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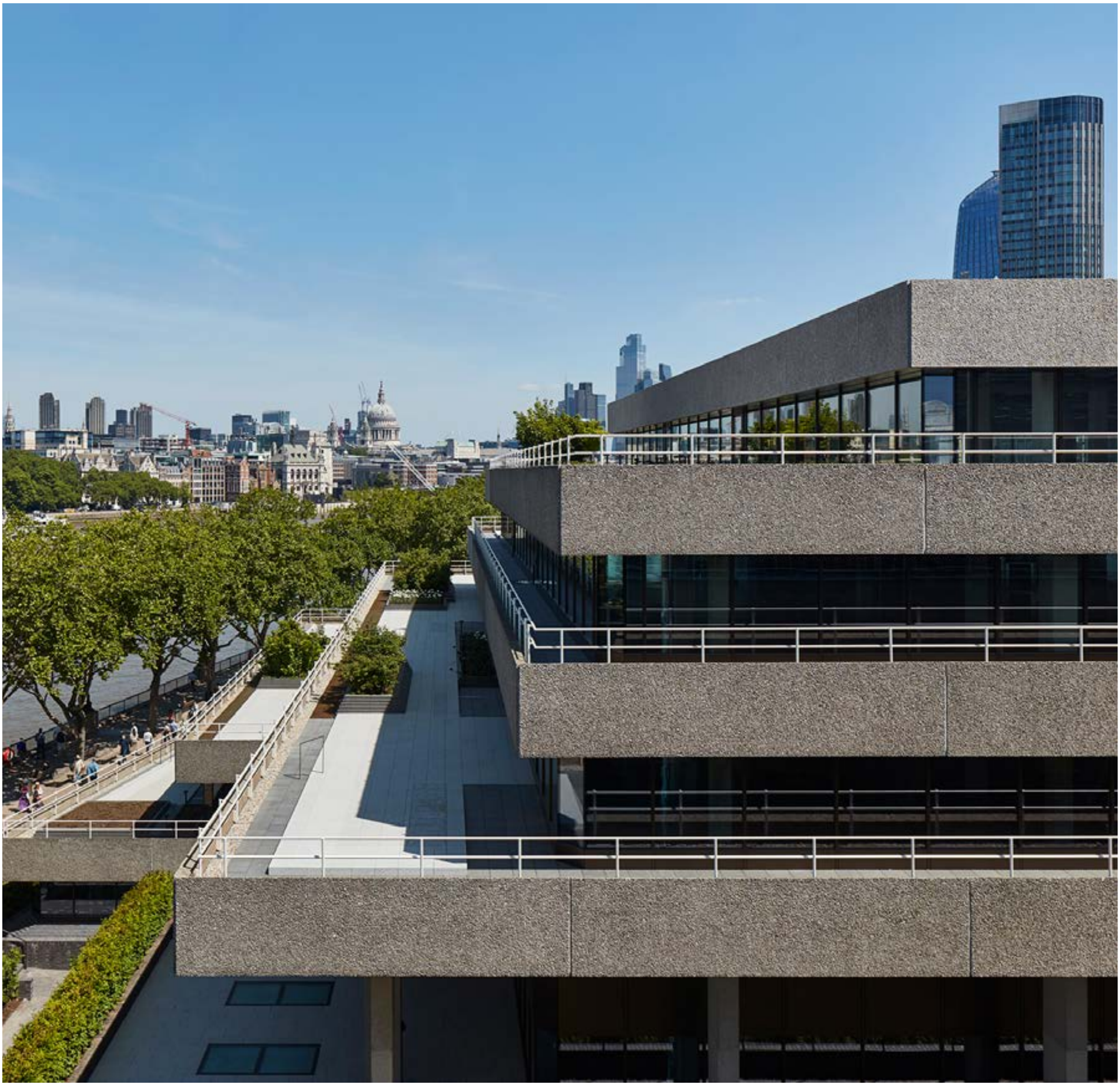

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INSPIRATION

APPLICATION

Elaine Toogood
Senior director, MPA Concrete
& The Concrete Centre

Life after 60

There's lots to learn from the reinvention of Denys Lasdun's 1980s IBM Building as a bang-up-to-date office (page 18). Projects like this are inspiring not only because they give architectural icons a new lease of life – and sometimes right the wrongs of a previous age – but also because they can tell us a lot about how to equip new buildings with longevity.

One of those lessons is that a concrete structure can last significantly longer than the original design life – structural analysis on the IBM Building (now called 76 Southbank) found that the concrete was much stronger than assumed, and that the substructure could bear an increased load of up to 30%.

Making buildings last as long as possible is at the core of circular thinking. By reusing an existing structure, we not only preserve the carbon in its construction, but reduce the need for new materials. Increasingly the expectation is that buildings should be able to be adapted, and that a retrofit will at least be considered before demolition.

So I always wonder why we still measure whole-life carbon over a default period of 60 years. Many structures have a design life that is far longer, illustrated by the other projects in this issue: 100 years for Melbourne's State Library station, and 120 years for Kengo Kuma's portico at Angers Cathedral (itself dating from the 13th century). Liverpool School of Architecture is expected to last well over a century too.

In the UK, the key guidance document is the RICS Whole Life Carbon Assessment Professional Standard. This has been really important for providing guidance, alignment and clarity around conventions, and for driving greater measurement. But it's worth noting that 60 years isn't a universal limit. Both the RICS methodology and the European standard upon which it is based, EN 15978, allow assessments to be based on other periods of, say, 80 or 100 years, where they are a better fit to the estimated service life of the building.

THE TROUBLE WITH MEASURING THINGS OVER A SHORT PERIOD IS THAT IT CAN LEAD TO SHORT-TERM THINKING

Much longer service lives are expected on infrastructure projects, and this is already reflected in the standard assessments period for these assets. In housing, on the other hand, the default period does not reflect the fact that many UK homes are still in occupation after a century or two. The Future Homes Hub has been creating conventions for the whole life carbon assessment of new housing which uses the default 60-year period but acknowledges that many houses will have a longer life cycle. The RICS document adds that for domestic projects a 120-year assessment should be undertaken for the envelope, but I have never seen this discussed or applied.

Many layers of a building won't last anywhere near that long, but a well-designed structure can and should. The trouble with measuring things over a short period of time is that it can lead to short-term thinking. If you don't plan for something to be long term, you're not facilitating it.

Standards are continually evolving as our understanding of carbon accounting grows, and measurements are our best guess at reality, rather than a direct reflection of it. There are many variables in a whole-life calculation, and it does become more difficult to predict the outcomes over a longer period. But that doesn't mean we shouldn't try – embodied carbon was once on the too-difficult pile. The industry has come a long way since then, but there is still much further to go to decarbonise new construction and existing buildings. Making sure we're using the right metrics is an essential step on the journey. ■

CONCRETE QUARTERLY

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76 Southbank by Denys Lasdun and AHMM. Photo: Rob Parrish

Photos: Paul Burroughs

ABOVE
Ureaka founder Philip Salter with the adapted brewing vessel used to process waste concrete roof tiles and recover cementitious material

INNOVATION

UREAKA

THIS UNIVERSITY OF STRATHCLYDE PROJECT IS ONE OF MANY STARTUPS RACING TO PERMANENTLY LOCK CO_2 INTO THE CHEMISTRY OF CONCRETE. BUT IT THINKS IT HAS A UNIQUE PROPOSITION

Locking away captured carbon dioxide within the chemical structure of concrete is a tantalising prospect. If this could be done at scale, it could help mitigate the costs associated with storing CO_2 in geological reservoirs. Because the bonds are permanent, the risk that it will escape back into the atmosphere is low.

Existing methods of storing CO_2 within concrete are often based on passing the gas over variously treated elements, including crushed concrete that is being recycled. "It works, but it can be slow and running the gas chambers can be expensive," says Philip Salter, founder of Ureaka, a prospective spinout company from the University of Strathclyde in Glasgow. "Our approach differs from most others in that it is based on a wet chemical process. It's fast, has a high degree of circularity and you don't need large inputs of energy or chemicals to make it work."

Salter came up with the idea almost by accident, while studying for a PhD in bio-cementation, using carbonate precipitation to bind materials together. "One of the experiments was not behaving as expected," he says. "There was no

"THERE WAS NO SMELL OF AMMONIA, USUALLY AN OBVIOUS SIGN THAT THE REACTION IS TAKING PLACE. THAT SMALL OBSERVATION SENT ME DOWN A FAR BIGGER RABBIT HOLE"

smell of ammonia, usually a very obvious sign that the reaction is taking place. That small observation sent me down a far bigger rabbit hole."

He started looking more deeply at ammonia chemistry, volatile compounds and whether the by-products of these cementation reactions could be captured and reused rather than treated as waste. "Over time, the question shifted from 'Why is this experiment not working?' to 'Could the whole chemistry be redesigned as a circular process?'"

Earlier this year, he pivoted again. Ureaka was originally set up to make bio-concrete from waste products and plant-derived enzymes. But he realised that there was much greater potential to change the industry with a supplementary cementitious material (SCM). He is now in the process of testing mortar prisms in which Ureaka's SCM replaces up to 30% of the cement.

The initial feedstock is rejected concrete roof tiles, supplied by manufacturer Wienerberger. "They contain calcium, silica and alumina that can be recovered and turned into new construction materials," says Salter.

The waste concrete is processed using a proprietary liquid. This separates the sand – which can be recovered

BELOW
Mortar prisms made with Ureaka's SCM. Colours vary depending on the composition of the roof tile feedstock

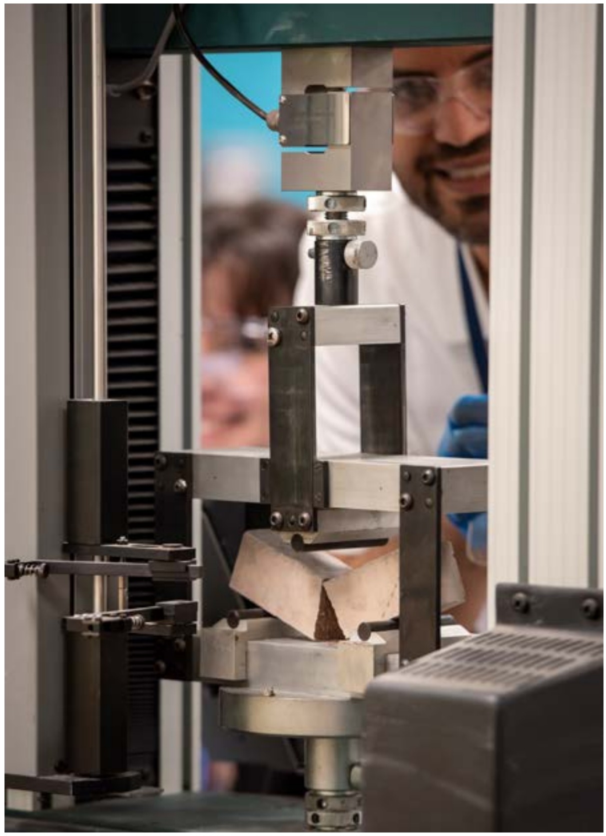
– from the cementitious material. Captured CO_2 is then rapidly mineralised in the solution to produce an activated cement replacement.

The CO_2 Salter is currently using is a waste product of whisky production, and is typically used to make dry ice and for other industrial applications. "It's a clean, controlled source, which is helpful while developing and validating the process," he says. "Longer term, the goal is to use CO_2 captured on site at cement plants and mineralise it directly into SCMs. That is where the technology becomes most strategically relevant."

He is quick to clarify that Ureaka would not be an alternative to carbon capture at cement plants. "Even with broader quarry, mining and industrial mineral residues, mineralisation won't operate at the same scale as geological storage. But by converting even a fraction of captured CO_2, we could produce tens of thousands of tonnes of material and significantly improve the economics of the wider carbon capture and storage system."

The process has another advantage, he adds: a low-energy route to recover the chemical inputs, so they can be reused. "That circularity could be attractive both environmentally and economically as the technology scales."

What about the concrete? Initial tests are encouraging, showing strength gain and compressive strength within the expected range for control mortar mixes made with Portland cement



ABOVE
A mortar prism made with 30% SCM undergoes a three-point bending test, showing similar performance to a CEM I control

(CEM I). They have also begun testing against Portland-limestone cement mixes (CEM II), retaining around 90% of the 28-day compressive strength of the control at a 20% replacement level. "We are now building out the full dataset with more standardised testing and repeatability," he says.

The team is preparing to supply a pilot batch to Wienerberger for testing under its roof-tile manufacturing and accelerated-curing conditions. External validation with other industry partners is also planned as production scales towards 25-30kg per batch.

Ureaka is currently planning a pre-seed round of funding to support scale-up and commercial partnerships. It is also actively seeking partners across the supply chain, including waste concrete suppliers, mining and quarrying companies interested in fines upcycling, cement and concrete producers, and construction materials companies. "The next phase is about converting the technical proof into repeatable pilot production and customer validation," says Salter. "There is a lot of competition for funding in this area, and inevitably that will affect how soon we can bring our process to market. We are building the industry partnerships, team and production capability needed to move quickly." ■

Interview by Tony Whitehead

BELOW
The team: Salter with PhD researchers Parvez Patel, Muftah Abu Obaida, Eirini (Irene) Zygouki and River Gowans

LASTING IMPRESSION

DOMINIQUE COULON

THE FRENCH ARCHITECT SELECTS TWO VIRTUOSIC COMPOSITIONS OF SPACE, LIGHT AND COLOUR, AND A MUSIC HALL OF CAREFULLY ORCHESTRATED CHAOS

In-situ concrete makes it possible to create continuous surfaces, leaving virtually no trace of how a building has been assembled. At the António Carlos Siza House in Porto, which Álvaro Siza designed for his brother, it feels almost as though the entire building had been cast in a single pour. The monochromatic yellow finish – which even incorporates the window and door frames – reinforces the impression of a fragmented monolith.

One can imagine how challenging it must be for an architect to design a building for a member of their own family. It is rarely straightforward, and I have heard countless stories. I don't know the history of this house in detail, nor do I know whether everything went smoothly between Siza and his brother. Beyond that, however, what immediately stands out is

Photo: Roberto Collovà

RIGHT
António Carlos Siza House in Porto, by Álvaro Siza, 1976-78

the freedom of its organisation. The plans reveal a fascination with geometry. Lines intersect one another, and there appear to be invisible regulating geometries beneath the composition. There are unexpected spaces throughout; you never quite understand everything at first glance. Certain elements convey stability – the living room plan is almost perfectly symmetrical – yet this order is disrupted by a double-height space, expanding circulation routes, compressed passages and moments where the spaces suddenly open up and breathe.

The views are particularly beautiful. From different points within the house, you can look back out towards other parts. It is almost as though the building is looking at itself.

The Casa Gilardi by Luis Barragán in Mexico City is another house in which concrete is used to create highly abstract surfaces. Here, however, the material is rendered rather than left exposed, giving it a texture that captures both light and colour beautifully. The interplay of light in the yellow corridor that leads towards the living room creates a space that feels almost velvety. There is a remarkable softness, enhanced by the fact that all the walls share the same material character. It is colour alone that transforms them.

Unlike the Siza house, the plans could easily have been drawn by a child. On paper, the gallery running alongside the courtyard appears entirely ordinary, yet walking through it is an extraordinary

Photos: Armando Salas Portugal, Barragan Foundation

ABOVE AND TOP
Casa Gilardi in Mexico City by Luis Barragán, 1975-77

experience. That is the power of architecture: it can create spaces of unimaginable richness from apparently simple drawings.

The tree standing within the courtyard introduces an intensely poetic dimension. One senses that it existed long before the house itself. The architecture has been designed around it, allowing it to become the organising focus of the project – the house is not imposed on nature but adapts to it. This is an idea I've explored in some of my own projects, for example the Porto-Vecchio Media Library (2022), where the building was shaped around rock formations and olive trees that we wished to preserve.

Photo: Hercules Milas / Alamy Stock Photo

ABOVE
Casa da Música concert hall in Porto, by Rem Koolhaas and OMA, completed in 2005

Finally, for me, Rem Koolhaas' Casa da Música is one of the most important buildings of the 21st century because it may well be the first project to establish a complete separation between container and content. Its faceted, monolithic external form – almost like a meteorite resting in the city of Porto – is entirely independent of the interiors. As one approaches the concert halls, the route winds around large volumes, alongside inclined walls, through compressed passages and expanding spaces, generating entirely new spatial tensions.

I take enormous pleasure in seeing this strange object occupying the public realm. Yet there is an equally great pleasure in entering it: discovering the complete freedom of its circulation, wandering through spaces of exceptional scale, and experiencing what feels like a carefully orchestrated form of interior chaos.

Concrete is not usually Koolhaas' material of choice, but it feels entirely natural. It is difficult to imagine another material expressing the building's sculptural presence with the same sense of inevitability. ■

Dominique Coulon is founder of Dominique Coulon & Associés

From the archive: Autumn 1982
LUXEMBOURG LUXE

The IBM men who used to trudge up to their office via a car park ramp under a plastic canopy might not want to hear this, but Denys Lasdun's 76 Southbank (page 18) has a sister building – and it's got a swimming pool.

The European Investment Bank in Luxembourg was completed in 1980, three years before the IBM Building, and shares many of the hallmarks: a staggered, horizontal form; deep terraces overhanging full-height glazing; precast concrete panels with exposed granite aggregate. Will Lee, director of Allford Hall Monaghan Morris, which led the IBM redevelopment, describes it as "almost the same building but in a different configuration".

There was, however, one crucial difference: money. While Lasdun was left fuming at cost-cutting on the South Bank, the Luxembourger bankers were happy to splash out on a rooftop meeting room submerged in its own water garden, an immaculately white-tiled pool and the finest of concrete finishes. CQ felt that the decision had paid off with interest: "This is not so much a building to be admired from a distance as one to be scrutinised through a magnifying glass – something exceptional by today's standards. If you were sure that you never liked concrete surface finishes, then you are recommended to take a look at the faces of this building, which will make you have second thoughts. As an example of high-class bespoke concrete tailoring, you will be lucky to find a suit of more stylish elegance, cut on simple – if severe – classical lines."

The high quality was an appropriately pan-European effort. "The panels were cast with Montefamo granite, 20-30mm in size, from Mergozzo in Italy, and with 80 per cent white cement and 20 per cent normal grey cement. The surface was deep-washed to expose the aggregate – a specialised technique developed in Britain. The panels were made under carefully controlled conditions in Metz, France. The result is an evenly textured silver-grey concrete which forms a splendid backcloth inside the building."

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HAUTE COUTURE IN CONCRETE

New Headquarters for the European Investment Bank, Luxembourg

by George Perkin

Client	European Investment Bank (EIB)
Architects	Denys Lasdun Redhouse & Softley
Consulting engineers	Scott Wilson Kirkpatrick & Partners in association with services sub-consultants Scott Houghton & Co. Projecco SA (Belgium) HL Technik GmbH (West Germany)
Quantity surveyors	Widnell & Trollope in association with Widnell & Trollope (Belgium)
Main contractor	Philip Holzmann AG (West Germany)
Precast concrete elements	G.T.M. Bâtiment et Travaux Publics S.A. (France) in association with Marble Mosaic Co. Ltd

HAUTE COUTURE IN CONCRETE *continued*

Architectural design

Photos: Nick Kane

ORIGIN STORY

LIVERPOOL SCHOOL OF ARCHITECTURE

O'DONNELL + TUOMEY'S GEOMETRIC EXTENSION OF CONCRETE, TIMBER AND LIGHT TWISTS AND TURNS TO MEET A BRIEF FROM THE SCHOOL, ITS STUDENTS AND A JUDGING PANEL OF ARCHITECTURAL GREATS

The new extension to the Liverpool School of Architecture started life a little differently to most projects. In 2019, the school launched an invited international competition for a building that would "redefine the nature of architectural education". The three-stage process would also be an educational opportunity, with students in close dialogue with the architect teams and taking part in the selection process, in a sort of reverse crit. The final round was to be judged by a panel of architectural and design eminences grises, including Kenneth Frampton, Maria Balshaw, Juhani Pallasmaa and Michael Wilford.

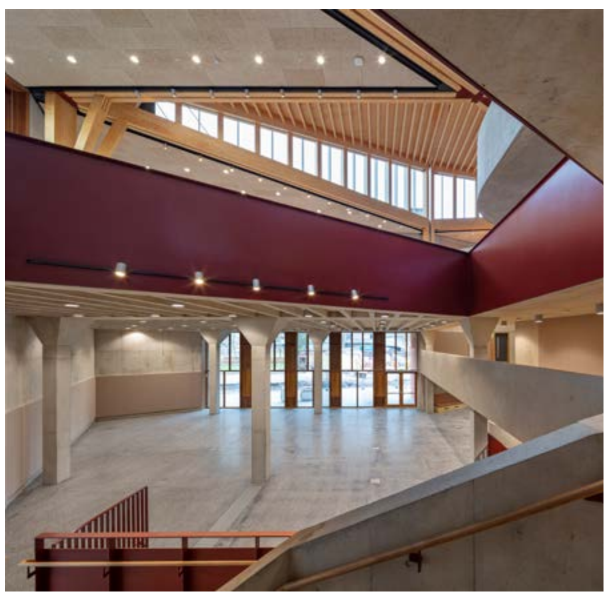
The school itself had a long list of demands. It wanted a "flagship project" and "a building respectful of tradition, but ambitious enough to anticipate the architecture to come". The context was challenging: adjoining the school's existing 1930s Leverhulme Building and Victorian terrace, but also facing out onto a public square, green space and Frederick Gibberd's Metropolitan Cathedral. The brief recognised the "lack of cohesion among the parts, a missing public core and social spaces" but stressed the need to retain all of the existing fabric to serve as a narrative history of the school.

At the end of the competition, the last architect standing was Irish practice O'Donnell + Tuomey. Its response was an energetic fusion of angular geometries and long spans, with a folded timber roof structure on top of a "table" of exposed concrete. The upper levels open up into daylit zones for design studios, while a series of overlapping, projecting spaces coalesced around an exhibition hall below. The judges praised the way the design "appropriately celebrated space, structure and light".

For Willie Carey, director at O'Donnell + Tuomey, it was both a direct, practical solution to the needs of the school and its students, and a spatial response to the various key views and axes. "It was a very unusual situation. There was a geometry established by the location of the cathedral, by the desire to create a new entrance into the school, by the opportunity to connect the 1930s building and 1850s terrace, while both ends of the building address a park."

The asymmetrical form twists and turns in relation to these constraints, angling away from the Leverhulme Building to open up a wedge-shaped entrance, and cutting back in to face

BELOW
The architects have exploited the varying play of light across polished concrete floors and lightly sandblasted walls



ABOVE
The column heads are all unique, twisting in response to the building's asymmetrical geometry

the cathedral. On the north-east corner, the first floor cantilevers out 7m to overlook the proposed university park. Internally, the irregular structure generates a series of dynamic, interconnected spaces, with no two floorplates the same.

Henrik Wolterstorff, associate at O'Donnell + Tuomey, says that it is hard to imagine these spatial sequences being created in any material other than concrete. "A non-concrete building would have to look totally different," he says. "So we just embraced it, and made sure every bit of concrete worked as hard as it can. There's no concrete used just for architectural reasons."

This dovetailed conveniently with another of the project's aims: as a building where people go to learn about buildings, it was important that both the concrete base and timber roof were structurally legible. "You can see exactly how the structure is working as you walk around," says Simon Smith, associate director at structural engineer AKT II.

The taut frame shows off every sinew. On the first floor, the 300mm slabs are ribbed, with 75mm-deep troughs, saving about 25% volume compared with an equivalent flat slab. "Where it has to work harder to support the cantilever, you can see it in the change to a flat soffit," Smith points out. Similarly, the columns have big trapezoidal heads (reminiscent of Denys Lasdun's IBM Building, page 18), which support the load on the band beams above and allow for a more slender column form below. These column heads are all unique, twisting in response to the building's various geometries.

With the structure exposed, Smith points out, there are no additional finishes, and therefore no associated embodied carbon. The ribbed slabs also increase the surface area of the concrete, which means more thermal mass – integral to the BREEAM Excellent building's natural ventilation. And there's an aesthetic quality to these legible devices, adds Carey. "It gives a character, a kind of energy to the space"

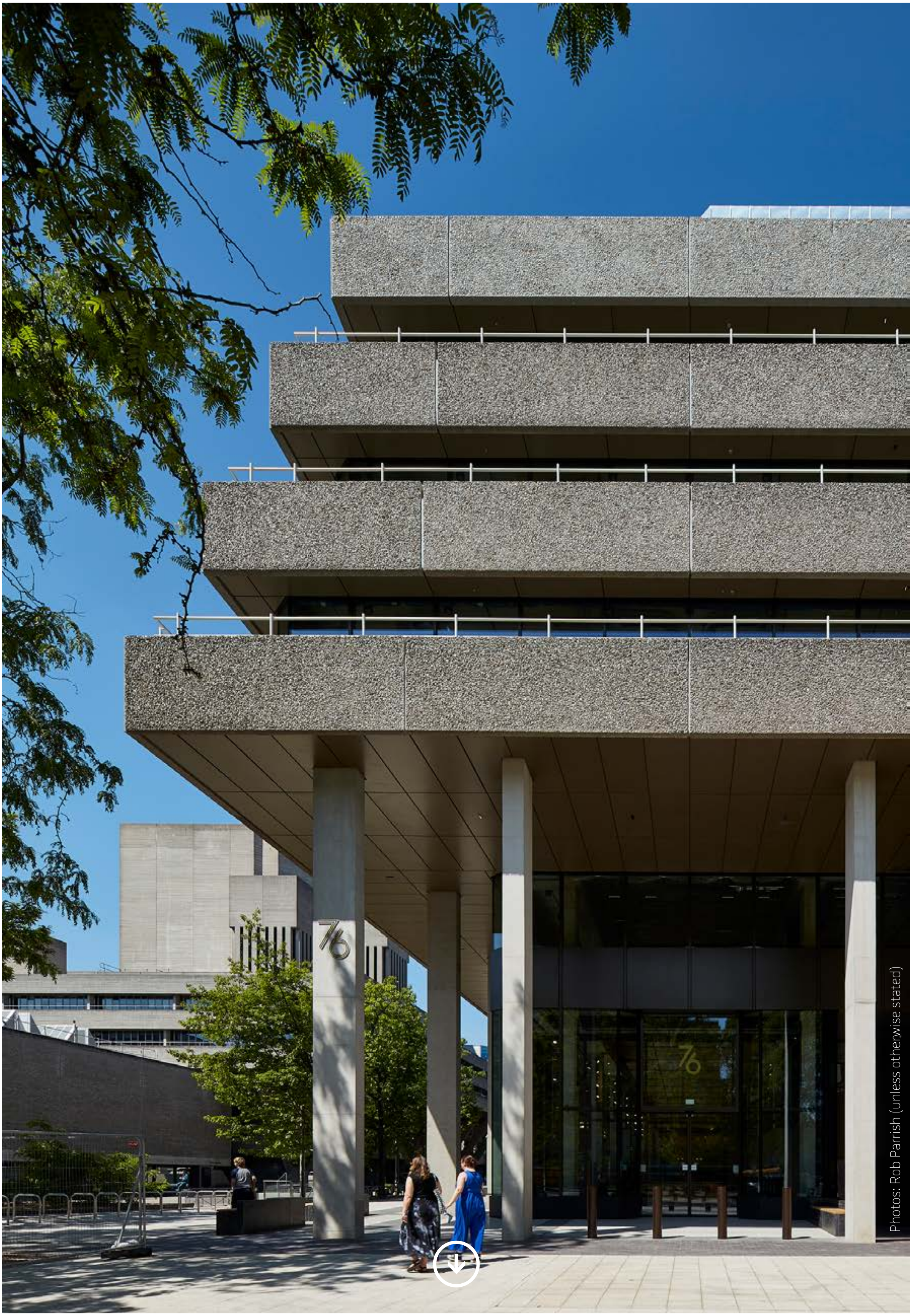
O'Donnell + Tuomey has a long history of using fair-faced concrete, on projects such as the Sean O'Casey Cultural Centre in Dublin and the Saw Swee Hock Student Centre at the London School of Economics. "We're very serious about how we pour the material, how we finish it. We get into the nuts and bolts of how a wall is made," says Carey.

BELOW
The ribbed slabs have reduced the volume of concrete in the floor structures by as much as 25%

At Liverpool, the concrete is light-toned from its 50% GGBS mix, and during the day it is bathed in light from the timber lantern above. While the floors and the tops of the balustrades are polished, the walls have been lightly sandblasted. This changes the way that light is distributed, he says: "On an as-struck wall, you get a lot of reflection, whereas this seems to hold the light and draw it along the wall rather than bounce it back into the space."

Not that the architects are too precious about their walls. "We wanted to make sure that the building was robust, long lasting and would stand the test of time. These buildings, they're not laboratories, they're not lecture spaces, they're kind of knockabout. But I think you might come back in 100 years and it would still feel the same." In other words, Liverpool students might have a long wait before they next get the chance to design their own school. ■

Words by Nick Jones



Photos: Rob Parrish (unless otherwise stated)

LASDUN 2.0

AHMM's digital reboot of the IBM Building has involved tenacious detective work, sympathetic restoration and an audacious retrofit of a car park ramp, writes Nick Jones

Completed in 1983, the IBM Building on London's South Bank was one of the last realised projects by Denys Lasdun. It was conceived as a companion piece to his National Theatre next door, and its staggered slab-like form, wrapped in granite-grey concrete, felt like a last blast of sixties brutalism.

ABOVE
Set back from the South Bank promenade and with bands of dark glazing, the building has always had a more corporate feel than its neighbours

Brutalism may have been on brand for IBM, as the face of sixties corporate America – but it immediately felt outdated in eighties Big Bang London. The offices had single glazing, low ceilings and confusing circulation. Where the main entrance should have been, there was an ugly ramp up to the car park. Saddest of all, the terraces that wrapped around its five ziggurat-like levels were barely ever used. Despite having some of the best views in London, their balustrades did not comply with building regulations, so they were simply gravelled over and left to the pigeons.

In 2020, with redevelopment plans afoot, the building was nevertheless deemed worthy of a grade II listing, with Historic England noting "its distinctive exterior character and form". There was also the sense of an unfinished story. Lasdun's original drawings had included an additional level, mirroring the massing of the NT to create a pairing across a valley, but the theatre did not like the taller profile and it was either value-engineered out or deemed surplus to IBM's requirements. The non-compliant terraces were also a victim of cost-cutting – a letter from IBM to an irate Lasdun promised to put this right at a later time, but it never happened.

He finally has his wish. Now rebranded 76 Southbank, the building has been remodelled by architect Allford Hall Monaghan Morris (AHMM) as an all-electric high-spec office, with a full hand of BREEAM Outstanding, NABERS 5-star, WiredScore Platinum and WELL Gold ratings. The terraces have been paved and landscaped, creating 5,000m^2 of outdoor space, and Lasdun's extra storey has been reinstated. The three upper floorplates have also been pushed outwards, expanding the net floor area by 50% to nearly 30,000m^2 of premium workspace. The parking ramp is gone, leaving only traces of its existence in one of the most spectacular building receptions in London.

This all seemed very unlikely in 2019, when AHMM took on the task of giving the building

"IT WAS A REAL HANGOVER FROM THE SIXTIES IN TERMS OF THE SERVICING AND CIRCULATION"

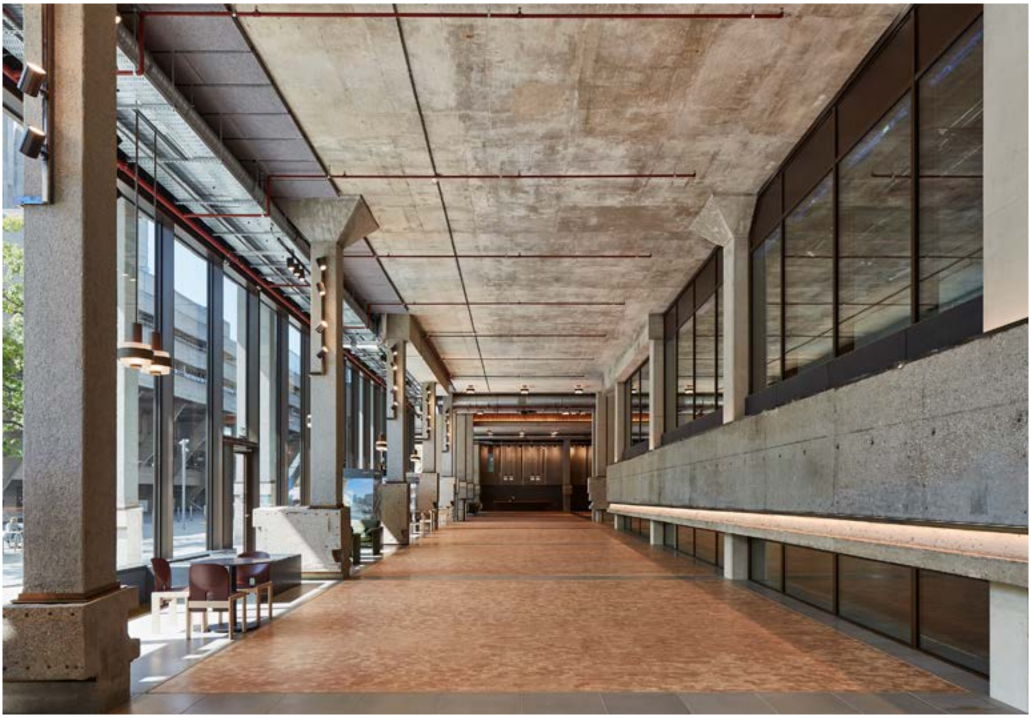
Photo: AHMM

a viable long-term future. “It was a real hangover from the sixties in terms of the servicing and circulation,” says director Will Lee. “The pedestrian strategy was pretty terrible and the vehicle circulation was obviously very outdated and really affected the public realm around it.”

This was epitomised by the ramp. Over time, the mass of IBM men commuting into nearby Waterloo station had taken matters into their own hands and made this the main pedestrian entrance to the building. A dispiriting plastic canopy was eventually placed over one side of the road to shelter them as they trudged up to the first-floor reception. A blank defensive wall cut off the whole 70m-long car park entrance from Stage Door Avenue, the public route and “valley” that Lasdun had envisaged between his two buildings.

One of AHMM’s key moves has been to demolish the ramp and bring the lobby down to ground level. The outer wall has been replaced with double-height glazing set in front of the original perimeter columns. The massive 1.2m-thick beams that supported the road have been

ABOVE
The IBM car park ramp before the refurbishment, complete with plastic canopy to shelter pedestrians entering the building from Waterloo station



sliced down to stumps, exposing polished nuggets of rebar as they trace the absent incline.

The ramp turned in a half-circle at first-floor level before rising another storey, and AHMM has exploited all of this 930m² area to create a sense of theatre. From the entrance doors, a terrazzo floor slopes gently upwards along the whole 70m – this space will be publicly accessible and used for events. The reception desk is placed right at the back, a distant focal point framed by the huge 3m-deep transfer beam that carried the building over the ramp.

The double-height glazing finally establishes the connection that Lasdun had always intended with the NT, opening the building up to Stage Door Avenue. It feels less like a valley, more like a canyon bed between the twin rocks of Lasdun's South Bank.

Even before the listing, AHMM was keen to keep as much of the original structure as possible. "We were aware it was a Lasdun building and that it had good qualities," says Lee. About 80% of the concrete frame

ABOVE
The ramp has been reimagined as a 70m-long reception space. On the left hand side, the sliced beams still rise up with the gradient of the car park entrance

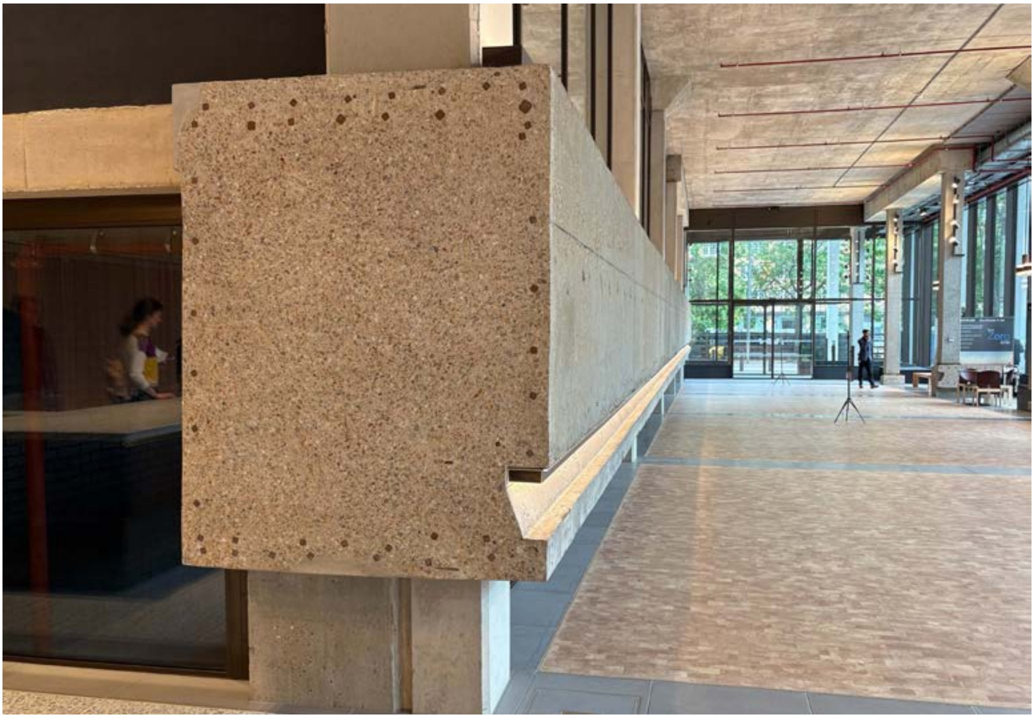


Photo: AHMM

ABOVE
The car park beams were sliced with a circular saw to expose the rebar and the edge polished to a nougat-like finish. The strip-lighting groove was originally a corbel detail

has been preserved; only the two cores were demolished and replaced with a single 60m-long spine. The original cladding panels have been restored – half in place and half removed to be steam-cleaned off site (see box, page 28). This retention strategy has contributed to a structural embodied carbon bill of just 109kgCO_2/m^2, saving 251kgCO_2/m^2 compared to a new-build.

But the scheme still needed to find a lot more floorspace in order to be commercially viable. Even before the architectural competition, structural engineer Heyne Tillett Steel (HTS) had been appointed to develop a detailed structural model of the building from archive drawings, showing how it worked and potentially how it could be adapted. "That meant that during the very, very early stages with AHMM, we knew how the forces were distributed through the building, how hard everything was working," says Andrew Middlebrook, director at HTS. "We also knew what would need to be strengthened, and what would need to be investigated."

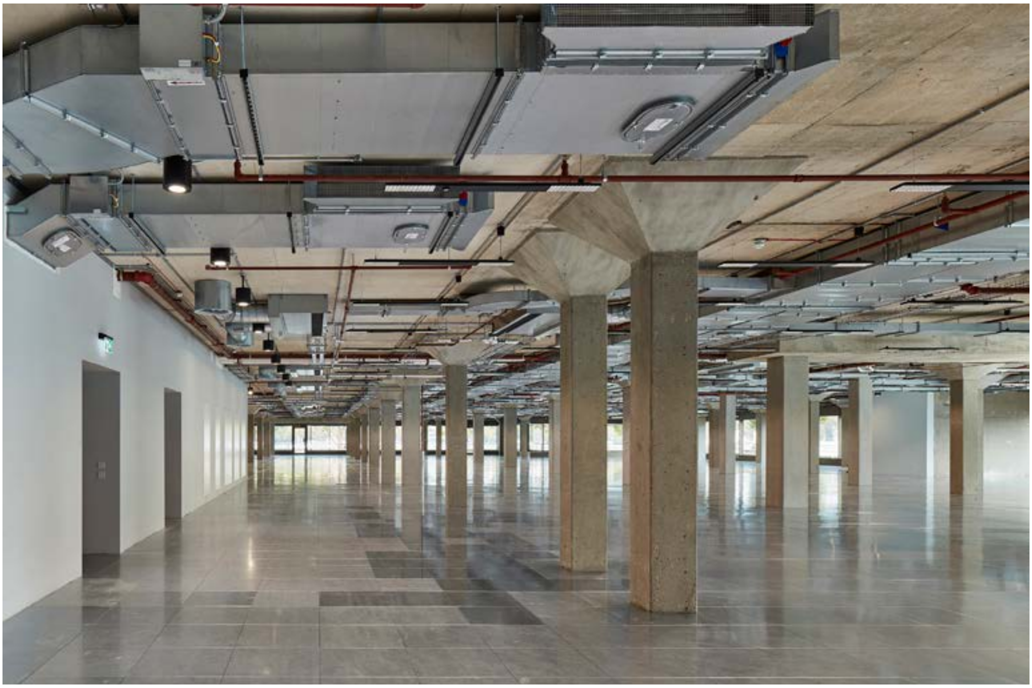
This forensic analysis was crucial to the new-build

ABOVE
Precast panels from the rooftop plant room have been repurposed as a decorative feature behind the reception desk

elements, which included extensions to the third, fourth and fifth-level floorplates of up to 17m on the east side (facing away from the NT) and 3m on the south, and a setback level on the roof. In-situ concrete flat slabs and columns was deemed the most practical solution for the terraced structure, as well as being in keeping with the listed status. Moreover, the slabs also had to support hefty new precast panels, which faithfully replicated the appearance of the originals. HTS was able to show how all this could be done while minimising additional reinforcement and foundations (see box, page 30).

The joins between the old and new structure are deliberately expressed, with suspended ceilings removed throughout. The existing slabs, which were never meant to be seen, have finishes of variable quality, while the extensions are smooth and light in tone, the result of a 50% GGBS mix and modern ply formwork. A clean shadow gap between the two accentuates the contrast.

The difference between old and new columns is equally stark. When the suspended ceilings were taken down,



this revealed the original trapezoidal column heads, designed to spread load and reduce the thickness needed for the slab above. These striking brutalist relics have been left exposed, while the new columns all have a straight-up, head-free form, again in smooth light-toned concrete.

These contrasts play out throughout the building. "There's finely finished new concrete and some really rough bits as well, and it's all on display," says Lee. The new in-situ cores include toilets with terrazzo floors, smooth walls, neat joints and boltholes, but also stairwells that are a little more grungy. In the reception, huge precast panels, salvaged from the former rooftop plant room, hang behind the main desk, scored with a decorative frieze. "We've gone for maximum texture in all finishes, he adds. "We wanted to express the cut and carve of the building."

The other major problem that AHMM had to contend with was the layout of the office floors, which Lasdun had organised in a figure of eight around two lightwells. "It was a bit of a rabbit warren because of the lightwells,"

ABOVE
Removing the suspended ceilings has revealed the trapezoidal column heads, which were designed to spread the load of the slab more efficiently

PROJECT TEAM
Architect Allford Hall Monaghan Morris
Structural and civil engineer Heyne Tillett Steel
Facade consultant Eckersley O'Callaghan
Main contractor Multiplex
Concrete contractor Keltbray
Precast supplier Evans Concrete

says Lee. "They were obviously there to create light, but they made it quite confusing to walk around."

AHMM has filled the lightwells in to create continuous floorplates, again making the most of some strikingly raw structure. Stairwells that once projected into these areas now sit in the middle of the office floor, two angled planes of exposed concrete converging on a vertical slit opening, looking eerily like Second World War pill boxes.

Even without the lightwells, the workspaces meet WELL daylighting criteria, just based on the amount of glazing and visible sky. The shade provided by the overhanging terraces means that the new double-glazing can be highly transparent and almost full-height without affecting the thermal performance. Removing the suspended ceilings has helped too, increasing the floor-to-ceiling height by 900mm. "It's largely about perception," says Lee. "It certainly feels quite open and panoramic."

Services are organised on the 3.3m-3.6m soffits in shallow runs of ducts and cables. Heating and cooling are provided by air-source heat pumps on the roof, which also hosts 175 solar panels. Operational carbon is expected to be 70% lower than it was pre-redevelopment.

The IBM Building always felt slightly out of place: a defensive corporate HQ set back from London's cultural promenade behind a moat-like recess. The building fits more happily into its surroundings now. Its extended floorplates project out closer to the walkway, although you suspect that few people will notice – unlike the interiors, the junctions between old and new concrete on the cladding panels are almost seamless. It has the air of not just a new chapter, but a story completed. "It feels like the same building," says Lee. "It's such an organic layered form that even adding a level didn't really change it."

BELOW

The double-height reception has re-established the connection with Stage Door Avenue, the "valley" that Lasdun envisaged between the IBM Building and the National Theatre

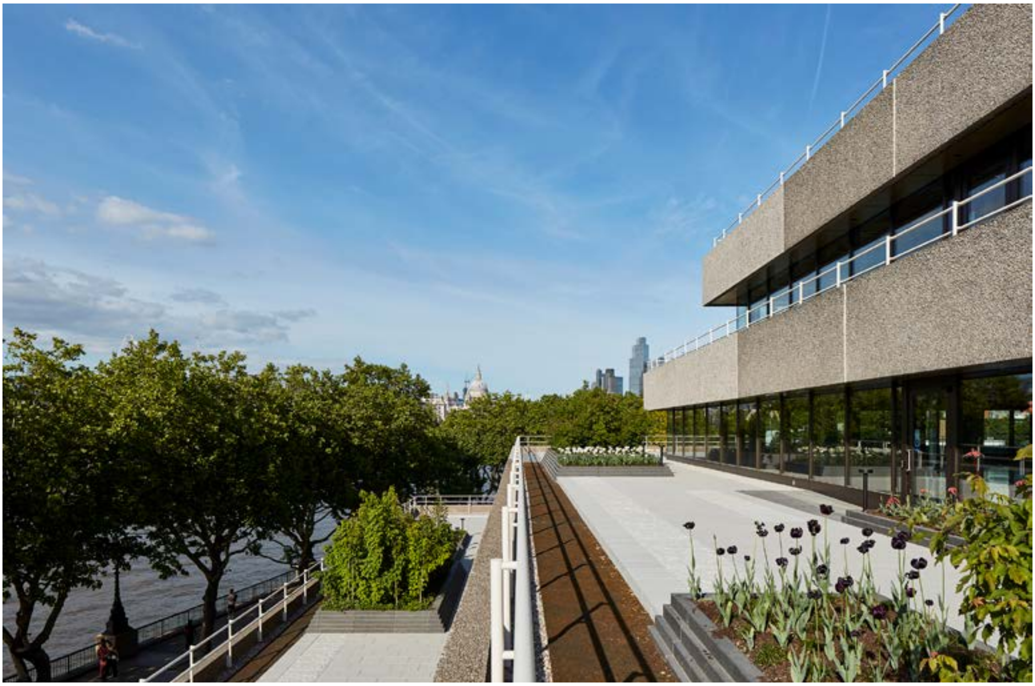


Photo: Rob Parrish

ABOVE
The new panels (on the far side of the building) will weather naturally to match the existing concrete

FACADE DETECTIVES

Removing, restoring and replicating the original panels

The precast-concrete facade is a defining feature of Denys Lasdun's design. Forming a continuous balustrade around the terraces on each level, the 7.2m-long panels were hand-seeded with granite aggregate to create a rough but controlled finish – more sober and business-like than the boardmarked in-situ concrete of the National Theatre. Working with facade consultant Eckersley O'Callaghan and masonry specialist Szerelmey, AHMM has replicated these panels for the extensions, as well as restoring the originals.

In order to carry out the restoration, more than 100 panels first had to be removed. Each weighed several tonnes, and the original lifting points had long since been grouted in and rendered unusable. They were also fully integrated into the structure, and it was unclear how much they contributed to the stiffness of the slab.

EOC undertook extensive core drilling, assessing the condition of the concrete and likely remaining service life of the units. From this analysis, it developed a removal strategy that involved extracting a 400mm slice of the terrace slab with each panel. These units were transported to an off-site yard, where the visible faces were steam-cleaned at high pressure. The original corbels and shear links were adapted into new bracketry.

AHMM had a benchmark for the tone of the concrete, as some riser panels from inside the building had been made using the same process, but spared 40 years of London weather. "We wanted to avoid the new panels being darker, because it would have made the building top-heavy," says AHMM's Will Lee "But we also wanted to avoid an exact match as they will darken over time." Using bronze bench-blasted aggregate from the original quarry, Carnsew in Cornwall, the team experimented until they got the right blend of silver and bronze tones. "The finished panels are slightly lighter, but they will weather down," says Lee.

Even though the team were able to track down the original manufacturer, Marble Mosaics in Weston-super-Mare, the exact method of hand-seeding the aggregate had been lost to history. "It's quite a lost skill," says Lee. "But there was a guy at Evans Concrete [then commercial manager Stuart Murison] who got right on top of it. He spent his evenings doing lots and lots of tests." Murison placed every piece by hand into a base layer of concrete. After an hour and a half, the mould was tilted and the aggregate gently washed with water, exposing the top 5mm. "He worked out how to make the aggregates stick, but also how to actually make them look good."

Photos: AHMM

TOP
The panels were seeded by hand with 32-40mm bronze bench-blasted aggregate from the same Somerset quarry as the originals

ABOVE
After 90 minutes, the panels were tilted and gently washed with water to expose the top 5mm of aggregate

ABOVE
The building was stripped back to the in-situ concrete frame, with the two original cores removed. The central lightwells were subsequently filled in

NEW GROUND

How HTS maximised reuse of the original structure

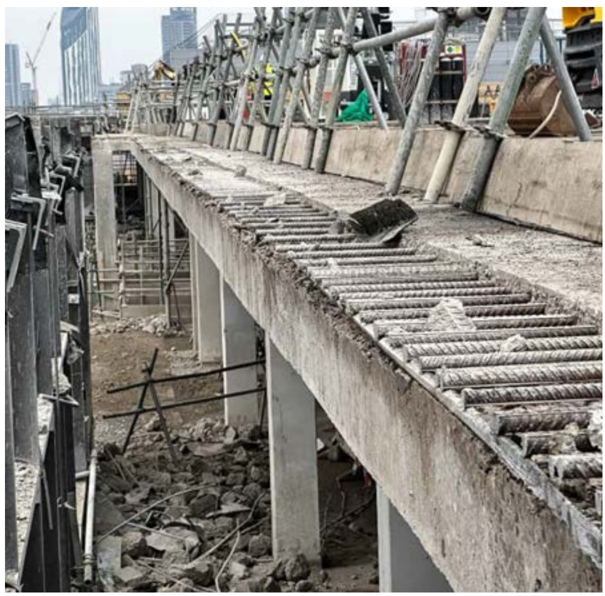
Often, extensions to existing buildings take the form of contrasting lightweight annexes or pavilions, which avoid adding too much extra load to the foundations. At 76 Southbank, however, all of the new elements use the same heavyweight brutalist construction as Lasdun's original.

From a structural engineer's perspective, this presented a number of challenges. "Almost all of the columns below the existing roof level were seeing a 200% increase in load because we were doubling the structure on top of them," says HTS's Andrew Middlebrook. "That trickles down the building." The same applied to the extended floorplates, which again doubled the load on the columns and foundations below.

HTS undertook a series of justification exercises to ascertain how much additional loading these elements could take. Tests on individual columns revealed that the concrete actually had a higher strength than specified and had probably got stronger over time. As a result, the number of columns that needed additional reinforcement was reduced from 160 to 110, cutting cost, embodied carbon and programme. HTS designed bespoke rebar "jackets" for each, which were then covered with an 80mm layer of concrete.

Testing on redundant piles showed that the existing substructure could also bear an increased load of up to 30%, cutting the number of new piles required. Due to the variable soil conditions of the riverside site, the building is founded on Franki piles, which have an enlarged, bulbous base to help withstand both compressive and uplift loads. The soil around these bulbs is stressed and essentially an active part of the structural system, so cannot be disturbed. This meant that the 300 new mini piles had to be driven at a splayed angle, away from the original piles – a first-of-its-kind solution.

The extended floorplates were tied into the existing slabs using hydro-demolition. Ultra-high-pressure jets of water were used to expose the reinforcement of the slab edge, which could then be lapped into the new rebar. The new slabs maintained the same 300m depth, and the connection required no additional columns or downstand beams, says Middlebrook. "If we had extended in another material, we might have had to put a secondary line of support on those new-to-existing edges. The two slabs work as one material and one diaphragm." ■



Photos: AHMM

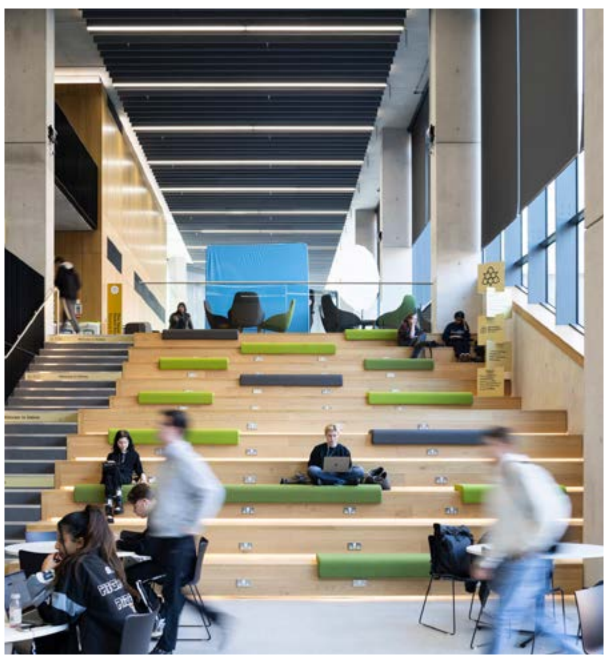
TOP
More than 100 columns were strengthened with bespoke "jackets" of reinforcement

ABOVE
The slab edges were exposed with high-pressure water jets, enabling the new rebar to be lapped in

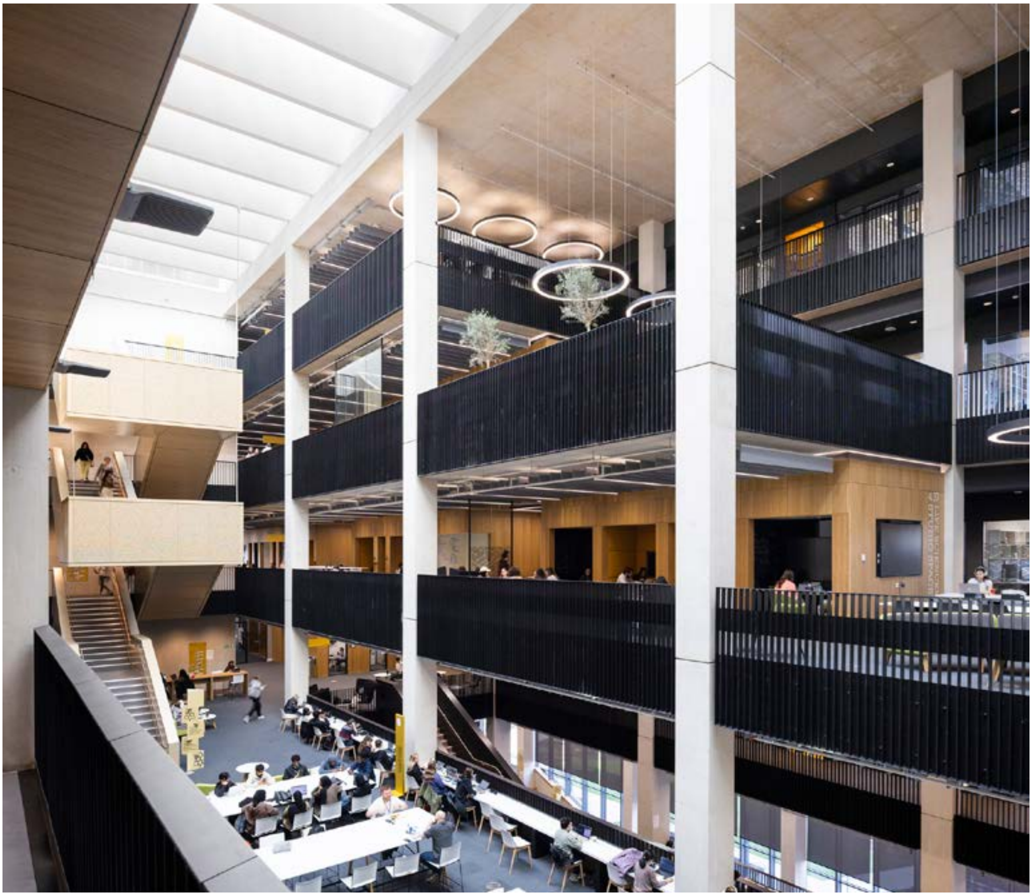
WELCOME MET

The Dalton Building, BDP's new science and engineering faculty for Manchester Metropolitan University, has been awarded North-West Building of the Year at the 2026 RIBA Awards. The seven-storey building is the largest on the MMU campus and acts as a gateway to the city centre from the busy Mancunian Way.

"This isn't just a building for the university, it's their front door, their civic presence to the city," says Mike Riley, architect director at BDP. "It was also an opportunity



Photos: Nick Caville / BDP



to put science and engineering on show."

Most of the structure is exposed, partly as a way of moderating the internal temperature: "We're trying to keep this building cool predominantly. There are a lot of people in it, and a lot of specialist processes that go on in it."

Active cooling slabs in the north side of the building turbocharge the thermal mass: "It turns the soffit into a massive reverse radiator. It worked really well in the recent heatwaves."

BDP also argued for an exposed structure on cost grounds. "The university sets aside a huge amount for ongoing maintenance. We said, if that's a pressure on your budgets, let's expose the concrete, let's not have sacrificial finishes. And by taking out those finishes, we now have a building that can be pretty heavily used by the students."

READ THE FULL STORY
concretecentre.com/cq

DEEP DOWN UNDER

It takes four long minutes to descend from the centre of Melbourne to the platform at State Library station – but it's worth the trip. Eleven storeys below the city, a single monumental space has been carved out of the bedrock, triple-vaulted like the nave of a cathedral and 10m high at the central aisle.

Opening up the platforms and the concourse was vital for alleviating congestion and claustrophobia on a line predicted to carry about 40,000 passengers an hour at peak times. However, a single vault spanning 30m would naturally have a very high arch, generating huge amounts of excavation material.

Instead, structural engineer Arup devised a unique "trinocular" solution, forming the cavern from three tunnels that overlap like the Olympic rings. This resulted in a smaller excavated volume, but with more concentrated useable space.

READ THE FULL STORY
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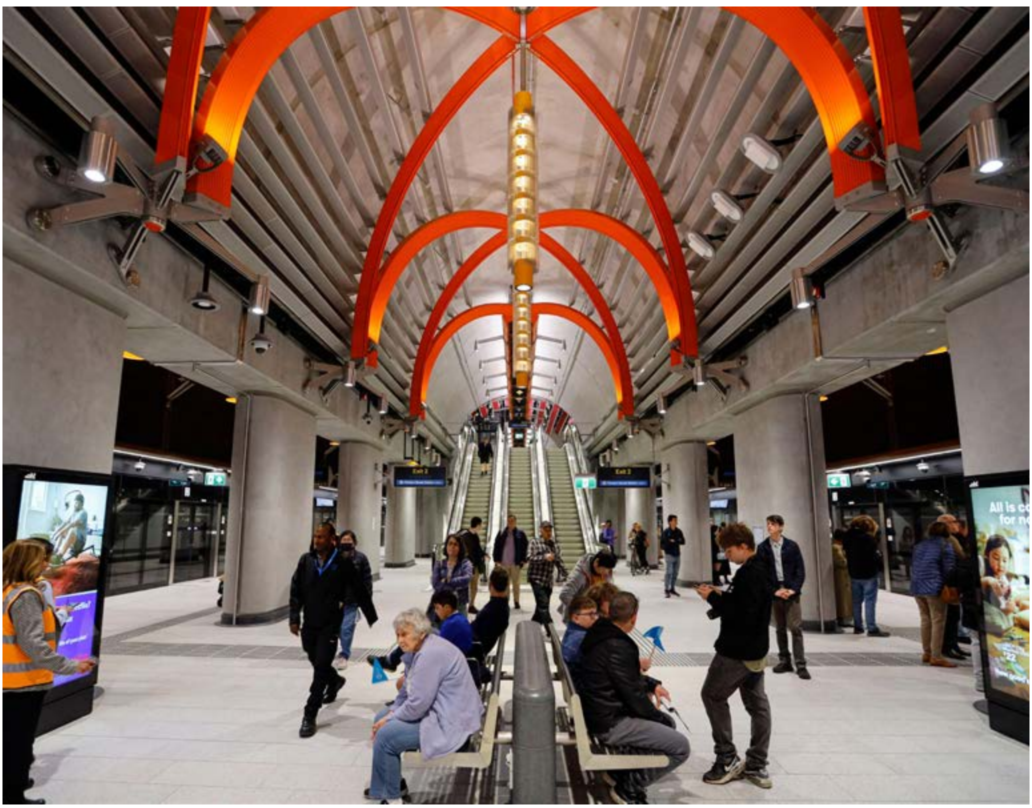


Photo: SIPA US / Alamy Stock Photo

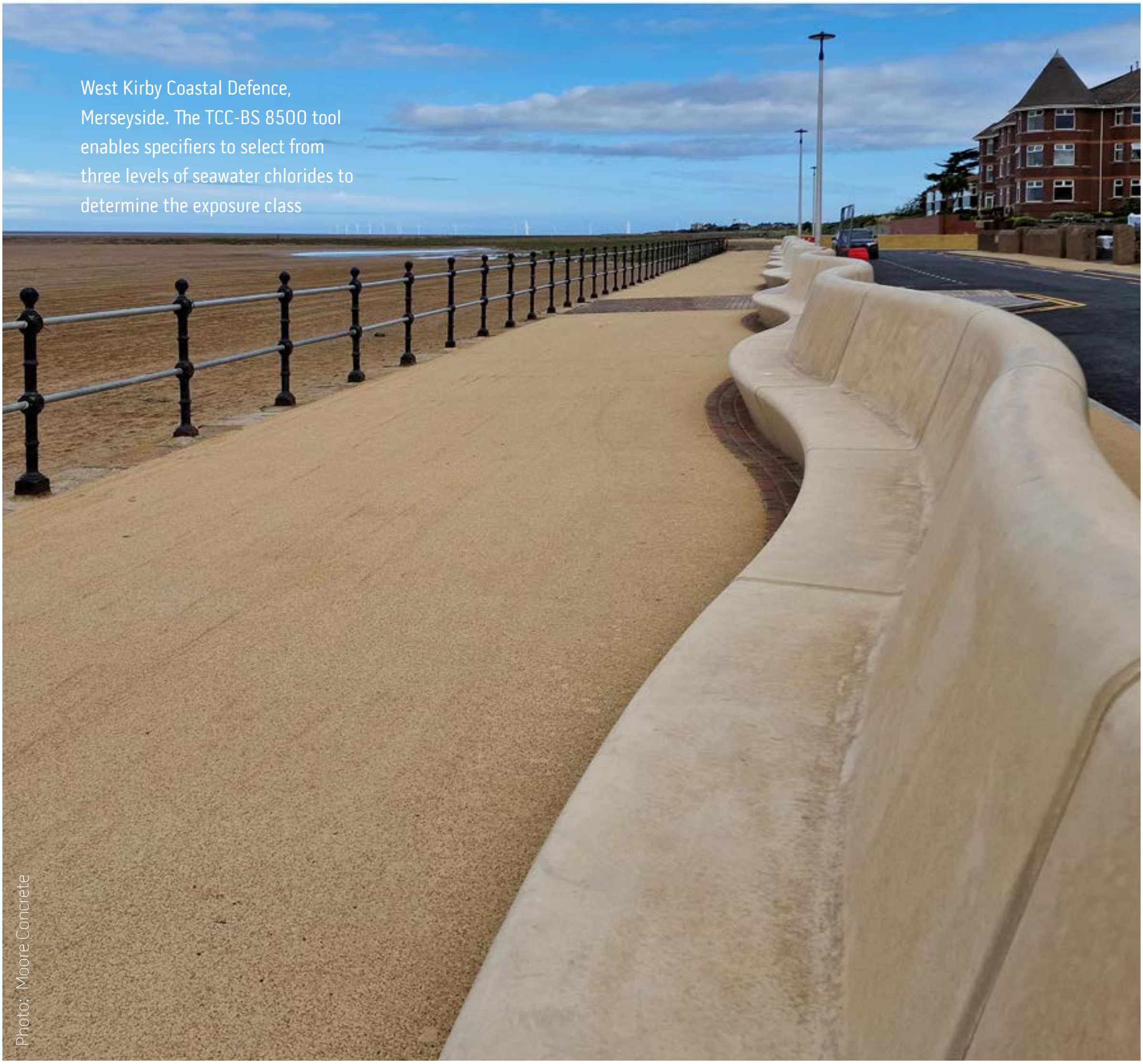
HEAVEN'S GATE

Japanese architect Kengo Kuma has added a precast-concrete portico to Angers Cathedral in northwest France. The 21m-long structure serves as a gallery, and a protective canopy for the sculptures that adorn the 13th-century edifice.

The studio said its goal was to "put ourselves in the shoes of the builders of the Middle Ages". The specially developed concrete was based on the shades of limestone found on the cathedral facade, with the sand and aggregates locally sourced from the Loire basin.

READ THE FULL STORY
concretecentre.com/cq

Photos: Guillaume Amat



West Kirby Coastal Defence, Merseyside. The TCC-BS 8500 tool enables specifiers to select from three levels of seawater chlorides to determine the exposure class

Photo: Moore Concrete

Simplifying concrete specification

The Concrete Centre has updated its TCC-BS 8500 tool, a free spreadsheet for helping specifiers to navigate the UK standard on concrete specification. Liam Forde explains how to use it

The UK standard for the specification of concrete, BS 8500, is a decision-making framework for translating design requirements, environmental conditions and the intended lifespan of a structure into a recipe for sound, durable concrete.

Specifying concrete is complex because it is not a single product, but a blend that must be tailored to meet different applications, exposure classes and carbon targets, and which may include a rapidly expanding range of lower-carbon cements.

The 2023 update to BS 8500 dramatically widened the menu of available options, increasing the complexity. It also changed the relationships between the exposure classes and limiting values of strength, minimum cement content and water/cement ratios, and introduced combined performance categories (CPCs) allowing producers to supply the lowest-carbon mix from many possible combinations.

Specifiers use the methodology in BS 8500 part 1 to determine a set of performance requirements – compressive strength, minimum cement content, maximum water/cement ratio and CPCs – for the concrete producer to meet. This can be a detailed calculation that involves optimising for multiple variables and balancing project constraints, structural design, buildability and carbon.

Fortunately, help is at hand: the TCC-BS 8500 tool was developed by The Concrete Centre to simplify the specification process and support early-stage decision-making on sustainability. Users input exposure conditions, design strength and cover. The tool then shows the limiting values that will satisfy durability requirements, compliant CPCs and indicative carbon values.

Specifying concrete with TCC-BS 8500

The TCC-BS 8500 spreadsheet is free to download from www.concretecentre.com/TCCBS8500. It is regularly updated, so specifiers should always check that they are using the latest version.

There are five tabs: Start, Specification – Concrete, Input Values, BRE and Notes. The key sheet is "Specification – Concrete". This is where most of the design and exposure data is input, and where the outputs are summarised. The specification itself is shown on the left, with the carbon calculation on the right.

There are three stages to producing a concrete specification that can be shared with a supplier.

1. Determine the exposure class

The first stage is to complete the exposure classes, under the "Exposure Conditions" heading, towards the top of the sheet. This provides the following options:

- Carbonation, XC – All concrete reinforced with normal reinforcing steel is subject to carbonation, so this exposure class is the only one that is always assumed to apply. The level of carbonation (XC1, XC2 or XC3/4) can be chosen from the drop-down list.
- Freeze-thaw, XF – The user chooses the level of freeze-thaw that the concrete will be exposed to (XF1, XF2, XF3 or XF4), and whether an air-entraining admixture should be added.
- Chlorides, either from seawater, XS or not from seawater, XD – Non-seawater chlorides would typically be from de-icing salts. Three levels are available in the drop-down lists (XD1, XD2 or XD3, and XS1, XS2 or XS3).

2. Do you need a Design Chemical class?

Below "Exposure Conditions", the next section is titled "Aggressive Ground Conditions to BRE Special Digest 1". When concrete is exposed to sulfates in the ground, it must be specified to a Design Chemical (DC) class. If this is the case, the drop-down box under the "DC" text should be set to "Yes", otherwise it should be left as "No".

The spreadsheet can calculate the required DC class from the results of a site investigation, following the guidance in BRE Special Digest 1. The relevant values should be input under "BRE 1". Background data is shown in the "BRE" tab for information, but cannot be changed.

The user does have the option to select a higher DC class in order to avoid using Additional Protective Measures (APM), such as surface membranes or sacrificial layers. They can also choose to allow the use of stronger mixes, which gives a greater range of options on cover and cement type.

Photo: Kilnbridge

3. Set the design requirements

Once the exposure classes have been completed, the user should return to the "Design Requirements" section at the top of the sheet to input the design strength class, working life (50 or 100 years), maximum aggregate size, minimum cover and permitted deviation in cover.

The adjacent box will show the minimum strength class required for the XC and the XF exposures. The user can change the chosen cover and/or the design strength class to ensure that the minimum required for the exposure is met.

The final specification

The bottom of the sheet will now give the final options: strength class, nominal cover, minimum cement content and maximum water/cement ratio for the compliant CPCs. This can be transferred into the specification for the supplier.

ABOVE
At Canary Wharf Group and Kadans Science Partner's One North Quay development in London, contractor Kilnbridge has tested and implemented 25 different concretes, including the first CEM VI mix to be used in the UK under BS 8500

Using the carbon calculator

Alongside the specification itself, the TCC-BS 8500 tool shows indicative carbon values. This enables users to easily see how different parameters affect embodied carbon and to explore ways of lowering it.

The carbon calculator has several functions to simplify the outputs. At the top right-hand side, there is a drop-down menu, from which users can choose to show only the embodied carbon values, or colour-code them according to one of two industry rating schemes:

- The Universal Classification by Arup-Innovate UK is intended for setting long-term targets and monitoring progress towards net zero. Concretes are ranked in static bands from A to G, where A is carbon-negative and G represents embodied carbon that is higher than a conservative industry baseline.
- The GCCA Classification (UK adaptation), developed by the Global Cement and Concrete Association, uses rating bands based on the current market to allow global comparison of products.

These ratings can help inform carbon targets, although any target should be sense-checked with concrete suppliers to ensure it is feasible.

At this point, users can choose to remove non-compliant cements that do not meet strength and durability requirements. They can also change the water content to alter the fresh properties – this will influence the cement content, and therefore the carbon values. The columns show the options for water/cement ratio and minimum cement content, in order to demonstrate the effect of these limiting values on carbon.

Rows show different cement types, with the cement content required to achieve the specified strength on the far right. This may be the most significant factor in the carbon calculation.

From the three limiting values (water/cement ratio, minimum cement content or strength), the carbon calculator will take the highest cement content, as this is how the actual cement content will be determined by the supplier.

Embodied carbon factors

Default embodied carbon factors are listed on the sheet titled "Input Values". These are typically based on data such as sector environmental product declarations (EPDs), but they can be replaced when more accurate data is available from manufacturers. The alternative figure should be input into the "User" column. In the adjacent column, "User" should be selected from the drop-down menu under "Used", and this will update the carbon calculations in the main specification sheet. The input values should be set back to "Default" for new projects.

This sheet also shows the input values for concrete density, water and admixture content, and the cement content required to meet design strengths. These can also be changed, but any data should be validated with guidance from suppliers.

The TCC-BS 8500 tool is intended to aid specifiers in understanding how using different cements, altering design inputs and changing fresh state properties can affect the final carbon figures for a concrete specification. While it is only indicative, it can help steer early-stage design decisions. As projects progress, working collaboratively with concrete suppliers is essential for unlocking further carbon savings. ■

Liam Forde is a chartered civil engineer and head of construction and infrastructure at the Mineral Products Association

BELOW
Holcim supplied a CEM VI mix incorporating limestone filler for developer GS8's Thornwood residential scheme in Essex, which results in an embodied carbon 48% lower than with CEM I

Photo: Holcim UK

Photo: Gilbert McCarragher

FINAL FRAME: TRACE, LONDON

Bureau de Change architects has updated a 1980s block of flats in London with a pink concrete facade made from demolition waste. Bricks and mortar from the original frontage were crushed into aggregate of up to 6mm in size. This was then incorporated into the hand-cast glass-reinforced concrete panels to create different tones from pale pink to deep red.