.

# RISK REMOVAL

Modern methods of construction are transforming how buildings are pieced together. Mace's Shaun Tate explains to **Catherine Kennedy**.

With an emphasis on offsite manufacturing, modern methods of construction (MMC) improve efficiency and safety and have the potential to revolutionise the industry.

"We're on the cusp of a massive change," says Mace Tech business unit director Shaun Tate. "I'm more excited now at this point in my career than I ever have been – you can see an opportunity to be part of something that will be a legacy that generations beyond us will see as the norm."

Tate speaks from experience – Mace is using the MMC method High Rise Solutions (HRS) to construct N06, a build to rent scheme at Stratford's East Village in London. This follows the success of the company's "Jumping Factory", the UK's first rising factory which facilitated the construction of retail, leisure and residential development N08, also in Stratford (*NCE* July 2018).

Using parametric modelling tools and artificial intelligence, HRS involves the offsite design and manufacture of a structure and façade sub-assemblies. This includes installing modules concurrently with bathroom pods, utility cupboards and mechanical, electrical and plumbing (MEP) service modules to reduce programme times and improve productivity.

When it comes to safety, the factory approach is a complete cultural shift, Tate says. Fewer people on site reduces safety risks. Working at height is also reduced as cladding, for example, is installed in the factory at ground level.

Meanwhile, the digital platform used means that components can be designed and replicated for future projects.

"You can have all the benefits of offsite – all the quality, the reduced vehicle movements and operatives onsite – but you can have your bespoke design and use the base design for the next building if you want to," Tate adds.

> **"I think innovative delivery solutions are being looked at in a more open-minded way than 12 months ago**

**Tate: Covid-19 has brought an increased focus on off-site manufacturing**

The digital and logistical aspects of construction can also be combined. Tags embedded in the building elements gather data for a digital database but also enable tracking, so the team knows when elements leave the factory, arrive on site and how long they take to install.

During the Covid-19 pandemic, such predictability has become increasingly important. "Moving operations offsite becomes a no-brainer," Tate says. "As dreadful as Covid has been, one thing it has done is force people to think differently. I think innovative delivery solutions are being looked at in a more open-minded way than 12 months ago."

Tate says widespread uptake will require teams to have confidence they can deliver across multiple projects.

"The industry has to be brave enough to take the leap of faith that clients will see the benefits case and start to demand this – not just want it," he adds.

With an increasing interest among clients, Mace Tech is currently looking at how the approach can be rolled out beyond residential , Tate explains: "It's very much a mindset and if you apply the mindset to the solution you're looking to deliver, the benefits are the same." N

ICE AWARDS

# Boston Barrier wins ICE Award for creative design

A project protecting thousands of homes and businesses from tidal flooding won one of the top prizes at this year's ICE Awards.

The Boston Barrier, built by a joint venture between Bam Nuttall, Mott Macdonald and the Environment Agency, was awarded the Edmund Hambly Medal at this year's awards event.

The award recognises creative design of engineering projects that make a substantial contribution to sustainable development.

This year's annual ICE Awards was held online for the first time in the event's history.

The Mangdechhu Hydroelectric Project Authority won the Brunel Medal for its inter-governmental hydroelectric plant project in Bhutan.

Gue See Sew won the International Medal, for his outstanding contribution to the civil engineering industry, including presenting more than 250 lectures on geotechnical engineering in Malaysia.

Shirley Sivakumaran took the Warren Medal, in recognition of her valuable service in Singapore promoting the ICE to young engineers and potential Fellows.

● **A full list of ICE Award winners is at ice.org.uk**

Award winning: Boston Barrier

ICE President Paul Sheffield told MPs that a clear infrastructure strategy is needed

INFRASTRUCTURE

# Engineers tell MPs of need for clear infrastructure strategy

Success of the UK's infrastructure networks will require a clear, long-term strategy set out by the government, senior engineers told the Commons Treasury select committee in September.

ICE President Paul Sheffield appeared before the committee with National Infrastructure Commission (NIC) chair Sir John Armitt, NIC chief executive James Heath and Infrastructure Projects Authority chief executive Nick Smallwood.

They were giving evidence about the government's plans to invest in infrastructure over the remainder of this Parliament as part of the committee's infrastructure inquiry.

They said much of the success of infrastructure over the coming decades depends on the government giving long-term clarity and certainty about its priorities.

This should be set out in the National Infrastructure Strategy, they added.

The strategy, which is expected to be published in the next Comprehensive Spending Review, is a response to the National Infrastructure Commission's infrastructure assessment, published in 2018.

Sheffield told the committee that Covid-19 had caused a short-term increase in the levels of people walking, cycling, and running, as well as an increase in people working from home.

He said that, as a result, higher priority should be given to active travel and improved digital connectivity.

He added that new infrastructure investments should prioritise the accelerated rollout of fibre-optic and 5G broadband in the short to medium term.

This would enable thousands of people to continue working flexibly, while ensuring that safe spaces for the public to continue to engage in active travel are in place.

PITCH 200

# Atkins graduate wins Pitch 200 prize

Competitors had just 200 seconds to present a civil engineering idea or principle to an audience made up of non-engineers

A graduate tunnel engineer representing London and South East England has won the 2020 national final of ICE's Pitch 200.

Atkins engineer Rui Jian Tee won the most public votes for his video explaining the innovative uses of geosynthetic geogrid to reinforce soils and similar materials.

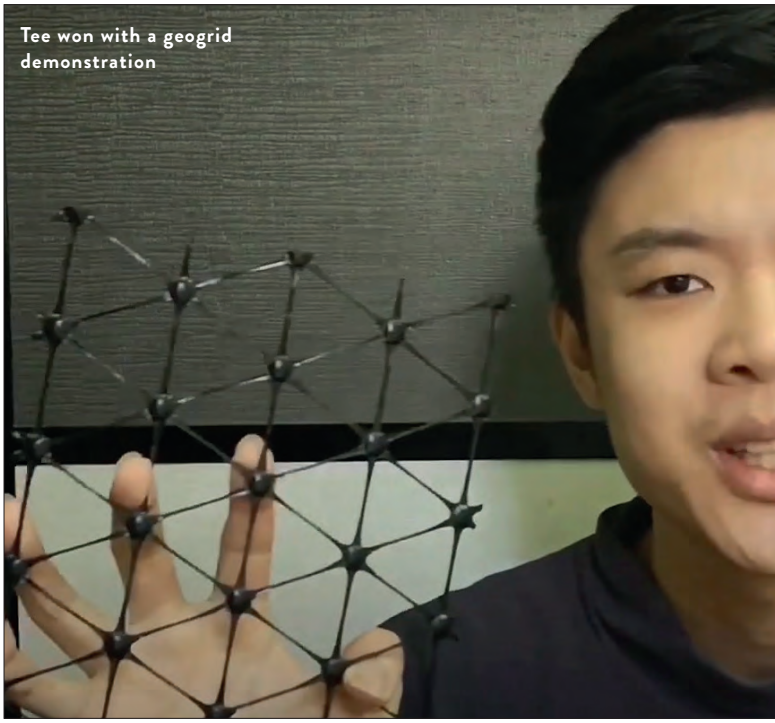
Pitch 200 is an ICE-run competition where civil engineers use their creativity and communication skills to explain a civil engineering idea or principle in just 200 seconds.

Tee's pitch explored the positive aspects of using plastic solutions like geogrids to bring lasting safety benefits to infrastructure projects.

Pitch 200 usually takes place before a live audience before a public vote. This year the event was moved online because of social distancing restrictions.

Eight civil engineers took part in the national final after being selected in regional heats.

University of Warwick civil engineering student Jasmine Brittan, who was representing the East and West Midlands, came second with a video making the case for Hyperloop as a low energy solution to future transportation needs.



Tee won with a geogrid demonstration

She explained the principle of this new technology using a hair dryer, ping pong ball and toilet roll.

Third place went to Costain civil and structural engineer Maria Eftimova who represented North West England.

The presentation focused on the wastewater treatment process and included a river water filtration demonstration with Maria drinking the clean

INFRASTRUCTURE

## Schultz is key speaker in 13th Brunel International Lectures

Seth Schultz, executive director of infrastructure consultant The Resilience Shift, will be the key speaker for the 13th Brunel International Lecture Series, which starts on 2 December. Established in 1999, in memory of pioneering engineer Isambard Kingdom Brunel, this 12 month series is entitled 21st Century Leadership is Partnership: How a Coalition of the World's Engineers Can Change the World and will be held online.

● **Full details of all the lectures, plus sign-up information, will be confirmed via www.ice.org.uk**

PROFESSION

## Webinar series sets out civil engineering career possibilities

A series of webinars showcasing the variety of careers available in civil engineering have been launched online. The ICE Inspiration Series is delivered by civil engineers who will share their stories and offer practical advice for study and development. The series provides a complete online careers programme for students and educational establishments who want to explore the rewarding and diverse world of civil engineering careers.

● **The series is open to all, and places can be booked at www.ice.org.uk/events**

ICE

## Arup engineer wins international Emerging Engineers award

Leeds-based Arup structural engineer Selina Rai has won the international final of the ICE International Emerging Engineers Award. She beat three others finalists and impressed the panel of judges with her presentation on the effect of staggered openings on the seismic performance of reinforced concrete shear walls. The award is aimed at students, graduates and trainee technicians and is intended to encourage and reward the communication of civil engineering ideas, research and best practice in projects and design.

ICE

## Members invited to debate extension of graduate voting rights

ICE members have been invited to take part in a debate about whether to extend voting rights for graduate members. At present graduate members can only elect other graduate members to Council. ICE Council wants to engage the membership in a debate before taking its recommendations to the Institution's Trustee Board. Changes would require approval by Corporate Members in a ballot.

● **The debate takes place online on 20 October and members can book their place at ice.org.uk/events**

end product.

First placed Tee won a £400 voucher, Brittan received a £200 voucher for coming second and Eftimova a £150 voucher for third place.

ICE

## ICE gears up for presidential address in November

The inauguration of Rachel Skinner as the ICE's next President takes place on 3 November. At a live-streamed online event, on 3 November 2020, Skinner will become the 156th ICE President. In her address, she will speak about her upcoming year as President, and discuss the changes that decision makers, industry and the public must undertake if the UK is to achieve its target of net zero carbon emissions by 2050.

● **Places are still available, those wanting to attend the event, should book at www.ice.org.uk/events**

VICE PRESIDENT'S VIEW

# ENGAGING NEW TALENT TO LEAVE OUR LEGACY

**Emer Murnaghan**

What do you love most about being a civil engineer?

For me, it is working in a profession that exists to serve the fundamental needs of society. Moreover, it is retaining that sense of enthusiasm and passion for civil engineering, three decades on. The work I do every day makes a difference to others – mostly, I hope, for the better. For many of you, I imagine, it is similar – civil engineers help transform lives, help build better communities, help create a more sustainable future. Why would anyone choose anything else?

Of course, getting these points across to others is sometimes a challenge. The stereotype of hard hats and construction sites remains – but it's changing. Campaigns aimed at primary school and secondary school students are working, with recent EngineeringUK figures showing that 44% of boys and young men, and 24% of girls and young women would consider a career in engineering.

But there is more to do.

We need to think about who we want to take our places in five, 10 or 20 years. What does the future of our society look like – and how can we ensure our profession is the one to make it happen? What personal responsibility must we each take today?

Much infrastructure conversation has recently concerned the government's levelling-up agenda and the need to further invest in communities across the country. Creating better regionality, through effective transport networks, and targeted economic support will help create the resilient future we need across the UK.

But focus cannot only be at the funding and financing level or focused on systems and supply chains – the how. We need to also focus on who will deliver this future infrastructure and who will dream up ideas using technological advances we have yet to discover.

> **"The work I do every day makes a difference to others – mostly, I hope, for the better**

The civil engineer of the future has an incredible opportunity – they will have centuries of experience to learn from, and the fourth industrial revolution to innovate and incubate new ideas.

As an industry, it is our duty to inspire those who will follow us, to help accelerate those journeys. My recent involvement in the Quest scholarship interviews was a privilege and a delight.

I had the chance to speak to students who were full of ideas and passion – interested in joining a profession that makes a difference to society, protects the planet and improves people's lives. The Quest scholarship programme offers students the chance to realise those dreams. They get to work with firms that are demonstrating the true impact of infrastructure and how civil engineers really make a difference. It is the kind of programme made possible by the support of responsible leaders who want to ensure a brighter future, and by firms willing to invest time and money to secure that future.

I encourage all of you to speak to your colleagues about whether this scholarship, or another scheme, is something you could support. It is our responsibility to ensure that talented and ambitious young individuals are nurtured, encouraged and supported to realise our aspirations of building a sustainable, digital and connected future.

What will your legacy be?

● *Emer Murnaghan is ICE vice president, UK regions*

EAST MIDLANDS VIEW

# FUTURE-PROOFING INFRASTRUCTURE

Ben McGrath

Global warming is real, and we can see it in the changing UK climate. The country has seen its top 10 warmest years over the last two decades.

February 2020 was the wettest on record for England, Wales and Northern Ireland; while the hottest day on record reaching 38.7°C was recorded in July 2019 at Cambridge University Botanic Gardens. Storm Desmond, in 2015, still holds the record for the largest rainfall within a 24 hour period, when Honister, Cumbria, received 341mm. By the end of the century, we can expect warmer temperatures, more serious flooding – particularly during winter – and some significant rise in sea levels. Civil engineers will need to address these issues when future-proofing our infrastructure.

Climate change is visible in the East Midlands. According to the 2015 *Changing Nature of Flooding in the East Midlands* report, published by East Midlands Councils, around 20% of the region is at risk of flooding. This is from a combination of sea, river, waterway and groundwater level rises and excess water in the local surface drainage networks.

At peak times, flooding costs the economy around £100,000 per hour, per major road affected. Billions of pounds and hundreds of thousands of jobs are put at risk due to these climate change events.

This has a significant impact on the mental health and wellbeing of people affected by flooding, so it is important that we look at what can be done to reduce those risks.

Flood risk management can be achieved by extensive research and planning, and by applying civil engineering processes and building flood-resilient infrastructure.

> **“At peak times, flooding costs the economy around £100,000 per hour, per major road affected**

This means that civil engineers in the region have an increasingly important role to play in protecting communities from flooding by including more elements of blue-green infrastructure.

To build more resilient infrastructure in the East Midlands, civil engineers must start with design. Design decisions affect the economy, the environment and society – today and in the future.

Good highway design should have people and communities at its heart by creating an inclusive, resilient and sustainable road network. This can be achieved by incorporating blue-green infrastructure elements within new projects.

Implementing sustainable drainage systems (SuDS) is now generally required as part of the design of new highways. They are environmentally friendly, natural drainage solutions, which are more resilient than the traditional pipes and sewers.

Other natural passive options include ensuring green spaces, such as playing fields, can act as water storage areas.

In order to reduce the risk of flooding in the region and future proof infrastructure, East Midlands civil engineers will have to embrace planning, design and understanding of blue-green infrastructure and address the current obstacles to the adoption of SuDS.

● *Ben McGrath is ICE East Midlands regional chair*

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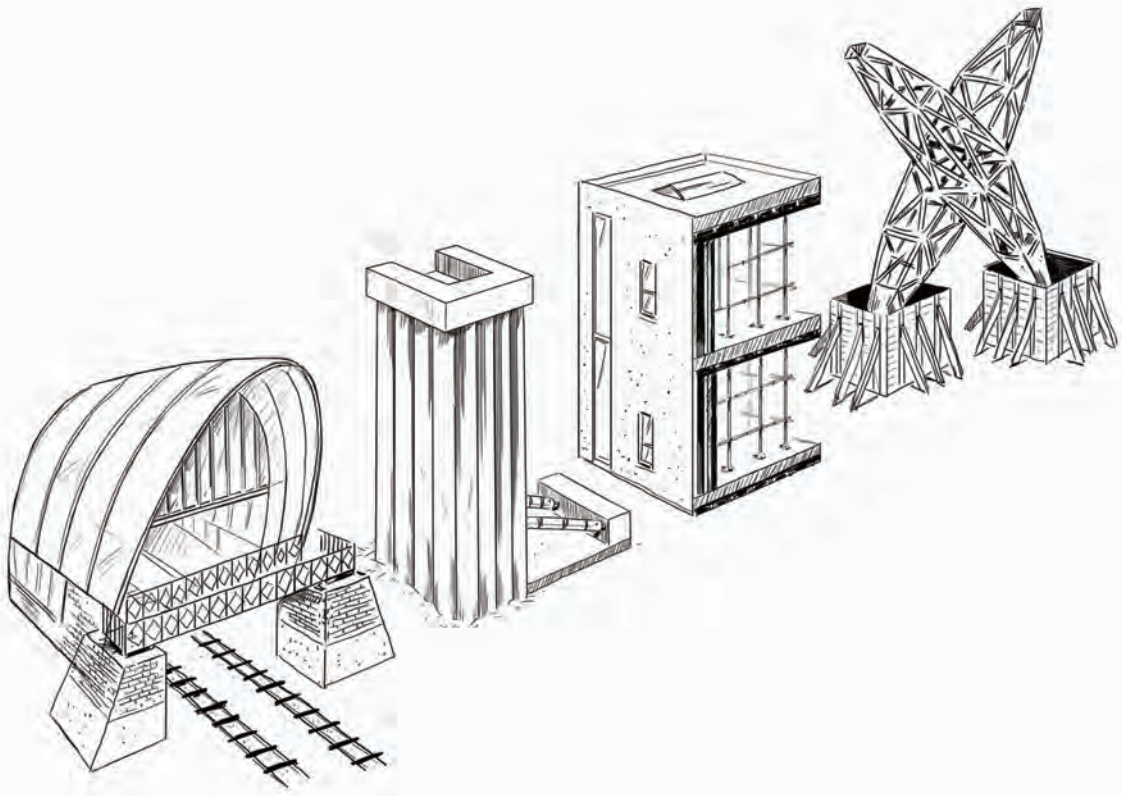

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