mpa The Concrete Centre

CONCRETE QUARTERLY

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LORD OF THE DANCE
Concrete demonstrates its dexterity at Glenn Howells' English National Ballet HQ

MEDICAL MARVEL
How Stanton Williams built a pioneering paediatric research centre – and made it look simple

BEYOND FABRIC FIRST
The new frontiers in the battle to reduce building energy consumption

CASTING OFF

INSPIRATION

APPLICATION

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CONCRETE QUARTERLY

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English National Ballet headquarters, London, by Glenn Howells Architects
Photo by Hufton + Crow

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Elaine Toogood
Head of architecture, The Concrete Centre

We need to talk

You'll notice a few changes in this issue of Concrete Quarterly, not least a new face in the editor's chair. I'm absolutely delighted to be taking on this role at such an exciting and pivotal time for building design and construction, when aspirations and targets are evolving rapidly in response to the need to address global carbon emissions.

As the pace of change necessarily accelerates towards net-zero, it is a challenge for everybody to know what the right solutions are and where to look for relevant, reliable information – and even what questions we should be trying to answer. Climate change is making us all think about what we do and how we do it, so it's more important than ever that designers understand what other disciplines bring to the table, and their perspectives, motivations and ways of working.

That's why we've merged our technical content aimed at architects and structural engineers into a single Application section (pages 14-19), and also added a new first-person section where designers discuss their influences and the processes by which ideas are developed into their built form. This issue's Origin Story (page 5) sees Adam Richards describe the thinking behind his award-winning family home, Nithurst Farm.

These conversations will be essential as we are forced to challenge our "normal" ways of working. None of us operate in isolation, and sharing knowledge and data will be even more important in the future for working out what's possible and making better decisions. All design is dependent on teamwork, but it's particularly important in the case of concrete, when so many of the opportunities for greater sustainability cross traditional boundaries. Visual concrete can be an aesthetic choice, but can also underpin a cooling strategy, for example; post-tensioned slabs enable much longer spans and maximise available space and floor-to-floor heights while using less material. There is so much to be gained from viewing projects holistically, rather than from within our silos of expertise.

In our Innovation section (page 3), meanwhile, we want to draw attention to the amazing research going on in labs across the UK and beyond, to further reduce the carbon content of concrete and to expand the frontiers of material efficient design – one example is discussed opposite by Dr John Orr at the University of Cambridge. After all, as the speed of change increases, these bold new innovations could be with us a lot sooner than we expect.

IT'S MORE IMPORTANT THAN EVER THAT DESIGNERS UNDERSTAND WHAT OTHER DISCIPLINES BRING TO THE TABLE

EVENTS

FUTUREBUILD & CONCRETE FUTURES

The annual Futurebuild exhibition and conference takes place at London's ExCeL on 3-5 March. The Concrete Centre will be on hand throughout to provide expert advice and guidance on low-to-no-carbon design and specification at stand E80 – the full programme will be announced shortly. Attendees will also be able to see and learn about innovative new products for themselves in the Concrete Futures exhibit. The Concrete Futures lecture series launches later this year, with the first taking place on 9 June at the Building Centre in London. Designers and researchers will discuss the latest developments at the forefront of sustainability, and how they can be applied today.
concretecentre.com/events

Photo: Paul Burroughs

Images: 1. BAM Nuttall 2. Apis Cor 3. Jorg 4. Rob Parrish

ROUND-UP: TO SPACE HOUSE AND BEYOND

There were exciting developments in the fields of artificial intelligence and robotics as the second decade of the 21st century came to an end. Concrete tech firm Converge and contractor BAM Nuttall unveiled what they claim is the world's first AI "concrete strength prediction engine", used on the expansion of London City Airport (1). Sensors embedded in the concrete are combined with machine learning to predict several days in advance when it will reach strength, helping a project team to plan when to mobilise teams for post-tensioning or formwork striking. Meanwhile, in Dubai, US-based 3D-printing company Apis Cor completed the world's largest 3D-printed building to date. The two-storey Dubai Municipality office (2), 9.5m-high with a floor area of 640m^2, was constructed from gypsum-based formwork, reinforced with concrete and rebar. Back to the 20th century, and Richard Seiffert's Space House, an icon of 1960s London, is set to be given a new lease of life under plans drawn up by Squire & Partners (3). The scheme would see a new "facsimile" storey, matching the 1960s structure's lower floors, added to the top of the building. And finally, in a further reminder of London's increasingly impressive record in reusing 1960s structures, the World Architecture Festival honoured Allford Hall Monaghan Morris' redevelopment of The Bower (4) with its New & Old award.

INNOVATION: ROBOTIC FORMWORK

"You waste less and significantly reduce the carbon involved in construction"

Photo: Paul Burroughs

You may have seen those pin-mould toys that make popular stocking-fillers; press your hand onto the bed of closely-packed blunt metal pins and – hey presto! – a 3-D sculpture of your hand. The Amazon listing promises that the "possibilities are endless" and invites buyers to "let their imagination run wild".

Doing just that is the ACORN team – a group of researchers at Cambridge, Dundee and Bath universities. Digital design experts at Bath are creating software tools that will be used – among other things – to power a giant 8m x 4m pin-mould in Cambridge to become bespoke formwork at the touch of a return key.

Heading up ACORN in Cambridge is Dr John Orr, lecturer in concrete structures: "Pin-moulds have already been used to make precast facade panels, but we are looking to build on the idea – for example, by having robotic arms place reinforcement within the flexible moulds and using them to make more efficiently designed structural elements."

The smarter production of columns and beams – elements that use just enough material and space to perform their structural function and no more – is the primary aim of ACORN. "The key benefit, compared with standard planar formwork, is that you waste less and so significantly reduce the carbon involved in construction," explains Orr. "But our approach also involves taking more manufacture off-site and realising other benefits such as faster construction and safer working."

Optimising structures in this way – entering a world of tapering columns and "fish-belly" beams that are thicker in the middle where the strength is needed – has been discussed before. But contractors and engineers are usually sceptical and fear higher design costs and questionable buildability. They should be reassured by Orr's approach: "I did my first degree at Bath University partly because it had a combined department of architecture and civil engineering. I think having an architect doing a squiggle and then passing it on to an engineer to build is not a good way of doing things."

Addressing the disconnects between design and practicality is at the heart of the ACORN project: "We do the messy concrete stuff here in Cambridge, but the digital side, mainly being done at Bath, seeks to optimise structural design and ensure it links coherently to automated or robotic manufacturing, while at the same time developing computational tools for constructability."

ACORN is not about creating impossible designs, says Orr: "Rather we are about moving from mass production to mass customisation – making it easier to design and build efficiently."

Staying true to his roots then, Orr wants ACORN to use the latest tech to allow architecture and engineering to work as one from the start. If they get it right, buildings will need less material and enjoy smaller carbon footprints. And some of them, at least, will look like nothing we have seen before.

■ **Interview by Tony Whitehead**

LASTING IMPRESSION

ALEX ELY

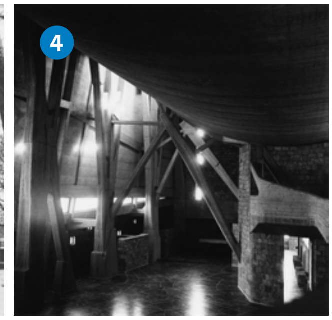
LE CORBUSIER'S INFLUENCE, AND INFLUENCING LE CORBUSIER

Six years ago, I was lucky enough to visit Moisei Ginzburg's Narkomfin building 1 in Moscow (1931). It's a housing block built during the heyday of constructivism, so there's a real energy and a liveliness to the architecture. Ginzburg raised the building off the ground on pilotis, put a terrace on the roof and ran ribbon windows along the length of the facade. You can see these ideas informed Le Corbusier – he claimed authorship, but Ginzburg got there first. Inside, it has this really interesting section, with the circulation on every other floor and the apartments wrapped around on split levels. At Mae, it has really informed the way we think spatially about housing.

I'm a big fan of the Swiss modernist practice Atelier 5. They made their name with Seidlung Halen 2 (1961), a development of 81 houses that step up a wooded hillside outside Berne. As with the Narkomfin Building, the concrete isn't expressive but it couldn't have been built from anything else. It nestles into the hillside, and over time it's been completely enveloped in greenery, so it looks like a wonderful ruin even though its fully occupied and loved. A more expressive Atelier 5 project is the housing at Brunnadernstrasse 3 (1971), also in Berne. The setting is quite suburban, but suddenly you see these amazing projecting balconies and circular staircases, staggered bay windows and brise-soleils with concrete fins that support window boxes. The concrete has a sculptural quality and I'm interested in how they've created depth in the elevations – using it to help manage climate and provide outdoor-indoor space.

I can appreciate where all of these projects are coming from, but with my final choice, I'm left wondering how an architect arrives at such a design. Last summer, I was on the motorway from Florence to San Gimignano when I spotted Giovanni Michelucci's church of San Giovanni Battista 4 (1964) out of the corner of my eye. When you step inside, there's this wonderful tent-like space with columns that look like trees and no repetition – each one does its own thing. I presumed there was some structural logic but I couldn't work it out. The light just creeps in at the apex of the roof, and you have the contrast between moments of bright light washing the billowing roof and areas of pitch black where it disappears into the recesses of the bell tower. It's quite mystical.

Alex Ely is founding director of Mae



Photos: 1. Heritage Image Partnership Ltd / Alamy Stock Photo 2. Ginkgo2g / CC BY 3.0 3. Tom Oliver Payne 4. RIBA Collections

FROM THE ARCHIVE: SUMMER 1991

A GREEN RADICAL, DEEP IN THE SURREY COUNTRYSIDE

Ted Cullinan, who died in November, was the architect of one of the great concrete buildings of the 1990s. The RMC headquarters in Thorpe, Surrey, was both a radical new approach to the office typology and a pioneer of passive energy design. The campus took the form of a series of pavilions set amid mature trees in the grounds of three historic buildings, including the grade II-listed Eastley End House. As CQ observed, "The innovative solution to the problem of accommodating a large new office complex on a sensitive green belt site was to form landscaped gardens over the new buildings, with courtyards in between." The magazine also noted that there was more than a nod to the client's core business: "It is hardly surprising that high-quality concrete, both in-situ and precast, has been used extensively in the structure and landscaping." Of particular note were the staircase flights, which were cast as single units and lowered in through the roof.

But perhaps the most significant role played by concrete in the building was as a sustainable material, long before the idea of sustainability had gained much traction. Working alongside Max Fordham as services engineer, Cullinan exposed the concrete slab supporting the roof gardens to exploit the material's thermal mass, thereby allowing the deep-plan offices to be naturally ventilated.

Access the full CQ archive at concretecentre.com/cqarchive. A book, The World Recast: 70 Buildings from 70 Years of Concrete Quarterly, is available from www.concretecentre.com/publications


Buried Treasure

ORIGIN STORY

NITHURST FARM

ADAM RICHARDS ON THE SOVIET SCI-FI FILM THAT UNLOCKED HIS SUSSEX FAMILY HOME

I'd always wanted to build a house for myself and my family. It's quite a profound thing, making a home for yourself in the world – human beings are always striving to find some sort of harmony with nature or their environment.

A key inspiration for the design was a 1979 film called Stalker by the Russian director Andrei Tarkovsky. It's the story of a journey into a forbidden zone where the normal rules of physics don't apply. At the heart of the zone, it is rumoured that there is a room where all your deepest wishes come true, but the film is a bit like a grail quest, as much about the journey as the destination.

The film implies that everybody has their own room – and, in a way, that's what the sitting room in our house is. There is a sense that you go on this journey through the landscape to get to the house, and then through the house into the room itself. Our kitchen is structured to resemble the antechamber to the room, through both its form and its materials, with great slabs of concrete down the sides that are very similar to the space in the film.

The zone is a mix of green landscape – not unlike the Sussex countryside – and post-industrial derelict buildings, with a sort of dystopian beauty. It was part of a moment where people were seeing the beauty in the ruins of 20th-century industry, similar to how 18th-century Romantic poets changed the way people saw ruined abbeys. That's one reason I was really keen to use concrete, but it also opens the door to a series of other associations – in its stone-like character, it makes a space potentially like a church or a castle.

The concrete is just as it came out of the moulds. The only contractor we could afford had done lots of things like water-pumping stations and he was really anxious about our local mix being dark grey, and not a visual concrete that we'd like. Meanwhile, we were talking about making it more sustainable and the suggestion was to introduce recycled content in the form of ground-granulated blast furnace slag. That lightened it up, and we ended up with this really lovely pearly grey.

In the Tarkovsky narrative, you are somehow changed by the experience of going into the room.

Photos: Brotherton Lock, Georgui Pinkhassov

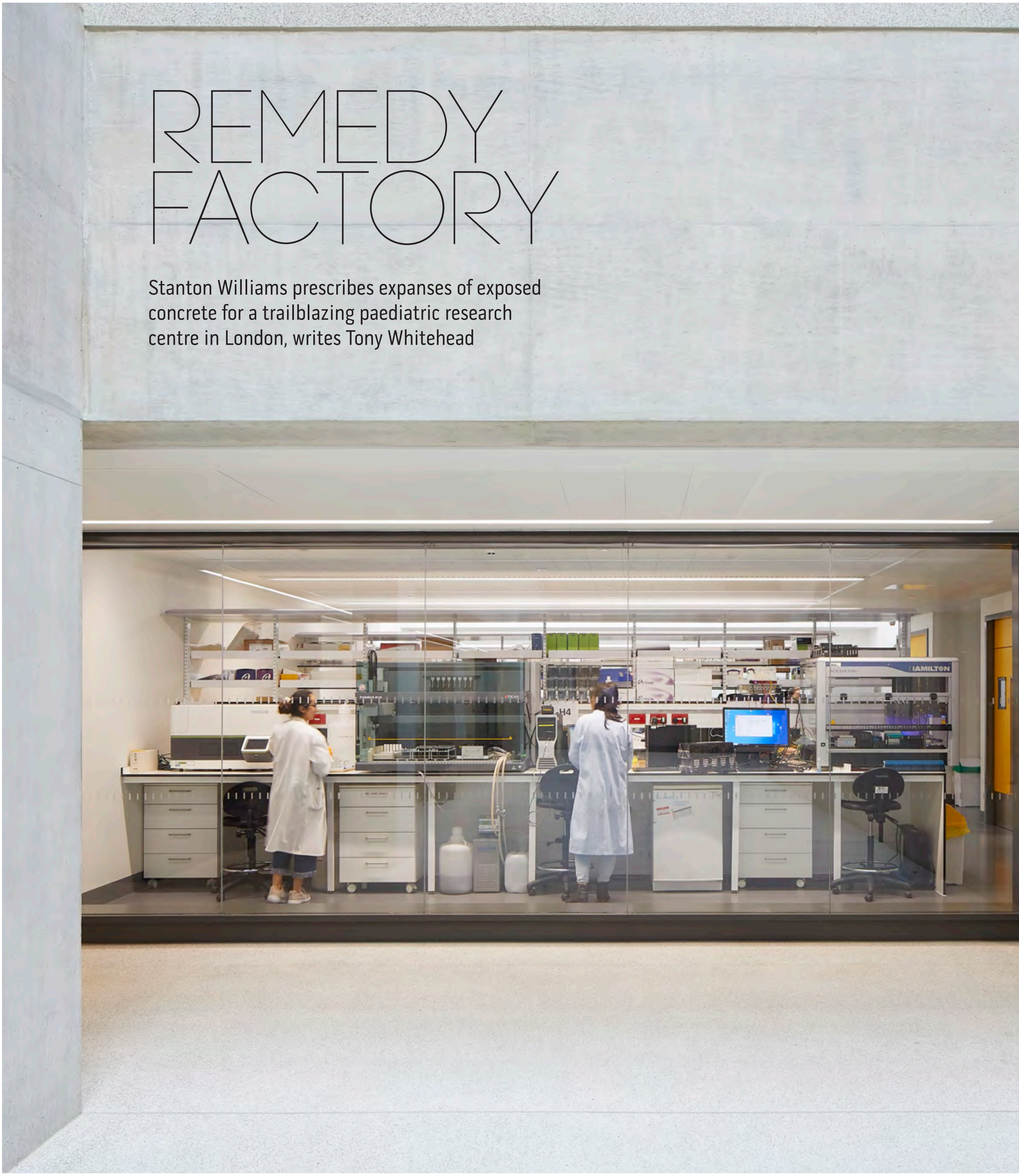
Nithurst Farm has a tapering plan – you come in at the end of the main space, and it gives you a false perspective so it looks longer than it is and more dramatic. It's so subtle that you can't tell – the only reveal is that the floorboards come together at a slight angle. But when you come back out into the kitchen from the living room, the space looks completely different, wider and shorter, because you are looking at it from the other end of the false perspective. So it's a naughty game that I'm playing. We obviously couldn't turn the landscape into a maze of traps, like in the film, but we could design the building in a way that makes it feel like the normal rules of physics don't quite apply.

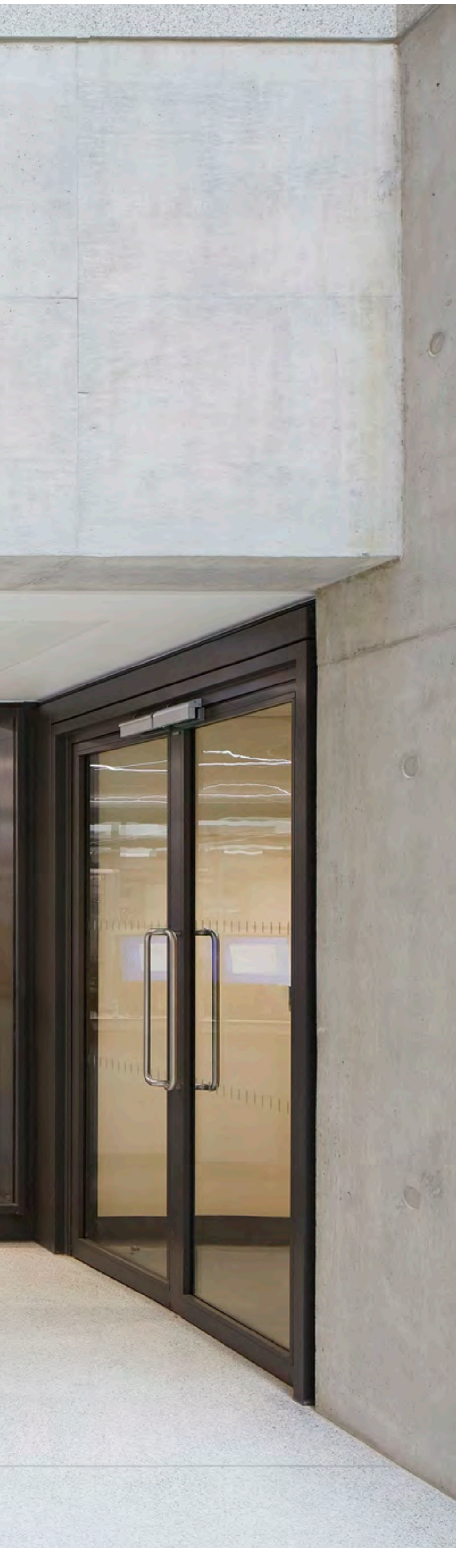
I first saw Stalker about 20 years ago, but it's one of those films you keep coming back to. My wife doesn't have quite the same obsession with it. Just before we moved in, we went to see it at the ICA. It was the middle of winter, we had stinking colds and we were on these really uncomfortable seats. At the end, we just looked at each and said 'we're never watching that film again'. But then I had to give a talk about it, so I thought I'd better watch it. And the penny dropped: I realised I could watch it in the house, in "the room". So I did. There was an amazing feeling of completion.

Adam Richards is founding director of Adam Richards Architects. Interview by Katie Puckett

REMEDY FACTORY

Stanton Williams prescribes expanses of exposed concrete for a trailblazing paediatric research centre in London, writes Tony Whitehead





The small park in north London known as Coram's Fields is the site of a former foundlings hospital and still preserved as a special place for children: no adult is permitted to enter unless accompanied by a child.

It is a fitting location for the newly constructed Zayed Centre. Designed by Stanton Williams and built by Skanska, the centre is both a world-class laboratory conducting research into rare diseases affecting children, and an outpatients centre for the nearby Great Ormond Street Children's Hospital (GOSH). Situated on Guilford Street, and overlooking the grassy expanse of Coram's Fields, the 13,000m^2 building can claim to be the most sophisticated paediatric research centre in the world.

"The centre brings together doctors from GOSH and scientists from University College London (UCL) with other specialists so they can all work together under the same roof," says Stanton Williams project associate Kalpesh Intwala. "The clients wanted the centre to be an 'ideas factory' where experts from different disciplines could interact creatively. That 'factory' idea helped to inform the aesthetic – with plenty of exposed concrete and open spaces designed to encourage communication."

Standing at basement level in the five-storey, full-height atrium that runs through the centre of the building, you can appreciate what he means. The in-situ concrete 10m-grid structure is laid out for all to see, with each floor open onto the atrium and able to view the others. The slab edges, widened with concrete upstands to conceal raised floor voids, look almost industrial, while a long in-situ concrete staircase running along one side connects all the main functions of the building, including a drug manufacturing facility, patient treatment rooms, office space, seminar rooms and a laboratory.

"The impression is that the stairs are supported by solid concrete – though of course it is hollow and there is actually floor space on the other side of the exposed concrete wall," says Intwala. "It looks a little as if it has been carved out of the concrete – the material has this sculptural quality – and its prominence encourages occupants of different floors to use it and interact with one another."

The Zayed Centre has been constructed on a site once occupied by a disused UCL building. "For sustainability reasons we looked at whether it might be possible to refurbish and reuse the old building," says Intwala, "but the Zayed Centre has specialist spaces, like the double-height laboratory, specialist functions, a low-vibration requirement and lots of complex laboratory and medical services, so sadly refurb was not going to be practicable."

IT LOOKS A LITTLE AS IF IT HAS BEEN CARVED OUT OF THE CONCRETE – THE MATERIAL HAS THIS SCULPTURAL QUALITY

Happily, however, the new building has been designed very much with sustainability in mind and the use of concrete is central to its BREEAM Excellent environmental rating. "It helps in a number of ways," says Intwala. "For example, we have used post-tensioned floor slabs to reduce slab thickness and so decrease the total amount of concrete required (see box, overleaf). Also, having exposed concrete walls and soffits in many areas throughout the building means that the structure is also the finish. This minimises the use of plasterboard, ceiling tiles and so on."

Bare concrete, he adds, is extremely low-maintenance: "This is particularly useful in high-use areas like the atrium. There are no linings to paint or replace over time. The building has a design life of 60 years but will hopefully remain useful long after that." Though purpose-built to support a range of specialist functions, Intwala says the facility remains eminently adaptable: "There are some upstands hidden within the raised floors of the building, but the flat slabs and lack of downstands should help with any reconfiguration occasioned by changing use. With clear spans, there's nothing to get in the way."

The concrete mix itself also contributed, comprising 30% ground granulated blast-furnace slag (GGBS) as a cement substitute. Because cement is the most carbon-intensive component of concrete, use of GGBS reduces its carbon footprint. "Ideally we would have liked a higher proportion of GGBS – perhaps 50% – but because this slows the curing and strength-gain characteristics of the concrete it would have created programme issues for the contractor. Thirty per cent was more manageable."

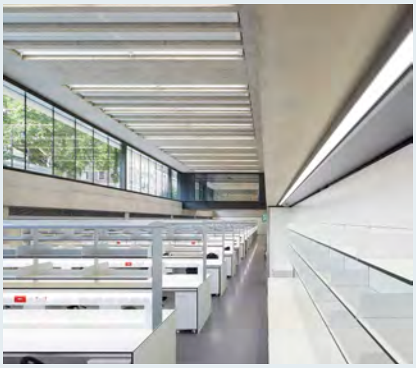
Finally, says Intwala, with much of the concrete structure exposed to the air inside the building, its thermal mass helps to regulate the internal temperature and reduce heating and cooling requirements. This technique makes a regular appearance in Stanton Williams buildings: it featured in the 2012 RIBA Stirling Prize-winning Sainsbury Laboratory, for example, and more recently at the Judge Business School in Cambridge (CQ 264, Summer 2018).

In all of these, exposed concrete absorbs excess heat, such as that generated by people and computers, and helps to keep the buildings cool during the day. In summer this heat can be vented overnight, or in winter retained to reduce heating requirements the following day. At the Zayed Centre, a combined heat and power plant (CHP) on the site contributes further efficiencies to the system.

The concrete used throughout the building was from standard mixes ranging from C50-60 for columns to C30-40 for upper-storey slabs. "We minimised special requirements," says Intwala. "It's a large building with a fair amount of concrete (4,300m^3) so cost was obviously a factor. Similarly, the formwork was standard ply boards with an MDO face."

He stresses, however, that despite the low-cost ingredients, finish and appearance were

Photo: Hufton + Crow



Spacious labs and PT slabs

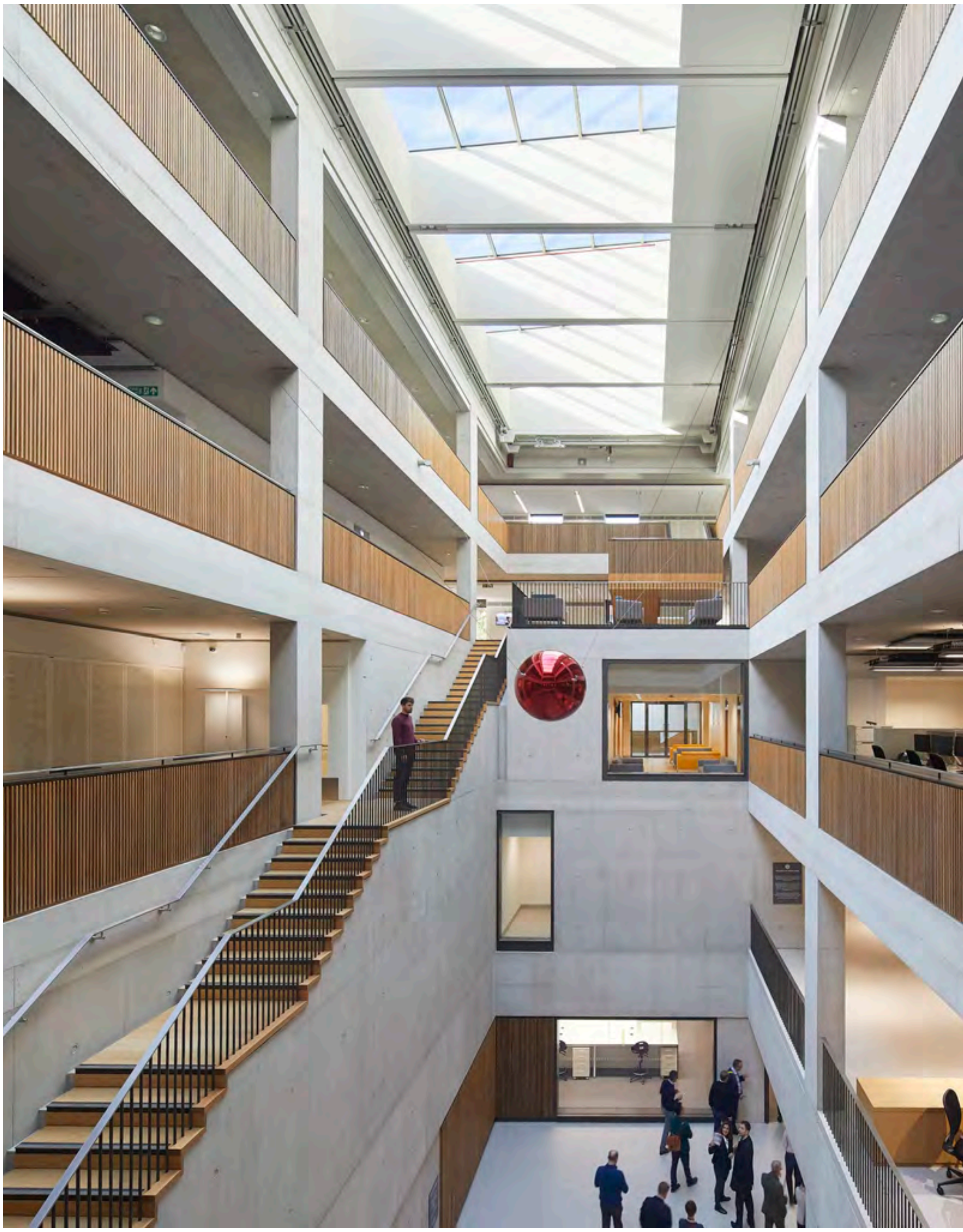
"In many ways this is a straightforward building," says Andy Murray, technical director at structural engineer Pell Frischmann. "It has a rectangular floor plan, with two-bay slab spans to the north and south of an atrium. But having said that, it takes a lot of hard work to make it look simple."

Much of this care and attention was geared to maximising the high-quality space that could be derived from this constrained site. A height restriction imposed by planners led to the deployment of post-tensioned (PT) slabs to fit in the required storeys, while ensuring generous floor-to-ceiling heights. The slabs are 290mm deep, says Murray, but without post-tensioning they would have been around 375mm – in other words, a gain of 85mm of head space.

More structural thoughtfulness was needed to create space in the lower-ground, double-height laboratory. "We used the whole footprint of the site below ground – the lab effectively extending a little under Guilford Street," says Murray. "There is then a step back to the building perimeter at ground level." This was achieved by concrete columns in the lab area which support the north elevation to ground level, at which point solid steel columns take over to provide a slimmer structure for the highly glazed ground floor.

From the first floor up, concrete columns resume their duties on the north elevation, but in order to form a secure base for their slightly offset loads to land, a strengthened first-floor slab was required. "At this point the 290mm PT slab would not be strong enough, so the solution was a thickened ribbed slab," says Murray. This comprised a 150mm-thick slab supported by in-situ reinforced ribs at 800mm centres, 750mm deep and 200mm wide. This was supported in turn by PT transfer beams at 9,600mm centres, 1,800mm wide by 750mm deep.

This is one of the very few areas with downstands of any sort and was made possible by the extra ceiling height of the laboratory. They have also been incorporated into the services design, with acoustic material, lighting and other services fitted within metal panels which slot neatly between the concrete ribs.



priorities. "Concrete is an important part of the aesthetic," he says. "The result is actually quite smooth – and for most of the visual concrete, and in particular front-of-house areas such as the atrium, we provided drawings for the joints and the setting out of boards and tie-holes to ensure the natural markings left by the formwork were tidy and symmetrical."

While small variations in the appearance of the concrete were accepted as part of the material's natural finish, in a few areas some extra finishing was required to improve consistency (see box).

Exposed concrete finishes have even been extended into some of the treatment areas by means of a sealant capable of resisting the chlorine found in hospital disinfectants – proof that harsh white surfaces are not inevitable in buildings of this type.

As Intwala says, the bare concrete, coupled with other natural materials like wood panelling and brick, "helps to create a relaxed, non-clinical aesthetic". It is an aspect of the centre no doubt appreciated by its younger visitors and their concerned parents.

PROJECT TEAM

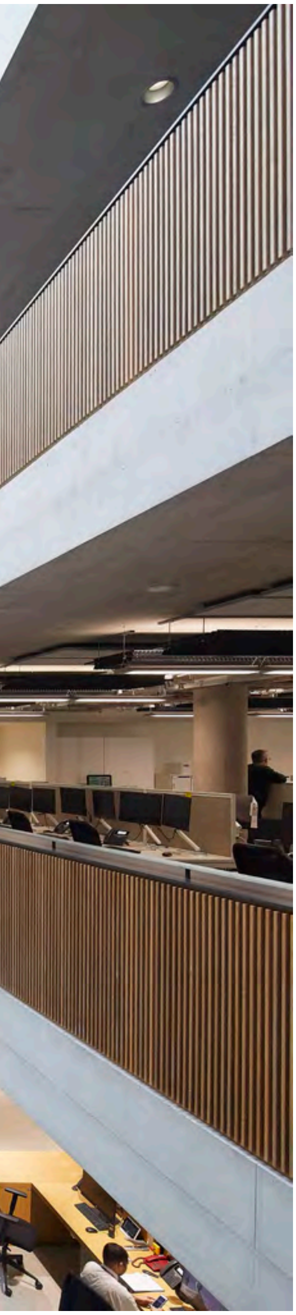
Architect Stanton Williams

Structural engineer Pell Frischmann

Main contractor Skanska

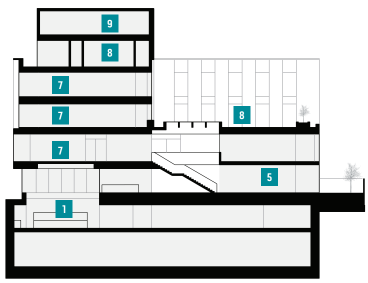
Concrete contractor Getjar

Concrete finishing GreyMatter

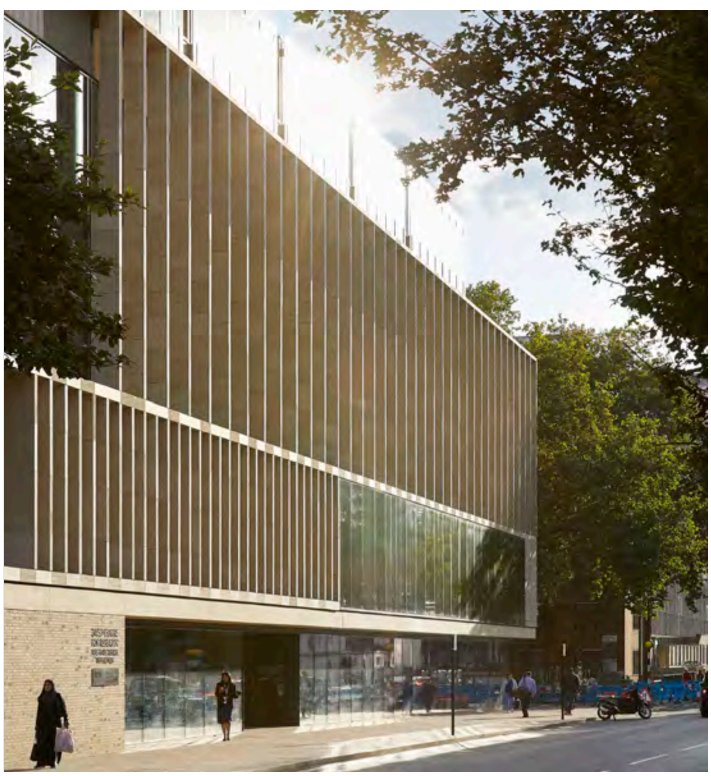


ABOVE The central atrium, where the in-situ concrete 10m-grid structure is clearly visible

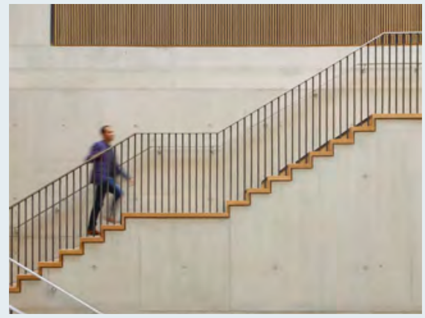
GROUND-FLOOR PLAN AND SECTION



1 Double-height laboratory
2 Entrance bridge
3 Main reception
4 Outpatients reception
5 Consultation rooms
6 Seminar room
7 Open-plan workspace
8 Clean rooms
9 Plant



RIGHT The Guilford Street facade – the glazed ground floor allows passers-by to glimpse down into the double-height laboratory



The art of post-finishing

"You never really know what you're going to get until you've got it," is how Jonathan Reid describes the art of casting concrete in situ.

He exaggerates a little. Experience and skill can produce remarkably accurate and predictable results. However, the natural variations that inevitably occur in concrete, the very thing that so many architects love about it, sometimes exceed their brief and need toning down a little. "This is not about 'making good'," says Reid. "This is about post-finishing – just part of a process that results in a great finish."

At the Zayed Centre, Reid's specialist finishing company GreyMatter attended to a number of areas, mainly to tone down variations in colour. The first stage of this process, he explains, is to wait and do nothing. "Once struck, you have to let the concrete have its time – for the surfaces to dry and something like the final colour to emerge. You then have to compare different areas and decide what amount of variation is acceptable within the original design intent."

He also advises seeing concrete in as finished a context as possible. "It looks very different surrounded by brick, timber or other finishes to when it's just sitting in a puddle on site."

Among areas needing consideration at the Zayed Centre were some of the columns in the laboratory area. "Mottling here was probably caused by slightly different absorbency levels in the formwork. It can vary, for instance, depending on how often boards have been used."

Elsewhere, some tie-hole halos (dark rings) and darkening around board joints also required attention. "Grout loss through cracks or holes can cause this," Reid explains. "The escaping moisture can drag fine particles of sand with it to the surface where they alter the colour."

To deal with this, Reid works rather like an oil painting restorer, employing a range of techniques as needed, some containing small amounts of cementitious material. "We are not covering the concrete," he says. "Rather, we are bringing back the existing surface to the surrounding shade."

There is no single solution or strategy that suits every project, Reid adds. He is, however, working to produce a book in which some of his art will be revealed.

Photos: Hufton + Crow

UNLIKELY BEDFELLOWS

Half co-working space, half boutique hotel, The Hoxton Southwark is a bold template for a loose-fit future, writes Nick Jones

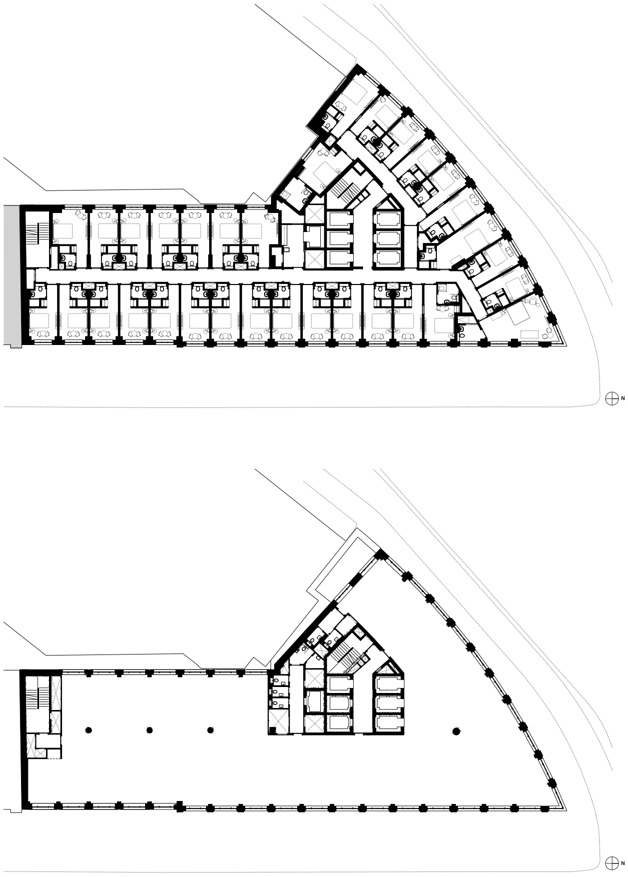
Everywhere you look, architects are inserting art galleries into hairdressers, grafting restaurants onto car parks or, if the opportunity arises, adding rooftop ski slopes to power plants. It's almost as if "mixed use" is now a function in its own right, the collision of disparate uses becoming a project's defining characteristic.

This is the guiding philosophy behind Lifschutz Davidson Sandilands' The Hoxton Southwark, an unusual fusion of boutique hotel and flexible office space. "Usually with mixed-use, the uses are totally disconnected in terms of how they're operated," says LDS associate director John Stimpson. "But with this building, one use informs the other. You might have someone staying in the hotel who hires a desk for the day; office workers might have lunch in the sky bar. People enjoy it and make it feel lived in, so when a hotel guest checks in, it feels like a buzzing place."

This hotel-office hybrid is the latest offering from The Hoxton hotel group, which has made a name for itself from Shoreditch to Portland as a master of millennial work-live-play culture. The brick-faced 17-storey building occupies an awkward, angular corner block on London's busy Blackfriars Road. Above two floors of public spaces – part of The Hoxton's "open-door lobby culture" – are stacked six floors of hotel rooms (192 in total), followed by a further six floors of offices and co-working space, a taller "winter garden breakout/crossover space" and a high-level plant floor. Finally, at the top of the building, the structure overshoots the brick envelope to frame a double-height sky bar and seafood restaurant, all publicly accessible.

From a building designer's point of view, the building's two main uses are not natural bed fellows: offices generally need to be flexible, with as little intrusive structure as possible, and have a high cooling load; hotels are inherently cellular – typically expressed on their grid-like facades – which allows for bits of structure to be inserted throughout the plan. They also usually require far more hot water and heating.

Photos: Paul Riddle; The Hoxton



FOURTH AND FIFTH FLOOR PLANS

The two plans above show the versatility of the structure. The fourth floor is a typical hotel layout with 32 en-suite rooms – all with external views – arranged around a central corridor. The fifth floor is an open-plan office space, with just four structural columns between the asymmetrical core and the perimeter columns.

CLOCKWISE FROM FAR LEFT

The gridded facade is composed of storey-high brick-faced precast-concrete panels; an open-air sky bar has been inserted at the top of the precast envelope; exposed concrete soffits add to the restaurant's industrial aesthetic

PROJECT TEAM

Architect Lifschutz Davidson Sandilands
Structural engineer Arup
Main contractor Kier
In-situ concrete JP Dunn Construction
Precast concrete Thorp Precast

In response, LDS has created a highly adaptable structure that not only incorporates both uses, but can switch between the two, or entertain new ones. At the heart of this strategy is a robust, mainly in-situ reinforced-concrete frame anchored to an asymmetrical core on the north-west side of the building and a shear wall at the southern end. The core was built using a slipform, while the south wall is a precast twin-wall construction. The vertical structure is completed by a ring of in-situ perimeter columns and – crucially – just four internal columns, meaning the 4,000m^2 of office space is capable of almost infinite variation.

It has already morphed considerably since the project's inception, when the plan was for a sharp-suited speculative City office. The Hoxton has now decided to run it as its own co-working venture, with a mix of desk-sharing and small offices aimed at start-ups and freelancers. Of course, should a corporate behemoth sweep in and take over all six floors, that could be accommodated too – Stimpson points out that the frame was designed with a series of soft spots to allow floors to be opened up and stairs to be inserted.

THE HOXTON WANTED TO PICK UP ON THE EARLY INDUSTRIES AROUND SOUTHWARK, LIKE LEATHER WORKING

The structure posed a different set of challenges when it came to the hotel floors. The core is necessarily large in order to accommodate six passenger lifts, a service lift, a generous stairwell, and service risers for both parts of the building. Stimpson stresses that there is very little redundancy in the system: "The plant and infrastructure doesn't double up on anything it doesn't need to. It was always intended to be managed as a single building." Even so, he admits that getting such a large core to work on the site's slender, irregular plan was like "threading the eye of a needle", and it took a considerable amount of design dexterity to organise 32 en-suite rooms of 16-25m^2 per floor, all enjoying external views.

The concrete structure plays a visual role too, lending itself to The Hoxton's trademark warehouse aesthetic. In almost all the hotel rooms, the flat slabs have been left exposed as soffits, enabling floor-to-ceiling heights of 2.75m. The finish is deliberately raw, with the plywood shuttering reused several times to reduce waste. "We started snagging it, saying remove that dink there, take the spray paint off," recalls Stimpson, "but they said, 'no, leave it, we love it, it'll make it more grungy'." The soffits on the 2.9m-high office floors are neater, with more precise board marking, largely because the decision to leave these exposed was made when the space was still to be let speculatively.

The warehouse feel extends to the exterior, with precast brick-faced concrete panels offering a rare break from the glass towers that are redefining the north end of Blackfriars Road (see overleaf). "The Hoxton wanted to pick up on the early industries around Southwark, like leather working," explains Stimpson. The units, made by Thorp Precast in Staffordshire, are two bays wide and one storey high and were pre-loaded with the building's distinctive Crittal-like glazing. This solution proved a huge boon on a site with very limited access – the panels were simply hung from the frame and bolted from the inside by one person, at a rate of four or five per day – enabling the entire building to be wrapped in just 12 weeks. Careful detailing has disguised the panel joints in recessed brick courses, creating the illusion of a traditional masonry structure.

Material efficiency was an important consideration throughout the project. The structural concrete contains 50% ground granulated blast-furnace slag (GGBS), with an impressive 70% GGBS used in the substructure. A regular grid, standardised perimeter columns and the use of precast twin-wall construction have all helped to reduce formwork waste, while the industrial aesthetic meant that additional finishes were kept to a minimum.

But perhaps the most sustainable aspect of the project is its successful mix of uses. As Stimpson says, "The whole building is designed to be as future-flexible as possible. The hotel lifts can become office lifts or vice versa, the offices could become a hotel, the hotel could become residential or serviced apartments …" The loose-fit, albeit tightly packed, design has made this possible, ensuring that the building remains resilient to whatever this ever-changing part of London throws at it.

Photos: Hufton + Crow; James D Evans / Alamy Stock Photo

CRACKING THE VASE

Andy Pearson finds out how WSP engineered the asymmetric form of London's latest Thameside tower

ABOVE The curving form is a commanding presence on the riverfront and was created using post-tensioned slabs and angled perimeter columns

PROJECT TEAM
Architect SimpsonHaugh
Structural engineer WSP
Main contractor Multiplex
Concrete frame contractor Byrne Bros

The Orkidia glass vase created by Timo Sarpaneva for Iittala was, according to House Beautiful magazine, the most beautiful object designed in 1954. More than six decades later, its asymmetric form has provided the inspiration for an object on an altogether grander scale: SimpsonHaugh's 170m-high residential tower on the southern side of London's Blackfriars Bridge.

As with Sarpaneva's vase, One Blackfriars swells out from a narrow base before tapering in at the top, its curvy form emphasised by a double-skin facade. But the smoothness of the exterior belies a thorny engineering challenge: one consequence of its unusual vitreous lineage is that each of the tower's 50 floor plates is different in size and shape.

"The biggest challenge was developing a structural solution that best fit the complex geometry of the tower," says Aret Garip, technical director at structural engineer WSP. Their solution was concrete: "Everything is concrete: the building's core, its perimeter columns and the floor slabs."

Garip might have added foundations to his list. The building sits on a 3,200m^3 concrete raft slab cast on top of 36 large-diameter concrete piles. Rising up from the raft is the tower's structural spine; a concrete core that houses escape stairs, service risers and lifts that link the basement car park to the five-storey penthouse suite.

The raft also carries the loads from the 15 concrete columns that ring the perimeter of the tower. These are exposed as fair-faced concrete at ground level but concealed behind the cladding as they as they rise up the tower.

The columns follow the perimeter of the floor plates as they extend outwards and then in again. "We adopted a combination of walking columns and raking columns," says Garip. On the tower's north, east and west elevations, where the facades are relatively flat, the columns are vertical and "walk" in or out – in other words, are set slightly inside or outside the floor below – depending on whether they are above or below the bulge.

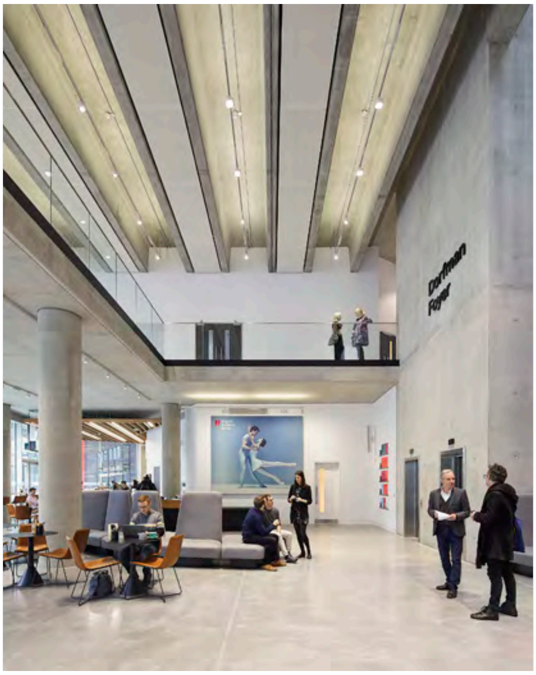
On the tower's southern elevation, where the change in floor plates is most pronounced, the columns are angled slightly. "Raking the columns generated some horizontal forces that had to be tied back to the core using the concrete floor plates," Garip explains.

In addition to vertical loads, the concrete structure also has to resist lateral ones, such as wind. Because the core is relatively small in plan, WSP has extended it outwards by incorporating "outriggers" – concrete walls that tie the core to the perimeter columns. The outriggers are staggered over the height of the building to minimise their impact on apartment layouts.

The floors are constructed using post-tensioned concrete. There are no downstand beams so the soffits are flat, giving greater flexibility in the layout of apartments. "The design of the apartment grid was a very intensive exercise," explains SimpsonHaugh partner Christian Male. "The structural grid is threaded within the party walls as much as possible so that it does not impact on individual apartment layouts."

Post-tensioning ensures the floor plates are as thin as possible to maximise floor-to-ceiling heights, increasing the sale value, while reducing the building's carbon footprint. "Post-tensioning saved 10% concrete by volume in the construction of the floor slabs," says Garip. "That's equivalent to five floor plates over the height of the tower."

■ **More on post-tensioning, page 14**



Photos: Hufton + Crow

DANCING PARTNER

Concrete performs several roles at once at the English National Ballet's new HQ, writes Pamela Buxton

CLOCKWISE FROM ABOVE
LEFT The 50% GGBS mix lends a mid-grey tone to the fair-faced concrete; the in-situ frame is able to support 15m x 15m single-span studios; the public can view the rehearsal spaces through the glazed envelope

PROJECT TEAM
Architect Glenn Howells Architects
Structural engineer OCSC
Contractors BCSL (shell and core), BW (fit-out)
In-situ concrete GCL
Precast concrete Banagher Precast Concrete

Designed by Glenn Howells Architects in London's former docklands, the new £36m home for the English National Ballet (ENB) is essentially the company's behind-the-scenes workshop. As such, the extensive use of industrial, practical materials, including concrete as the exposed structural frame, seems entirely appropriate.

Located on London City Island within a cluster of new residential towers, the building offers a rehearsal space that replicates the venues where the ENB will perform, as well as providing seven further studios and medical facilities. Two floors of offices are also included at the top of the 9,300m^2 building, which is wrapped in translucent glass cladding to give passers-by a tantalising sense of the dancers as they rehearse.

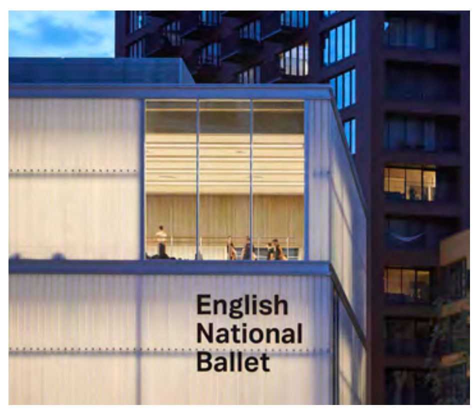
According to studio director Dan Mulligan, concrete was chosen for the structure for many reasons beyond its aesthetic. "It was a very tight budget, so every material had to do several jobs," he said. "The great thing about concrete is that it's one product that does multiple things – long spans, thermal mass, fire protection, robustness – as well as providing the aesthetic."

This, combined with its inherent longevity, gives it a stronger sustainability story too. "If we'd used steel, we'd have had to wrap it in plasterboard and add on more to attain the relevant codes. So in the long run, it probably wouldn't be lower carbon than the concrete." The thermal mass, he adds, was particularly important in a dance context since the dancers need a stable, warm environment without temperature fluctuation for optimum performance.

The concrete also achieves the structural demands for the spaces, which include 15m x 15m single-span studios. This consists of a chunky, 2m-thick in-situ frame with a 150mm topper screed, combined with 1m-deep, double-tee precast-concrete beams. Together, says Mulligan, these three elements avoid movement by "creating a monolith to absorb the energy generated by 60 dancers jumping up and down". Perimeter columns of 600mm x 600mm (square) and 700mm-diameter (round) are set out on a 7.5m grid.

The in-situ concrete has a 50% ground granulated blast-furnace slag (GGBS) mix and is in a mid-grey to match the colour of the precast-concrete studio soffits. Three different standards of surface finish were specified. A "special" finish was chosen for the prominent entrance soffit, lift cores and columns, created with plastic-finished shuttering boards for both a smooth surface and perfect board alignment. A "plain" finish, without the same exacting setting-out, was used for awkward areas such as those next to lift lobbies, achieved with the same plastic-finished boards. In stair cores, escape staircases and in the largely concealed soffit of the open-plan office, an "ordinary" finish was specified using plywood shuttering.

Finally, the robust nature of the building meets the client's requirements for low maintenance costs, says Mulligan. "It's inherently robust. It's a very, very, lean industrial-type building that reflects, in terms of how it's put together, the nature of the ENB itself."



High tension: An introduction to specifying post-tensioned slabs

Jenny Burridge explores the benefits and relative costs of one of the most efficient forms of construction

Post-tensioning is now widely used as an efficient way of designing floor slabs in concrete-framed buildings. It is a way of putting a pre-compression into the concrete, in this case after it has been cast. This means that when the slab is working under normal vertical loads, spanning between columns, the tension that would result in the concrete from bending forces is significantly reduced by the pre-compression. Since the tensile strength of concrete is only about 10% of its compressive strength, this makes it work much more efficiently.

In the simplest form of post-tensioning, the concrete is prestressed by putting high-strength tendons in ducts through the slab and tensioning the tendons with a jack when the concrete has gained sufficient strength. The tendons are usually draped within the depth of the concrete, putting an additional bending moment into the span, which balances the bending moment from the vertical loads.

With the requirement for much greater material efficiency, post-tensioning is now being used much more frequently on projects. Post-tensioned (PT) slabs are one of the most efficient forms of construction, as they enable the two main construction materials to work in the most efficient way. Significant savings can be made in comparison with conventional reinforced concrete, equating to about 20% of the concrete and 50% of the steel in a flat slab.

Figures 1 and 2 provide engineers with a guide to the sizing and rates that will be required for typical flat slabs – a guide that has been agreed by specialist designers.

FIGURE 1: SPAN-TO-DEPTH RATIOS AND RATES FOR POST-TENSIONED FLAT SLABS

Multiple spans (m)	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0
Overall depth (mm)									
Imposed load: 2.5kN/m^2	200	200	215	240	275	310	340	390	475
IL: 5.0kN/m^2	200	210	240	270	300	325	370	400	500
IL: 7.5kN/m^2	200	235	270	300	340	375	410	500	
IL: 10.0kN/m^2	200	275	310	350	390	440	500		
Tendons (kg/m^2)									
IL: 2.5kN/m^2	3.5	3.8	4.4	5.1	5.7	6.9	7.6	9.2	10.1
IL: 5.0kN/m^2	4.0	4.6	5.3	6.3	7.1	8.4	9.3	10.8	11.2
IL: 7.5kN/m^2	4.6	5.6	6.3	7.3	8.4	9.6	10.4	11.6	
IL: 10.0kN/m^2	5.4	6.9	7.8	8.6	9.7	10.7	11.7		
Mesh and loose rebar (kg/m^2)									
IL: 2.5kN/m^2	14	14	14	15	16	19	20	24	25
IL: 5.0kN/m^2	14	14	15	16	17	19	21	25	26
IL: 7.5kN/m^2	15	15	16	17	19	23	24	27	
IL: 10.0kN/m^2	16	17	18	19	23	24	26		

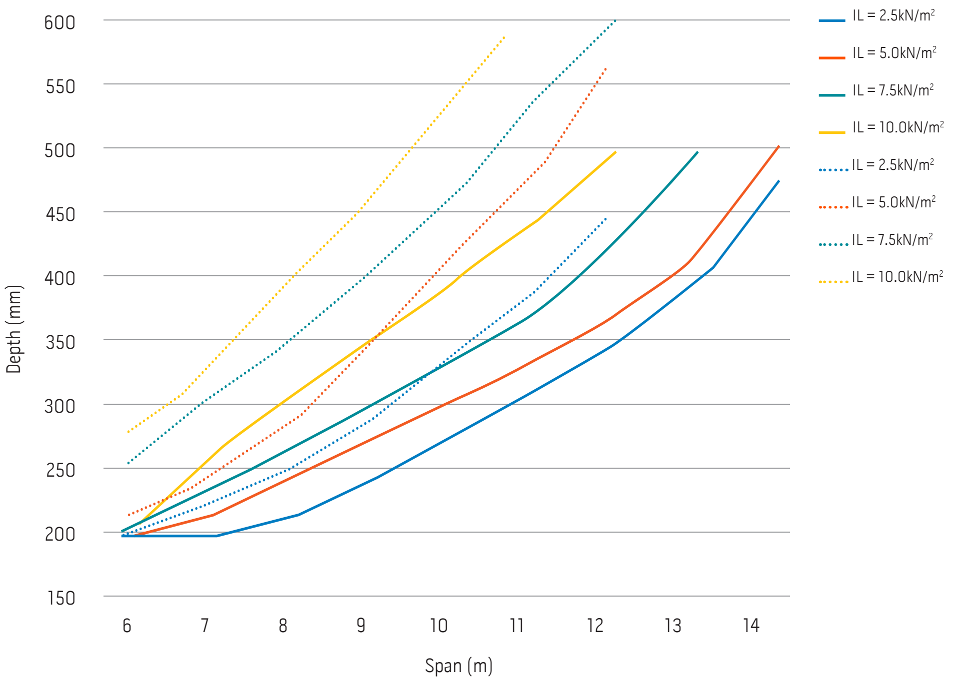
Notes on table

1. These values are mid-range for the options available. It is possible to have slimmer slabs with more tendons
2. A depth limit of 200mm has been adopted as this is standard within the industry and gives a fire resistance of up to four hours
3. The mesh and loose rebar rates include an allowance for anti-burst reinforcement around the anchorages, bottom mesh, edge reinforcement, punching shear links, top mesh for slabs of >375mm for constructors to walk on, pour strips between areas of post-tensioning, construction joints, small amounts of trimming reinforcement around holes. It does not include upstands, beams, core connections or couplers
4. Exposure class XC1 assumed. This covers internal concrete, but not concrete for a car park, for example. If higher exposure classes are required then higher rates would be necessary. Eurocode 2 requires that for XD and XS exposure classes bonded tendons should lie within concrete in compression under the frequent load combination
5. Tendons are assumed to be 12.9mm or 15.7mm Superstrand (A_{ps} = 100mm^2 or 150mm^2, f_{pk} = 1,860MPa.) Either can be used, but one or other should be chosen, rather than both, on the same project
6. Concrete is assumed to be C32/40 with $f_{ck(t)}$ at transfer of 20.8MPa
7. A superimposed dead load of 1.5kN/m^2 is assumed with a perimeter load of 10kN/m
8. Design is in accordance with Eurocode 2 (BS EN 1992-1-1 and BS EN 1992-1-2) and Concrete Society Technical Report TR43, Post-tensioned concrete floors Design handbook
9. Panels are assumed to be square with three bays in each direction.

ABOVE RIGHT At the Newfoundland tower in Canary Wharf, London, the overall slab depth was reduced by about 17%, with a 75% saving in the amount of steel

Photo: Nigel Bowles / Alamy Stock

FIGURE 2: SPAN-TO-DEPTH RATIOS, SHOWN AS A GRAPH



Benefits

Because they are more efficient, PT slabs are thinner than conventionally reinforced equivalents, and smaller floor-to-floor heights can be achieved without losing anything from floor-to-ceiling heights. This produces either lower buildings, with a consequent saving on the cladding materials, services and internal finishes, or enables a greater number of floors to be accommodated within a tall building. For example, Allford Hall Monaghan Morris' tower at 240 Blackfriars Road in London (overleaf) was able to include two additional storeys within the same building height.

The reduction in steel means that PT floors are also quicker to build than conventional in-situ reinforced concrete slabs, because the time taken to fix the reinforcement is significantly less. The fixing and stressing of the tendons are additional work items, but overall the programme is less.

In order to take advantage of the programme savings associated with post-tensioning, the

POST-TENSIONING CAN RESULT IN SAVINGS OF ABOUT 20% OF THE CONCRETE AND 50% OF THE STEEL IN A FLAT SLAB

ABOVE High-strength tendons draped within a floor slab, waiting for the concrete to be poured at the Newfoundland tower, London

RIGHT At 240 Blackfriars Road in London, the use of PT slabs enabled architect AHMM to add two storeys without increasing the building height

Photos: Timothy Soar; Praeter Engineering

concrete has to have early strength gain so that the tendons can be stressed shortly after it has been cast. The concrete for PT slabs has therefore traditionally been specified with a high proportion of Portland cement (CEM 1). However, 50% ground-granulated blast-furnace slag (GGBS) or 40% fly ash mixes have also been successfully used to lower embodied carbon in buildings. The use of high levels of replacement cements is an issue if the concrete is cast during winter.

The increased use of PT slabs in tall buildings was demonstrated by the Post-Tensioning Association (PTA) project award for 2019. Three of the shortlisted projects were high-rise residential buildings where post-tensioning had been used to increase the number of storeys for a given building height and to speed up the construction programme. The award was won by Praeter Engineering for the Newfoundland tower at London's Canary Wharf, where the overall slab depth was reduced by about 17%, with a 75% saving in the amount of steel. The reduced size of the concrete elements led to smaller columns and a reduction in the size of the piled raft foundation.

Rates

The detailed design of post-tensioning is frequently done by specialists, but the engineer for the frame can complete a concept design to size the slab and estimate the number of tendons and amount of reinforcement using standard rates.

Since post-tensioning has become more mainstream, the design of PT slabs has become even more efficient. The Concrete Centre book, Economic Concrete Framed Elements, contains tables for PT slabs and beams. The specialist designers within the PTA have found that the book gives higher rates for tendons with lower rates of conventional reinforcement than would normally be the case. The numbers in the tables have therefore been revised (see Figure 1), with the result that PT becomes more cost-effective.

One of the benefits of post-tensioning is that it is very flexible in the design. The deflection of the slab can be counterbalanced with greater levels of pre-compression or a slightly deeper slab. The drape of the tendon can be modified to give the most economic or efficient solution. PT systems are also very efficient for long cantilevers, as the pre-tension helps to control deflecton.

Figure 1 (previous page) gives a good starting point for a scheme design of a PT flat slab, the most common use of PT in the UK; figure 2 presents this information as a graph.

The PTA has produced a model specification for the procurement of the design of PT floors from specialist designers: Model Specification for the Design and Performance of Post-tensioned Concrete Floors in Building Structures. It also provides useful guidance on the considerations for designers when designing PT slabs. A free download is available at concretecentre.com.

For further information, see Post-tensioned Concrete Floors, published by The Concrete Centre

Photo: Hawkins\Brown

ABOVE Hawkins\Brown's first phase of Agar Grove in Camden, London – the largest Passivhaus scheme in the UK

In search of **new lows**

Fabric first is a well-established approach for reducing energy use in buildings – but we can't stop there, writes Elaine Toogood

Reducing the energy consumption of buildings is an important part of whole-life carbon reduction, and is arguably the most impactful way for designers to improve the credentials of a new project, with savings that accumulate over the life of the building. But reducing the energy consumption of buildings has other, far-reaching potential social and economic benefits, such as tackling fuel poverty and fuel security, making it a natural priority for many clients.

Buildings account for around 40% of the UK's total energy use. The government's industrial strategy includes a mission to "at least" halve the energy use of new buildings by 2030, as part of meeting its Grand Challenge on clean growth. By the same deadline, the RIBA has set the architectural profession the more ambitious challenge of reducing operational energy demand and carbon by at least 75%, before offsetting. With the revised Part L1A of the Building Regulations for England and Wales – the Future Homes Standard – set for publication in 2020, the appropriate minimum level of energy use for new building construction and its method of measurement is the subject of heated debate.

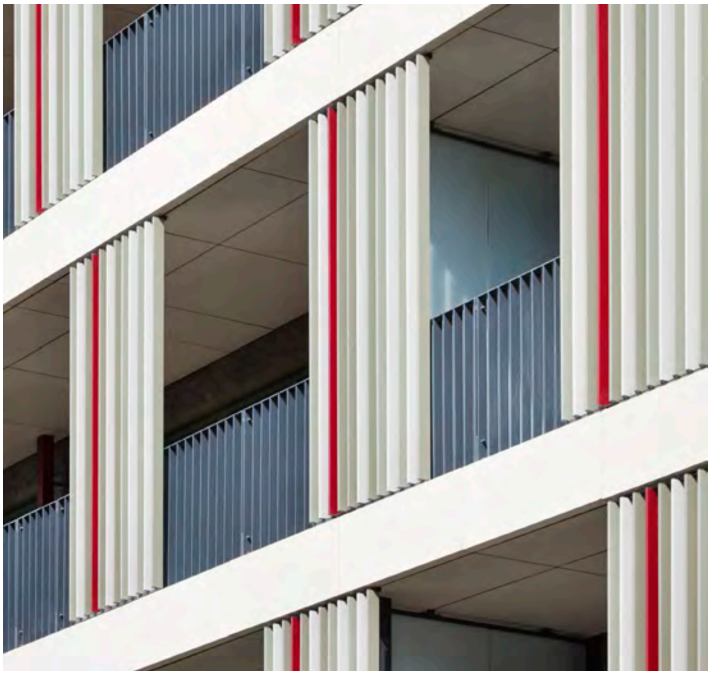
The government's clean growth energy challenge is framed in the context of new technologies, but this is not a prerequisite for achieving better performance – the Green Construction Board's recommendations include exemplar buildings in a range of construction methods and materials, including concrete masonry. A fabric-first approach, for example, is a well-established means of ensuring long-term energy efficiency. Insulation and detailing to reduce thermal bridging and air leakage are fundamental to thermal performance – the latter becoming more significant as insulation values have improved, particularly for housing where heating makes up a significant proportion of energy use.

The concrete and masonry sector has developed a wide range of resources to assist designers in eliminating thermal bridging, including freely available high-performance details of solid and cavity blockwork wall junctions. Each detail has pre-calculated thermal bridging values for use with current and proposed amendments to Part L1A.

Airtightness

Concrete walls, floors and roofs, whether cast in situ or as precast panels, provide inherent benefits in terms of reducing air leakage, with comparatively few joints to consider and the material itself

THE NEED FOR FANS AND OTHER COOLING DEVICES PUTS LOWER-INCOME HOUSEHOLDS AT RISK OF SUMMER FUEL POVERTY



offering durable, long-term performance. For blockwork, parging and plaster coats have been proven in research and practice to provide excellent airtightness. As high thermal performance becomes more mainstream, solutions will continue to evolve in response to the demands of larger-scale construction. Low-conductivity cavity wall ties, for example, are now commonplace.

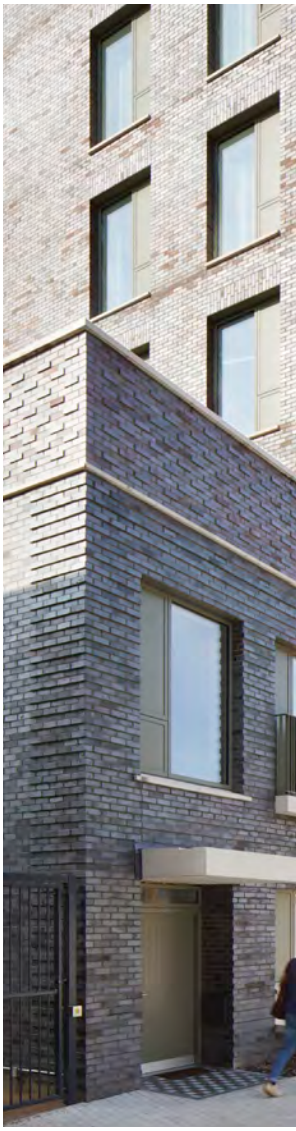
Passive cooling

Concrete's greatest potential contribution to reducing energy use in buildings is by providing passive cooling through its high thermal mass. Exposed internal concrete surfaces, in combination with appropriate ventilation or night-time purging, is an established means of avoiding or reducing the need for air conditioning. The resulting reduction in energy use can be very significant, with associated savings in running costs. Exposed concrete soffits are useful sources of thermal mass and these can also be painted in light colours to reduce the need for lighting – and its associated energy use – without hindering cooling performance.

To date, this low-energy building strategy has been used primarily in buildings with high internal heat loads such as offices, libraries and schools. With predicted rises in temperatures, the need to provide low-energy cooling will become a higher priority for other building types, so a concrete frame is one means of future-proofing. It is now generally accepted that housing also requires some measure of passive cooling to prevent overheating, now and in a future warmer climate. The need for fans and other cooling devices puts lower-income households at risk of summer fuel poverty, an issue identified by the Zero Carbon Hub. Research published by the Department for Communities and Local Government in September 2019 found that thermal mass with night-time cooling was an effective means of passively reducing overheating risk in new housing.

Passive solar design

Beyond passive cooling, thermal mass can also help to reduce fuel consumption during the heating season through passive solar design (PSD), whereby thermally massive internal walls and floors absorb solar energy from south-facing windows, as well as internal heat gains from activities such as cooking. The heat is then slowly released overnight as the temperature drops, helping to keep the building warm and reducing the need for supplementary heating. Simple design strategies concerning building orientation and the location and sizing of windows can provide fuel savings of up to 11% (see Thermal Mass for Housing, published by The Concrete Centre, for full reference). This increases to up to 40% where more sophisticated PSD techniques are adopted, such as sun spaces. This is not a new concept but there has been renewed interest in recent years, with rising energy prices and challenging carbon targets, as well as the shift to alternative forms of domestic heating. Buildings orientated to optimise photovoltaics can also benefit from PSD.



ABOVE The first phase of Agar Grove, a 38-unit apartment block designed by Hawkins\Brown, was completed in 2018

TOP LEFT The apartments' south-facing balconies are freestanding structures clad in glass-reinforced concrete

CENTRE LEFT The 493-home masterplan is arranged around the existing 17-storey Lulworth Tower, which will undergo a deep retrofit

BOTTOM LEFT The second phase of 57 homes designed by Mae is due to complete later this year

Photos: James Retief, Hawkins\Brown

◀ Agar Grove, London, 2018-

Agar Grove is the largest Passivhaus development in the UK to date. The first phase, a 38-unit apartment block, was completed in 2018 and is fully occupied. A subsequent phase of 57 homes is well underway on site, the detailing of which has benefited from post-occupancy evaluation of the earlier phase and feedback from "lessons learned" workshops. Both phases have an in-situ concrete frame, key to simplifying the detailing, with infill blockwork of aerated autoclaved concrete (AAC) and external facing brick facades. The project was won in competition, the 493-home masterplan created through a joint design proposal by Hawkins\Brown and Mae Architects, with Hawkins\Brown taking the design lead for phase 1A and Mae for phase 1B.

For the client, the London Borough of Camden, a major motivation for adopting Passivhaus was addressing fuel poverty among its tenants. The first building benefited from a very good form-factor ratio of 1.6 – the ratio of heat loss area to the total floor area, and a measure of efficiency. It was constructed over five to seven storeys and orientated on a north-south axis, ideal for Passivhaus principles.

Subsequent blocks have had to compensate with slightly more insulation, increasing the depth of blown mineral wool insulation in the cavity from 150mm to 200mm. Thermally broken cavity ties and structural insulated connectors help to minimise thermal bridging of the brick facade and some of its more complex details. The south-facing balconies are freestanding structures clad in glass-reinforced concrete (GRC) and restrained back to the facade using thermally broken fixings. These balconies provide shading in the summer while allowing some benefit from solar gain in the winter.

The airtightness barrier is provided by a parge coat applied to the external face of the blockwork immediately behind the insulation layer and thoroughly taped around window and concrete frame junctions. Compared to the more usual location, behind internal plasterboard linings, this innovative but robust solution offered programme benefits and reduced the risk of damage from follow-on trades – the team felt that, on balance, the advantages outweighed the potential lack of future accessibility. For the next phase of construction, they are evolving the detail to use a liquid-applied membrane with the potential to replace both the parge coat and taped junctions, which would offer yet further programme savings.

Another detail that evolved over the course of discussions was the incorporation of structural insulation breaks at the base of the lift cores and between dwarf columns in the pile caps, below the slab. This was deemed simpler than wrapping the cores and pile caps to provide a thermal break with the ground.

The second phase of construction is due to complete later this year, to be followed by further new blocks, including a deep retrofit of the concrete-framed 17-storey Lulworth Tower at the heart of the plan. This will include the extension of the perimeter to provide wintergardens, as well as the addition of two more storeys.

PROJECT TEAM
Architects Hawkins\Brown, Mae
Delivery architect (Phases 1A and 1B) Architype
Structural engineer Peter Brett Associates
Passivhaus consultant designers Max Fordham; Architype/Elemental Solutions/Enhabit
Contractor Hill Partnerships

Demand-side response

Thermal mass also supports the variable energy profile of our increasingly renewable energy supply. Demand-side response (DSR) is a more carbon-efficient way of using energy, and can assist the transition to renewable sources by spreading demand across the 24-hour cycle. This means it reduces stress on the national grid at peak times, and also that consumers can make greater use of cheaper off-peak energy tariffs, cutting fuel bills.

Combined with the electrification of heating and cooling systems and a so-called "smart grid", concrete and masonry buildings could play a significant role in demand-side flexibility due to the thermal inertia of heavyweight construction. According to renewable energy consultant 3E, buildings with high thermal mass can maximise the use of renewables and cut peak electricity demand by up to 50%.

At the Bullring shopping centre in Birmingham, which has a concrete structure, the use of DSR saved £23,000 over a six-week initial trial period for the system.

Post-occupancy evaluation

To significantly reduce the energy consumption of our buildings requires approaches on many levels, and it must become a greater focus both during design and construction and after completion. This includes use of energy performance targets, quality assurance for construction, commissioning and after-care. More accurate predictions for energy use are required, including consideration of all uses – that is, beyond those covered by regulations – and post-occupancy evaluations will have a significant role in this. As more measured data becomes available, designers will become increasingly informed and equipped to feed back successful practice into new low-energy design.

Examples of post-occupancy evaluations include Wimbish Passivhaus, a social housing development built from solid masonry walls with rendered external insulation, where 10 years of data indicate continued high performance. Publications from the Green Building Store on Denby Dale, the first cavity-wall Passivhaus in the UK, and its subsequent Golcar Passivhaus are useful resources. Similarly, Montgomery Primary School, completed in 2012 and the UK's first Passivhaus-certified school, was built using an insulated modular precast concrete system and is reported to be performing well eight years later.

The performance targets and measurement of carbon and energy related to the construction of new buildings is changing and no doubt will continue to evolve over time. It is unlikely that any single construction solution will be able to meet every performance need every time, given the variety of changing demands on the built environment. But, for the foreseeable future, energy consumption will be a key priority, and it will remain a very good place to start.

For more information on reducing energy use, and links to all the documents referenced in this article, go to concretecentre.com/energyefficiency

FINAL FRAME: GREIFSWALDERSTRAßE, BERLIN

On a prominent corner site in the Berlin district of Pankow, Sergei Tchoban has completed a six-storey office building with a twisting precast-concrete facade. The main street frontages are composed of a square grid of repeating columns and floor slab strips, all of which appear to turn slightly along their length. The panels meet alternately at either a high point – protruding 50cm from the building line – or a low point to form a coherent, organically flowing pattern.

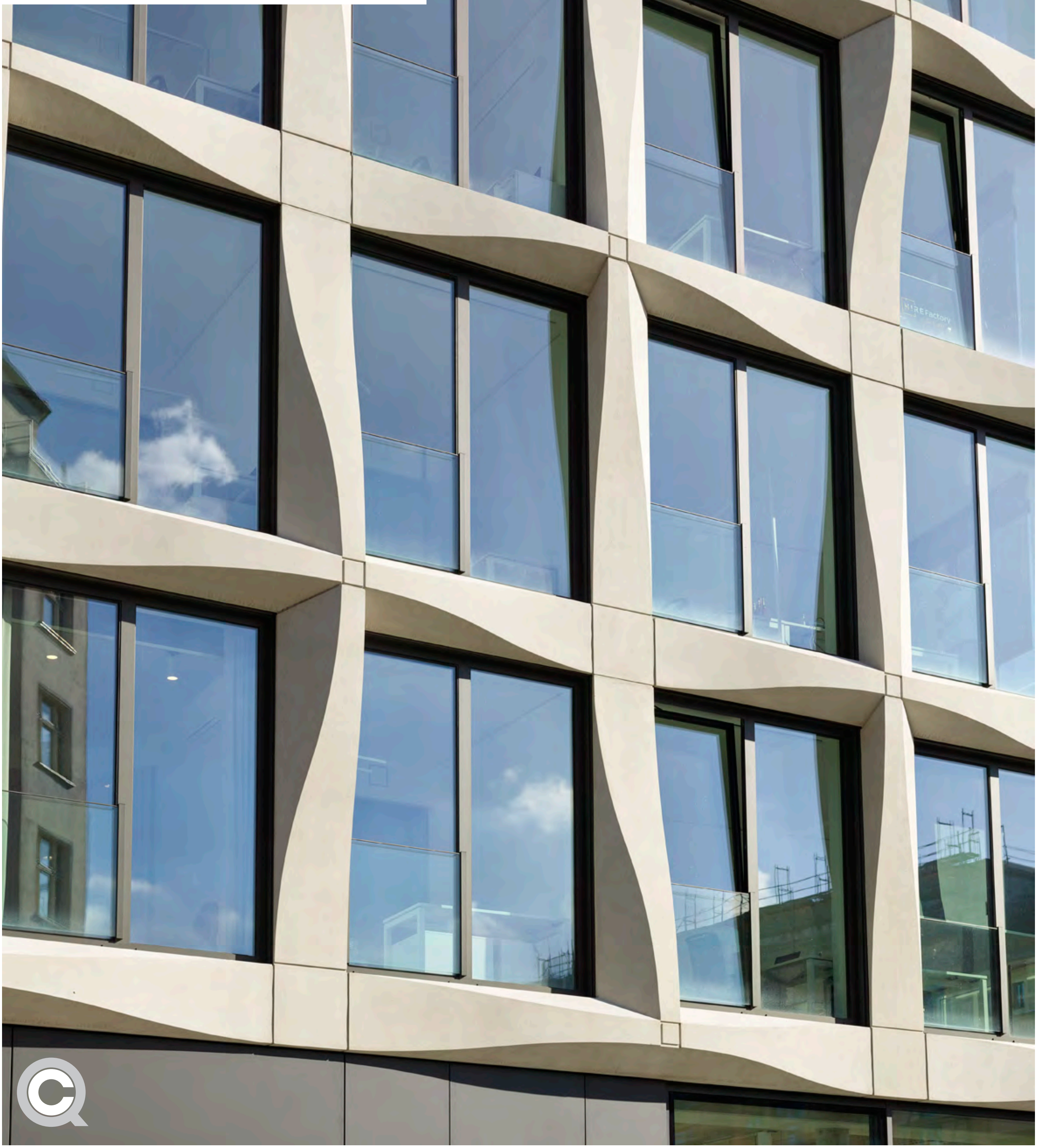


Photo: Roland Halbe