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CONCRETE QUARTERLY

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How did Howells make a tower smaller on the outside but bigger on the inside?

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On the cover
Sloane Robinson Building, Bristol by FCB Studios. Photo by Andy Stagg



Elaine Toogood
Senior director, MPA Concrete & The Concrete Centre

Counters' revolution

A large and growing part of our output at The Concrete Centre concerns data – gathering it from our members, and synthesising it into design tools and guidance for specifiers. We have just published the **2026 Low Carbon Concrete Group (LCCG) Market Benchmark**, which revealed that the average embodied carbon of UK ready-mixed concrete fell by about 5% in 2025, based on data covering 55% of UK production. We also work with other industry bodies to iron out anomalies, so that wherever specifiers source their information, they can be confident that it's fit for purpose.

This emphasis reflects just how central data has become to sustainability, although I would argue that the construction sector is still at a relatively early stage in the journey. There is some discussion that planning authorities could impose limits on whole-life carbon. My question would be, are we ready? There have been really big steps on carbon measurement, but there is a lot of learning to be done. Best practice is also continually evolving – an important next step is the 2027 revision to BS 8500 on concrete specification, which will add reference values for embodied carbon. Right now, measurement should absolutely be mandatory, but basing legally binding rules on immature data is likely to backfire.

"Just specify a target and let the supplier work out the best way to deliver the required performance"

The more immediate task is to upskill the industry on the different metrics that are out there, and how to use them appropriately. **A recent Concrete Centre publication** demystifies environmental product declarations, for example, and a forthcoming document will focus on benchmarks.

Our headline message is: specifiers don't need to get into the mix design, just set a performance target and let the supplier work out the best way to meet it. Today, it's possible to hit the highest benchmark ratings by using innovative products under the BSI Flex 350 standard, but the further you go from current practice, the greater the implications may be for other aspects of the project.

The starting point is to understand your client's true aspirations. Benchmarks are invaluable to those discussions, but it's the discussion itself that's key – and we need to be sure that everyone is talking about the same thing. ■



Photos: Paul Burroughs

INNOVATION

DAVIDE ZAMPINI

Cemex's vice president of global R&D on the two key ingredients for ultra low-carbon concrete: chemistry and people

Thirty years ago, as a freshman at Northwestern University in Chicago, Davide Zampini was all set to study medicine. Then he walked into the office of legendary materials scientist Hamlin Jennings. "It was my first day and he was my counsellor. He said, 'If you ever wanted a challenge in your life, you would study the chemistry of cement. Millions of cubic metres are used worldwide, but to this day, no one has cracked the science.'"

Zampini was hooked. He ended up devoting his studies and his career to understanding concrete at the deepest molecular level. For the last 17 years, he has been head of global R&D at cement giant Cemex. Startlingly, he believes that for all the progress in making stronger concrete and lowering embodied carbon, there are even more unknowns today.

"Five years ago, the majority of cements being sold were ordinary Portland cement, consisting predominantly of clinker. Now, we're talking about cements with a clinker factor of 50%, which means that other constituents are playing an important role. We're going to another level of complexity. There are

“For the future, the key word is integration, and putting different technologies together. There’s not going to be a single panacea”

very bright people putting the puzzle together, but there’s an additional dimension that’s never been looked at.”

Zampini is responsible for around 50 of those people, based mainly in Switzerland and Mexico – a small team in the context of Cemex’s 40,000-strong global workforce. “Sometimes it’s not how big your team is, it’s the talent pool and how innovation is managed to fit the company’s strategy. We don’t have infinite resources, so we have to be very creative, very efficient and very focused.”

His job is essentially to think radically and disrupt his own industry from within, while remaining hard-nosed about the economics. “Making ends meet” is how he describes this mission. “When I look at our research activities, be it decarbonisation or developing new products or manufacturing processes, it’s really making sure that the things we’re altering work when they get to the concrete, not just in terms of strength and how it looks in the building, but also the fresh properties. Because in the end, the concrete is the product that faces the market, and the market is pretty demanding.

“The bottom line is to be continuously curious, open to everything that’s coming out, but to assess it critically – or we’re not doing the industry any favours. Sometimes you see startups coming up with great ideas, but the business case will never fly because they’re trying to sell limestone for 900 times more than today.”

His team’s work spans the value chain, from manufacture to design to delivery. “For the future, I think the key word is integration, and being knowledgeable about how to put different technologies together and have them align and work in synergy. There’s not going to be a single panacea.”

Digitalisation will be important, he says – Cemex has just launched BIM Concrete Studio, a free set of design tools that can plug into any building information model (BIM) to analyse embodied carbon at element and material level throughout a project. He also thinks artificial intelligence could help to finally crack how concrete constituents interact at a molecular level. →

BELOW
At the UIS Málaga campus in Colombia, folded elements were created using Cemex’s BIM Concrete Studio digital tool and Resilia high-performance fibre-reinforced concrete





"Just seeing that there's a problem isn't enough. You need the insight to know how to tackle it"

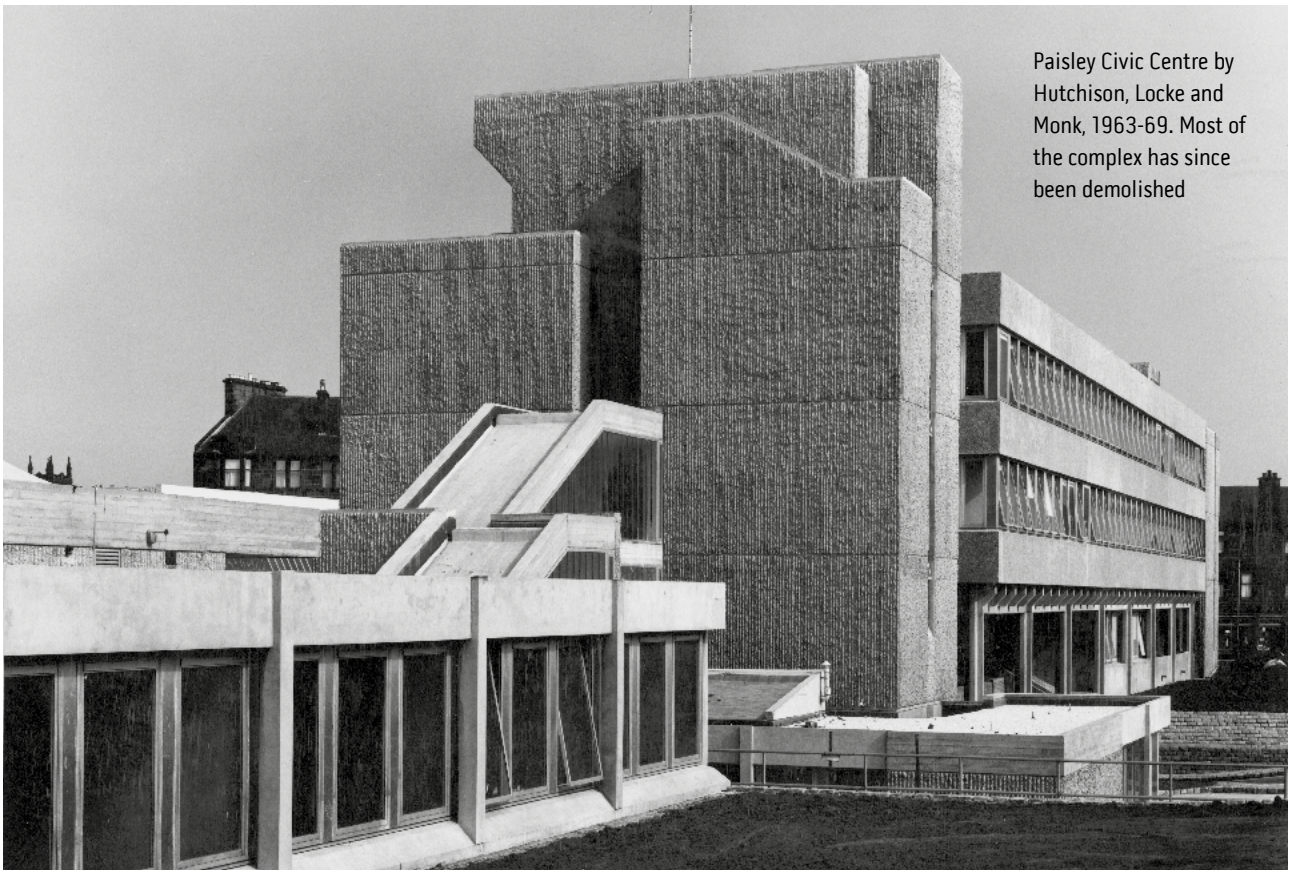
After all these years, it's still chemistry that excites Zampini most. He sees great potential in admixtures, chemicals added in small quantities that change the properties or behaviour of a mix. "Admixtures are an enabler of all the concrete technologies that we see, or what we can achieve in terms of super-reductions. We're really only scratching the surface." Imagine if we could triple the strength of cement tomorrow, he adds – that could allow far higher rates of substitution, and correspondingly large drops in embodied carbon.

Cemex's official 2030 target is to produce cementitious material with an embodied carbon below 430kgCO_2e/tonne, down 47% on the 1990 baseline and 31% on 2020. But Zampini thinks it could go as low as 200kgCO_2e/tonne. "There's a lot of conventional wisdom about how clinker is manufactured. I'm a very firm believer that we can completely revisit clinker chemistry, and how clinker is manufactured, to produce it at very low emissions. Who's to say that what we call concrete today is going to be what we call concrete in the future? One way to think of it is like, what if trees underwent a radical genetic transformation. It still looks like a tree outside, but maybe the way it intakes water or the leaf structures are completely different. The concrete that you cast 30 years from now may look exactly the same, but everything inside could be completely different."

But to transform clinker chemistry, you have to really understand it. That's why the other part of his mission is to get young people excited about the future of concrete, and inspire them to study it at university. "Just seeing that there's a problem isn't enough. You need the insight to know how to tackle it. I was very fortunate because I studied under great cement chemists and concrete technologists who could really articulate the problems to be solved. Civil engineering and materials science departments are seeing numbers dwindle. That's a problem because you need to attract the talent base to generate those radical, innovative ideas."

He recently got chatting to some young guys working in a store in Chicago. "They were studying architecture. I started showing them videos of the stuff that we do with concrete, and they were like, 'Woah, that's really interesting. Can we get a copy, can we contact you?' I think everyone in the sector should see themselves as having that responsibility. There's still so much to be to be done. But I think the first thing is to get young people excited about it." ■

Interview by Katie Puckett



Paisley Civic Centre by Hutchison, Locke and Monk, 1963-69. Most of the complex has since been demolished

Photo: Architectural Press Archive / RIBA Collections



LASTING IMPRESSION

GERRY O'BRIEN

From Paisley's brief blast of civic brutalism, to structural pyrotechnics in the North Sea and structural poetry from an Italian master

I grew up in Paisley at a time when the baby-boomer generation was spilling out of Glasgow into the new towns. There were a lot of interesting architectural typologies emerging, many of them brutalist. Basil Spence's Glasgow Airport, which opened in 1966 just north of Paisley, was a proper day out for us. The White Cart Viaduct was this incredible flyover more than 20m above the River Cart – at the time, any boat in the world could pass beneath it. Paisley Civic Centre, designed by Hutchison, Locke and Monk (later HLM Architects) was another building I used to run around as a kid. When the complex opened in 1969, it felt like a symbol of hope. Brutalist buildings can do that. It's to do with the strength with which they sit in the landscape – you just cannot miss their stature and civic presence.

Those buildings were really aspirational for me, but it was a brief moment in time. The industries that gave places like Paisley their identity were already vanishing. The docks closed months after the White Cart Viaduct opened. New civic buildings and housing can't do much on their own. Poor Paisley is very down at heel these days, but it still has some amazing architecture. →

I keep hoping that one day it gets reinvented as an undiscovered suburb of Glasgow.

As a structural engineer, I have to pick a building by Pier Luigi Nervi, because he is still so relevant. He was always trying to make buildings affordable and deliverable, but without sacrificing design quality, and that's pretty much what I think engineering should be all about. The beautiful dome of the Palazzetto dello Sport in Rome is just structural form and the minimum amount of material. The shell and ribs were made with ferrocement which, combined with the curving geometry, generated the required stiffness for very little weight. And it was almost entirely precast concrete, which meant they didn't have to put up any timber formwork, an enormous cost saving at that time.



There was similar ingenuity at play for my final choice – but it comes with a caveat. The Troll A gas platform is 472m high – basically two Heron Towers – and is still the tallest object ever to have been moved across the face of the earth. I remember watching on the news back in 1995 and just being absolutely stunned: this 666,000-tonne structure being towed into place like a boat before being essentially sucked into the seabed on immense vacuum piles.

Of course, 30 years on, such monuments of fossil-fuel extraction are seen more as cautionary tales than structural wonders. But the example of Troll A offers hope too, that human ingenuity can do extraordinary things. Now we've got to get on and do them. ■

Gerry O'Brien is co-founder of structural engineer Agentia.

Read more about the Palazzetto dello Sport on page 28



Photos: Le Nouveau Programme; RIBA Collections

ABOVE RIGHT
Palazzetto dello Sport by Pier Luigi Nervi and Annibale Vitellozzi, 1956-57

RIGHT
Troll A gas platform, Norway, completed in 1995



Photos: Hufton + Crow

ORIGIN STORY

THE OCTAGON

The new eight-sided tower on the Birmingham skyline is a geometric paradox: architect Howells shrunk it on the outside while creating more interior space. Nick Jones finds out how it was done

"It shouldn't work," says Dav Bansal, partner at Howells. "If someone told you they were reducing the area of a building's facade, but the apartments inside would get larger, those two ideas don't go together in a sentence."

It seems hard to argue with this logic. Indeed, the only thing undermining Bansal's premise is the fact that he and Howells have just built an apartment tower where they did just that.

The Octagon, which sits at the northern end of the £1.2bn Paradise regeneration scheme in central Birmingham, lays claim to being the first purely octagonal residential tower in the world. From an eight-sided central core, eight apartments radiate outwards on each floor. Each quarter contains a one- and two-bed flat, arranged so that – despite their different floor areas – both have a frontage that extends across one full face of the octagon. In all, the 49-storey tower contains 370 apartments.

Compared with a rectilinear plan for the same site with the same number of apartments, the facade is 7m shorter, equating to about 20m² less surface area per floor. "If you take that over 49 storeys, that's nearly →

1,000m² less facade, which is a huge saving both in carbon and build costs," points out Bansal. At the same time, the net-to-gross floor area has increased slightly, from 75% to 76%, with the result that apartments exceed national space standards by up to 10%. And each home actually has a more generous facade than the rectilinear equivalent, with 12.5m of wall-to-wall perimeter glazing compared with 6.5m and 10m for typical one and two-bed flats respectively.

The idea for an octagonal tower emerged from the constraints of the site, which is squeezed between two roads at the very northern tip of the Paradise scheme. "We were really struggling. Because it's a commercially led masterplan, we were left with a very small footprint for the residential element in a very awkward part of the site," says Bansal. He quickly realised that moving away from a rectangle had several benefits – not just maximising internal space and daylight, but doing so with a symmetrical, easily divisible structural form that could be manufactured off site and delivered on a just-in-time basis. Service runs are also shorter, coordinated in a concentric circle around the core, and wind loadings are reduced. "There's a reason why the Victorians built cylindrical factory chimneys," says Bansal. "Wind sweeps around the building rather than hitting into it, which meant we could optimise the thickness and strength of the concrete and the overall diameter of the core."

The efficiency of the floorplan led to cost and carbon savings at every stage. Compared with the RICS's 2022 benchmarks for residential construction (A1-A5, cradle to completion), upfront carbon is 44% lower on the substructure, 21% on the superstructure and 43% on the facade. Overall, A1-A5 embodied carbon weighed in at 516kgCO_2e/m² compared with the benchmark of 850kgCO_2e/m².

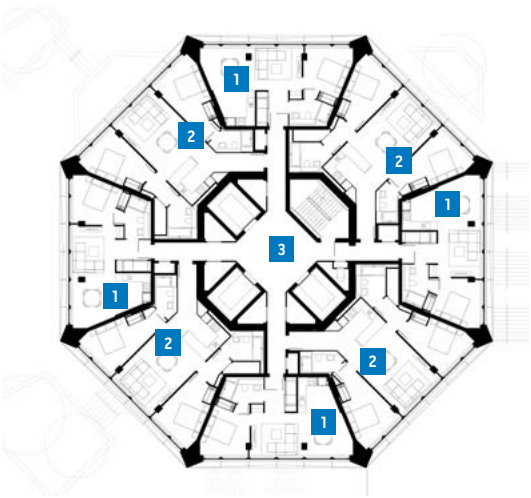




ABOVE RIGHT
The part triple-height ground level contains a private dining room, lounge, co-working area, juice bar and 24-hour concierge

RIGHT
All windows are openable beneath the transom

TYPICAL FLOOR PLAN



1 One-bed flat
2 Two-bed flat
3 Circulation core

BELOW
The faceted aluminium facade was fixed to the slab edge, without the need for additional structure



Photo: Greg Holmes

The structure was almost entirely precast and repeated from floor to floor. The core walls were installed first, followed by triangular lattice planks, and then the columns. These comprised a primary diamond-shaped perimeter column at each of the eight corners, two secondary perimeter columns between the corners and a blade column halfway along each radial axis. The 200mm-thick party walls and 100mm-thick internal walls are all made from insulated concrete panels, providing all spaces with two hours' fire separation and high levels of acoustic protection.

The aluminium facade panels – 600mm deep and faceted to draw in daylight from below while maximising shading from above – were also manufactured off site. These lightweight elements were pre-glazed and insulated, and fixed to the slab edge, with no additional internal structure required.

There is a sense of spectacle to the construction of precast structures of this scale, and the pace at which it takes place. "Everyone was just following the building as it went up," says Bansal. "It became a social media event: people were saying, I was only in Birmingham two weeks ago, and it's gone up five storeys."

So why has no one ever built an octagonal residential tower before? The answer probably lies with the perceived difficulties of wedge-shaped layouts radiating from the core –furniture tends to fit better in right-angled spaces. Howells was able to call on its experience redeveloping Birmingham's grade II-listed modernist landmark, the Rotunda, 20 years ago. There, it had turned a drum-shaped tower of outdated office space into sought-after city-centre apartments, breaking the plan into similar trapezoidal layouts.

At the Octagon, there is an 800mm zone beneath the glazing, which means that furniture can be placed along the outer wall, while views out can still be enjoyed from seating. Prefabricated bathroom and utility pods have been installed in the smaller, more awkward areas towards the core. "Everyone thinks that pods need to be rectangular," says Bansal, "but they can be any angle, as long as they're repetitive and there are a lot of them."

The Octagon clearly shares some DNA with the Rotunda, as well as the slender profile of Birmingham's other mid-century icon, Richard Seiffert's Alpha Tower. There's a suggestion too of the brick chimneys that dotted the skyline during the city's industrial heyday. "It's definitely a building with a Brummie accent," says Bansal. "It's a city that was defined by innovation and advanced manufacturing. It's a bit brutal, a bit modernist, a bit futuristic." ■



Photo: Buro Happold

GO SHORT

At the University of Bristol's flagship Sloane Robinson Building, FCB Studios and Buro Happold show that shorter spans and lower carbon don't need to mean less flexibility. By Nick Jones

There is a tension at the heart of most new university buildings. They must be flexible, to keep up with the fast-changing world of learning, teaching, testing and researching. At the same time, universities are under pressure to reduce the embodied carbon of their estates.

Flexibility tends to translate into carbon: "loose-fit" column-free spaces need long spans and deeper slabs, supported on a chunkier frame and larger foundations. "It's a difficult one to balance with the aspiration to limit embodied carbon," says Ian Fiebelkorn, associate director at engineering consultancy Buro Happold.

The Sloane Robinson Building, the flagship building at the University of Bristol's new Temple Quarter Enterprise Campus, is a valiant attempt to solve the problem. Designed by Feilden Clegg Bradley Studios, with Buro Happold providing multidisciplinary engineering services, it bears all the hallmarks of a modern, multipurpose faculty building. Across six storeys and 38,000m^2, there are a range of teaching areas, research labs and workshops, all organised around two full-height atriums. There is a 300-seat lecture theatre and a huge publicly accessible entrance hall. And yet it is largely based on a modest 7.5m x 7.5m grid.

This has made a huge impact on the building's carbon impact – reducing the structural embodied carbon by 25% compared with the original 15m-spanning design. So how did Buro Happold achieve this without losing the looseness?

It started with Covid. With the project still in its early stages and the world on hold, the structural solution suddenly came into sharp focus. Buro Happold had originally designed the building with a steel frame and hollowcore planks to maximise future flexibility. This spanned a 15m x 7.5m grid with minimal downstands, limiting potential disruption to services. It was, however, "quite heavy on the steel", says Fiebelkorn, while the planks were also deep: 400mm with a 75mm in-situ concrete topping.

Against a changing economic backdrop, the team revisited the structural approach. "We asked whether we could make a →

BELOW
The double-height ground-floor plinth is clad in pale precast concrete with fluted columns



Photo: Andy Stagg

fundamental change to create a more efficient building, and deliver significant embodied carbon savings," says Fiebelkorn.

By this stage, the project team had a fuller understanding of the different functions of the building and how much flexibility they really needed, he explains. They worked out that by introducing an intermediate grid line and switching to a reinforced concrete frame with 300mm-deep flat slabs, they could reduce the structural embodied carbon from 487 to 354kgCO_2e/m^2 without affecting the majority of the building uses. With a better understanding of the functioning of each room, they could also avoid localised strengthening in areas such as the quantum computing labs, which needed strict vibration control. "Rather than making the structure respond perfectly everywhere through expensive strengthening, we could focus key equipment in less excitable areas."

The biggest impacts of the new grid were on the lecture theatres and the multi-use spaces for teaching very large numbers of students. "These functions want to be at ground level, so we have incorporated transfers where necessary to allow the areas above to remain on the more efficient grid."

The result does not appear grid-like or plagued by columns. Behind the facades of glass and pale precast concrete, the spaces

"We asked whether we could make a fundamental change to create a more efficient building, and deliver significant embodied carbon savings"

BELOW
The structural frame was reduced from 15m spans to a 7.5m x 7.5m grid

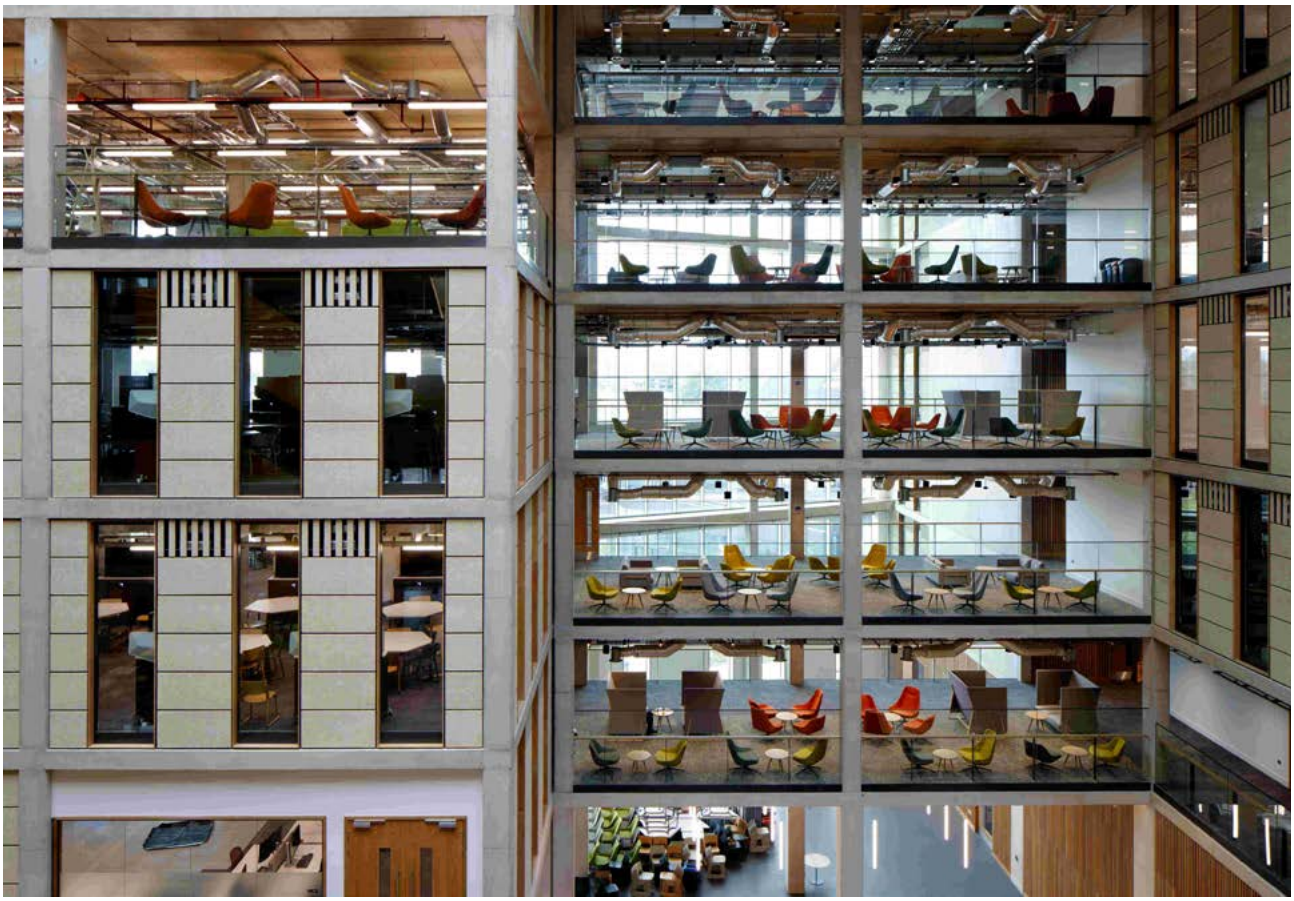


Photo: Buro Happold

unfold in a sequence of visually connected public routes and 7m-wide corridors. The ground-floor reception is huge: 37m long and 6m high, with a 15m-wide avenue running the full width of the building. A bright yellow double-width staircase leads up to the main atrium, which extends through the upper five storeys. This vast open area is framed in exposed concrete columns and slab edges, with sharp joints expressed at the intersections between the two, while a monumental fluted-concrete core rises all the way up to the roof.

There are a number of larger spaces integrated into the plan: active learning areas for up to 90 students, the quantum computing lab, a ground-floor events space and workshop areas. The centrepiece is the lecture theatre, which takes the form of a 15m-diameter circular steel drum with 360-degree screens, suspended from the concrete frame. "Originally, that space was going to be split into two more conventional lecture theatres," says Fiebelkorn. "But when Covid hit, the university did a lot of work looking at the future of learning, and said, actually, this is a better format for us."

Throughout the interiors, as-struck concrete exudes permanence while an overlay of exposed services suggest more of a plug-and-play approach. Lighting and ductwork are suspended from the soffits, again clearly expressing the idea of the building as layers that can be renewed in different cycles. Apart from the toilets, there are no suspended ceilings anywhere in the building.

Despite the expanses of visual concrete, few special finishes →



Photo: Andy Stagg

ABOVE
The building sits on a 7-acre island site between the River Avon, a canal and the railway

TEMPLE RISING

How the university is leading Bristol's new city-centre district

The Temple Quarter is a 130ha regeneration scheme next to Bristol Temple Meads Station. The plan is to turn a swath of loosely connected post-industrial sites, empty commercial units and car parks into a new district providing 10,000 homes and 22,000 jobs.

The Sloane Robinson Building is one of the Temple Quarter's flagship developments, the centrepiece of a 7-acre university campus on an island site between the River Avon, a feeder canal into Bristol's floating harbour and the railway. The site previously housed a brutalist Royal Mail sorting office, which had lain derelict for decades.

The project has also included wider landscaping of the pedestrian campus, a new £23m eastern entrance to the station and connections to river walkways into the city.

A CERTAIN RATIO

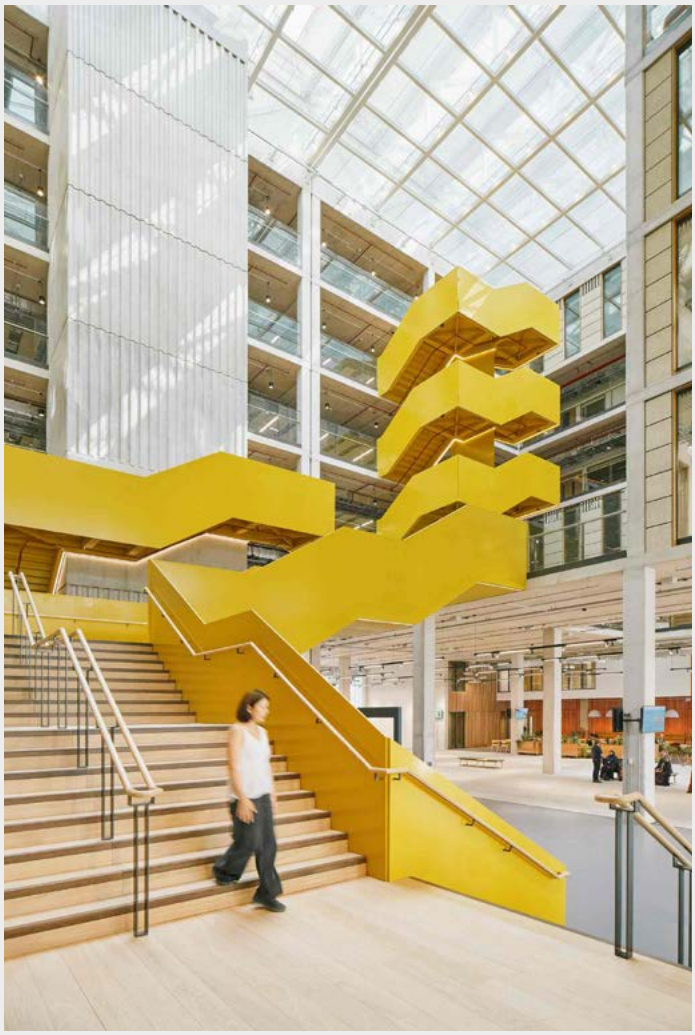
How Toureen fine-tuned the concrete for long pours and fluted cores

One of the biggest challenges facing concrete contractor Toureen Group was the double-height ground floor – the main public route – which FCB Studios wanted to convey a strong civic quality. Contracts manager David McLeod took the ambitious decision to cast the vertical elements in a single 7.2m-high pour to avoid horizontal joints and emphasise the sense of scale.

Toureen's intention had been to increase the GGBS in the concrete from 35% to 40% in these areas, in line with its own carbon-reduction commitments. However, initial tests showed some evidence of water bleed during the high-pressure double-height pours. McLeod suggests that this may have been due to the local limestone aggregates, which don't offer the same cohesion as gravels used elsewhere in the UK (although they did seem to improve early strength gain in the high GGBS mixes).

The concrete design for the ground floor was adjusted to increase the cement content from 300 to 370kg/m^3 – the minimum deemed necessary to avoid bleeds. The GGBS was reduced to 36% and the water-cement ratio lowered from 0.55 to 0.45. Superplasticisers were added to keep the mix workable.

The concrete team were nervous that the smoothness of the flexible formliner used on the fluted feature core might still cause water to rise to the top of the pour, leading to further bleeds. Although embodied carbon was the priority with most of the concrete, the surface quality of the core was paramount. The decision was therefore taken to also use the redesigned mix on the 3.6m lifts for the upper levels of the ribbed feature core. "There was a lot of pressure to achieve the crispness of the joints because it's a real visual centrepiece," says McLeod. "It does dominate the space, and it looks fantastic."



ABOVE
The fluted concrete core was cast using flexible formliners

Photo: Andy Stagg



Photo: Andy Stagg

ABOVE
A 15m-diameter circular lecture theatre has been suspended from the concrete frame

were specified. The only exceptions were the soffits and entrance walls in the public reception area, for which FCB Studios designed the plywood board layouts, and the atrium's feature core, which was cast using a flexible formliner to give definition to the fluted surface (**see previous page**).

"Bristol were very open to having characterful concrete," says David McLeod, contract manager at frame contractor Toureen Group. As part of the early engagement, Toureen produced a large sample panel to test tie hole arrangements, board layouts and different shutter types – a joint decision was taken to use timber rather than steel, due to its less shiny finish.

Lower-carbon concretes have been used throughout. Again, the Covid lockdowns enabled a change of approach to specification. "Usually it's quite a linear process," says Fiebelkorn. "The engineers specify their requirements, and that gets passed to a contractor who adds their requirements for early stage design, and that then gets passed to a supplier. Instead, we held a series of workshops →

where we talked about the practical limitations. So rather than us as engineers saying, just take as much carbon out as possible, we were taking on board everyone's drivers and coming up with a compromise position, and actually getting to the most efficient practical solution."

With high levels of GGBS available locally at the time from the Port Talbot steelworks, the specification included 75% for the foundations, 50% for the columns, ground-floor slab and retaining walls, and 35% for the superstructure slabs. All proposed concrete mixes were assessed against the **Lower Carbon Concrete Group (LCCG) Market Benchmark**, and all materials were monitored on site by main contractor Sir Robert McAlpine using a proprietary tracking system. Of more than 35,000m^3 of concrete poured, 93.7% was B-rated or better, aligning with ConcreteZero's definition of "low embodied carbon concrete".

On top of the carbon savings made during the design process, the specification of A- and B-rated concretes reduced the total structural embodied carbon to 268kgCO_2e/m^2, almost half the original long-span steel frame and close to the LETI 2030 target of 228kgCO_2e/m^2.

A lot of this was down to asking the right questions of the right people at the right stage of the process, which led to a more efficient structure, more achievable concrete mixes and a far clearer idea of what the client meant by flexibility. It seems that loose fit might be going out of fashion: the future lies with clever tailoring. ■

Watch Ian Fiebelkorn talk about the Sloane Robinson Building on the Concrete in Practice webinar: concretecentre.com/Events



Photo: Andy Stagg

PROJECT TEAM

Architect Feilden Clegg Bradley Studios
Structural engineer Buro Happold
Main contractor Sir Robert McAlpine
Structural frame contractor Toureen

ABOVE

The landscaped 7-acre campus includes a new eastern entrance to Temple Meads station



Photo: Mark Newton Photography

ONLINE

LIVE ON AIRE

"Square peg, triangular hole," is how Cartwright Pickard director Ian Walsh describes the design challenge at Kellstone, a grade A office scheme in central Leeds.

The building occupies a triangular plot at the gateway of Aire Park, a mixed-use district taking shape on the former site of the Tetley Brewery. Unusually, it was always going to be precast concrete: almost the entire building, from the ground-floor columns to the brick facade panels, to the core, stairs and even non-structural walls, was manufactured off site.

On the one hand, this meant that the practice could tailor the design to the right construction method, rather than having to shoehorn it in later. On the other, Walsh points out, they faced the unavoidable challenge of reconciling two different geometries: "From the outset, we had a fixed triangular plot parameter and a fixed orthogonal system." ■

READ THE FULL STORY
concretecentre.com/cq

ONLINE

TUMBLING BLOCK

In the famously flat, fenland city of Cambridge, Pollard Thomas Edwards has built a hill. The Icon is a 106-home apartment building that tumbles down in boulder-like concrete-framed cubes towards a neighbouring cricket pitch.

PTE describes the form as "a lived-in architectural landscape", and in many ways it is as much an outdoor space as a residential building. Each cube supports a 3m x 3m terrace, in addition to a shared roof garden the size of a city block. Circulation is via a tree-lined "street" that slices lengthways through the 100m-long plan like a canyon. The building – the latest addition to the University of Cambridge's exemplar low-carbon Eddington development – acts as part of the landscape in more subtle ways too, with a rainwater strategy that plugs into a wider sustainable drainage network of swales and wetlands. ■

READ THE FULL STORY
concretecentre.com/cq



Photo: Nick Kane

ONLINE

FIXING FELIX

In Ghent, north-west Belgium, ATAMA has turned a redundant complex of brutalist council offices into a vibrant piece of city with an unusual hybrid of services that includes a dance academy and a police station.

Designed by the celebrated Belgian modernist Paul Felix, the civic centre in Gentbrugge exemplified his rationalist principles – clean lines, geometric rigour and functional layouts. It was built in the mid-1970s, but rendered obsolete almost immediately by a boundary change.

Now rebranded De Felix, the complex has been resuscitated as the beating heart of the community. The five-storey former administration block has become a dance and music school, while a new-build performance hall encloses one end of the complex to create a courtyard with a play area for children. One of the two-storey blocks has become a primary school, with a library, cafe, coworking area and council services on the ground floor, and another playground on the roof.

"It's very lively all the time," says architect Jorg Leemans. "In the morning, parents or grandparents can drop their children off, they can have a drink in the cafe, go to the library, pay a bill. It really works." ■

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Photos: Stijn Bollaert



Photos and diagrams: Permeable Paving Manual, MPA Precast

Permeable paving for SuDS

Under updated national planning rules, sustainable drainage systems will be required on most new developments. Concrete block permeable paving can fulfil a range of functions, writes Chris Hodson

Sustainable drainage systems (SuDS) are a method of surface water management that mitigates flood risk, supports green infrastructure and reduces pressure on local sewage systems. As climate change results in wetter winters, drier summers and more extreme storms, they are an important measure for making towns and cities more resilient.

Essentially, SuDS reverse the long-term trend of paving over natural surfaces, which results in rainfall being channelled straight into urban drainage rather than absorbed into the ground where it falls. When a large amount of rain falls within a short period of time, drainage systems can become overwhelmed, resulting in surface water flooding.

In the new National Planning Policy Framework, released in August, the government made SuDS integral to new developments in England. It states that SuDS should be incorporated into proposals that could affect drainage on or around the development site, to control flow rates and reduce the volume of run-off. Where possible, these systems should provide multifunctional benefits, and improve water quality, biodiversity and amenity. SuDS are already a legal requirement on most developments in Scotland and Wales.

How do SuDS work?

SuDS mimic natural drainage in several ways. Water is allowed to soak into the ground or be conveyed slowly on the surface. Pollutants are filtered out, and controlling the flow allows sediments to settle out. To achieve this, they incorporate a range of "hard" and "soft" features tailored to the requirements and opportunities of each site.

A key SuDS concept is "source control", where water is dealt with when and where it falls, through green roofs, rainwater harvesting and permeable surfaces. A steady flow of relatively clean water moves onward along a "management train". This is a series of SuDS features that progressively clean and channel it to where it can be stored to provide benefits for people and wildlife, for example in open basins, wetlands and ponds.

Supporting nature

Features such as tree pits, geocellular systems and impermeable sub-bases can also be included to support street trees and green infrastructure, provide additional water storage, accommodate statutory services or meet other requirements. Materials can also be combined using methods such as the Stockholm system. →

BELOW
Street trees at the Lamb Drove SuDS monitoring project



This mixes a load-bearing base of compacted crushed stone with additions including biochar, compost, soil or other materials to provide voids that encourage tree root growth.

Concrete block permeable paving

Pervious pavements are used as part of SuDS to provide a hard surface for pedestrians and vehicles, while still allowing rainwater to infiltrate down into the lower layers.

The term "pervious" encompasses two sub-categories: in "porous" surfaces, water infiltrates through pores across their area. In "permeable" surfaces, it infiltrates through joints between impermeable units.

Concrete block permeable paving is an example of the latter. The key difference to conventional block paving is that the joints between the blocks are enlarged, and filled by with angular grit rather than the usual block paving jointing sand. Angular grit is also used as a laying course, typically supported by a coarse-graded aggregate sub-base with voids of approximately 30% by volume. This means that water can drain away between the blocks. The grit filters out pollutants, and the subgrade temporarily stores the water before releasing it slowly down the management train.

Types of permeable paving system

In most permeable pavements constructed to date, water is stored and released slowly using one of three systems: total infiltration, partial infiltration or no infiltration. It is important to determine the appropriate system for specific applications and conditions.

This will depend on infiltration rates, groundwater levels, the need to manage contaminants and pollution, and whether the water is intended to be used for landscaping or other purposes.

1. Total infiltration

These systems are used where all of the collected water can be discharged into the ground. Water infiltrates between the concrete blocks, passing through the constructed layers below and into the subgrade. None is discharged into the next stage of the management train or the sewer system, and there is no need for pipes and gulleys.

2. Partial infiltration

These systems are used where the existing subgrade is only capable of absorbing water slowly, or where interception is required. Perforated outlet pipes within



ABOVE
Concrete block permeable paving can be used around standard tree pits, enabling healthy roots without the need for reservoirs or pipes

the paving collect the excess water and drain it to another part of the management train or drainage system. A flow-control device slows the discharge, so that water is temporarily stored within the pavement. Alternatives to pipes include fin-drains, proprietary drainage systems or geocomposite blankets placed below the pavement or vertically around the edges.

During smaller rainfall events, water entering the pavement will typically infiltrate into the ground. During more extreme events (1 in >10 years), excess water discharges to an outfall to either surface or sewer, at a maximum allowable rate agreed with the regulator. This ensures that water does not sit on the surface of the subgrade for long periods and the risk of soil softening is negligible.

3. No infiltration

These systems are used where infiltration rates are very low, such as on heavy clay, and designed on the basis that all water entering the pavement is discharged via outlet pipes. Even minor losses into the ground can be beneficial for reducing the volume leaving the system, so normally the system would not be tanked. But a geomembrane can be included where the water is being stored for reuse, or where it must be prevented from entering the ground due to contamination or geotechnical risk.

Retrofitting permeable paving

Concrete block permeable paving can also help urban environments adapt to changing weather patterns as an overlay to the existing road construction. These installations comprise only the paving units and laying course, with a thin drainage medium below. This is a low-cost approach that preserves the embodied carbon of the existing road-base. As an overlay, permeable paving can collect, clean and store up to 20mm of rainfall, representing 95% of rainfall events.

In the absence of a permeable sub-base, the storage volume and level of water treatment is reduced, but this can be supplemented by discharge to a secondary SuDS component such as a rain garden. The paving overlay can also discharge to existing road gulleys below the pavement surface, for example when traditional stepped kerb streets are transformed into shared surfaces.

The structural design of the overlay should take account of the condition of the existing road surface. If it is in poor condition, the water could soak into cracks and reduce the strength of the underlying →

TYPES OF PERMEABLE PAVING SYSTEM

Fig 1. Total infiltration

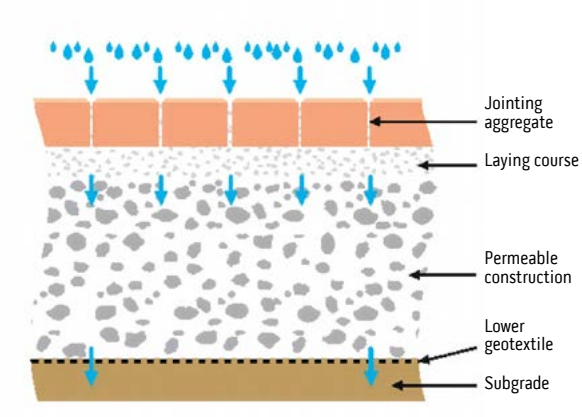


Fig 2. Partial infiltration

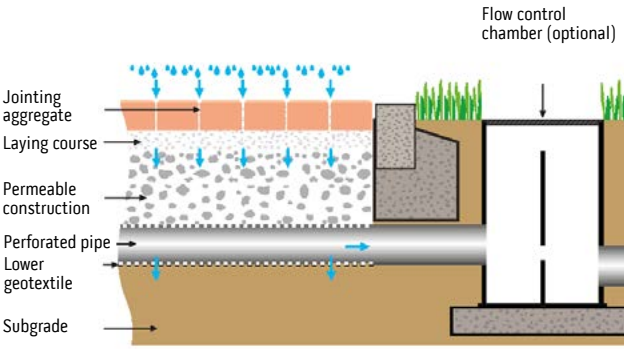
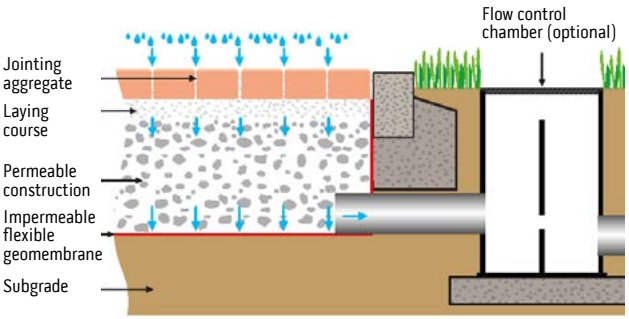


Fig 3. No infiltration



pavement. The existing surface should be sealed.

It is not necessary to provide a waterproof membrane between the new structure and existing, adjacent impermeable structures. The sub-base is dry most of the time, even during the majority of rainfall events, and stored water depths are normally too low to cause sideways pressure or water flow from the structure. The permeable sub-base will also act as a drain for any water trapped in adjacent sub-base materials.

Permeable paving should not be retrofitted where the road geometry could cause concentrated surface-water flows, for example where there are significant cross falls or long falls that channel water into the gutter. It should also not take water from upstream areas that could be discharged as a concentrated flow in the gutter. In both cases, this could overload or bypass the permeable paving system.

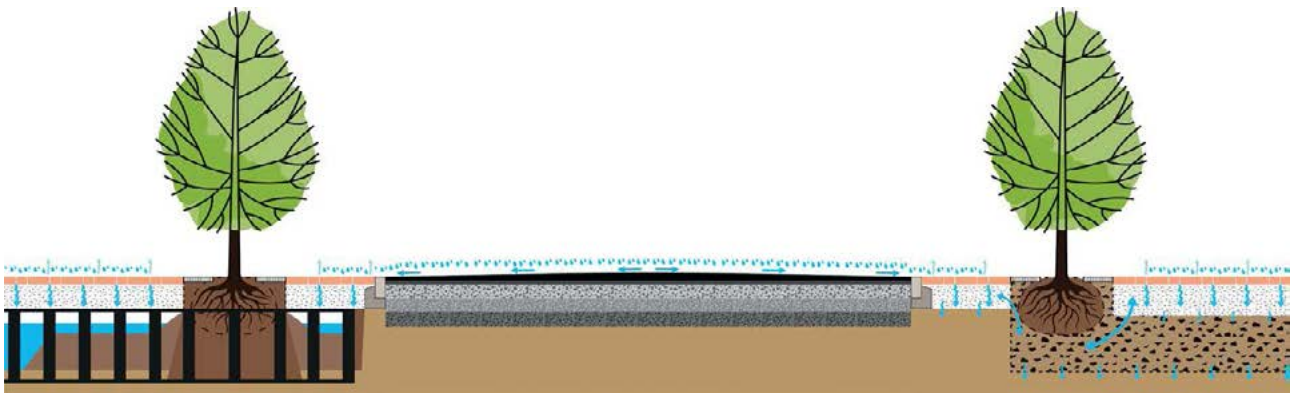
Partial street replacement

An alternative approach is to partially replace an impermeable road surface with concrete block permeable paving along one or both sides, to avoid statutory services and demarcate on-street parking areas.

Here, the existing road profile directs water from the impermeable carriageway and adjacent footways onto the permeable paving, which can accept twice its own area of runoff. ■

To help designers meet the national standards for SuDS using concrete block permeable paving, MPA Precast has published The Permeable Paving Manual, co-authored by Chris Hodson, Bob Bray and Steve Wilson. This contains comprehensive guidance on all aspects, from overarching principles to detailed design, specification, construction and maintenance. Download it from mpaprecast.org/paving

BELOW
Partial street replacement can be combined with a geocellular system (left), structural soil profiles (right) or rain gardens to support urban greening



SUMMER 1958
NERVI'S PANTHEON

"A 'big top' in concrete, held by taut concrete guy ropes, its concrete edges lifting to the wind." That's how *Concrete Quarterly* introduced readers to the Palazetto dello Sport (page 8), completed two years before the 1960 Rome Olympics.

There was a "wonderful grace" to the structure, which had been designed by Pier Luigi Nervi in collaboration with architect Annibale Vitelozzi. The secret was the interplay between the perimeter structure of 36 forking buttresses and the diamond-shaped sections of the 200ft-diameter dome, "narrowing to the apex and broadening to the base".

The buttresses were in the form of a low, raking Y and were self-supporting, with a second leg branching out from the junction of the Y. "The combination of good concrete with strong timber markings gives them a look of fine, taut strength. (Nervi, however, was not satisfied: the concrete should have been better ...)."

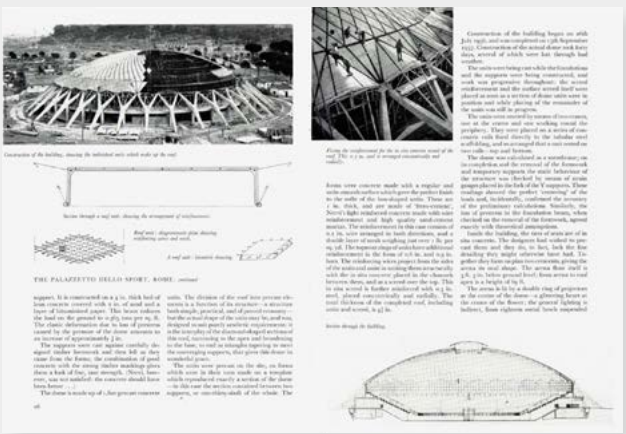
The ribbed units of the dome were precast on site, on forms made on a template that reproduced exactly a 10 degree section of the dome. The outer layer was a 1-inch thick shell of ferro-cement, Nervi's trademark light reinforced concrete made with wire reinforcement and high quality sand-cement mortar.

But it was the structural ribs below that truly took our correspondent's breath away. "The vast unfolding flower of the roof spreads its petals across what seems immense space, filled, spilling over, with light". ■



A 'BIG TOP' IN CONCRETE:

The Palazzetto dello Sport, Rome



THE PALAZZETTO DELLO SPORT, ROME—*continued*

"The combination of good concrete with strong timber markings gives them a look of fine, taut strength"

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Final frame: La Vallée Verte, Bordeaux

La Vallée Verte is a 70-home apartment complex with a crater-like central courtyard. "The crater is conceived as an excavation within a solid mass," says its Dutch architect, MVRDV. "Concrete surfaces reinforce the sense of a carved-out landscape." The building's slopes and angles are designed to maximise direct sunlight throughout the year.

Photo: Paul Lefevre