mpa The Concrete Centre

CONCRETE QUARTERLY

SPRING 2013 | COOL CONCRETE | ISSUE NUMBER 243

OSCAR CELEBRATION
Remembering the genius of Niemeyer – the man who made concrete cool

SECRET SERVICE
Concrete goes undercover to play a vital role at the Co-op's new HQ – a BREEAM 'outstanding' office

SURREALISM BY THE SEA
Is it a plant? Is it a cheesecake? Strange goings-on in the south of France ...

WELCOME

TIMELESS ICONS

This spring issue of Concrete Quarterly shows the best of concrete's past, present and future. Past and present are represented by the works of the Brazilian architect Oscar Niemeyer, a supreme interpreter of concrete's design potential, who died in December aged 104.

And the future is represented by the new buildings featured throughout the issue. Concrete, with its inherent durability and energy efficiency, creates buildings that stand the test of time. As designers increasingly consider whole-life performance during material selection, concrete is already shaping the icons of tomorrow.

"Cool concrete" is an apt theme for this issue. As well as the ingenious design of the Musée Cocteau in the south of France (page 8), we reveal the dynamic interiors of Archi-union's Shanghai teahouse (page 9), where concrete effortlessly does two jobs at once, as both structure and finish. And hidden within the structures of all our featured buildings is the unseen attribute of thermal mass – "cool" is, perhaps most importantly, an inherent benefit of a material that will play a vital role in controlling temperature in a warming climate.

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

NEWS ROUND-UP

Cool Concrete takes centre stage at Ecobuild

The Concrete Centre will be delivering a series of bite-size seminars at Ecobuild, the world's largest event devoted to sustainable design and construction, which is taking place at London's ExCel centre from 5-7 March.

As part of the Cool Concrete feature, sponsored by Lafarge Tarmac, The Concrete Centre's in-house experts will give masterclasses on a range of topics.

Architect Elaine Toogood will be holding seminars on decorative concrete and achieving in-situ visual concrete, with advice on workmanship and specification. She will also be giving presentaions on sustainable concrete.

Building physicist Tom de Saulles, meanwhile, will be explaining thermal mass – how it's measured and how it can enhance comfort and energy efficiency. De Saulles will also be giving talks on floor solutions for passive and active cooling.

Each session will last 20 minutes, followed by a question-and-answer session, and the speakers will be available to offer practical advice at The Concrete Centre information hub throughout the event.

Attendees to Ecobuild will find much else to inspire and inform during the event, with more than 1,500 exhibitors and 750 speakers across 150 conference and seminar sessions.

The Future Materials Gallery is expected to be one of the most popular features, offering the chance to get hands-on with the building materials of tomorrow, including self-healing and translucent concrete, and even concrete that bends.

Cool Concrete, sponsored by Lafarge Tarmac, will be at stand N1640. For more details of The Concrete Centre's seminars at Ecobuild visit www.concretecentre.com/events

IN THIS ISSUE

On the cover: The Teatro Popular de Niterói, designed by Oscar Niemeyer and completed in 2007. Photo: Michael Moch (viewpictures)

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

SPRING 1993: COOL CONCRETE AND THE COSMOS
Using a series of abstract concrete elements, including a giant egg, to symbolise the relationship between man and nature, may not be everybody's idea of cool. But Masaharu Takasaki's Tanama City Observatory on Japan's Kyushu island is certainly extraordinary. What particularly impressed CQ was the way that the various elements of the 18.5m-high structure were developed from freehand drawings in a process of trial and error. To create the egg-shaped "Zero cosmology" space, for example, a full-scale mock-up was created, followed by a mould formed of more than 320 plywood panels.

Louvre Abu Dhabi starts on site

Construction is to begin on the Louvre Abu Dhabi, after a AED2.4bn contract was awarded to a joint venture led by contractor Arabtec.

The museum has been designed by Pritzker Prize-winning architect Jean Nouvel and is one of a number that will be located in the new cultural quarter on Saadiyat Island, just off the coast of Abu Dhabi.

Nouvel's design is envisaged as "an island within an island", a complex of pavilions, plazas, alleyways and canals covering 64,000m^2, sheltered under a geometric lace dome spanning 180m.

The substructure for the building has already been completed, using more than 4,000 piles, and 21,000m^3 of concrete. The museum's concrete frame is due to be completed by the first quarter of 2014, and the dome by the end of the year.

In 2009, a temporary platform was built in the sea to provide a dry base for the works; upon completion, the 40m-high concrete walls will be removed to allow sea water to flow in gradually, before the museum opens to the public in 2015.

Photos: Ateliers Jean Nouvel

Spanish make 'biological' breakthrough

Spanish researchers have developed a new type of "biological" concrete, which can be used to create moss and lichen-covered building facades in Mediterranean climates without the need for external structures.

They claim it offers not only new aesthetic options, with colours changing over time and with the seasons, but absorbs atmospheric carbon dioxide and solar radiation, helping to regulate the building's internal temperature.

The material was developed by the Structural Technology Group at the Universitat Politècnica de Catalunya in Barcelona. To create the right conditions for biological growth, the team used two cement-based materials to create a surface with a pH close to neutral, and modified other properties such as porosity and surface roughness.

The product comes in the form of a panel with four layers: the structural layer, a protective waterproofing layer, the biological concrete layer which holds water and supports colonisation, and finally a discontinuous coating that permits the entry of rainwater and prevents it from escaping.

The researchers are now looking into ways to speed up the colonisation process, with the aim of achieving an attractive appearance in less than a year. Catalan manufacturer Escofet has expressed an interest in making th prefabricated panels available commercially.

CONCRETE ELEGANCE EVENT

Photo: Hufton + Crow

TWO 'EXCELLENT' ADVENTURES

Low-energy office architecture was the theme of the most recent Concrete Elegance lecture, which took place at the Building Centre in London on 19 February. Attendees heard from designers of two BREEAM "excellent" buildings, which both use exposed concrete frames with low embodied energy to great environmental and aesthetic effect. Nicholas Burwell of Burwell Deakins discussed the Loughborough Design School (above), an 8,000m^2 faculty building that provides an open, airy but robust home for a range of design activities. Exposed concrete in the walls, floors, ceilings and roof plays an important role in the noise attenuation as well as the ventilation strategy.

The audience was also treated to a tour of Wakefield One, the city's new civic offices, which also include a museum, cafe and library arranged around a central atrium. Peter Cartwright of Cartwright Pickard Architects explained how his team achieved an extremely efficient layout with just two stair cores, providing a high degree of flexibility and an optimum depth for displacement ventilation and environmental cooling.

To watch videos and interviews of the Concrete Elegance lecture series visit http://vimeo.com/album/2099560. To find out about forthcoming lectures visit www.concretecentre.com/events

THIS IS CONCRETE

Surface strengths ... Concrete is sometimes a victim of its own success, fears This is Concrete blogger Elaine Toogood. When it comes to temporary exhibitions, its ability to be used over large areas, its weight and permanence all mean that it rarely features at any scale. It's a shame, she says: "Next to displays of veneers and artificial coverings, the appeal of concrete as a final finish is self-evident ... The variety in its surface reflects its natural origins and its versatility offers scope for unique creations in form and pattern."

To redress the balance, she worked with specialist installers Lazenby and White & Reid on a fringe event at the Surface Design Show: "I explored the benefits of exposed internal concrete surfaces, including use of floors for low-energy heating and cooling. With nearly 100 attendees and plenty of discussion afterwards, it is clear that there is an appetite for decorative internal concrete. I look forward to sharing the samples as part of Cool Concrete at Ecobuild too."

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

"Judging by the time that attendees at the Surface Design Show spent stroking samples of concrete finishes, it can feel pretty good too"
Elaine Toogood, MPA The Concrete Centre

this is concrete

INVISIBLE TOUCH

Hidden within its structure and deep underground, concrete has played a central role in turning the Co-op's new Manchester HQ into the UK's greenest office. Tony Whitehead reports

It might have the highest BREEAM rating of any office building in the UK, but the Co-operative Group's new head office in Manchester wears its eco credentials lightly. With its dramatic lozenge shape and imposing play of steel, concrete and glass, it is every inch the prestige corporate HQ. The facade is adorned with twisting white columns and a bronze-anodised glazing frame, while the interior boasts a stunning atrium rising the full height of its 15 floors. This is statement architecture, designed to project a sleek and go-ahead image for its client.

It is all a very far cry from the kind of driftwood-and-windmill look that sometimes accompanies the very highest levels of energy efficiency. So how has this new 50,000m^2 Manchester landmark managed to environmentally outperform every other office block in the land?

Mike Hitchmough, head of offices at architect 3DReid, explains: "What we realised early on was that if you go for BREEAM 'outstanding', there's no half-way house. Energy planning has to be fundamental to the design from the beginning. There's no way you can do it with add-ons."

For the Co-op, that meant ensuring from the start that the building would have a great deal of thermal mass to retain heat and iron out inefficiencies caused by diurnal temperature fluctuations. These days, of course, there is nothing too unusual about that, and large amounts of concrete are routinely specified in commercial buildings for just this purpose. What is striking about the Co-op building, though, is the way that concrete has been deployed to achieve the required mass, and the techniques Hitchmough has used to turbo-charge the thermal mass effect.

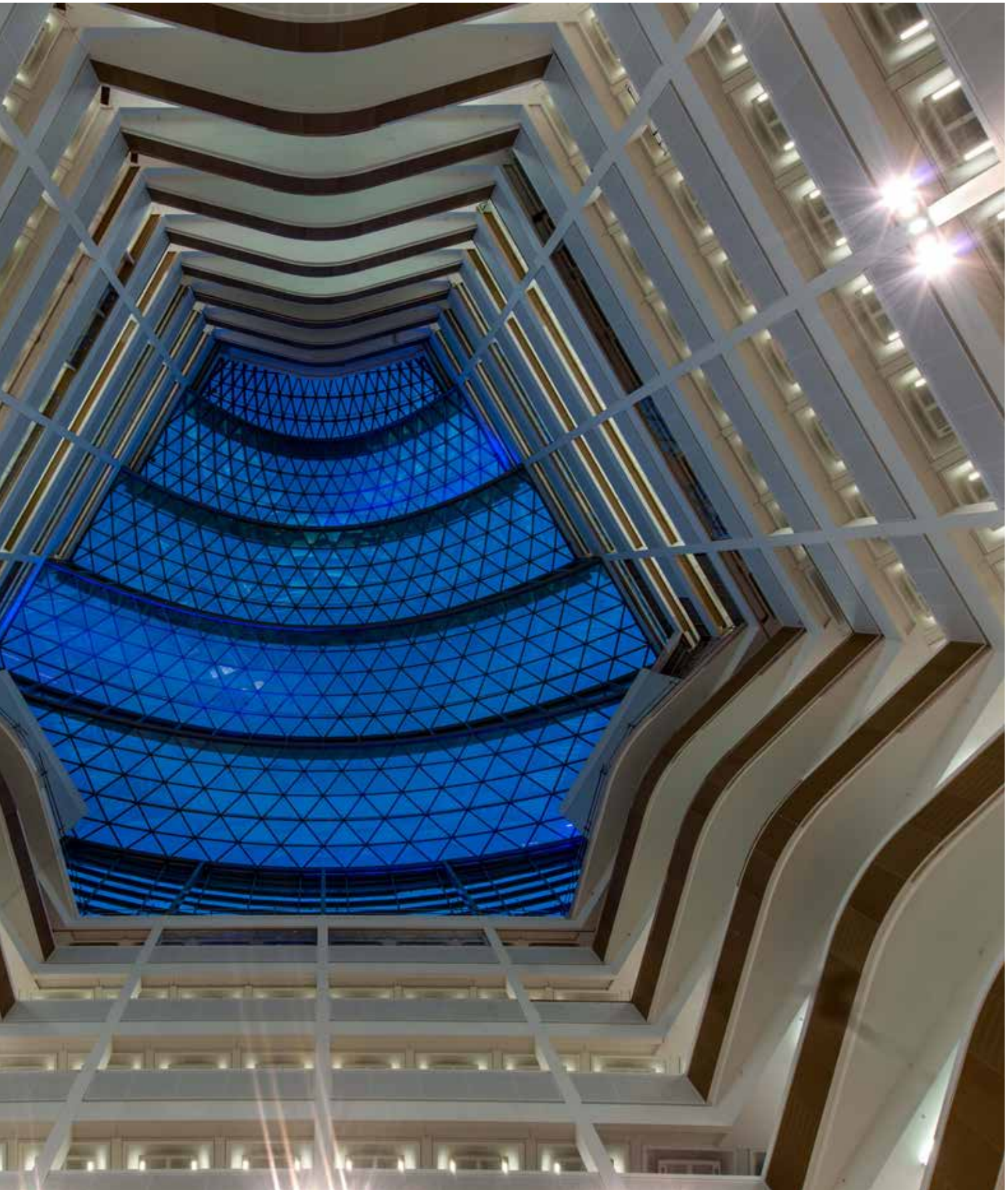
ENERGY PLANNING HAS TO BE FUNDAMENTAL TO THE DESIGN FROM THE BEGINNING. THERE'S NO WAY YOU CAN DO IT WITH ADD-ONS

The floor slabs are a hybrid of precast and in-situ concrete on steel beams. These have been created by lowering some 2,000 large precast concrete coffer units, weighing up to 6.5 tonnes each, onto steel beams and then adding a topping of in-situ concrete. Three in-situ slip-formed concrete cores add to the thermal mass, but since these areas of the building are less occupied, it is the coffers that play the biggest role in the heating and cooling strategy. The exposed concrete ceilings provide a huge area of thermal mass to the occupied office space, absorbing heat in summer, and retaining it in winter.

The ceiling makes a further contribution to the building's BREEAM rating – through the unusual decision to paint it. "The finish that was achieved on the coffers was beautifully smooth and some might think it sacrilege to paint concrete of that quality. But we used two coats of white Kiem Optil mineral paint to increase the amount of light that reflects into the floors from the exterior and from the atrium. That enabled us to save more energy by reducing the lux level of the lighting."

If the coffers' thermal mass is central to the design, equally important is the way in which air moves around the building, and perhaps the Co-op's most unusual energy-saving devices are the enormous subterranean earth tubes used to temper air brought in to ventilate the building. There are three main tubes, 3m in diameter, running from precast intake "chimneys". These are situated at ground level some distance from the building (see box, overleaf). Formed from in-situ concrete, the tunnels suck air deep below the basement levels before releasing it up vertical shafts for distribution throughout the building.

"Since the temperature down there is a fairly constant 12°C, this heats the air in winter and cools it in summer," says Hitchmough, adding that the natural stack effect of the atrium helps spread this tempering effect. "The whole building



How the coffers were made

Thorp Precast manufactured some 2,000 concrete coffer units for the Co-op building, stockpiling around half of these before the first was installed to facilitate speedy construction on site. "We fitted an average of about 18 units a day," says Chris Jones, contracts director of Thorp Precast. "We had about 20-odd mould types, with the largest being 6m long, 3m wide and weighing 6.5 tonnes. We could have made them larger, but we were limited by the loading capacity of the site's three tower cranes."

The coffers were made from standard grey, self-compacting concrete using steel moulds. "The units have a smooth, ex-mould finish. We chose steel moulds mainly because of the large amount of coffers we needed to make from each one. With a contract this size, timber or GRP moulds would have needed frequent refurbishing."

Most of the coffers had a standard radius, and many were also of standard lengths. "The variation came around the perimeter, where more special shapes were required," says Jones. Thorp reduced the number of moulds needed by designing them with moveable end shutters to allow for changes in length.

"The design also called for false joint lines to make the ceiling look even more regularly modular than it was," adds Jones. "As we were using steel moulds we decided to use magnetic formers to create these. We part-filled real joints on site to make them look like the false ones."

Installing the coffers was tricky, as they had to be lowered at an angle through up to three floors of completed steelwork. "We created a mock-up of the frame in our yard so we could test the process to ensure we could do it safely and quickly. As well as allowing us to fine-tune the installation process, this also helped the engineers to test deflection on the beams."

The test helped the contract to progress well on site – Thorp following steelworkers and followed itself by PC Harrington, which added the in-situ topping above the coffer units. Each trade worked on a third of the building, constructing three floors before moving on to the next level. In this way the trades spiralled up the building like the thread of a screw. "It sounds complicated but it worked very well, enabling us to finish the contract two weeks early," says Jones.

ABOVE
A double-skin glazing system adds extra insulation to the 15-storey building

ABOVE RIGHT
Three precast intake "chimneys" draw air into earth tubes that run deep beneath the basement levels

RIGHT
The exterior precast columns were made from white acid-etched reinforced concrete to give an attractive Portland stone-like finish

is naturally ventilated – just not through windows. To make it even more efficient we have placed heat exchangers at the top of the building to extract any spare warmth and send it back down the system."

As you might expect from a building with the rare accolade of a BREEAM "outstanding" rating, the Co-op HQ has many other environmental features to admire. Such heating as is required is provided by a cogeneration CHP biofuel boiler that runs on oil from rapeseed grown on the Co-op's farms, as well as waste cooking oil. A double-skin glazing system adds extra insulation, and the lighting is LED. But Hitchmough says that passive measures such as the earth tubes and high thermal mass form the bedrock of the design. "Our approach was that active measures would only kick in as a last resort – so, for example, the chilled beams that are attached to the coffered ceiling units only start up when the concrete is saturated with warmth. And in winter, because the air is pre-warmed by the earth tubes, heating should be kept to a minimum."

How long the Co-op's HQ retains its crown as the BREEAM king of office buildings remains to be seen: one imagines that its usurpers are already beyond the drawing-board stage. But whatever look they go for, it seems increasingly likely that the design will include a substantial concrete element, and you would not bet against earth tubes becoming a more regular feature of 21st-century commercial development.

PROJECT TEAM

Client The Co-operative Group
Architect 3DReid
Structural engineer Buro Happold
Contractor Bam
Precast concrete supplier Thorp Precast
In-situ concrete supplier PC Harrington

Digging deep to cut energy

Some careful engineering judgments were involved in the construction of the new Co-op head office. For example, achieving BREEAM "outstanding" calls for a thrifty use of materials to minimise embodied energy values – but creating the large earth tubes beneath the basements involved digging trenches below temporary sheet piles and then pouring concrete over traditional formwork.

"It wasn't a straightforward calculation," concedes Kevin Gilsenan, associate director with engineer Buro Happold. "But in the end it was clear that over the life of the building the benefits of the earth tubes far outweigh any extra material usage."

The kind of tunnels was also an issue: "In the Middle East it is common to force air to take a tortuous route around a complex system of sleeper walls," says Gilsenan, explaining that this boosts cooling by exposing the air to a greater surface area of concrete. "But when we factored in programme and cost considerations, we decided against smaller complex tunnels and went for large, simple ones. And they are big. You can easily lose a dumper truck in them." In fact the tunnels can bring in 50,000 litres of air per second, heating or cooling it by up to 4°C, depending on the differential between internal and external temperatures.

Buro Happold was also closely involved in specifying the precast concrete columns which run around the exterior of the ground floor. Gilsenan explains that supporting columns in the basement

Above: The precast concrete columns taper in two directions, giving them a twisted appearance

are not square in section, but more like blades to facilitate three cars being parked between them. This blade section has to be translated to a squarer one to properly support the composite steel and concrete structure higher up, and it does this by tapering in two directions to give a slightly twisted appearance. "We looked at simple steel stubs in reinforced concrete – but it wasn't strong enough to carry the forces involved," he says. "So the connections are actually to a substantial steel section surrounded by reinforced concrete."

Finally Buro Happold was able to reduce material in the floors by using the compressive strength and mass of the in-situ topping to the coffers to work structurally with the steel frame. "We were spanning up to 16.5m, and in some steel or composite floors you can get vibration at those distances. This approach gives a high-quality, solid feel while still using materials efficiently."

HALL OF FLAME

A museum dedicated to surrealist film-maker Jean Cocteau has been given a suitably unsettling white-concrete facade

Something slightly surreal has happened to the French Riviera town of Menton. Amid the Belle Epoque splendour beloved of holidaying 19th-century aristocrats is a structure that has been compared to the tendrils of a mysterious plant, "bewitched" hair and a cheesecake that has spent three hours out in the sun.

This curious building is the Musée Cocteau, dedicated to the work of the surrealist artist, writer and film-maker Jean Cocteau, a regular visitor to Menton. Cocteau's films, such as Orpheus and Beauty and the Beast, were known for their often dream-like quality, with trick camerawork creating the sense that nothing was ever quite as it seemed.

Provencal architect Rudy Ricciotti has brought something of the same spirit to Cocteau's museum, conjuring a seamless white-concrete structure that appears to be facade, roof and perimeter columns all at once. Some 42 trunk-like columns, spaced around an uneven four-sided footprint, rise from the ground, widening as they grow. At a height of 4.5m, the walls turn in on themselves and the forms merge into a gleaming white roof.

This facade allows controlled levels of sunlight into the museum and also creates a sheltered walkway to the sea on one side, where the glass-box interior is set back 2m from the columns. But its main role is to provide a Cocteau-esque sense of theatre. By day, the mysterious tendrils draw people in, offering tantalising glimpses of the building within. By night, light from the glazed interior pierces the facade like flames.

Concrete was essential to creating the organic appearance of the columns and roof. First, nine different forms were established, which became the basis of the lithe, irregular tendrils. For each of these, a model was created in wood, from which moulds were taken in high-density polysterene. Similar laser-cut moulds were made to set out the voids in the vast 2,700m^2, 45cm-thick roof slab. In all, 3,700m^3 of C40 structural concrete was used in the construction of the facade.

The moulds were covered in resin to ensure a smooth cast and contractor Vinci dedicated significant time to the concrete pour to ensure a homogenous, bubble-free finish. Ricciotti has described the exterior as a "magnificent smooth white skin" and the museum inside as its "entrails" – it is an apt image for a building that bathes brilliant, unblemished and faintly menacingly in the Mediterranean sun.

PROJECT TEAM

Client The town of Menton
Architect Rudy Ricciotti
Contractor Campenon Bernard Cote d'Azur (Vinci Construction)

CLOCKWISE FROM TOP

The 42 perimeter columns merge into a single roof slab; the roof is 45cm thick; the columns also serve to control sunlight

Photos: Eric Dulle, Lisa Ricciotti, Olivier Amsellem

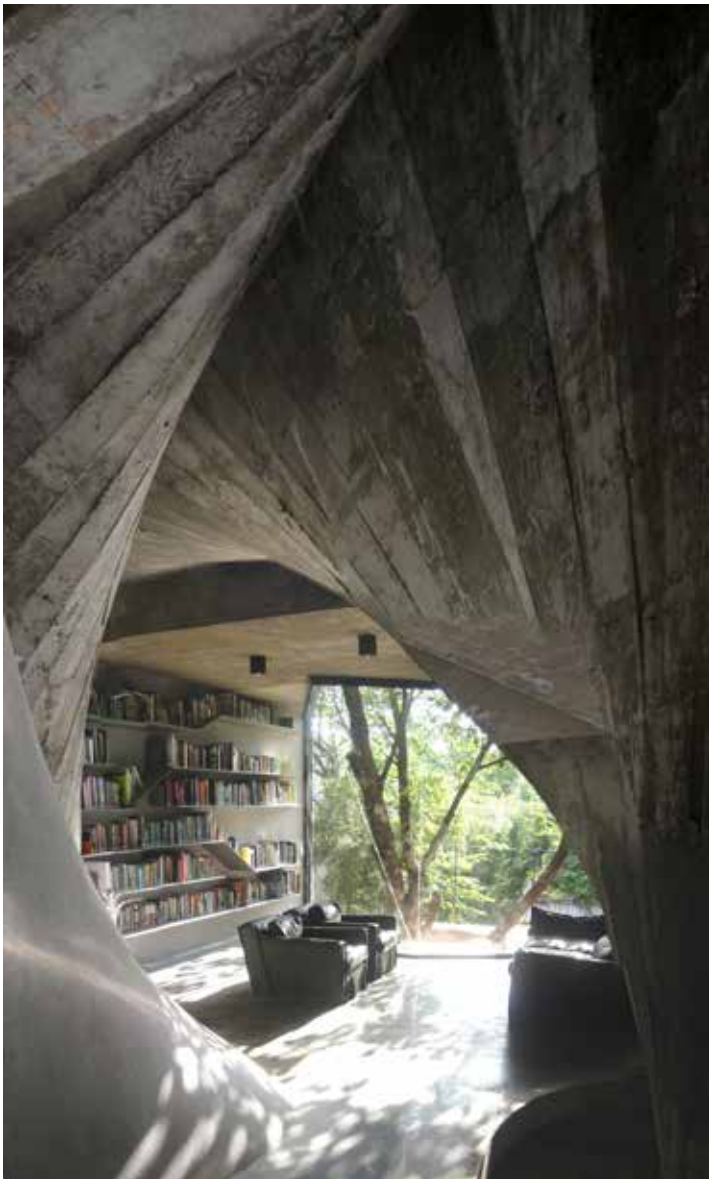
STORM IN A TEAHOUSE

Behind its calm exterior, this Shanghai architect's office extension swirls into a chaotic, twisting structure, ingeniously built using traditional methods

This teahouse by Chinese architect Archi-union is a stunning fusion of the latest 3D digital design techniques and low-tech manual construction methods, with an extraordinary twisting structure that it describes as "impossible to understand through plans", yet has somehow still managed to build in the traditional way.

When the Shanghai-based practice cleared an old warehouse from its garden, it decided that the best use for the space was as an office extension that offered a peaceful place to read or have tea with friends. The resulting 300m² building does not immediately disclose the structural pyrotechnics that take place within. The front facade has a rectilinear fair-faced concrete frame, set out as two sides of an inverted triangle in order to create space for a first-floor balcony. This has been neatly cast around an existing tree – an indication of the extremely tight nature of this site, which is hemmed in by walls on the other three sides. Floor-to-ceiling glazing allows views in and out of the two main spaces – the ground-floor tearoom and first-floor reading room.

But peering through those windows reveals an interior defined by dramatic rock-like structures. First, bursting out of the back of the tearoom is a vast staircase – a non-linear concrete form that bends and twists through more than 180 degrees as it surges up through the floor of the reading room and merges into the concrete soffit. Meanwhile, the back wall of the reading room seems to rise organically from the smooth concrete floor before spiralling chaotically into the ceiling. The void between these two contorted volumes creates a compelling doorway to the reading room, like the entrance to a cave.



Photos: Zhonghai Shen

RIGHT
A cave-like opening leads into the first-floor reading room

BELOW
The facade is designed as an inverted triangle, with an existing tree rising up through the first-floor balcony

BELOW LEFT
A layer of rebar was inserted into the hand-built timber shuttering

Archi-union created the building's twisting shape using Rhino 3D modelling software, but the difficulty came when translating this into simple instructions for construction methods that could be carried out by the in-house team. The team had to learn as they went along, first redrawing the curved shape as interlacing straight lines, then spacing these lines to the dimensions of timber formwork. From this, a full-size formwork was produced for each element (see photograph, far left), which was covered in timber shuttering. The concrete, which was reinforced by rebar, was cast by hand.

The resulting building has an appealingly expressive quality. The timber formwork remains imprinted on the walls and staircase, and occasional imperfections from the manual casting process, such as bubbles and exposed rebar, are left visible – an indelible reminder that even with the most high-tech designs, there is no substitute for the charm of the material itself.

THE WORLD THAT OSCAR BUILT

Oscar Niemeyer designed more than 500 buildings in a career that spanned nine decades and liberated modernism from the rigours of the Bauhaus. Steve Elliott looks back on the life and works of the 'poet of concrete'

Some artists choose oils to paint the beauty of mountains, the ocean and the human form. Others choose words to describe what they see. Oscar Niemeyer, who died in December aged 104, chose concrete. Niemeyer is one of the most celebrated architects of the 20th and 21st centuries, designing more than 500 buildings across his native Brazil and worldwide during his long career. In a memoir, published in 2000, Niemeyer explained the inspiration behind his architecture: curves. "I am not attracted to straight angles or to the straight line, hard and inflexible, created by man. I am attracted to free-flowing sensual curves. The curves that I find in the mountains of my country, in the sinuousness of its rivers, in the waves of the ocean and on the body of the beloved woman. Curves make up the entire universe, the curved universe of Einstein."

Born in Rio de Janeiro in 1907 to an affluent middle-class family, Niemeyer studied architecture at the Escola Nacional de Belas Artes in Rio. While there, he undertook intern work in the office of Lucio Costa, one of the few modernists practising in Brazil at the time. Through Costa, Niemeyer was introduced to Le Corbusier. Both men were to have a significant influence on Niemeyer's career.

TOP LEFT
Capanema Palace, Rio de Janeiro, completed in 1943

TOP
Communist Park headquarters, Paris, 1972

TOP RIGHT
The National Congress, Brasília, 1960

ABOVE
The UN headquarters, New York, 1952

After graduating in 1934, Niemeyer worked under Costa on designs for Brazil's Ministry of Education and Health building, for which Le Corbusier was the consultant. Completed in 1943, the building, named the Capanema Palace after the minister of education, was the first modernist public building in the Americas. Niemeyer added both serenity and playfulness to the original rigid Le Corbusier design. The building was an instant hit and remains an icon in the architectural history of Brazil.

While working on the Capanema Palace and under the patronage of Juscelino Kubitschek, then mayor of the city of Belo Horizonte, Niemeyer began working on a series of leisure buildings and a church around an artificial lake. The buildings showed Niemeyer's free-flowing interpretation of modernism, in contrast to the rigours of the Bauhaus. However, the hangar-like church proved

RIGHT
Serpentine Gallery temporary pavilion, London, 2003

BELOW RIGHT
Museum of Contemporary Art, Niterói, Brazil, 1996

BELOW
Itamaraty Palace (foreign ministry), Brasília, 1970

Photos: Michel Moch (viewpictures); Alan Weintraub, G Jackson, Galit Seligmann, Richard Bryant (Arcaid Images)

too controversial for the local archbishop who declared it "unfit for religious purposes" – the building was not consecrated for another 16 years. This reaction was not unusual. During his career Niemeyer often had to declare: "You may like my buildings or you may not, but you'll never be able to say you've seen anything similar before." Others were more positive, with fellow modernist Oswald de Andrade describing the church as "the only cathedral still capable of inspiring conversion".

Niemeyer's reputation as a new architectural force was growing. In 1944 he was the star of Brazil Builds, an exhibition at the New York Museum of Modern Art. This was followed by an invitation to contribute to the design of the UN headquarters in New York, which was subsequently built to his plan.

As Niemeyer's architectural career was developing so was the political career of his patron Kubitschek, who became president of Brazil in 1956. The following year, Niemeyer was awarded the commission of a lifetime, to design a series of modern public buildings for the new capital of Brasília. Niemeyer's designs for the Square of the Three Powers, the National Congress, the high court, national theatre, the foreign ministry and the crown-shaped cathedral are monumental and inspiring. The city provides the most complete expression of Niemeyer's architectural vision. In 1987, it was made a Unesco World Heritage Site.

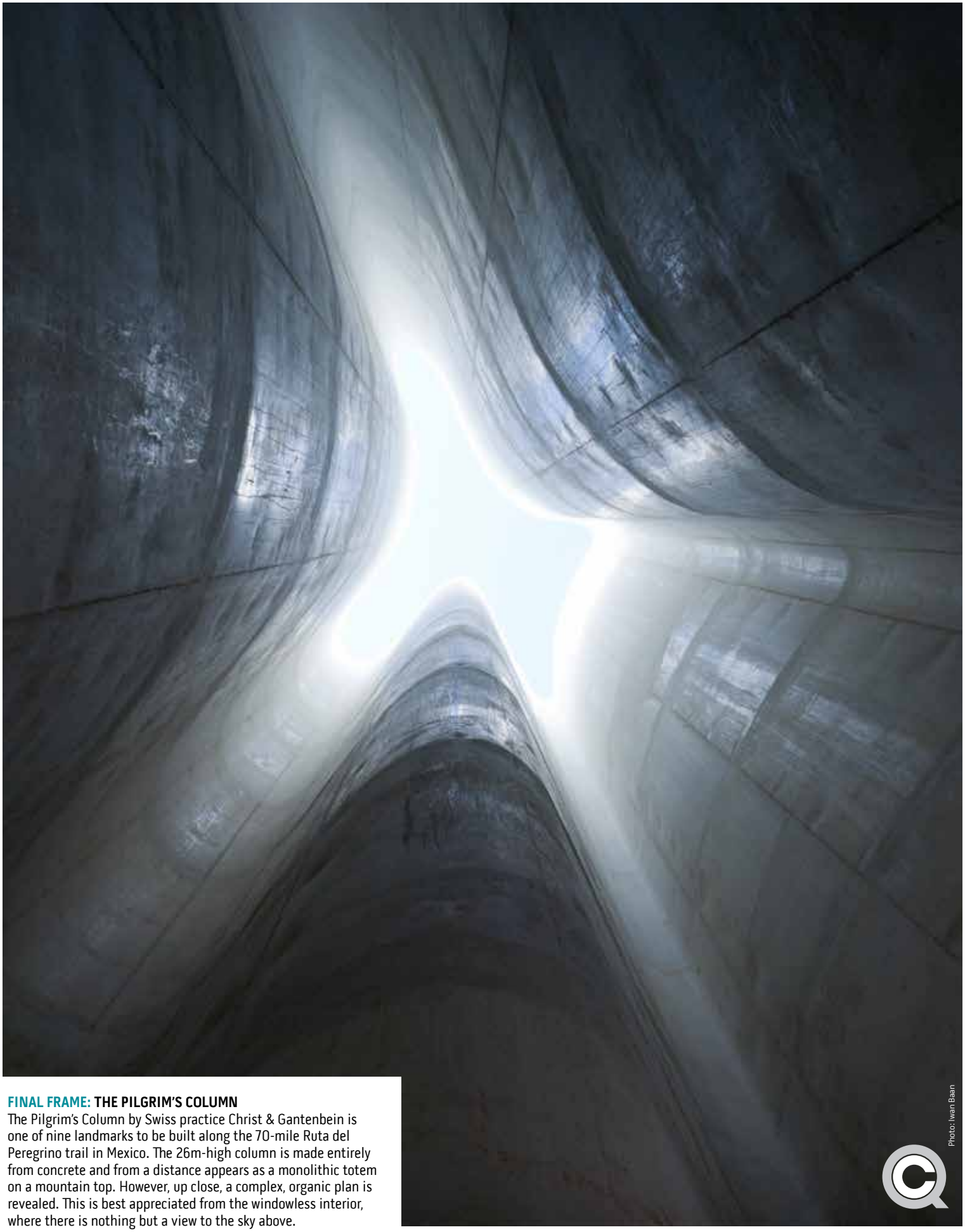
Following Kubitschek's fall from power to a military dictatorship in 1964, Niemeyer – a life-long communist and close friend of Fidel Castro – exiled himself from Brazil. His architectural commissions took him all over the world and included the Communist Park headquarters in Paris, the University of Haifa in Israel, the University of Constantine in Algiers, and the Mondadori editorial office in Milan. He didn't return to Brazil until 1985, with the re-establishment of democracy.

In 1988, Niemeyer was awarded the Pritzker prize, and in 1998 Royal Gold Medal for Architecture – before he had ever designed a building in the UK. That changed in 2003 with the Serpentine Gallery's temporary pavilion in Kensington Gardens, London.

His work in this century, such as the Niemeyer Museum at Curitiba, Panama, and the International Cultural Centre in Avilés, Spain, demonstrated his ability to continue to inspire wonder. Niemeyer worked until his death and towards the end of last year was working on designs for Converse trainers.

Throughout his career, Niemeyer's concrete poetry inspired many generations of architects. His genius will undoubtedly inspire many more to come.

Concrete Quarterly has previously featured the work of Niemeyer in CQ Summer 1960, CQ Winter 1996 and CQ Winter 2006. Visit www.concretecentre.com/cq



FINAL FRAME: THE PILGRIM'S COLUMN
The Pilgrim's Column by Swiss practice Christ & Gantenbein is one of nine landmarks to be built along the 70-mile Ruta del Peregrino trail in Mexico. The 26m-high column is made entirely from concrete and from a distance appears as a monolithic totem on a mountain top. However, up close, a complex, organic plan is revealed. This is best appreciated from the windowless interior, where there is nothing but a view to the sky above.

Photo: Iwan Baan