mpa The Concrete Centre

CONCRETE QUARTERLY

SPRING 2014 | ISSUE NUMBER 247: SUSTAINABILITY

NOW ARRIVING AT KING'S CROSS
The BREEAM "outstanding" offices that are turning N1C into London's most sustainable postcode

LOW-CARB RECIPE
A Brisbane research centre becomes the world's first cement-free concrete building

THE HANGING GARDENS OF MIAMI
Herzog & de Meuron uses concrete, timber and tropical plants to frame an entire art gallery

WELCOME

THE LONG GAME

The long-term view has become increasingly influential in the decisions we make about building design and construction materials. In this issue, we present a range of public and commercial projects, both in the UK and globally, that have been built with both eyes fixed firmly on the future.

Our cover feature explores the BREEAM "outstanding" offices of London's regenerated King's Cross, an exemplar commercial project for the UK. Elsewhere, we consider LEED and Green Star buildings from Abu Dhabi to Brisbane. That their project teams have come up with such different solutions is testament to the versatility of concrete and to the creativity that it continues to inspire.

The long-term view is something we particularly appreciate at Concrete Quarterly. CQ is rare among magazines with such focused content, in that it is able to draw on an archive spanning nearly 70 years. But we have our eyes fixed on the future too: from now on CQ will be published mainly in electronic form. We very much hope that you will continue to enjoy the magazine and be inspired by its content, as we look forward to the next phase of CQ's long history.

Guy Thompson
Head of architecture and housing
The Concrete Centre
www.concretecentre.com/cq

NEWS ROUND-UP

Sustainable concrete to be the talk of Ecobuild 2014

The Concrete Centre will be delivering a series of seminars at 2014's Ecobuild exhibition and conference, which takes place at the ExCel centre in London on 4-6 March.

As part of the Lafarge Tarmac on-stand seminar programme, experts from The Concrete Centre will be speaking on all three days, covering essential topics for all those involved in the design and delivery of sustainable buildings. They will also be available to answer questions from attendees on the specification and use of sustainable concrete.

Architect Elaine Toogood will provide an introduction to "Specifying sustainable concrete". She will address both design and construction considerations, from obtaining responsibly sourced materials to understanding the BRE Green Guide rating system and energy and material efficiency.

Meanwhile, in "Thermal mass explained", building physicist Tom De Saulles will offer a guide to thermal mass and discuss how it can be harnessed and measured, including how it can influence SAP ratings and enable buildings to comply with the latest revisions to Part L1A of the Building Regulations.

Head of structural engineering Jenny Burridge will speak on "Designing for whole-life and long-life performance". She will explain how the industry can deliver on the government's Construction 2025 strategy, providing an overview of costs, carbon emissions and whole-life efficiency for sustainable concrete solutions.

Seminars will take place at Stand N320 throughout Ecobuild.

For more information on training and events, or to download guidance documents on all of these issues, go to www.concretecentre.com

IN THIS ISSUE

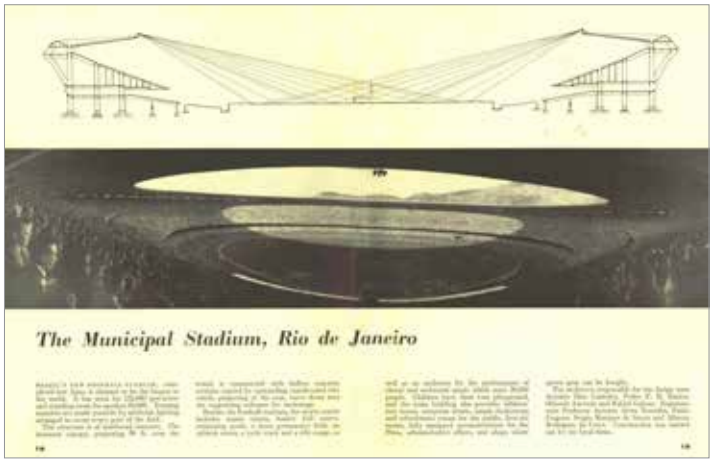
On the cover: A visualisation of Two Pancras Square in north London, designed by Allies and Morrison

CONCRETE QUARTERLY

mpa The Concrete Centre

The Concrete Centre is part of the Mineral Products Association, the trade association for the aggregates, asphalt, cement, concrete, lime, mortar and silica sand industries.
www.mineralproducts.org

FROM THE ARCHIVE



SUMMER 1951: BRAZIL (ALMOST) MEETS ITS DEADLINE

As FIFA frets over the completion of the stadiums for this summer's World Cup in Brazil, it is worth looking back to the last time the country hosted the event. In 1950, Rio's all-new Maracanã stadium staged eight matches including the final – despite the fact that it wasn't officially completed until 1965. FIFA may be relieved to note that, despite still being a building site, the Maracanã became an instant icon. Reporting in 1951, CQ was impressed by such features as its immense concrete canopy, "projecting 99ft over the stand", and the innovation of artificial lighting, allowing the possibility of evening kick-offs.

Access the full CQ archive at www.concretecentre.com/cq

Photo: Hufton + Crow

AQUATICS CENTRE OPENS TO PUBLIC

The London 2012 aquatics centre (featured in CQ 241) is due to reopen to the public in March, offering UK swimmers who aren't quite up to Team GB standards the chance to swim beneath its extraordinary coffered roof. Designed by Zaha Hadid, the aquatics centre was one of the Games' most striking venues. It features more than 50,000m^3 of structural and visual concrete, most notably in its curving internal walls and sinuous diving boards.

Concrete industry on target for 50% fall in injuries from 2008 levels

The UK concrete industry is on course to meet its 2014 health and safety target, set in 2008 as part of the Concrete Industry Sustainable Construction Strategy.

The wide-ranging strategy includes targets on every aspect of sustainability, and was adopted by manufacturers across the aggregate, cement, ground granulated blast furnace slag, fly ash, admixtures, ready-mixed and precast concrete sectors. Together, the signatories represented 81% of total concrete production in 2012.

Between 2009 and 2014, the industry committed to halving lost time injuries (LTIs). In the industry's sixth annual performance report, showing progress up to the end of 2012, reportable injuries were 39% lower than in 2008. LTIs across the concrete and reinforcement sectors were 50% lower than in 2009 and about 30% lower than 2010, when a more rigorous data capture method was adopted.

The performance report also details the industry's successful completion of targets to 2012, covering environmental management, quality management, carbon dioxide emissions, emissions to air and water, waste, and waste materials as an alternative source of energy.

Download the full report, as well as Concrete Action, a two-page summary for designers published by The Concrete Centre, from www.sustainableconcrete.org.uk

CONCRETE ELEGANCE EVENT

Photo: Jack Hobhouse

GRIDS, GRACE AND GRAVITAS

Many architects designing schools and universities have been drawn to concrete in recent years, but January's Concrete Elegance event highlighted its contribution to some very different types of learning space.

Mark Shaw from Duggan Morris Architects told a packed audience how the practice created the Ortus learning centre (above), a 1,550m^2 addition to the Maudsley hospital in south London. Taking inspiration from its Georgian surroundings, it is a very graceful but simple rectilinear form, with a restrained pallet of materials that includes fair-faced concrete and a brick, glass and precast concrete grid facade. It may look expensive, but it was created by a close-working team of specialists to a very keen budget for its charity client.

ADP Architects' The Forum in Southend-on-Sea is shared between the council, the University of Essex and South Essex College, and includes teaching facilities and a municipal library. ADP partner Roger FitzGerald explained how precast concrete panels were used externally both to provide solar shading and to create an imposing civic presence. Meanwhile, exposed internal walls and soffits unify the different spaces and provide thermal mass to support a BREEAM "excellent" rating.

The next Concrete Elegance event, featuring Heatherwick Studio, will be held on 9 April at The Building Centre in central London. For more details and to book your place, click on "Training & Events" at www.concretecentre.com

THIS IS CONCRETE

This is Concrete blogger Elaine Toogood admits to casting a jealous eye to the Continent for its use of bold, contemporary concrete. But she increasingly finds much to admire at home. "There seems to be no shortage of interesting buildings with high-quality concrete finishes, often combined with strong sustainability credentials," she says. "The benefits of using the exposed thermal mass of concrete to reduce energy bills seem now to be widely understood by clients with a direct interest in a building's running costs, and it is heartening to see this spreading to speculative offices, as exemplified by Argent's Pancras Square development at Kings Cross."

Pancras Square's BREEAM "outstanding" buildings also feature flexible floorplates and generous floor-to-ceiling heights, intended to make them as future-proof as possible. Toogood hopes this is the start of a new phase for office development in the UK, "one that not only places more value on energy efficiency in use but also over a very much longer useful life – and features impressive concrete along the way".

This is Concrete is a campaign to champion concrete projects, sustainability and innovation. Join the debate on twitter at @thisisconcrete and online at www.thisisconcrete.co.uk

"Concrete is inherently durable and robust to alteration and adaptation, so it can be designed to last for hundreds of years"

this is concrete

LONDON'S CONCRETE QUARTER

The transformation of King's Cross includes some of the UK's most sustainable office buildings – and concrete is key to all of them. Tony Whitehead reports

Photos: John Sturrock

Since the completion of the Olympic Park, King's Cross has had few rivals for its claim to be London's – and arguably the UK's – biggest building site. It is a huge, 67-acre development featuring no fewer than 50 new buildings, 2,000 homes, 20 new streets and 10 new public squares.

Over the past four years this troubled, post-industrial wasteland has truly been transformed and, with many buildings completing this year, it is set to become some of the most desirable real estate in the capital.

Developer Argent makes much of King's Cross' green credentials – as well it might, since from the beginning sustainability has been at the centre of everything that has happened here. King's Cross has its own combined heat and power (CHP) plant, providing heating to most of the development. Many of the building roofs are "brown" – that is, they feature lawns, trees and flowers to enhance and sustain local biodiversity. Public transport links are, as you might expect, superb, built as it is around one of London's most connected mainline and underground hubs. And the buildings themselves are remarkable in that BREEAM "excellent" is considered a base level and many have achieved "outstanding".

If King's Cross is an exemplar of up-to-the-minute sustainable development, then a stroll around its impressive acres immediately reveals the central role of concrete in realising that ambition. There are sparkling concrete facades, monolithic interiors, paving, bridges and more.

"As on any large development, we have used concrete extensively," says Phil Sullivan, senior projects director at Argent. "It's in the groundworks, big retaining structures, basements, embankments and roadways. But I have been privileged to work with some very talented engineers and architects who are really pushing boundaries and showing what can be done with concrete. I've learned a lot about the way the material can be used – especially within buildings from a sustainability point of view."

The much-admired converted Granary building now housing Central Saint Martins College of Art and Design, for example, features a concrete frame and spectacular areas of exposed interior concrete, including huge concrete blade walls running along its central atrium.

"A lot of the buildings here are using post-tensioned (PT) concrete slabs," says Sullivan. "We like to give occupants more ceiling height than the standard 2.7m and these slimmer slabs help to achieve that while reducing a building's carbon footprint."

One example is Two Pancras Square, a stunning 10-storey building clad in sparkling white precast, designed by Allies and Morrison. Above retail outlets at ground level, it will provide around

I'VE LEARNED A LOT ABOUT THE WAY THE MATERIAL CAN BE USED – ESPECIALLY WITHIN BUILDINGS FROM A SUSTAINABILITY POINT OF VIEW

Five Pancras Square

Five Pancras Square is a new 150,000ft², BREEAM "outstanding" headquarters for Camden council. Due for completion this year, it will provide public facilities including two swimming pools and a library on the lower floors and basement, while the upper nine storeys will house office space.

Peter Fisher, associate director at architect Bennetts Associates, says the building's exceptional environmental performance is underwritten by extensive use of concrete – especially on the upper storeys. "Using concrete is the easiest way of achieving the benefits of a large thermal mass," he says, "so the upper nine floors are constructed from precast concrete columns and conventional in-situ concrete slab floors."

He explains that because of noise around the site, particularly railway station announcements, the building cannot simply vent via windows during the day. "Instead we use a displacement ventilation system running partly through the floor voids, and purge-vent the building at night." In this way the concrete in the frame and floors is cooled overnight to a point where it can keep the building cool throughout the following day. In winter, heat from daily activity is stored by the concrete, minimising the need to reheat the building every morning.

Fisher explains that both columns and ceilings have been left exposed to maximise the effect of the thermal mass. "The columns are bare concrete while the ceilings are simply painted white to maximise natural light. Light fittings are suspended from them, and the lack of a suspended ceiling effectively gives the floors an extra 300mm of ceiling height, and a lighter, loftier feel."

At first-floor level, a huge transfer beam supports the building above the swimming pools below. "The pools are 15m wide so we had to take out a central column," explains Fisher. "It is a large steel beam encased in in-situ concrete acting compositely, and the lower floors are a steel structure suspended off that."

Outside, the lower, public levels are defined by pale cream precast concrete cladding panels."We were very careful with the detailing of precast panels clipped to the outside of the building," says Fisher. "We were able to choose the colour and style from [supplier] Techrete's library of concrete finishes, and designed in deep reveals to the glazing at ground level."

The result, says Fisher, is cladding that mirrors the form of the internal transfer beam. "The panels line up with the beam to give the effect of a column with a capital – which is in fact the end of the transfer beam."

Another benefit of the concrete, in sustainability terms, is that it results in a very long-lasting and surprisingly adaptable building. "Every 20 years or so, as needs change, you can knock it about, cut holes in it and adapt it, and it will take all that, being strong and easily repaired. I believe concrete results in a much more robust and adaptable building than many lighter-weight structures more normally associated with flexibility."

PROJECT TEAM

Architect Bennetts Associates
Contractor Kier Construction
Structural engineer AKT II
Concrete frame contractor Mitchellson
Precast concrete supplier Techrete

CLOCKWISE FROM TOP LEFT
Visualisation of the white concrete facade at Two Pancras Square; the building's floor slabs were cast in situ; One Pancras Square's in-situ concrete columns are clad in cast iron; pale cream precast concrete panels clad the lower levels of Five Pancras Square

PROJECT TEAM
Architect Allies and Morrison
Contractor BAM
Structural engineer AKT II
Concrete frame contractor Morrisroe
Precast concrete supplier Techrete

130,000ft² of office space in the nine upper storeys and is to complete this summer.

Planning restrictions mean that most of the King's Cross development is limited in height. So, as Allies and Morrison director Jason Syrett explains, the challenge was to achieve a commercially viable floor area while also satisfying strict criteria on sustainability, as well as indulging Argent's penchant for high ceilings.

"Using a concrete frame with bonded PT floor slabs was the key way that we addressed this," he says. "PT slabs are considerably stronger than standard slabs, and can therefore be much thinner. This allows you to minimise floor-to-floor height, while maximising floor-to-ceiling height."

PT slabs are poured in situ and have steel tendons cast in ducts which are tightened after the concrete has set. Unbonded PT slabs have "free" tendons, but bonded PT slabs are more flexible because there is grouting around the tensioned tendons. This means that they can be cut in a way that unbonded ones cannot, so buildings can be more easily adapted to meet the needs of future tenants.

Syrett also points out that using thinner PT slabs reduces the amount of concrete and reinforcement required, and thus helps to reduce the carbon cost of the building.

Externally at Two Pancras Square, precast concrete cladding panels have been used to create deep reveals to the windows, a feature with practical as well as aesthetic benefits. "The deep reveals provide shading to reduce solar gain, but the shadows also give the building a distinctive appearance," notes Syrett. "It is a four-fronted building and will be viewed from many different angles, often obliquely, so the building will look different depending on the light and from where it is viewed."

This dynamic shadow effect has been accentuated by adding gold metal alloy plates to the window sides which reflect a rich light onto the white dolomite aggregate of the precast panels.

Syrett adds that, although not immediately obvious, the windows actually become wider and deeper-set the higher up the building they are. "They are set back an extra 100mm every storey so that by the time you reach the top, the windows delaminate [separate] from the frame."

This effect has been facilitated by an unusual approach to creating the facades. Traditionally, precast facade panels would be attached to the structure first, before installing windows to fill the gaps. At Two Pancras Square, however, a full facade of curtain walling was installed to close off the edge of the building and then the cladding panels were bolted to the outside.

In all, some 450 reconstituted stone cladding panels were used, so reducing the environmental impact of their manufacture was a priority. At supplier Techrete, UK sales and pre-construction manager Tom Salmon explains: "The panels are made on steel casting tables with adjustable shutters – meaning that large quantities in a range of sizes can be produced from just a few moulds. Where more bespoke shapes are required, we have used timber formwork which could typically be used up to 20 times before being recycled. And where possible we use local aggregate to reduce the environmental impact of transport."

Salmon adds that Techrete's large attenuation tank means that 70% of the water used to wash down the precast panels is recycled.

Now installed at Two Pancras Square, those panels themselves incorporate a bespoke system to collect and divert rainwater. This allows the water to be used within the building, reducing the burden on the mains supply and contributing towards Two Pancras Square's BREEAM "outstanding" rating.

But the system also performs another important practical function, Syrett adds. "It prevents rain dripping over the edge of the window sills where, over time, it could colour the building's white concrete." Hopefully, this should ensure that the building's pristine facade retains its sparkle for many years to come – and that its aesthetics are as sustainable as everything else.

One Pancras Square

"Ironclad and dressed in black", according to its website, One Pancras Square is a whole-hearted homage to the industrial past of the King's Cross area. The nine-storey, 59,000ft² retail and office building is known as the Gridiron and features 400 hefty black cast-iron pillar units. But despite its heavy-engineering aesthetic, the building is actually the result of a very contemporary, energy-efficient approach that has earned it a BREEAM "outstanding" rating.

Mick Kelly, project director at contractor BAM, explains: "The building has an in-situ concrete frame with bonded, post-tensioned (PT) concrete floor slabs. That means it benefits from a large thermal mass. The effect is boosted by the fact that much of the ceiling comprises exposed concrete soffits." Kelly adds that using bonded PT concrete allows the floor slabs to be reduced in thickness from 350mm to about 250mm.

Concrete also features extensively on the Gridiron's exterior. The cast-iron pillars are hollow and clad the frame's in-situ concrete columns. These are connected by precast concrete spandrel panels at each floor – some 700 in total – with two different types of concrete used to achieve this. Tom Salmon at supplier Techrete says: "On the long side of the building, these are made of 150mm-thick blocks of reconstituted stone, but on the short side, where the floors project to form balconies, we have used GRC [glass-reinforced concrete]. Because we have matched the aggregate and colour, the GRC and cast stone blocks are virtually indistinguishable."

Techrete also supplied 36 non-structural precast GRC coffered panels, including 12 unusually large 6m x 3m ones, to form a feature ceiling in the Gridiron's reception – a stunning combination of concrete and black marble.

PROJECT TEAM
Architect David Chipperfield
Contractor BAM
Structural engineer AKT II
Concrete frame contractor Morrisroe
Precast concrete supplier Techrete

BACK OF THE NET

Photos: Morley von Sternberg

Hopkins Architects is bang on target at Wembley, with the UK's first BREEAM 'outstanding' public building

Footballers and Russian linesmen aren't the only ones to have made history at Wembley; concrete has a pretty impressive record in that part of north London too. Owen Williams' Empire pool of 1938 – now Wembley arena – once boasted the largest concrete roof span in the world. Now, on a site just opposite, concrete is playing a key role in the UK's greenest public building.

Hopkins Architects' £90m Brent Civic Centre is a building of two halves – reflecting the fact that it houses both public services and Brent council's administrative functions. A nine-storey L-shaped block accommodates all of the office staff, while a timber-clad "civic drum" contains the library, community hall and council chamber. These two volumes are linked by a showpiece atrium under an ETFE roof. Through a mix of passive measures and sustainable technologies – including natural ventilation and a CHP unit that runs on fish oil – this triumvirate of spaces has become the first public-sector project to achieve a BREEAM "outstanding" rating.

The use of concrete has been essential to the environmental strategy. The post-tensioned slabs in the office block have been left exposed as soffits to allow their thermal mass to do its work. Inside the drum, too, the in-situ columns and library and community hall ceilings are left to quietly absorb and store excess heat.

Such extensive use of exposed concrete required early design meetings between Hopkins and concrete contractor Mitchellson. With no suspended ceilings in which to hide services, penetrations had to be cast in for light fittings and sprinklers, and they needed to be spot on. "You don't get a second chance," says Hopkins associate partner Armin Buchbinder. "If you cast anything in the wrong place, any repairs will remain visible."

The BREEAM target also placed the sourcing of materials under scrutiny. Recycled Cornish stent made up 25% of the aggregate used on the project, while 50% of the cement was replaced with ground granulated blast furnace slag.

Not that the project was just about sustainability: Brent Civic Centre wears its concrete with pride. "We were quite clear that the natural qualities and imperfections should be visible," says Buchbinder.

It may look natural, but the effect was precisely controlled. All of the detailing, down to the types of joint, was carefully drawn out in advance, again in close collaboration with Mitchellson. The highlights are perhaps the ceilings of the community hall and library, where meticulous radial joints fan out gracefully to the edge of the timber-clad drum.

PROJECT TEAM

Architect Hopkins Architects
Contractor Skanska
Structural and services engineer URS
Concrete frame contractor Mitchellson
Concrete supplier London Concrete

CLOCKWISE FROM TOP LEFT

The library ceiling has carefully detailed radial joints; the concrete columns and ceilings were cast in situ; the building comprises a rectilinear office block and a "civic drum" linked by an atrium

MIAMI REFRAMED

With its passive design and canopy of hanging gardens, Herzog & de Meuron's Perez Art Museum shows a new way of building in the Florida sun

Miami is the kind of city where you're in either an air-conditioned building or an air-conditioned car (unless you're on the naturally ventilated beach, of course). Traditionally, little thought has been given to external urban spaces, or to the way that they relate to buildings. With the Perez Art Museum, which opened in December, Swiss architect Herzog & de Meuron suggests a new approach.

The Perez's 3,000m^2 of galleries are housed in a three-storey rectilinear volume of glazed and cast-in-situ concrete walls. Next to the windows, the concrete has been polished to give it a reflective quality; elsewhere it is chiselled, exposing its natural ingredients. This use of exposed concrete continues throughout the interiors. Christine Binswanger, a partner at Herzog & de Meuron, says: "We wanted the building to be rough, to feel real, inside and outside – and not invent another interesting cladding. Concrete as a structure and a finish has rarely been done around here."

But it is beyond the main building's perimeter that the most interesting architectural flourish occurs. The museum is nested within a large trellis that acts as a kind of parasol, shading both the windows and the concrete shell from the harsh Miami sun. This is a key plank of the building's LEED Silver rating, as it reduces the cooling load of the building. And it's also intrinsic to the building's aesthetic: the timber panelling and impressively slender reinforced-concrete mullions and beams serve to soften the main structure's hard edges.

But perhaps most importantly, this canopy allows the external areas to become a transitional space between the hot Miami streets and the cool concrete interiors. Tropical hanging gardens have been planted in and around the frame and will gradually overtake it, further dissolving the building into the surrounding landscape and creating a kind of buffer zone – according to Herzog & de Meuron, this lush inside-outside space will even enjoy its own microclimate.

The distinction between internal and external is further blurred by the extensive glazing – in fact, the museum features the largest expanses of hurricane-proof curtain walling ever used in Florida. This is achieved thanks to a customised system of very narrow, ultra-high-performance concrete mullions, which rise up to 4.9m. These support the glass but also minimise any obstruction to the panoramic views out over both the Pacific and the neighbouring Museum Park, which is itself undergoing extensive renovation. Perhaps Miami might soon become an outdoors city after all ...

PROJECT TEAM

Architect
Herzog & de Meuron
Executive architect
Handel Architects
Project director
Paratus Group
Structural engineer Arup

CLOCKWISE FROM TOP LEFT

Tropical plants have been planted around the canopy; exposed concrete is preferred to conventional white cube galleries; the canopy is supported on slender concrete columns

Photos: Iwan Baan

Photo: Paul McMullin

NOTHING TO IT

Siemens' new HQ in Abu Dhabi is the first LEED platinum building in the Middle East. The key is not what's there, but what's been left out ...

The new regional headquarters of electronics giant Siemens in Abu Dhabi shows that, when it comes to sustainable construction, less really is more. By using innovative void-forming technology in the construction of the building's concrete floor slabs, architect Sheppard Robson and structural engineer Aecom were able to cut the amount of material used by more than half, delivering impressive savings in embodied carbon, energy and water consumption – and helping the building to earn the Middle East's first LEED platinum rating.

The Siemens HQ sits at the heart of Masdar, the world's first wholly planned sustainable city. While the entire city is intended to run on renewable energy, the buildings must also meet stringent standards for energy efficiency – and it's here where Sheppard Robson and its team have set a new benchmark.

The 18,000m^2 building was conceived from the inside out as a "box within a box". The interior is encased by a highly insulated, airtight internal facade, which is then covered by a lightweight aluminium external shading system. The internal facade facilitates the use of passive cooling methods that channel air throughout the building, while the shading system minimises solar gain and maximises daylight penetration. It also gives the building its aesthetic, with each faceted aluminium panel precisely angled in relation to the path of the sun.

These approaches, combined with the extensive use of advanced building management systems such as lighting motion and brightness sensors, have enabled the building to achieve a 45% cut in operational energy consumption and a 50% cut in water consumption compared with similar buildings in the region.

Equally striking is the low level of embodied carbon in the building's construction. The floor plates incorporate 15m spans using post-tensioned flat concrete slabs with integrated void-forming technology. This reduced the concrete requirement by 60% but conceded nothing in strength: in fact, the floors are able to be column-free, which means they are adaptable to changing needs, giving the building an element of future-proofing. The embodied carbon of the concrete was also minimised through the use of ground granulated blast furnace slag.

The floor slabs extend to the internal facade, where they turn at right angles into 90cm-high concrete upstands and 1m-deep downstands, with the glazing sandwiched in the middle. Concrete is also used for the stilts, which emphasise this innovative structure's lightness as they raise it effortlessly above a shaded public plaza.

PROJECT TEAM

Architect Sheppard Robson
Contractor Al Fara'a General Contracting
Structural engineer Aecom

ABOVE

The highly airtight concrete-and-glass internal facade is shaded by a system of aluminium panels

BOUND FOR GLORY

A sustainability research centre in Brisbane has become the first building in the world to use cement-free binder in its concrete

PROJECT TEAM
Architect
Hassell Group
Structural engineer
Bligh Tanner
Contractor
McNab Builders

RIGHT
The precast Earth Friendly Concrete floor beams have been left exposed

BELOW
The institute's shading system tracks the sun like a plant

Photos: Peter Bennetts

The Global Change Institute is at the forefront of the search for innovative sustainability solutions, and it has ensured that its own building is no exception. Located on the Brisbane campus of the University of Queensland, the Hassell Group-designed building is intended to achieve zero net energy operations.

What this means is that the institute will not just be carbon neutral, but it will actually produce more energy than it consumes. It generates its own power supply from 479 photovoltaic cells that provide up to 175,000kWh/year. Electricity is stored in a large 40kWh zinc bromide battery, while surplus energy is fed into the regional grid.

The designers also took inspiration from nature, with a series of biomimicry features such as natural ventilation, a sun-shading system that tracks the sun like a plant, and a central atrium that acts as a lung to expunge warm air through a thermal chimney. On top of all this, the 3,865m^2 building features a green wall, a "bush tucker garden", 60,000 litres of rainwater storage and greywater treatment facilities.

But the institute's real world first is its use of cement-free concrete. The 33 precast floor beams that form three suspended floor plates were manufactured using "Earth Friendly Concrete" (EFC), developed by materials supplier Wagner as a low-carbon alternative to conventional concrete. EFC contains no Portland cement. Instead, it uses a geopolymer binder made from the chemical activation of two industrial wastes: ground granulated blast furnace slag from iron production, and fly ash from coal-fired power generation. This means that its associated carbon emissions are 80-90% lower, significantly reducing the embodied energy of the building. EFC has previously been used in the construction of ground-bearing pavements, masonry blocks and other low-level structures, but the Global Change Institute is the first application for large-scale construction.

The concrete beams also play a key role within the building's passive cooling system, with hydronic pipes cast into these precast elements. During the day, chilled water is produced by a solar-powered heat pump and this is pumped through the pipes to cool the building during the evening. And the concrete's contribution to the building is not only structural and thermal, but visual too: the panels' high-quality, class 2 finish has been left exposed.

The mission statement of the Global Change Institute is "to foster discovery, learning and engagement by creating, applying and transferring knowledge for innovative and integrated solutions to address the challenges of a changing world". By building a home for itself that not only consumes minimal resources but also generates renewable energy for use elsewhere, it has certainly made an impressive start.

FINAL FRAME: UNIVERSITY SQUARE STRATFORD
Make Architects has united Birkbeck University of London and the University of East London in a £33m building that provides flexible spaces to support the institutions' mission of accessible learning. Make used fair-faced concrete throughout the interiors to create a "calm and confident atmosphere". The material's thermal mass is also central to the building's impressive low-energy performance, which has earned it a BREEAM "excellent" rating.

Photo: Make Architects