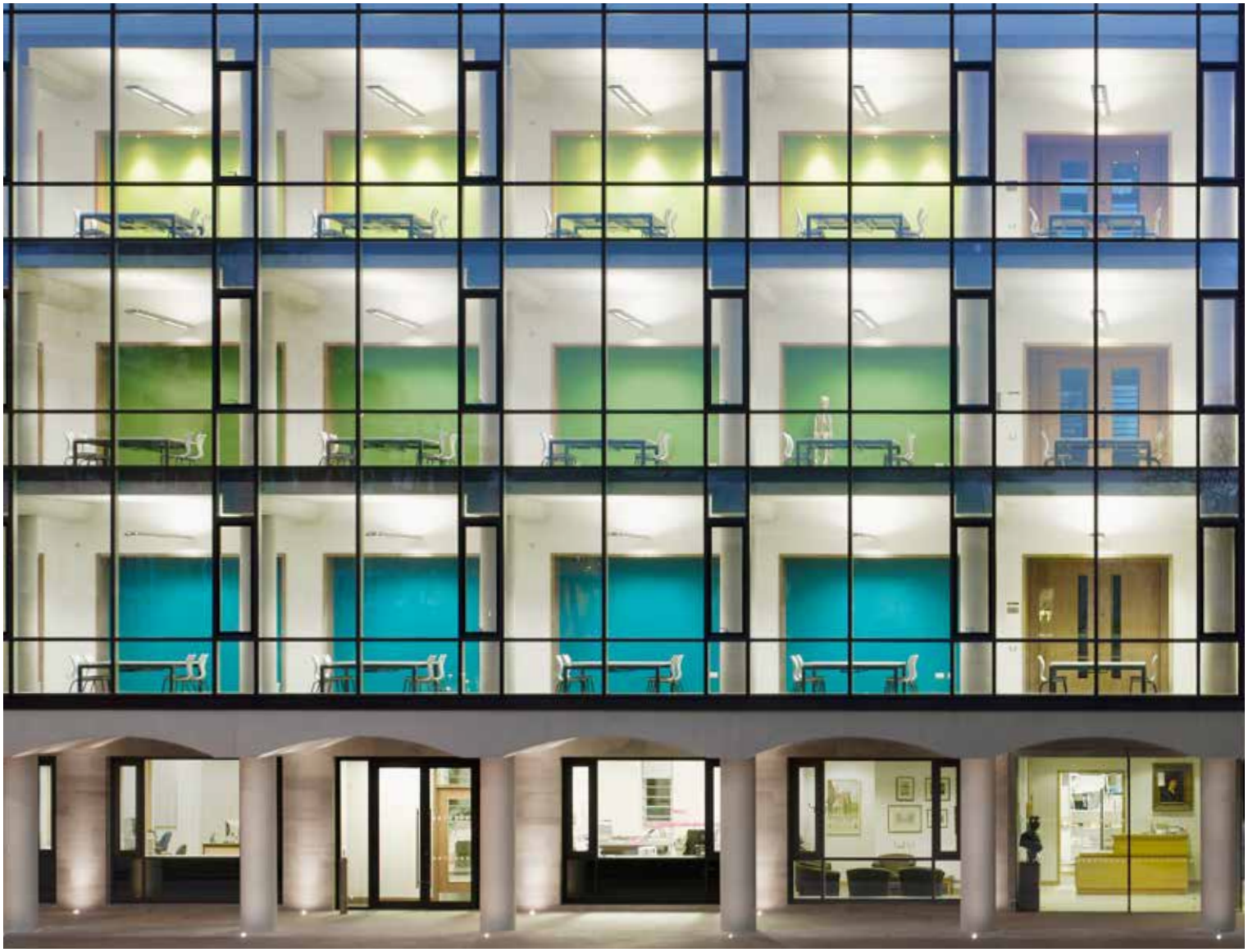
mpa The Concrete Centre

CONCRETE QUARTERLY

AUTUMN 2013 | CONCRETE LEARNING | ISSUE NUMBER 245



DAMASCENE CONVERSION
500-year-old St Paul's School sheds its tired sixties buildings for Nicholas Hare's concrete cloisters

LOAN STAR
How Birmingham bucked the trend and built the biggest library in western Europe

THE NEW RED BRICK
Falmouth becomes the latest university to fall for the raw charm of exposed concrete

WELCOME

INTELLIGENT DESIGN

In this issue of CQ, we examine the role that concrete can play in buildings devoted to learning – schools, universities, libraries and museums.

There are many fine examples of concrete architecture in this broad sector – as the number of education buildings on recent awards shortlists shows. This may be because these buildings are always designed to serve the public for many decades to come, which favours solutions that offer durability and low maintenance. Perhaps it is also because they are often commissioned by enlightened clients who keep a close eye on quality and doing justice to their important public role.

The buildings featured on these pages use both the form and function of concrete to address the public realm, while creating spaces on a human scale with a sense of intimacy to encourage thinking and creativity in their users. They harness the practical environmental benefits that concrete can offer, but also make full use of a range of fair-faced finishes. Nowhere is this exemplified better than at St Paul's School, this issue's cover project, where concrete provides both structure and finish to Nicholas Hare's elegant concrete cloisters.

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

NEWS ROUND-UP

New guidance brings clarity to CE marking for concrete

The Concrete Centre has published online guidance for specifiers on CE marking for construction products, clarifying new European rules that came into force in July.

The Construction Products Regulation (CPR) requires that many – but not all – construction products have CE marking if they are to be sold anywhere in Europe. It applies only to products with a harmonised European standard, such as those made from precast concrete and components of concrete such as aggregates and cement.

Exemptions from the CPR include site-batched products, ready-mixed concrete and reinforcement, and also bespoke products such as some precast concrete.

The rules were originally intended for national market surveillance authorities, to indicate that a product complies with applicable EU legislation and may legitimately be sold within the European market. CE markings were not intended as references for product specification, and specifiers should continue to refer to current EN and BS standards. They may also prefer to choose suppliers that have achieved accreditation under third-party schemes, such as QSRMC or BSI for ready-mixed concrete.

"CE marking is really about production control," said Andrew Minson, executive director at The Concrete Centre. "Design professionals do, however, need to be aware of its purpose, and limitations, in order to fully safeguard the interests of their clients and to protect their own potential liability."

For a full list of harmonised standards relating to concrete and to read The Concrete Centre's guidance on CE marking, click on the Codes and Standards tab at www.concretecentre.com

IN THIS ISSUE

On the cover: St Paul's School Science Building in London, designed by Nicholas Hare Architects. Photo: Alan Williams Photography

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

WINTER 1967: EVENT OF THE YEAR

"Every now and then, a building comes up which you might call a concrete 'event'," said CQ of the Berkeley Library at Trinity College, Dublin, designed by Ahrends, Burton and Koralek. Not only was concrete left exposed on the outer walls, but the architects had decided that the material should flow inside. Screens, table supports and study desks were all of exposed concrete, given life by the "unfussy" reuse of random, roughly sawn formwork. The idea was that, as a library "is furniture", these elements should all be part of the building form. It was "a feature ... almost unprecedented in history", CQ suggested.

Concrete designs shine amid Oxford's dreaming spires

Concrete features prominently in several extensions to prestigious Oxford colleges, all opening to welcome students for the new academic year.

Bennetts Associates has completed the £7.5m Gateway Buildings for St Antony's College, a five-storey addition to the site that includes a new main entrance. The reinforced concrete frame and exposed finishes play an integral role in the development's low-energy strategy.

For a new lecture theatre at Wolfson College, Berman Guedes Stretton has echoed the architectural language of Powell & Moya's original 1960s concrete campus, pairing precast columns, beams and wall panels with warm timber panelling (pictured).

Meanwhile, Design Engine is just completing the John Henry Brookes Building, the second phase of a £132m redevelopment at Oxford Brookes University. The design adopts

an arboreal theme, which is reflected in the rough-sawn, softwood texture engrained in the internal concrete frame.

Watch an exclusive video about the design and construction of the extension of St Antony's College at www.building.co.uk/cq

High achievers in line for top honours

The recent spate of high-quality concrete education buildings has been recognised by both the Stirling Prize and the Concrete Society Awards – which for the first time is devoting a whole category to the sector.

The Stirling Prize shortlist includes four new buildings at the University of Limerick in Ireland by Grafton Architects. The project is anchored by a medical faculty that makes spectacular use of massive expanses of exposed concrete, which rise up through a full-height central atrium. The development also includes a concrete pergola that can be used as a bus and bicycle shelter (pictured).

Photo: Dennis Gilbert

University of Limerick: Could this be the first bus shelter to win the Stirling Prize?

The shortlist also features Heneghan Peng Architects' Giant's Causeway visitor centre in County Antrim (CQ 242); Hawkins\Brown's reinvention of the brutalist Park Hill estate in Sheffield (CQ 238); and Niall McLaughlin's Bishop Edward King Chapel in Oxfordshire (pictured, above right). The Stirling Prize ceremony will be held on 26 September.

Meanwhile, the shortlist for the Concrete Society's specialist category for education buildings includes Coventry University Faculty of Engineering and Computing Building, Manchester Metropolitan University School of Art & Design, the New Stratford Library at the University of East London, as well as this issue's cover star, St Paul's School Science Building. The winner will be announced on 7 November.

Read about these projects in the CQ archive: www.concretecentre.com/cq

CONCRETE ELEGANCE EVENT

Photo: Niall McLaughlin Architects

SPACE EXPLORERS LAND ON BUILDING CENTRE

Exploring light and spatial creativity is the intriguing theme for the next Concrete Elegance evening event, to be held at the Building Centre in London on 24 September.

Fermin Vázquez of Spanish practice b720 Arquitectos will describe the realisation of the Costa Brava Gran Casino in Girona, north-east Catalonia. This angular three-storey structure closely follows the gradient of its sloping site, with a black-pigmented concrete facade and illuminated upper storey softened by a lush green roof that emerges as the continuation of the hotel gardens next door.

Architect Niall McLaughlin will introduce a much more intimate space – the Stirling-nominated Bishop Edward King Chapel in Cuddesdon, Oxfordshire (pictured). The intention was to communicate both a sense of being rooted to the ground and lifted to the trees, with a delicate umbrella of soaring white timbers soaring over a pale grey in-situ concrete floor.

To find out more about upcoming Concrete Elegance events, reserve your place or watch videos of presentations from previous events, go to www.concretecentre.com/events

THIS IS CONCRETE

Come to Oxford, says This is Concrete blogger Guy Thompson, a city whose peaceful libraries and refined college buildings are being joined by a dazzling range of modern landmarks (see above). "Touring Oxford – or Cambridge for that matter – gives the lie to the commonly held opinion that modern or contemporary architecture is not up to the challenge of adding to or enhancing our most cherished urban environments," he says.

What makes these most classical of cities such beacons of modernity? "Perhaps it is because many of the colleges have been such adventurous and successful patrons of modern architecture, committed to investing in both quality designers and materials for the long term," he suggests.

After you've admired Bennetts Associates' addition to St Antony's College, check out an earlier concrete icon – the college's grade II-listed Hilda Besse Building. But you'll have to come back next summer to see Zaha Hadid's startling "Softbridge" building there, now under construction. "Which of the two will be listed first?" wonders Thompson.

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

"You only have to view the plans of Bennetts Associates' Gateway Buildings at St Antony's College to get a waft of excellence"

this is concrete

BEST DAYS OF ITS LIFE

Architectural standards were slipping at the 500-year-old St Paul's School in London, but the elegant exposed interiors and concrete colonnades of Nicholas Hare's new science building augur well for the future. Tony Whitehead reports

Since its foundation in 1509, St Paul's School in London has existed in many different buildings on several different sites. The original, in the precincts of the famous cathedral, was destroyed by the Great Fire of 1666. A later site, an imposing Waterhouse-designed building in Hammersmith, was evacuated during the Second World War and used by Field Marshall Montgomery, himself an old Pauline, as a base from which to plan D-Day.

It's a rich history, but while the school remains one of Britain's most prestigious, its current premises in Barnes are hardly its finest architectural moment. System-built on an old reservoir site in 1968, the buildings now look tired, and, even when new, the site had its problems. The reservoirs were filled with loose ground – reputedly from the excavation of the Victoria line – and this took such a long time to settle that sports matches could not be played on the fields until 1979.

So it was with a sense of history that Nicholas Hare Architects approached its commission to design replacements for the worn-out buildings and restore the school to something of its former glory.

"Having been accommodated in some grand buildings in the past, the school was looking for new premises with some substance and presence," explains David Tompson, the project's lead architect. "They required buildings that were not only fit for today's teaching needs, but could also potentially last for centuries rather than just a few decades."

The first new building on the site was completed this year. At a main contract price of £16.5m, it accommodates the school's science departments and it had to be robust, says Tompson. "Robust in the sense that schools are a tough environment and the building has to cope with that, but also robust environmentally – so it is energy efficient, low maintenance, and able to remain so long-term."

THEY REQUIRED BUILDINGS THAT WERE NOT ONLY FIT FOR TODAY'S TEACHING NEEDS, BUT COULD ALSO POTENTIALLY LAST FOR CENTURIES

He adds that the extensive use of concrete throughout the building goes a long way to meeting these requirements. "We have an in-situ concrete frame, and concrete floor slabs which are largely left exposed. Obviously this helps to create a tough, hard-wearing environment that requires no painting. But it also allows the building to benefit from the concrete's thermal mass."

The use of concrete in this way is particularly appropriate for schools. Densely populated by day, hundreds of active bodies generate considerable heat. The mass of concrete absorbs this, keeping the school cool in summer and acting as a heat reservoir in winter. By helping to iron out both diurnal and seasonal temperature fluctuations, the concrete frame is fundamental to Hare's plan to achieve a BREEAM rating of "excellent" for the overall redevelopment of the school.

The initial challenge for the construction team, however, was the rather basic one of establishing a firm base for the 18 new state-of-the-art teaching laboratories. Lee Hutchinson was the project manager for main contractor, Mace: "Our first issue involved the concrete filter beds of the old reservoir, situated 5m down and covered with made ground," he says. "The solution was to sink rotary bored concrete piles 30m deep and cased for the first 9m."

The columns for the in-situ concrete frame rise from these piles, which also provide the base for one of the building's key architectural features: a colonnaded walkway comprising 20 structural precast concrete pillars topped with gently arching precast concrete roof vaults (see box, overleaf).

Hutchinson says that, because the pillars of the colonnade are in a precise line, their placement had to be perfect: "The piles were very exactly positioned electronically, as is usual, but the bigger issue was that the reinforcement in the pile cap had to be just right for the precast columns. These had a hole in the base and had to fit perfectly onto the pile reinforcement. If they didn't end up perfectly in a line, it would have looked very wrong."

Mace's attention to detail here has obviously paid off: the precast columns are perfectly vertical and aligned, forming an elegant, cloister-style walkway around the new courtyard, and providing an

Photos: Alan Williams

understated nod to the school's grand past.

Hutchinson explains that the columns of the colonnade are topped by immensely strong reinforced precast concrete lintels, which support the weight of a double-thickness brickwork facade to the floors above. The lintels, in turn, are positioned adjacent to the precast roof vaults of the colonnade (which are not in themselves structural) and these connect to the in-situ concrete slab of the first floor.

"It was challenging," concedes Hutchinson. "The vaults had to be temporarily supported by falsework, and as some of them weighed as much as six tonnes, this had to be substantial, and also specially shaped so it could evenly support the weight of the curved vaults."

Once the vaults were in position, insulation was placed above them, positioned around exposed reinforcement protruding from the vault tops. Hutchinson explains that the insulation was also specially shaped to fill the "dips" created by the slopes of the vaults below. "By filling in the dips, the insulation created a flat surface for an in-situ slab to be poured on top," he says. This minimised the weight on the falsework during construction, and ensured the most efficient and cost-effective use of materials.

Pouring the slab on top of the precast vaults effectively glued them to the main in-situ frame and first-floor slab. Once this had been done, the supporting falsework below could be removed.

It was a nerve-racking time for the contractor: "Once the temporary supporting falsework was in place, it hid the underside of the vaults from view," says Hutchinson. "Naturally we took great care to get the joints of the vaults aligned and level, but until the slab above was cured and the falsework removed, we didn't know what the final appearance below would be."

Again, the efforts of Mace, and concrete contractor on site, Atlantic, have paid off and the neatly positioned vaults provide a cathedral-like shelter for those strolling the colonnaded walkway.

Inside, the teaching labs feature all the services you might expect, from gas for Bunsen burners to data cabling for interactive whiteboards. By any standards they are heavily serviced – but with so much plain exposed concrete around, the question of where the services are hidden naturally arises.

"All the conduit routes for small power, data, fire alarms etc – they are all cast into the concrete," says Hutchinson. "Even the precast vaults have conduits cast in."

To achieve this required close co-operation between M&E engineer Arup and the concrete contractor. As Hutchinson says, "M&E had to be designed early and coordinated with the design of the precast vaults and the slabs, so conduits could be cast in and reinforcement designed with

ABOVE
The colonnade's columns are topped by immensely strong reinforced precast lintels that support the brick facade above

RIGHT
The main facade uses a mix of high-quality materials including sandstone, bronze anodised aluminium and precast concrete

BELOW
Due to the long flights, the internal staircases were constructed in situ

Finishing school: Perfecting the exposed concrete

With so much exposed concrete both internally and externally, the finished appearance of the material at St Paul's was all-important. Mace project manager Lee Hutchinson says: "A huge amount of effort went in to making sure the concrete achieved a consistent colour and smooth finish. The concrete contractor, Atlantic, constructed a dozen sample panels and tried several suppliers before arriving at just the right mix."

The original ambition was for a mix containing around two-thirds ground granulated blast-furnace slag (GGBS) cement replacement, but this proved impracticable. Hutchinson says: "That high a GGBS proportion results in a longer curing time, which would have affected our programme, so in the end the mix was 35% GGBS. It also contained limestone and limestone filler to achieve the creamy colour."

Although a self-compacting concrete is often used to reduce voids where a high-quality finish is required, here a "halfway house" was chosen between standard and self-compacting – a high-slump, highly workable mix with 10 and 20mm aggregate vibrated carefully to remove voids.

Extra care was taken over the timber formwork, with joints aligning, board patterns regularised, no visible nail marks, and tie holes regular distances apart. "So when it's struck it looks like there's been a thought process behind it," adds Hutchinson.

Despite the quality of finish required, and a number of repeating floor and column forms, timber formwork was used throughout. "Steel or plastic can give a shiny finish, but the design called for matt, which is best achieved with timber." Fresh timber was used for all forms as re-use could have affected the finish.

Particularly neat carpentry was required for the internal staircases which, unusually, were built in situ: "They comprise quite long flights," says Hutchinson, "and if they had been precast, the weight would have exceeded the limits of the crane. Even the rebates for the step nosings were cast in, allowing an aluminium strip to be fitted."

the services channels in mind. It meant we were considering how light fittings would recess into the vaults, for example, during the piling stage."

The result is that false floors and walls are largely absent, allowing the thermal mass of the concrete to do its work unfettered by the insulating effect of plasterboard or ceiling tiles. It also means that the frame, as Tompson puts it, remains "legible throughout the building".

And it seems somehow appropriate that a science block should function in this way. Students simply have to look up from their desks to see not only how the building is supported, but also how it kept at a comfortable temperature with the minimum of powered heat or ventilation. Pure physics.

PROJECT TEAM

Client St Paul's School
Architect Nicholas Hare Architects
Contractor Mace
M&E and structural engineer Arup
Project manager Gardiner & Theobald
In-situ concrete Atlantic Contracts
Precast concrete Techrete

How the walkway works

The external aesthetics of the science building at St Paul's School derive in large part from the combination of high-quality materials used. These include British sandstone cladding, York paving slabs, extensive brickwork, bronze anodised aluminium windows and, of course, precast concrete, particularly in the colonnade.

Architect David Tompson explains: "These elements were precast because of the large number of repeats and the consistency of finish that can be achieved in factory conditions."

Each of the 600mm-diameter colonnade columns is 3.1m high and weighs 2.23 tonnes. The lintels, spanning 4m between columns weigh nearly four tonnes each, and a typical precast vault, also spanning 4m and 125mm thick, weighs 3.75 tonnes. These varied in size, however, with some larger vaults specified for certain areas weighing in at a hefty six tonnes.

"The mix for the precast elements gives a light, creamy colour," says Tompson, "but it includes a dark micacious aggregate, which when acid-etched gives a slight speckle and texture to the surface. We achieved some visible differential between the elements by specifying a deep acid etch to cills and copings, and a standard acid etch to the columns, vaults and lintels."

Above: The gently arching vaults weigh up to six tonnes
Top: Each column is 3.1m high and 600mm in diameter

Photos: Tim Crocker, Tim Soar

PERFECTLY BEHAVED

Concrete creates a strong civic presence at two north London schools, while quietly working to reduce energy use within, writes Elaine Toogood

Two major schools in Camden, north London, have just begun a first full academic year in new homes. Both are constructed to BREEAM "excellent", using in-situ concrete frame and soffits for thermal mass and precast concrete external cladding.

On a prominent site in Swiss Cottage close to important local landmarks, the £26m UCL Academy is designed to accommodate 1,150 when it reaches full capacity in September 2015. It shares the site and some facilities with Swiss Cottage School, the largest special educational needs (SEN) school in London, which was constructed as part of the same Building Schools for the Future (BSF) contract.

Precast concrete was chosen for the external cladding in order to imbue a sense of robustness and permanence to the schools, qualities not always possible on BSF budgets. But civic presence was not the only driver behind the choice. There were also technical and economic factors, arising from the height of the UCL Academy – which due to its colocation with the SEN school rises to six storeys – and its proximity to a busy main road. The precast concrete provides a protective screen around the heart of the site and could be erected very quickly, without the need for scaffolding and its access and programme implications.

The academy has no corridors, with varied teaching areas opening off from a flexible open-plan space, and it is arranged around five "household" areas, reducing the scale to a more intimate level. Five different colours and textures of concrete were chosen to express the five households. This meant the team faced quite a challenge to optimise the use of repetition. The designers worked hard with the specialist supplier to try to maximise reuse of formwork in the factory wherever possible, and found that a trip to the factory with the client was an important step in agreeing quality standards and finish.

The local authority's sustainability demands for the combined project exceeded those of the BSF programme, with a target of a 72% reduction in carbon dioxide on 2004 Building Regulations. An energy-efficient mixed-mode system was developed to achieve this, with additional openable windows in cellular spaces. Key to this low-energy strategy is the thermal mass provided by internally exposed concrete soffits and frame.

The design team understood the benefits of establishing an early servicing strategy and evolved a tidy solution in the form of a central ceiling-mounted spine. Acoustic rafts extend at high level into adjacent spaces with integrated lighting and ventilation, providing more freedom for the first-fix locations of services than if left completely exposed. Underfloor heating is set in floor screed, using the thermal mass to run the boilers at more efficient lower temperatures.

All exposed concrete soffits were painted white prior to the services installation. This improved light reflectance and reduces the energy load from artificial lighting, without compromising the thermal mass of the structure. The early application of paint also served as an ingenious means of on-site services co-ordination, since painted soffits effectively demarcated a "no-surface-fixing zone".

Although colour control was not critical for the finish of the soffit construction, build tolerances were. Pre-construction quality was agreed between client, design team and contractors by visiting and benchmarking another recently completed local school by the specialist concrete supplier, and the quality check took place following early pours.

The quality of the finished build is a credit to the attention to detail and resourcefulness of the project team – and could perhaps offer a lesson to others seeking to win high marks for low-energy concrete buildings.

PROJECT TEAM

Client Camden council, UCL
Architect Penoyre & Prasad
Structural and services engineer Buro Happold
Contractor BAM Construction
Concrete frame contractor Toureen Mangan
Precast cladding Techrete

ABOVE LEFT

Precast panels give a sense of robustness to the main facades

ABOVE RIGHT

The concrete buildings provide a protective screen around the heart of the site

TAKING TO THE STREET

Burwell Deakins' Exchange building gives Falmouth students a vibrant new thoroughfare in which to meet and study

Exposed concrete is becoming as much a part of student life as pot noodle breakfasts and late-night essay crises. Following on the heels of Haworth Tompkins' Dyson Building, Stanton Williams' Central St Martins and Burwell Deakins' Loughborough Design School comes the Exchange, a £6.5m teaching and student services building, also by Burwell Deakins, on Falmouth University's Penryn campus.

"There's a move away from having to do everything to a very high finish and a bespoke shuttering level," says architect Nicholas Burwell. "It's a student environment – there's going to be a degree of rough and ready to it."

At the Exchange, this aesthetic is evident as soon as you enter the vast "social street" that runs through the building – the walls and uplit soffits proudly bearing the marks of their rough-cut plywood shuttering. Burwell Deakins designed the formwork to be deliberately simple, with the joints aligned in one direction only: "We had some of the plywood ripped down to half or one-third size," says Burwell, "and this pattern of different shuttering runs across the building."

This finish was certainly cost-effective, contributing to an impressive build cost of £2,400 per m^2, but it was also highly controlled. "It's all done very deliberately," he adds. "We specified the aggregate with china clay to bring it out whiter, and we've used some very sharp materials next to it, such as glass balustrades and oak acoustic linings.

Photos: Hufton + Crow

It's that contrast that makes the concrete sing."

The street has given a much-needed focal point to the campus and its winding route links the new facilities – which include a lecture theatre, seminar rooms and a student services hub – with the neighbouring Daphne du Maurier library. It is a thoroughly modern university space, encouraging collaborative learning and relaxed patterns of movement. People flow naturally through the building as it follows the rising landscape, moving from three storeys at one end to a single level at the other. There are plenty of informal study and social areas along the way, and several bridges across the upper levels that release library users from the confines of the existing building into the Exchange's day-lit group-study facilities.

The significant vertical spaces created by this approach make exposed concrete an ideal material, says Burwell. "Because of the big, open spaces, you can use natural ventilation more easily, and a concrete soffit is a very good heat sink." The heat stored in the concrete is purged at night through rooflights and louvres in the glass facade – all part of a passive energy strategy that has put the Exchange on course for a BREEAM "excellent" rating.

PROJECT TEAM

Clients University College Falmouth, University of Exeter
Architect Burwell Deakins
Contractor Leadbitter Group
Concrete contractor Farrell Construction Services

CLOCKWISE FROM ABOVE

The three-storey "street" winds through the building; a timber canopy oversails the glazed facade; oak acoustic linings and glass balustrades contrast with the exposed concrete

IT WON'T BE QUIET...

From its complex concrete structure to its patterned aluminium facade, Birmingham's 'people's palace' is a confident riposte to those who believe that the library is dead

In building the largest public library in western Europe, Birmingham council is certainly swimming against the tide. While more humble book lenders fight for survival up and down the country, the new Library of Birmingham is being trumpeted as a flagship for the regeneration of the city. And expectations are further heightened by the fact that it replaces the iconic Central Library designed by John Madin, an unashamedly brutalist presence that has divided public opinion for 40 years.

Fortunately, the library has been designed with no shortage of ambition. Described by its architect as a "people's palace", it covers 31,000m^2 and is intended to welcome 10,000 visitors a day. Francine Houben, founding partner of Mecanoo, the Dutch practice behind the project, hopes that "the adventure of going through the building will draw many more people towards the joy of learning and reading, and to experience the pleasure of social interaction that a great public space can provide".

The £188.8m library is part of the Big City Plan, a £17bn scheme to revitalise the city centre over the next 20 years. Located in Centenary Square, between the Birmingham Repertory Theatre and the art deco, grade II-listed Baskerville House, it houses a world-class archive and special collections of photography and rare books, including a copy of Shakespeare's First Folio printed in 1623.

The internal spaces are organised around a central atrium that shifts slightly as it rises to create a series of overlapping rotundas. This provides easy navigation for visitors and brings natural light and ventilation into the building.

The library comprises 10 storeys, with nine above ground and a lower ground floor. On levels five and six, a "golden box", surrounded by gold-coloured anodised aluminium panels, provides a highly insulated and secure archive storage facility.

The building was originally designed with a structural steel frame, but it was decided to switch to post-tensioned concrete floor slabs with post-tensioned concrete transfer walls and arches. This offered both programme and cost savings, helping the project to complete on time and below budget.

Photos: Christian Richters

The use of post-tensioned concrete gave a number of other benefits, too. The floors were able to deliver the required archive volume without increasing the building height, and provide the large spans necessitated by the low number of columns. The versatility and strength of concrete was a vital factor in a complex structure where most of the floors are cantilevered and of different sizes (with some double-height), and where loads are unusually high, increasing with each floor. These loads are supported by slender composite columns, made from high-strength concrete with heavy steel sections, as well as concrete transfer walls and arches.

And concrete's value to the scheme is not just structural: the material's thermal mass will play a key role in achieving a BREEAM "excellent" rating. This is part of a low-carbon strategy that also includes hot and chilled water from a combined heat and power engine linked to a district energy scheme.

One of the most striking aspects of the scheme is the delicate filigree of interlocking aluminium circles wrapped around the glazed exterior, intended to evoke the city's jewellery heritage as well as the canals, chimneys and tunnels of its industrial past. "With the circular pattern, the Library of Birmingham honours the city's industrial heritage, in particular the craftsmanship in metal work," says Houben.

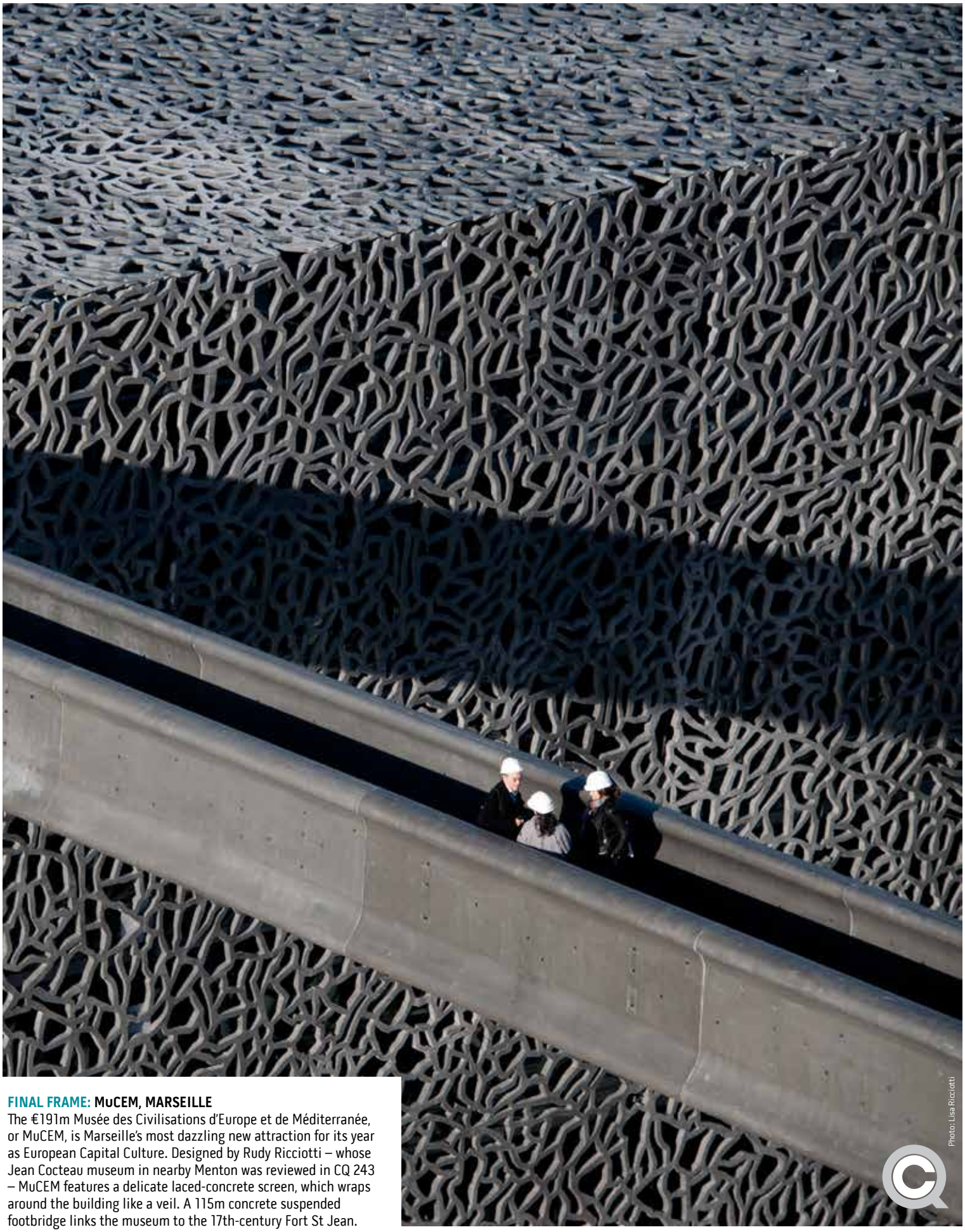
In a time of austerity, when the role of public libraries is under threat, Birmingham council's decision to go ahead with such a large-scale cultural project verges on the heroic. The new library offers a welcome blueprint for the future of such facilities, while giving the city a landmark that should raise its profile nationally and internationally, realising its aim of becoming "a global city with a local heart".

PROJECT TEAM

Client City of Birmingham
Architect Mecanoo
Structural engineer Buro Happold
Contractor Carillion
Concrete contractor AJ Morrisroe

CLOCKWISE FROM TOP LEFT

The library is nine storeys, topped by a golden rotunda; slender composite columns support high structural loads; a central atrium encourages visitors to explore; the atrium shifts slightly in the floorplan as it rises



FINAL FRAME: MuCEM, MARSEILLE
The €191m Musée des Civilisations d'Europe et de Méditerranée, or MuCEM, is Marseille's most dazzling new attraction for its year as European Capital Culture. Designed by Rudy Ricciotti – whose Jean Cocteau museum in nearby Menton was reviewed in CQ 243 – MuCEM features a delicate laced-concrete screen, which wraps around the building like a veil. A 115m concrete suspended footbridge links the museum to the 17th-century Fort St Jean.

Photo: Lisa Ricciotti