THIS IS CONCRETE

mpa The Concrete Centre

NEW IDEAS...

...AND GOOD IDEAS THAT NEVER GET OLD

HOW BIM IS ALREADY CHANGING THE WORLD

101 WAYS TO BEAT FLOODING

LOW-CARBON CEMENTS: THE LATEST REMIXES

CONTENTS

The Concrete Centre provides guidance, seminars, courses, online resources and industry research for the design community. Our vision is to make concrete the material of choice, and to enable all those involved in building design, construction and maintenance to realise its full potential.

The Concrete Centre is supported by industry to inform, educate and inspire. Our members are Aggregate Industries, Allen Newport, British Precast, Breedon Group, Brett Group, Britannia Aggregates, Cemex, Cormac, Deme Building Materials, FM Conway, Gallagher Aggregates, Grundon, Hanson, Harleyford Aggregates, HH & HE Drew, Hills Quarry Products, J & J Franks, J Clubb, JJ Prior, Marshalls Group, Moorhouse Sand & Gravel, Moreton C Cullimore, Morris & Perry, Myers Group, Rotherham Sand & Gravel, Salop Sand & Gravel, Sea Aggregates, Smith & Sons, Springfield Farm, Tarmac, Trefigin, Tudor Griffiths, Volker Dredging and Wildmoor.

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

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This is Concrete shares interesting facts about concrete and showcases amazing projects via our website, blogs twitter feed and our project and fact ads. Our mission is to engage the design community and share the endless possibilities of concrete.
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Cover illustration by Nick Watts

NEW TWISTS

We chose the theme of "innovation" for our This is Concrete magazine this year, but it's been difficult not to be distracted by the material's long history.

Natural deposits of cement compounds were formed in the planet's geology 12 million years ago. Cement was used with bamboo on the construction of the Great Wall of China back in 3000 BC, and the Romans were experimenting with cementitious mortars around 300 BC – which they later mixed with stone to form concrete. By 200 AD, the Pantheon had been constructed. It wasn't until 1824 that Joseph Aspdin patented Portland cement. But after that the pace of change increased again with the first reinforced concrete house in 1854, the first bridge in 1889, the first tall building in 1904… The list goes on.

Indeed, when you start looking at innovation, it quickly becomes clear that there is a great deal of learning and proven performance that we can't afford to leave behind. The needs of our society and built environment continue to be met by concrete and masonry solutions. This can be from applying proven thinking to a new problem, working with designers to create new solutions, or through new product development. In this magazine, we're seeking to explore those changing needs, and the solutions that designers need – whether that's from new ideas or just good ideas that never get old.

Andrew Minson, executive director, The Concrete Centre

WHEN YOU START LOOKING AT INNOVATION, IT QUICKLY BECOMES CLEAR THAT THERE IS A GREAT DEAL OF LEARNING AND PROVEN PERFORMANCE THAT WE CAN'T AFFORD TO LEAVE BEHIND

ON GOOD IDEAS

GOOD IDEA

A network of chilled water pipes are embedded within a generous 3.5m-high concrete soffit

21ST-CENTURY THERMAL MASS: ANCIENT TECHNIQUE, NEW APPLICATION

The merits of using thermal mass are well established and certainly not new, but a range of new applications are emerging to meet the challenges of the changing environment.

The use of innovative passive and active strategies is well illustrated by one of the most hotly anticipated buildings of the year – Allford Hall Monaghan Morris' White Collar Factory in Old Street, London. Thermal mass plays a central role in this 16-storey building's bid to brand itself as an entirely new type of office, one where sustainability, flexibility and the health and wellbeing of occupants seamlessly merge. A network of chilled water pipes are embedded within a generous 3.5m-high concrete soffit, transferring heat and radiantly cooling the building in conjunction with the ceiling's thermal mass.

Watch our video of the White Collar Factory at www.concretecentre.com

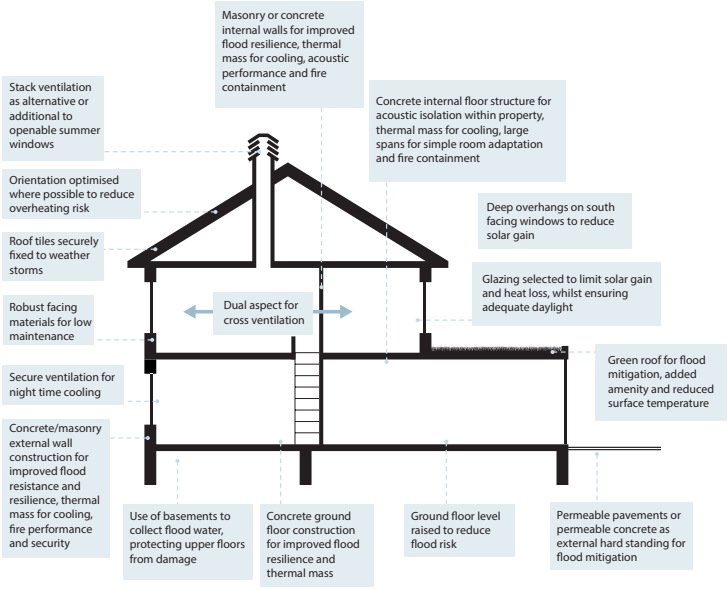
DESIGNING RESILIENT BUILDINGS

The resilience of a new home can be enhanced simply and effectively through the selection and detailing of appropriate material components.

While some design decisions may have a significant impact on the look of the property, this is not always the case. Quite simple interventions can make significant improvements to long-term performance, addressing a range of risks with minor cost implications. Concrete and masonry structures and components have a major contribution to make in this regard, as the diagram on the right shows.

Truly resilient homes will address the cradle-to-grave impacts of a building in terms of the selection of materials, design, construction, in-use performance, longevity and their anticipated reuse and end-of-life potential.

Download an extract from the forthcoming Concrete Centre guide, Resilient Homes, at www.concretecentre.com. For more on the resilience of concrete buildings and infrastructure, turn to page 11

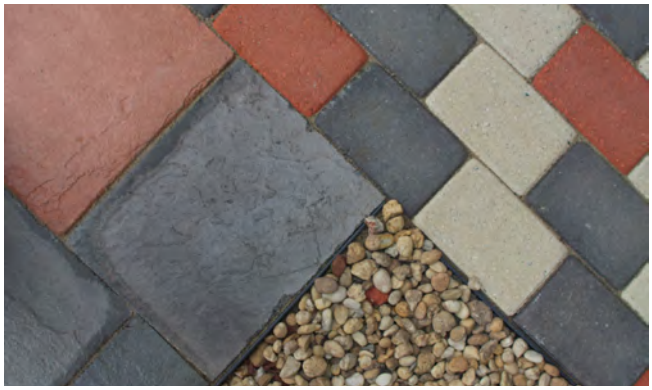


TAKING HIGH-PERFORMANCE FLOORS TO THE NEXT LEVEL

The structure of a floor offers hidden but long-term performance benefits throughout the lifetime of a home. Precast-concrete floors are an opportunity for designers to improve the quality and performance of new housing.

Precast concrete has a number of advantages over alternative flooring materials. In terms of safety, it easily exceeds a one-hour fire rating, protecting against the spread of fire between rooms. In terms of energy efficiency, it has a high thermal mass, which can smooth out temperature gains and losses, thereby reducing the need for space cooling and heating in the home. And it cuts down on transport and the associated carbon footprint – precast flooring can be made locally, using local materials and skills, therefore reducing travel distances from factory to site.

The question is, why is it only usually used on ground floors, when it can provide a speedy solution to the UK's housing needs? Once in place, precast flooring provides an early, secure and broad platform from which subsequent site activities can be undertaken, making the site less vulnerable to delays caused by inclement weather. And, perhaps most important for the residents day to day, it reduces the transmission of sound between rooms. When did you last hear a concrete floor creak or squeak?



Left: Solidia Technologies' paving is based on calcium metasilicate compounds

▲ REINVENTING CEMENT FOR THE NEXT GENERATION

We explore new developments in low-carbon concrete on pages 16-18. But some of the biggest innovations are in the field of novel cements. These are mainly developed to reduce the carbon impact of calcination – the process, achieved by heating the raw materials to high temperatures, that is responsible for up to 60% of the CO_2 emitted from Portland cement production. Colum McCague, technical manager of MPA Cement, examines the alternatives.

How do novel cements work?
Most react in a familiar way with water, but some react with CO_2 to solidify and harden. The quantity of limestone being calcined is usually reduced and, in some cases, eliminated.

So how can cements be made to react with CO_2?
If the proportion of limestone is reduced and kiln temperatures are lowered from 1,450°C to about 1,200°C, unique "calcium metasilicate" compounds may be formed. These react with CO_2 to form a hardened paste based on calcium carbonate and silica gel.

Researchers at Solidia Technologies claim that the manufacture of metasilicates produces 30% less CO_2 than Portland cement CEM I, with a potential reduction of a further 40% if CO_2 is fully sequestered. Hardening is based only on carbonation, and water is used merely to mix the material and is removed later in the process.

Due to the requirement of a CO_2 chamber, the technology is limited to precast applications. This product is also less alkaline than Portland cement, which will require further investigation before it can be used with steel reinforcement.

What other alternatives are being developed?
There's calcium hydrosilicate cement, which was invented in the 1990s at the Karlsruhe Institute for Technology in Germany. Limestone is again reduced and is heated at about 1,000°C to produce lime. The lime is then mixed with water and processed with silica under hydrothermal conditions to form partially hydrated calcium silicates. It is claimed that this saves 50% of CO_2 compared with CEM I. When fully hydrated, calcium hydrosilicate cement has a chemistry not dissimilar to Portland cement.

If limestone is partially replaced with sulfur and aluminium-bearing minerals and fired at a lower temperature of around 1,200-1,300°C, various calcium sulfoaluminate compounds are formed. The Aether project, funded by LafargeHolcim, is well established and full-scale industrial trials recently found that sulfoaluminate cements can be manufactured using identical kilns to those used for Portland cement with an estimated 25% reduction in CO_2 emissions.

Are such high temperatures really needed?
Alkali-activated materials (AAMs) do not require cement kilns. By-product materials such as fly ash and ground granulated blast-furnace slag (GGBS), which are rich in calcium, silica and alumina, are activated using alkaline chemicals. It is claimed that this process cuts CO_2 emissions by as much as 80% compared with Portland cement. However, as some activation chemicals are synthesised using an energy-intensive process, it is important to consider additional embodied carbon. There are also concerns over the long-term local availability of fly ash (see opposite).

NEW IDEA

The manufacture of metasilicates is claimed to produce 30% less CO_2 than CEM I

THE CASE FOR MULTI-COMPONENT CEMENTS

The Mineral Products Association is coordinating a project to investigate how limestone powder can be optimised in the production of cement and, as a result, concrete.

Finely ground limestone is a highly sustainable material with a wide array of uses. Due to its abundance and ease of processing, it has gained popularity as a filler material for extending the main constituents of various construction materials.

Limestone powder is already used in combination with Portland cement clinker to make cement – known as Portland-limestone cement (PLC) – which usually contains about 15% limestone powder. In the UK, PLC is designed to meet performance criteria for most building applications and is permitted by application standards. While PLC is available in bulk, the majority is currently supplied in bags.

Recent research has demonstrated that if the grinding of limestone is optimised, PLCs can be produced to have similar performance to that of Portland cement CEM I, leading to significant cost and carbon savings without compromising concrete performance.

In the UK, fly ash and GGBS have been more popular than finely ground limestone, as higher levels of clinker substitution can be achieved. However, the phasing out of coal-fired electricity generation means that domestic supplies of fly ash will reduce.

Possible solutions for optimising the use of limestone powder in the production of cement include either manufacturing higher strength PLC or incorporating limestone powder in three-component CEM I-fly ash-limestone or CEM I-GGBS-limestone composite cements. Such practices are now commonplace in many European countries, and such cements are covered by the European cement standard EN 197-1. However, the use of three-component, limestone-containing cements is still not permitted by UK application standards.

The aim of the MPA project is to provide a case for standardisation for BSI so that new three-component, limestone-containing cements can be included in the UK concrete standard, BS 8500. This would enable specifiers to improve resource efficiency without compromising performance.

OFFSITE, PRECAST AND MODULAR – THE HOLY GRAIL OF SPEED AND COST

Concrete is highly compatible with fast construction – it's a readily available material, and modern methods of construction, such as sophisticated formwork systems, post-tensioning and precast elements can all help to crank things up a gear.

At FCB Studios' Manchester Metropolitan University Student Union (left), for example, Creagh Concrete supplied not only the precast-concrete frame but also glazed-brick-faced cladding panels, which cut the need for scaffolding and reduced onsite labour and waste. Fast programmes can also reduce disruption to neighbours, and lead to earlier occupation.

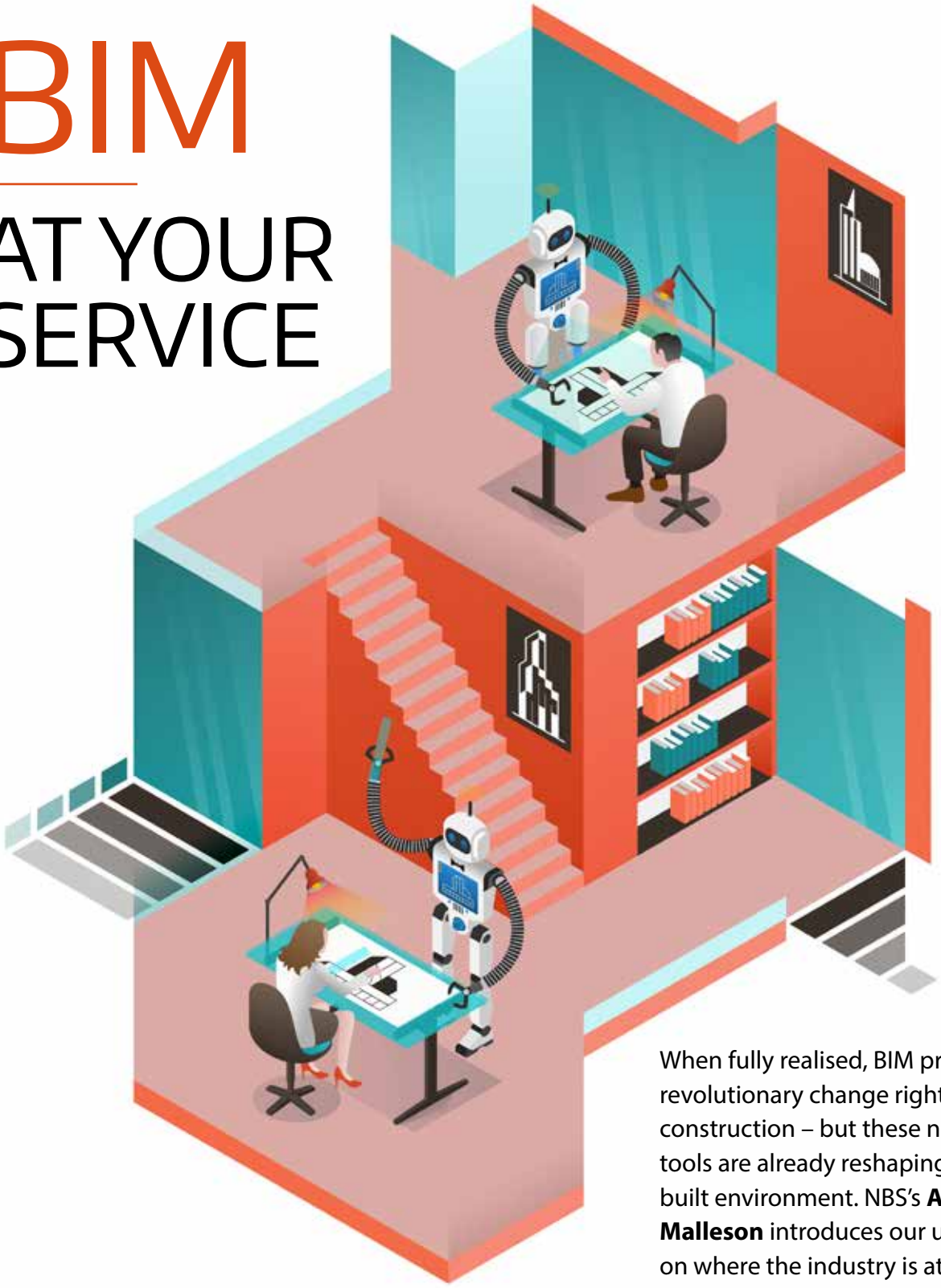
Speed is not, however, an overriding necessity for every project, or even every element of construction. For large housing developments, for example, the ability to adapt to sudden changes in programme may be more critical, which makes the short order times of concrete and masonry products a key advantage.

GOOD IDEA

Brick-faced cladding panels cut the need for scaffolding and reduce onsite labour and waste

BIM

AT YOUR SERVICE



When fully realised, BIM promises revolutionary change right across construction – but these new tools are already reshaping the built environment. NBS's **Adrian Malleson** introduces our update on where the industry is at

Illustration: Infomen

BIM is becoming a norm for design practice in the UK. At NBS we have been monitoring BIM adoption, and attitudes towards it, since 2011. That year, only 13% of respondents were using the technology, 45% were aware of it, and 43% were neither aware of nor using it. By the time of the 2016 survey, completed before the implementation of the BIM mandate, a majority (54%) were using BIM on some projects, 42% were just aware of it and only 4% were unaware of it. In the future, we can expect greater use. Within one year, 86% of building designers expect to be using BIM. Within five years that figure rises to 97%.

The findings suggest that this rise in adoption is not just because of the government mandate for level 2 BIM to be used on publicly procured projects (though it has spurred activity). There are tangible benefits too. Designers see it as delivering cost efficiencies, better client outcomes, improved visualisations and the ability to see design clashes between and within disciplines.

As the government strategy envisaged, BIM is reaching the bottom line: almost two-thirds see that BIM will help bring about the government's strategic aim of a 33% reduction in the initial cost of construction and the whole-life cost of built assets.

In some ways, the progress we have seen in BIM in the UK is just the start. Anecdotally, the design community has done much of the initial heavy lifting; in the coming years BIM will become increasingly integral to clients, contractors, manufacturers and asset managers too. We are seeing the start of this already.

As BIM becomes more engrained in the whole construction lifecycle, we will see even greater benefits. As data and information about the performance of buildings (and their parts) becomes readily available, design, product selection and maintenance decisions will be increasingly evidence-based. This is the start of level 3 – to which the government made clear its commitment when it set out the 2016 budget.

We have seen dramatic changes in BIM since 2011. These have already brought significant value to the construction sector. And it looks unlikely that this pace of change will drop, as the use of BIM both widens and deepens in the coming years.

Adrian Malleson is head of research at NBS. The 2017 NBS BIM survey is now open. Your views are welcome at surveys.ribaenterprises.com

WITHIN ONE YEAR

86%

OF BUILDING DESIGNERS EXPECT TO BE USING BIM. WITHIN FIVE YEARS THAT FIGURE RISES TO **97%**

'We need to keep up the momentum'

*Mace's **Jon Harris** gives a contractor's eye view*

On a scale of one to 10, to what degree has the UK construction industry already used the potential offered by BIM?
It really depends on the sector and discipline but overall I'd give it three or four. While some sectors and disciplines are already on board regarding BIM adoption and execution, others aren't.

What impact has BIM had on UK construction so far?
BIM can mean different things to different people. In the public sector where it's mandated there's been a huge efficiency benefit, and the private sector wants some of that too.

What are the stumbling blocks?
Although we have laid down some good foundations, there are still barriers to overcome to achieve a true integration of project and delivery, particularly in the industry's engrained adversarial culture.

BIM is all about integration. We need more integration, trust and teamwork between all disciplines so that there is a shared approach to risk and reward in delivering the built ▶

asset. Unfortunately, design-and-build procurement routes encourage a confrontational, every-one-for-themselves approach that isn't entirely suitable for BIM to be a fully integrated and collaborative process – although BIM does help to pull together the fragmented team structure and drive efficiency and effectiveness. Further integration will be addressed by Level 3.

Which country is leading the way in terms of BIM use?
We're certainly leading the way in the UK, but more mandating and the right culture is needed to make it fly. Owner-operators are embracing it as they can see the whole-life benefits. Contractors see the advantage in being able to access the right level of information at the right time. In terms of sectors, public-sector projects are coming on leaps and bounds. But it's not the time to be complacent. We need to keep up momentum for change moving forward.

Where is there greatest room for improvement in how we use BIM?
The biggest barrier to BIM is change in industry culture and mind-set. This isn't easy and takes time to gain trust. BIM adoption and execution is a journey. Some of the things that still have to change in order to gain the full benefits of BIM include commercial and legal procurement strategies, early contractor and supply chain engagement, integrated project delivery and fear and trust of new technology. This will allow us to better care and create for the built environment and optimise

outcomes and service delivery for our clients in all stages of the project lifecycle.

Who stands to benefit the most from greater BIM use?
It should be everyone – there are huge benefits for everyone from clients to the entire industry. BIM is a really good catalyst for improving not only how things are built but how they perform, and in monitoring that performance.

How long do you expect it to take to maximise BIM's potential in the UK?
It's hard to say with the capacity constraints in the industry. It depends on the sector and discipline but as an industry, I think the UK should be fully there in the next couple of years. We need to keep the momentum alive – we're already talking about Level 3. But we need to make sure that everyone can get to Level 2 first as well.

Jon Harris is operations director at Mace

GOOD IDEA

"Owner-operators are embracing BIM as they can see the whole-life benefits"

Data kings

***Matt Butcher** explains how manufacturers can use BIM to support the rest of the project team*

For the benefits of BIM to be fully used there should be a wealth of data linked to objects and models, which might cover anything from cost and maintenance to thermal performance and environmental impact. That means that product manufacturers have an important role to play in supporting the entire team to get the most out of their investment in BIM.

The information stored in the BIM "common data environment" grows in detail as the project stages progress until the complete data set is handed over to the client at completion. As the model is created, manufacturers can add scheduling information (lead times, construction and installation periods and curing times) which helps to guide the construction process. The addition of this time-related data gives 4D BIM. Cost consultants also have a role to play by linking in cost data. This allows cost planning and the generation of estimates for the tendering process, known as 5D BIM. When information to support facilities management and the whole-life impacts of a built asset is included, this is known as 6D BIM.

Manufacturers need to understand what information stakeholders need about their

product and when they will need it. Providing access to data they wish to share with the project team in a usable "BIM ready" format is essential. One way to facilitate this could be to create a 3D model or BIM object for products to which relevant information such as size, installation tolerances, weight, price and lifespan can be attached and accessed by designers and specifiers at any stage of the process. Manufacturers could also include aspects of 4D, 5D and 6D BIM to satisfy future client requests. They could even supply placeholder models for bespoke products (such as concrete stairs or other structural elements), designed to match specific specifications later on. Fills and concrete pours can be added as layers to a 3D model with attached technical information.

What's exciting about BIM isn't just the improvement in process and the 3D representation of the buildings, but the ability for it to spark innovation in the construction sector. BIM realised to its full potential could allow models to be linked up to the production process with data exported straight to computer numerical control (CNC)-enabled plants, enabling computer-generated manufacturing processes. Over the last few years, 3D printing has seen amazing growth in both the technology and profile. In China, 10 houses were constructed for about £3,000 each using quick-drying concrete piped with multi-directional sprays. In the UK, Skanska have teamed up with Loughborough University to research the use of a concrete 3D printer. Developments in ▶

IN PRACTICE

Blavatnik School of Government, Oxford

The Blavatnik School of Government could not have been built without BIM. To walk past the £55m Oxford University facility is to know that it must have been an extraordinary feat of structural engineering. Designed by Herzog & de Meuron, the building rises in five irregular disc-like storeys, with several deep cantilevers; and even though it has a robust in-situ concrete frame, its thin slabs fulfil the architects' wish that the whole thing should appear to "float". As Tim Rowe, the project manager at contractor Laing O'Rourke's specialist concrete division Expanded Structures, says: "10 years ago, we wouldn't have had the 3D capability to build a building like this."

This is BIM at its most pragmatic – although the university had issued a general requirement to use some element of BIM on the project, Laing O'Rourke extended the use of the technology simply because there was often no other way to build it. The design of the reinforcement in the concrete slabs is a case in point. "Because the architect wanted thin slabs, the rebar density was higher than normal," says Rowe. This, coupled with the irregular architectural plan, meant that traditional 2D modelling would have been insufficient. "As there were so many curves and circles, beams and slab thicknesses, we did it in 3D so we could use clash detection, and the steel fixers could see where the bars go more easily."

HdM supplied a 3D architectural model, which the project team could then develop for detailed design, coordination and sequencing. This also proved vital to the M&E design, for which Crown House Technologies created a detailed digital model. As the walls and soffits consist of vast expanses of monolithic in-situ concrete, most of the services had to be cast in – Rowe says that one floor has about 650 containment boxes embedded in the underside of the slab. It was therefore essential that all the M&E was designed in advance, with absolute certainty over the positioning of cast-in elements.

The team also explored elements of BIM even beyond Level 2: Laing O'Rourke piloted a scheme connecting the 3D model to the ongoing operation and maintenance of the building. The contractor is now working with Oxford University to incorporate BIM into future projects.

Watch our case study film of the Blavatnik School of Government at www.concretecentre.com/blavatnik

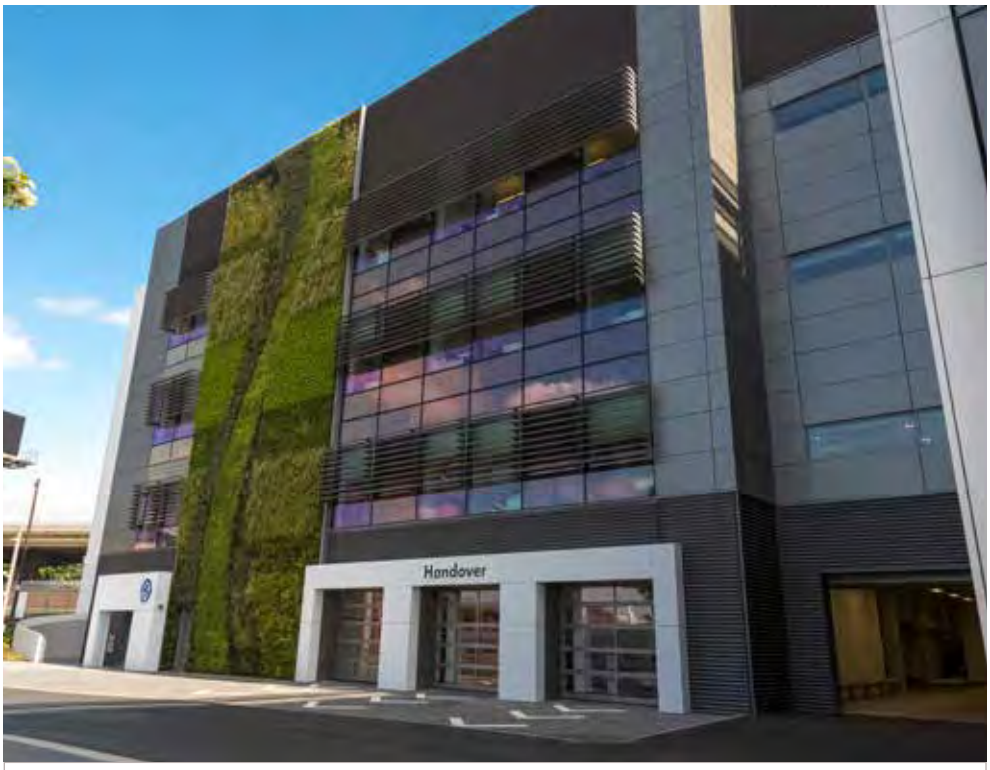
BIM and 3D printing could even lead to types of automated onsite construction not seen since the 1960s when concrete manufacturers had onsite facilities to make concrete cladding panels for tower blocks.

It is the benefits of 6D BIM that are perhaps the most interesting for sustainability professionals. With data on maintenance, lifespans and energy performance of different components, the whole-life impact of a built asset can be planned for. Information taken from environmental product declarations (EPDs) linked to BIM objects will allow architects and designers to model the embodied impacts of their material and design choices. If the model is kept up to date, it can provide a good starting point for any alterations or extensions to the asset. At the end of the building's life, the model can inform safe demolition and also the specifications for recycling. 6D BIM shifts the thinking from capital to whole-life cost, and it has the potential to bring the construction industry a huge step closer to a circular economy.

Matt Butcher is environmental and technical officer at British Precast

NEW IDEA

"Developments in BIM and 3D printing could lead to types of automated onsite construction"



IN PRACTICE

Volkswagen Sales and Services Centre, London

Speed is usually of the essence in the car world, so it's fitting that the use of BIM helped Volkswagen to build its new west London showroom in just 18 weeks.

This is all the more impressive as the building has a number of unusual elements. Its constrained site, next to the M4 motorway, meant that the dealership had to be multi-storey, with showrooms and a customer car park above ground level. It was also designed to incorporate a 230m^2 living wall and to achieve a BREEAM Excellent rating.

Architect Bond Bryan has an established digital services division and was keen to use BIM from the project's inception. At the concept stage, a 3D model was used to create a fly-through video that was used extensively by the client and helped to generate early design changes. Intelligent modelling also enabled the designers to overcome a potential right-to-light issue caused by the need for four storeys.

To ensure speed of delivery, a precast-concrete frame was specified, and 3D modelling was also integral to this part of the design. The building includes more than 1,500 precast-concrete components, and the use of Revit software by precast contractor PCE meant it could accurately model all connections, as well as avoid clashes between the structure and M&E. (Hollowcore flooring units with an in-situ structural concrete topping helped with cabling runs.)

The BIM model also proved vital to developing logistics and erection programmes. The precast components were manufactured in six different factories, but the data-rich shared model enabled the team to coordinate just-in-time delivery, thereby managing to maintain a fast onsite construction programme.

Read more at www.concretecentre.com/VW

WHAT'S ON AT THE CONCRETE AND MASONRY PAVILION

DAY 1
Tuesday 7 March

11:00 Sustainable concrete

Good ideas for the specification of responsibly sourced, sustainable concrete, including low-carbon cements and recycled aggregates.

- Guidance on specifying sustainable concrete – Elaine Toogood, The Concrete Centre
- Traceability of reinforcement – Bahadir Karadayi, UK CARES
- Ask the expert – the speakers and other technical experts answer your queries

12:30 21st-century thermal mass: Ancient technique – new applications

The merits of using thermal mass are well established and certainly not new, but new applications are emerging to meet the challenges of the changing environment in which we live.

- The use of thermal mass with demand side response (DSR) electric heating – Tom de Saulles, The Concrete Centre
- Offsite concrete solutions providing thermal mass – Neil McIvor, Creagh Concrete
- Ask the expert

14:00 Good-looking concrete

Concrete can provide high-performance, cost-effective structures, as well as a material-efficient, robust and elegant finish – whether pigmented, polished or textured, patterned, plain or anything in between.

- Achieving good-quality visual concrete – Elaine Toogood, The Concrete Centre
- Permanent pattern and graphic images – Tim Brookfield, CHRYSO
- Ask the expert

15.30 High-performance floors for housing

The structure of a floor offers hidden but long-term performance benefits throughout the lifetime of a home. Concrete floors provide acoustic performance, durability, energy efficiency, fire resistance, robustness and adaptability and can improve the quality of new housing.

- Precast concrete floors in housing – Nick Gorst, Precast Flooring Federation
- Flooring systems using beam, block and screeds – Christopher Truran, Cemex
- Ask the expert

DAY 2
Wednesday 8 March

11:00 Innovations for housing using concrete and masonry

The new products and methods of construction facilitating the construction of energy-efficient, high-performance housing.

- Innovation and evolution in this sector – Elaine Toogood, The Concrete Centre
- Insulating concrete formwork for housing – Richard Wilks, Aggregate Industries
- Ask the expert

12:30 New ideas for low-carbon concrete

Including novel cements, concrete's whole-life performance, and the ability of concrete to act as a carbon sink.

- Overview of concrete's whole-life performance, including CO_2 uptake through carbonation – Tom de Saulles, The Concrete Centre
- The use of low-carbon cement in concrete today – Ian Evans, Hanson
- Novel cements – Colum McCague, MPA Cement
- Ask the expert

14:00 Demystifying BIM and EPDs for concrete and masonry

This session seeks to explain the principles behind BIM and environmental product declarations and how the concrete industry is supporting their development.

- Demystifying environmental product declarations – Matt Butcher, British Precast
- How the concrete industry is supporting the development of BIM – Andrew Minson, MPA
- Ask the expert

15.30 Sustainable performance and resource efficiency – an update on industry initiatives

Find out more about the concrete industry's carbon and waste reduction and the role of the sector in enhancing biodiversity.

- Update on the sustainability performance of the UK concrete and masonry industry – Andrew Minson, MPA
- Resource efficiency action plans (REAPs) for the concrete and clay sectors
- First REAP progress report launch (16:00)

DAY 3
Thursday 9 March

11:00 Clever concrete

Concrete is fundamentally a clever material, usually designed and supplied to suit specific requirements. It is useful for an unparalleled range of applications in housing, landscaping and infrastructure, but new forms of concrete are evolving all the time with different characteristics and potential uses.

- Recent innovations in concrete including ultra-thin and light-transmitting concrete – Guy Thompson, The Concrete Centre
- The science and technology behind concrete, its supply and product evolution – Tarmac
- Ask the expert

12:30 Basements and waterproofing – essential information

Contemporary basements help create desirable, sustainable properties, with more space and storage potential. This session provides guidance on the detailing, waterproofing and construction of basements.

- Essential guidance for designing and detailing basements – Jenny Burridge, The Concrete Centre
- The principles of waterproofing and the solutions available for domestic basements – Marc Hutchison on behalf of The Basement Information Centre
- Ask the expert

14:00 Reducing thermal bridging and maximising fabric performance

Reducing cold bridging is an essential part of contemporary energy-efficient design, not only to improve overall thermal performance but also to reduce the likelihood of mould growth. This session provides guidance on detailing, and the products and construction solutions developed to reduce thermal bridging.

- How to minimise thermal bridging in concrete and masonry homes and deliver optimal fabric performance – Tom de Saulles, The Concrete Centre
- Max Frank's new thermal isolator, designed to reduce thermal bridging at balcony connections – Martin Ernst, Max Frank
- Ask the expert

WHO'S WHO IN THE CONCRETE AND MASONRY PAVILION ...

Aircrete Products Association
E156 / www.aircrete.co.uk

We are … The product group of British Precast for aircrete block manufacturers, promoting best practice and providing guidance on topics such as Part L.
What's new? As insulation and air tightness values have become more stringent, a larger percentage of energy is lost through thermal bridges, making it even more advantageous for architects and developers to use thermal bridging details from product manufacturers.
What's not? Fire resistance and the ease of building with aircrete blocks is not a new concept – but it is as valuable as ever.

The Basement Information Centre
E147 / www.basements.org.uk

We provide … technical guidance and assistance to enable the design and construction of quality basements in homes.
What's new? We have launched a new website with a unique "ask the expert" function. We can help with any queries on the design and construction of basements. Our members provide products and services including waterproofing, underpinning, design and construction, and we offer regulatory guidance.
What's not? Basements have always been an effective way to provide additional living space within the same footprint, something that is only becoming more sought-after as urban populations grow.

British Lime Association
E145 / www.britishlime.org

We represent … the UK's three major manufacturers of lime: Lhoist UK, Singleton Birch and Tarmac.
What's new? We have just published our latest Sustainable Development Report with examples of energy savings, emission reductions and production innovations within the industry. We will also be announcing details of a BLA conference on the use of lime in road and pavement solutions at Lord's Cricket Ground on 16 November.
What's not? The Society for the Protection of Ancient Buildings promotes the use of lime binders for repairs because they are vapour-permeable and allow buildings to breathe. This reduces the risk of trapped moisture and consequent damage to the building fabric.

CARES
D139 / www.ukcares.com

We are … an independent, not-for-profit certification body, established to provide confidence to the users, purchasers and specifiers of constructional steels through regulation, testing and inspection.
What's new? Major changes in public sector procurement may affect the availability of steel product elements on future building projects. Talk to us to learn more.
What's not? The peace of mind that comes from knowing that constructional steel products manufactured by CARES-approved companies are fully traceable throughout the supply chain. All companies have an environmental management system certified to ISO 14001, a quality management system certified to ISO 9001 and an independently verified EPD or validated carbon footprint data.

CEMEX
D130 / www.cemex.co.uk

We make … readymix concrete, cement,

aggregates, asphalt, mortar, screed, floor and wall systems, concrete blocks, hard landscaping.
What's new? Permaflow, our permeable concrete technology. Permaflow is a solution for surface and storm water management, and can be teamed with our other permeable products: Viaflow permeable asphalt or Readyflow permeable blocks.
What's not? ReadyFloor and ReadyTherm structural flooring, used on housing developments throughout the UK due to its ease of installation, improved sound and thermal insulation properties and enhanced fire protection. It is also rated "Very Good" under the BES 6001 standard for responsible sourcing – ensuring that this established product remains relevant to the challenges of today.

CHRYSO
D148 / www.chryso.com

We make … chemical additives for concrete, cement and plaster. We design and manufacture solutions for the global cement and concrete industries, across more than 70 countries.
What's new? We're launching a cementitious flowing screed binder, Belitex, available exclusively through Tarmac. We also have a number of new admixtures developed to meet the ever-increasing demands placed on concrete, such as our slump extension range Equalis, or our Fill Free technology for precast concrete.
What's not? CHRYSO's Optima super plasticisers for ready-mixed concrete are well known throughout the industry for offering excellent performance and robustness, even in a market that is fast evolving. Whether they are used for high-cement-content mixes, pumping, flowing concrete or SCC, we continually review and adapt the range to meet our customers' needs.

Hit the Innovation Trail

New for Ecobuild 2017, the Concrete and Masonry Pavilion will feature a mini exhibition of the latest innovations in concrete, new products designed to have a lower carbon footprint, improved thermal performance – or simply to be more beautiful. Come and discover concretes of many kinds, from ultra-high strength to water-resistant, permeable to architectural precast, lightweight to light-transmitting.

Concrete Block Association
E156 / www.cba-blocks.org.uk

We are … the product group of British Precast for manufacturers of aggregate concrete building blocks in various strengths, weights and surface textures. We run a programme of product development, research and testing to provide new design and construction solutions.
What's new? Thermal bridging details from product manufacturers are increasingly important as insulation and air tightness values get tougher and a larger percentage of energy is lost through thermal bridges.
What's not? Fire resistance and being able to ensure a locally produced product are just two of the features of concrete aggregate blocks that make them an enduringly popular choice.

The Concrete Centre
D150 / www.concretecentre.com

We provide … technical guidance and inspiration for specifiers to inform the design and construction of concrete and masonry. This includes CPD webinars, seminars, lectures and courses, and a wealth of online resources. We also the proud publisher of Concrete Quarterly magazine, now in its 70th year.
What's new? Visit us for the latest information and best-practice guidance on specifying

sustainable concrete, low-carbon concrete, visual concrete, resilient solutions to address overheating and flooding, and case studies of concrete and masonry construction.
What's not? The properties of concrete and masonry have been exploited for thousands of years. Concepts such as thermal mass and the use of secondary and recycled aggregates are proven solutions for energy and resource efficiency, while concrete has long been specified for its robustness and durability.

Creagh Concrete Products
E158 / www.creaghconcrete.com

We make … precast and prestressed flooring, including hollowcore and prestressed slabs, precast stairs and landings, for a diverse range of market sectors across the UK and Ireland.
What's new? Spantherm – an off-site concrete solution for ground floors, and an efficient alternative to labour-intensive beam-and-block installations. High-performance insulated structural concrete units are produced off-site enabling much quicker installation of a fully insulated ground floor on site.
What's not? Creagh Concrete is well established in the residential market. Strong, robust and durable, our concrete products have a long lifespan and are built to last. Concrete homes provide many benefits, including noise reduction and greater thermal mass.

Hanson UK
D129 / www.hanson.co.uk

We make … aggregates, ready-mixed concrete, asphalt, cement and cement-related materials. We have sites UK-wide so we can efficiently supply contracts of all sizes while minimising transport costs.
What's new? We're launching a high-performance concrete for the power sector. Powercrete is a heat-conducting concrete that helps to dissipate the heat generated by high-voltage electrical cables. Its high thermal conductivity means it can be used as a bedding and infill material for underground high-voltage and ultra high-voltage cabling, helping to minimise transmission loss.
What's not? On our stand, you can also find Regen GGBS, a by-product of iron-making that can be used as a cement replacement to significantly reduce the environmental impact of a project. Regen reduces the carbon impact of concrete through both its manufacture and its use: replacing one tonne of Portland cement with one tonne of Regen® reduces its embodied CO2 by around 850kg.

Longley Concrete
D134 / www.longley.uk.com

We make … precast concrete products and supply beam-and-block, hollowcore and insulated flooring systems, precast staircases, lift shafts, landings and stadia, from our three UK manufacturing plants.
What's new? Our stand features a model of our recently Agrémented Jablite insulated flooring system. Jablite uses Longley's prestressed concrete floors beams, which are infilled with lightweight expanded polystyrene (EPS) infill blocks and topped off with an EPS structural board, available in a range of depths.
What's not? Beam and block flooring continues to be the foundation for most new housing developments. Easy to handle and quick to install, it is a robust, damp-proof, fire resistant and rot-proof solution that provides an immediate working platform on site.

Max Frank
E151 / www.maxfrank.co.uk

We make … extruded fibre reinforced concrete spacers, formwork liners, groundwork products, sealing systems and reinforcement technologies.
What's new? We've invested in state-of-the-art in-house testing equipment for our Pecavoid product, enhanced software for Egcobox, and the BBA certificates for both have been extended. We are also introducing our self-supporting Stremaform product to the UK market as an effective concrete jointing solution.
What's not? Our Pecafil permanent formwork and fibre concrete spacers have been used worldwide for 35 years. Shearail was established in the UK as a prefabricated punching shear reinforcement solution, and is still the only BBA and CARES-certified system on the market.

Mortar Industry Association
E156 / www.mortar.org.uk

We are … the trade association for producers of factory-made mortars, renders and screeds.
What's new? We've just developed detailed data sheets and guidance on all aspects of mortar and masonry. You can also see daily demonstrations of block-laying and standard construction details.
What's not? Almost 80% of mortars used in the UK today are produced in a factory rather than being mixed on site. Their use reflects the ever increasing demand for quality building products in all areas of the built environment.

Precast Flooring Federation
E168 / www.precastfloors.info

We are … a product group within British Precast, promoting the structural and commercial benefits of precast flooring.
What's new? We're seeing increasing use of squeak-free precast concrete for upper floors in traditional homes.
What's not? We're still producing low-carbon flooring with the whole-life benefits of acoustic performance, durability, energy efficiency, fire resistance and robustness.

Tarmac
D131 / www.tarmac.com

We are … thousands of different concrete formulations for virtually any application, from self-compacting and fibre-reinforced mixes to decorative or permeable concrete.
What's new? We're introducing a new flowing floor screed: Topflow Screed C Belitex is a cement-based, free-flowing screed that offers significantly reduced drying times. It can be trafficked after just 24–48 hours and dries within 14–21 days, providing flexibility in installation and the overall build programme. As a cement-based product, it is also compatible with most adhesives and floor levellers.
What's not? Every project is different, but whatever the challenge, all must be completed on time and on budget. Placement of conventional compacted concrete often requires considerable manpower, machinery and time, whereas self-compacting Topflow can be poured quickly to provide a high-quality finish.

YOU HAVE TO ADMIT IT'S GETTING WETTER

With extreme flooding almost an annual occurrence in the UK, it is vital that resilient design and construction becomes standard practice. Whether it's in the structure of new homes, the paving on residential roads or the defences holding back our rivers, concrete is on the frontline

We used to turn to Biblical times to find an appropriate comparator for an extreme flood. Now we just have to cast our minds back a year or two. The changing weather patterns have led to increasingly regular periods of intense rain, which in turn have led to a number of significant floods over the last 10 years, with major incidents in 2007, 2009, 2012 and 2013/14. December 2015 was the wettest month since records began in 1910, with more than 17,000 properties affected.

However, while the frequency of such events is unprecedented, the events themselves are not. Catastrophic floods have been documented throughout British history, from 1362 when hurricane-force winds drove tsunami-like waves along England's eastern seaboard, to 1953, when a violent North Sea storm inundated coastal towns, leaving 307 people dead and 40,000 homeless.

If the problem isn't new, it follows that many of the solutions don't need to be completely groundbreaking either. From its first issues in the late 1940s, Concrete Quarterly magazine has highlighted the resilience of concrete to water, and different techniques for exploiting this characteristic. After the 1953 floods, long lines of 7m-high in-situ concrete stepped structures were built along the North Sea coast; later, precasting techniques were introduced to improve durability and ease of construction. On the other side of the North Sea, Dutch engineers were proving even more ambitious: between 1953 and 1978, the Delta flood-defence plan involved the construction of four massive concrete dam systems, which together held back the Rhine estuary and reduced the Dutch coastline by 430 miles.

Above: CHRYSO's graphic flood defence on Brookvale Road, Birmingham
Left: The Netherlands' Delta flood defence
Bottom left: The £62m upgrade of Blackpool's sea defences, built using precast concrete containing 50% Regen GGBS by Hanson

The work of improving concrete defences continues today – for example, Tarmac has developed TBlocks, a modular system of interlocking blocks that can be built quickly and require a reduced footprint on shorelines.

But of course, it is not just a question of holding back the sea. Many recent UK floods have been particularly severe in low-lying inland areas, and DEFRA's National Flood Resilience Review, launched in September 2016, sets out to reassess our understanding of both fluvial and coastal flood risk and to test the resilience of key infrastructure to extreme scenarios.

Nor is this just a case of improving defences. According to the Environment Agency in 2014, over 5.5 million, or one in six, properties are at risk from all types of flood across England ▶

GOOD IDEA

"We should not see flood defences as something you graft on and that adds cost, but rather something that is beautiful, but also resilient"

5.5 million

PROPERTIES AT RISK FROM ALL TYPES OF FLOOD IN ENGLAND AND WALES

IN PRACTICE

WItton and Perry Barr flood defence scheme

The Tame might not be the most apt name for the river that flows through Birmingham. In June 2007, a torrential downpour caused it to burst its banks. Workers were trapped in a factory and properties were badly damaged by floodwater. The water level reached 1.5m on the busy Brookvale Road.

The Environment Agency's response was to propose a two-phase scheme of defence improvements in the districts of Witton and Perry Barr, with the aim of reducing the risk of flooding for 1,378 properties, including 845 homes. The first phase included raising the 455m-long barrier on Brookvale Road to a maximum of 1.5m above road level, about 30cm higher than the existing wall. This led to some concerns in the community – and to a highly inventive solution.

Although residents were keen to prevent a repeat of the 2007 flood, responses to the EA's consultation document also raised fears that such a high wall, stretching for half a kilometre, would disconnect the community from the river – which is designated as a Site of Local Importance for Nature Conservation – and could, in short, be a bit ugly. Drawing on funding from the Arts Council and input from local charity MADE, the agency proposed using the wall as the canvas for a giant artwork. Enter graphic concrete specialist CHRYSO.

With CHRYSO working alongside local artists, a design took shape that was directly inspired by the river and local heritage. Large words on the wall show the name of the river and are reversed to show the direction in which it is flowing; words in between describe how the river behaves and what it means to local people. The typeface was used in the 1920s and 1930s by the Kynoch Press, a printing house that was once Witton's biggest employer.

The design was etched into the reinforced-concrete wall panels as part of the precasting process. A formliner was placed at the bottom of the concrete mould, with a surface retarder used to etch the print 1mm into the concrete, exposing the aggregate underneath. The concrete – which contained a pinkish quartz aggregate to provide the colour for the exposed areas – was then poured in. When the panel was demoulded the following day, the liner was removed and the surface washed to expose the aggregate and reveal the design. "This is a very simple process for the contractors to undertake," says Peter Lawrence, general manager at CHRYSO, "and any type of image can be created, from simple patterns to more detailed photographic images." An anti-graffiti coating was also applied to the panels prior to being sent to site.

The completed scheme chimes with the spirit of the EA's National Flood Resilience Review, which was published in September 2016. This highlighted the danger of defences proving a barrier not just to water but to nature, and to an inspiring built environment. Oliver Letwin, the former government minister who drew up the review, has warned of "a terrible tendency" to treat flood barriers as an after-thought, only added at a higher cost when an area has already been drenched. "We should not see flood defences anymore, in an urban context, as something you graft on and that adds cost, but rather something that is beautiful, viable – indeed highly saleable and desirable – but also resilient." The taming of the Tame does exactly that.

Photos: Tim Brookfield, Isai'Symens, Hanson

NEW IDEA

Baca Architects' LifE project explores how we can live with water, rather than trying to keep it at bay

and Wales. In other words, as sea and river levels rise and surface flooding becomes more common, even in areas without a significant threat level, buildings are likely to face an increased risk in the near future.

In the face of this gathering storm, more inventive thinking is required. For example, the LifE project, developed for DEFRA by Baca Architects, sets out an integrated approach to planning and design that explores how we can live with water, rather than trying to keep it at bay.

It is also necessary to design resilient measures into buildings themselves. DEFRA's Property Flood Resilience Action Plan, launched alongside the National Flood Resilience Review, pinpoints a number of measures that need to be taken, including developing skills and guidelines, in order to make flood-resilience standard practice within the next five years.

The focus will be on measures that can help prevent water ingress into a building or aid rapid recovery and allow householders to simply wash out and disinfect after flooding, rather than replace the fabric wholesale. And as with the response to the 1953 floods, the resilience of concrete will bring this material to the fore. As the structure is usually the most costly and disruptive part of a building to replace, it is vital that this is not compromised by a flood. BS 85500:2015, the British standard for flood-resistant and resilient construction, recognises that concrete and masonry perform well in most flood situations and uses these materials as the basis of the recommended details for new construction. Again, this performance benefit is not necessarily unknown but, as Elaine Toogood outlines below, it is essential to building a more flood-resilient future.

Not that concrete has always been the hero. Increased urbanisation and the relentless growth of the road network over the past century have resulted in expanses of hard surfaces – often concrete or asphalt – that can cause drains to become rapidly inundated under heavy rainfall. One increasingly effective way of combatting this is through the use of sustainable drainage systems. SuDS include a variety of components including green roofs, wetlands and tanks to store run-off water before releasing it slowly or letting it soak into the ground. One key element of SuDS, examined by Nick Gorst opposite, is permeable paving, which allows water to filter through the subsoil to the water table, and can also temporarily store it. Another is pervious concrete, a cast-in-situ surface designed to allow water to drain through it. Concrete surfaces may in some cases contribute to the high levels of water run-off in urban floods, but they are also a key part of the solution.

Designing flood-resilient homes

***Elaine Toogood** explains why the latest standards recommend the use of concrete and masonry structures*

Water damage is the number-one cause of property insurance claims in the UK, whether through flooding from external sources such as rivers or the sea, or so-called "vertical floods" from leaking water pipes and drainage. The latest guidance, BS 85500:2015, helps to identify when flood-resilient and resistant construction is appropriate and gives guidance on achieving it, but its principles are useful for protecting against all forms of water damage.

BS 85500 recommends the use of a range of concrete and masonry structures, as they retain their structural integrity in flood conditions. Concrete has the strength to keep water at bay and has few construction joints to let the water through. It can be designed to resist very high loads, and is robust enough to withstand impact from debris. But it doesn't only help to keep water out of a property. It is also easier, compared with materials such as timber, to wash and disinfect if water does get in, and it is more resistant to rot or fungal growth. This helps to reduce costs and disruption, particularly for short-duration floods.

Reinforced concrete or concrete blocks can be used as the structural wall in a solid-wall solution, or as one or both of the leaves in a cavity-wall construction. Another approach is to adopt an insulated concrete formwork system, which uses rigid insulation as the mould within which ready-mixed concrete is cast, before being finished with a surface treatment. The insulation properties are unaffected by moisture, making ICF appropriate for most flood situations.

Where it is not possible to place the ground floor above the predicted flood level, a reinforced concrete slab, at least 150mm thick, is the preferred construction solution. This should ideally be ground-bearing to avoid water and mud entering under the building. Deeper floods are likely to require thicker slabs to maintain their structural integrity – for example, a 200mm slab for a 450mm flood above ground level, or 300mm for a 600mm deep flood.

Rigid closed-cell insulation is the preferred choice for all parts of the building likely to be affected by flooding, as it is able to retain integrity and resist moisture absorption. In floors, a minimum 1,200-gauge damp-proof membrane is also recommended. Suitable floor finishes include ceramic or concrete-based floor tiles that are robust, water-resistant and easily cleaned after a flood.

The Concrete Centre is developing new guidance for Designing Resilient Homes, which will be published later in 2017. A diagram showing the key elements of resilient homes is shown on page 3.

Elaine Toogood is senior architect at The Concrete Centre

IN PRACTICE

Sustainable paving, Peterborough

Concrete block permeable paving is a proven solution for helping to meet requirements for sustainable drainage systems (SuDS) on developments. Hard surfaces are necessary on housing schemes – whether for traffic, parking, pedestrians or play – but permeable paving provides an inherent drainage system, addressing both flooding and pollution issues by attenuating and cleaning water run-off at source. This technology largely eliminates pipework, gulleys and manholes, and can cost less than conventional drainage. Concrete block permeable paving can simply filter to the ground where conditions allow or collect water for transmission to other SuDS features or to conventional drainage.

Peterborough City Council is trialling this approach at Fleetwood Crescent, the 28-home first phase of a new development in the Eastfield area of Peterborough for Cross Keys Homes. The estate road makes extensive use of concrete block permeable paving, reflecting Peterborough council's desire to incorporate SuDS in developments. The scheme shows how permeable-paved drives, parking and adopted roads on a typical new housing development can attenuate, store and treat run-off from all the hard surfaces without using any additional land or other SuDS features.

How it works

The 0.87ha brownfield site – formerly a secondary school – has a 0.8m depth of made ground overlying clay and sand, giving a low permeability. The drainage is designed to temporarily store rainwater runoff on site and remove pollutants before gradual discharge to an existing surface-water sewer that eventually outfalls into a nearby watercourse.

Because of the low soil permeability, a Type C tanked permeable paving system is used. This means that a perforated pipe within the construction collects water, running the length of the road and connecting to the sewer. Here, water discharge from the development via the permeable paving is restricted to greenfield run-off rates by a device called an orifice plate flow control chamber, thereby protecting the local sewer from overloading. Surface water storage volumes on the site are designed to cater for rainfall events exceeding the 1-in-100-year storm, plus a 30% allowance for climate change.

House driveways and shared parking areas are also constructed in concrete block permeable paving, linked to the road construction with pipes below the footpath. Rainwater from all roofs drains into the permeable driveways via perforated diffuser pipes. Services are generally accommodated in corridors within the footpaths, with an impermeable block-paved road crossing.

All the concrete block permeable paving has been designed and constructed in accordance with Interpave guidance.

Nick Gorst is engineering technical manager at Interpave. Download guidance at www.paving.org.uk

SILENT STAR

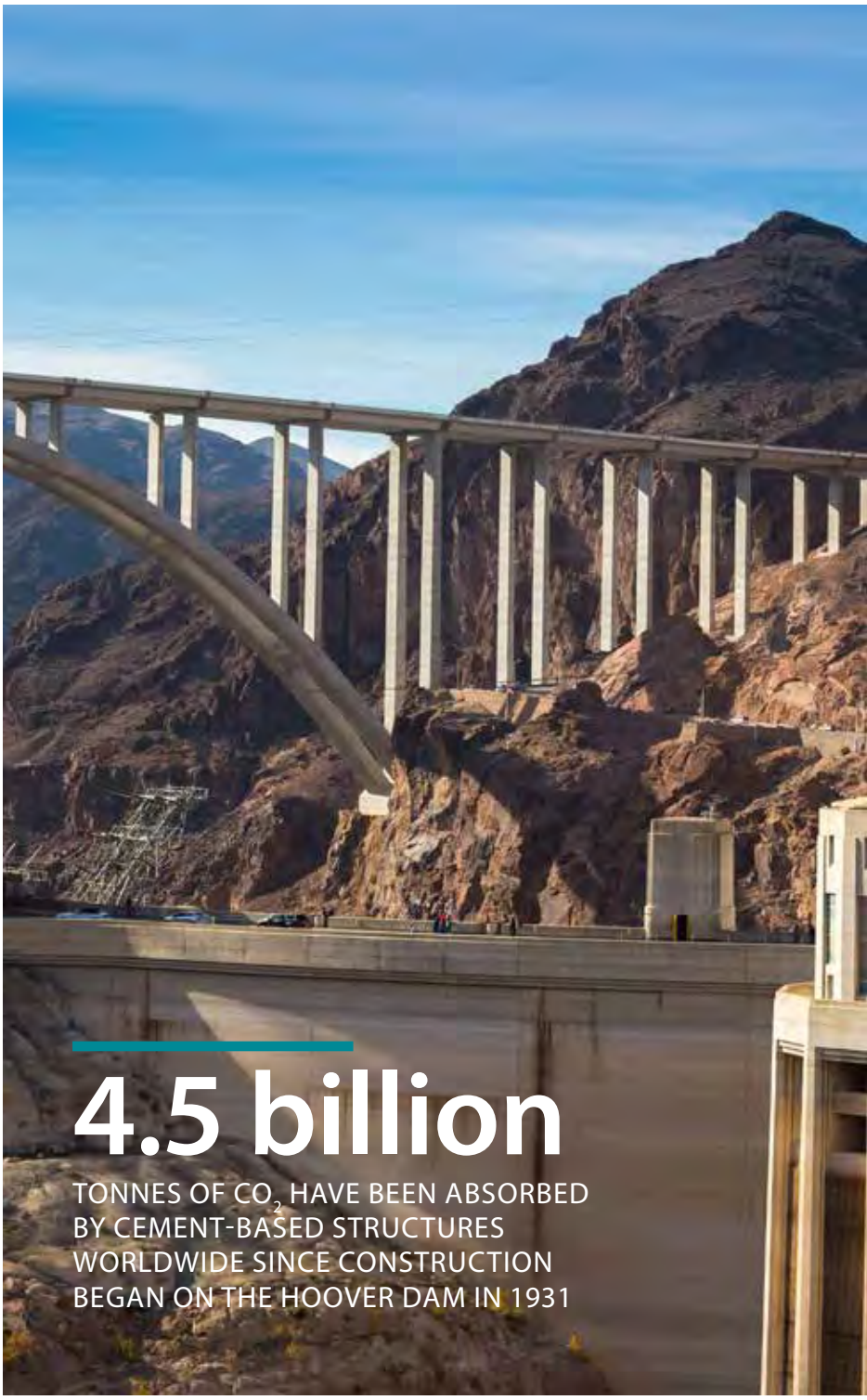
Concrete can contribute to low-carbon design in a number of unsung ways – from absorbing CO_2 to acting as a thermal battery in a future electricity network. By Tom De Saulles

Concrete and masonry have been around for a long time and are highly evolved materials – no bad thing given the limited provenance of many new construction systems. The evolution continues, for example in the way these materials are used in low-carbon building design.

While this largely centres on their resilience, longevity and thermal mass, other less recognised qualities are starting to play a role. These relate to the way concrete gradually absorbs CO_2 from the atmosphere over its lifecycle, and to the ability of concrete and masonry to act as a thermal battery.

This is proving to be a useful function in smart, low-energy buildings able to respond to a national electricity grid that increasingly seeks to balance supply with demand. These disparate properties can usefully reduce a building's carbon footprint, albeit in very different ways.

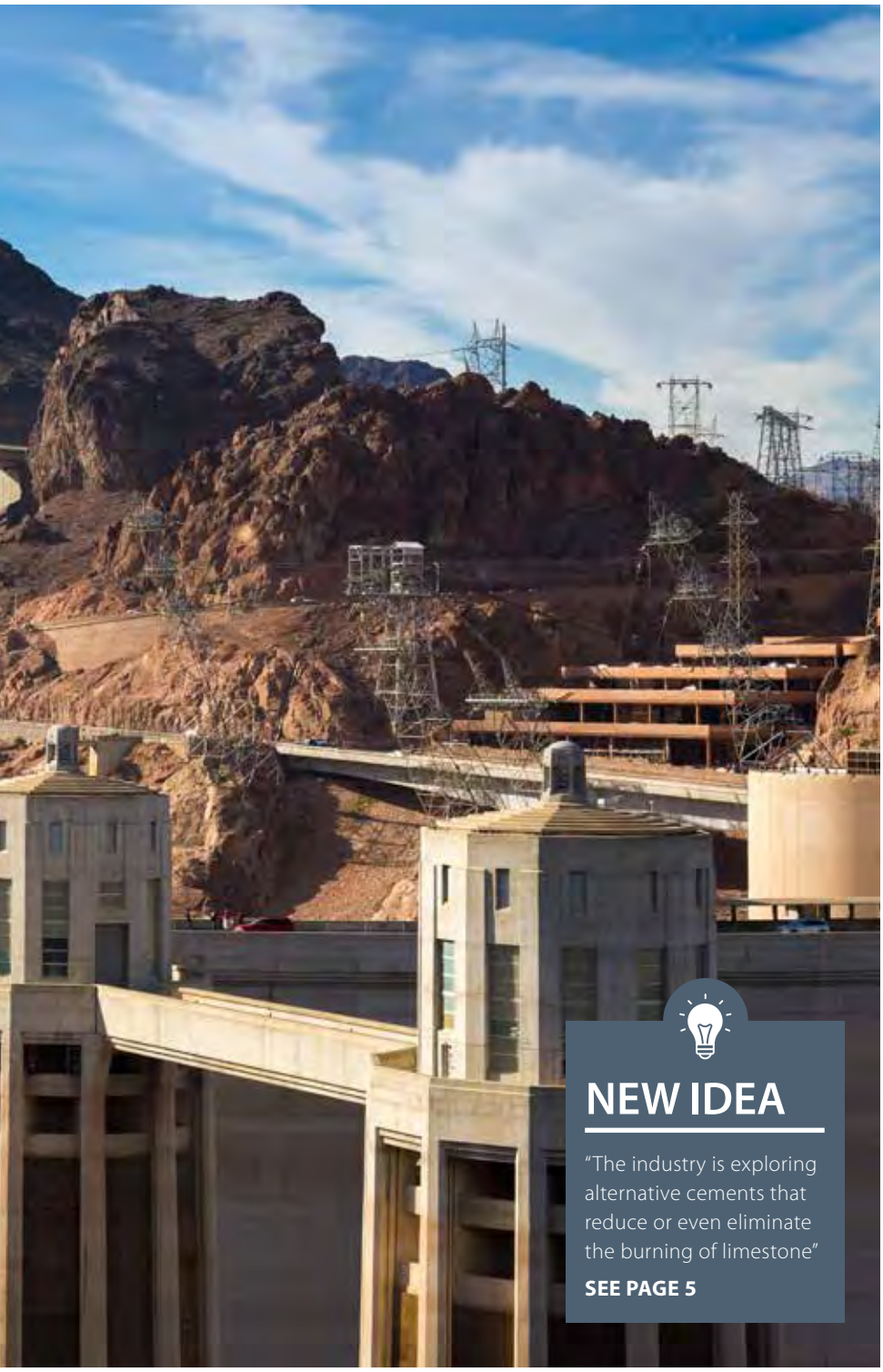
This is also true of recently developed high-performance construction details for concrete and masonry, which provide a highly effective means of reducing heat loss and emissions from buildings.



4.5 billion

TONNES OF CO_2 HAVE BEEN ABSORBED BY CEMENT-BASED STRUCTURES WORLDWIDE SINCE CONSTRUCTION BEGAN ON THE HOOVER DAM IN 1931

Photos: Fotolia, Corbis



NEW IDEA

"The industry is exploring alternative cements that reduce or even eliminate the burning of limestone"

SEE PAGE 5

The secret carbon sink

The absorption of CO_2 by plants is basic biology, but we could be forgiven for not knowing that concrete and other cement-based materials soak up a significant amount of CO_2 from the atmosphere. This naturally occurring process, called "carbonation", is happening all around us in our buildings and infrastructure. At a global level, between 1930 and 2013, CO_2 uptake from cement-based materials was in the order of 4.5 billion tonnes, according to research led by Chinese Academy of Sciences researcher Fengming Xi.

While overall emissions from the manufacture of cement remain more significant than the effects of carbonation, the study estimates that over its lifecycle, carbonation leads to about a 43% takeback in manufacturing emissions, excluding those from the fuel used. When fuel is included, the figure is about 26%, which broadly aligns with the findings from other carbonation studies.

Although it is not detrimental to the concrete, carbonation is purposefully limited during reinforced-concrete buildings' in-use phase to protect against any corrosive effects on steel reinforcement. This is ensured through a combination of the concrete mix design and adequate cover of the steelwork. But CO_2 uptake increases markedly in the end-of-life phase, when concrete is crushed, increasing its surface area and exposure to air. While the deconstruction process may only last for a few weeks, it's long enough to account for around a fifth of the lifecycle carbonation figure.

But this is not the end of the story, as the process continues well beyond the building's lifecycle, extending into the concrete's secondary life where, after being crushed, it is used in a range of other applications. In fact, the bulk of the CO_2 takeback is likely to occur in the secondary life phase.

The publication later this year of EN 16757 will set out the rules for precast-concrete products when producing an environmental product declaration (EPD). This will be the first CEN standard to explicitly recognise carbonation in footprinting calculations.

Download Whole-Life Carbon and Buildings from www.concretecentre.com

Houses with high thermal mass, such as Stride Treglown's Great Bow Yard in Somerset, could play a part in an intelligent control system

Smart thermal mass

The energy industry is undergoing a quiet revolution that will shape the way we use and pay for electricity in our homes. Central to this is the steady shift to renewable power, which now accounts for 14% of the UK supply. This figure will grow as new schemes come online.

This is undoubtedly a good thing, but it does challenge us to balance an increasingly intermittent supply with our energy needs. Government and regulators must design a system that can both manage intermittency better and take advantage of innovations in storage, interconnection and IT to create a truly dynamic energy scheme.

So, what has this got to do with concrete and masonry? The answer lies in the ability of these materials to store and release heat – their thermal mass – which can be used as the basis of a demand-side-response electric heating system. This involves using the floors and walls in medium and heavyweight buildings as a form of storage heater, linked to an intelligent control system that takes advantage of electricity when demand and price are low. At other times, the heating is switched off as much as possible and comfort is maintained by the slow release of stored heat.

NEW IDEA

"Smart meters are being rolled out that can respond directly to real-time energy pricing and link to heating controls"

This may not sound particularly ground-breaking, but the game-changer is the roll-out of smart meters that can respond directly to real-time energy pricing and link to heating controls. Also, there are new regulations in the pipeline that will extend a half-hourly settlement arrangement to domestic smart meters, so homeowners can benefit from real-time pricing.

Putting the heat into floors and walls can be achieved directly with embedded pipes or electric heating mats, in the manner of an underfloor system, or indirectly by simply allowing internal surfaces to absorb heat from convectors or radiators in the building.

Read more in the European Cement Association's report, Structural Thermal Energy Storage in Heavyweight Buildings, available via www.concretecentre.com

High-performance details

A fabric-first approach to low-carbon design is an undeniably good idea, and it now forms the basis of Part L1A compliance for new dwellings. What makes it an even better idea is the use of pre-calculated high-performance construction details, which save designers time and enable them to meet thermal bridging performance criteria more simply.

Thermal bridging caused by poor detailing can be responsible for up to 35% of a dwelling's heat loss, so their use offers an easy win, as a no-cost means of enhancing thermal performance. The alternative is to use details that have not been independently assessed, which will require use of SAP's punitive default thermal bridging value. This results in around a 60% increase in the calculated heat loss from junctions than would otherwise be the case, a figure which looks likely to become even more punishing in the next version of SAP, now under review.

High-performance construction details for common types of masonry wall construction and different block types/densities are available from the Local Area Building Control (LABC) website. These details are particularly useful for SME builders and they use products that are readily available from builders' merchants.

Details can also be downloaded from the Concrete Block Association (CBA) for aggregate blocks, or from Constructive Details for aircrete blocks. The Modern Masonry Alliance website provides further explanation and all necessary links. Construction details for insulating concrete formwork are available from the Insulating Concrete Formwork Association (ICFA).

www.modernmasonry.co.uk
www.icfa.org.uk

REDEFINING THE POSSIBLE

Formwork contractor ***Don Houston*** has seen the industry transform itself during his career. But some things will never change …

What are the most significant innovations that you have seen over the course of your career?
Concrete technology has moved on enormously. When I started out, mixes were 35-40N tops, now they're routinely 80-95, rising to as high as 150. The development of system formwork has also been important – it's so much more sophisticated and safe to erect than the scaffolding formwork we used when I started out. Another game-changer was when we started doing slipform cores around 15 years ago. It's a lot quicker and safer and now everyone is doing it.

Is there scope for further technical innovation?
Absolutely. At any one time I'm testing six or so different things. There's definitely scope for getting more built offsite – there isn't enough prefabrication in reinforcement in particular and we'd like to change that.

Is it getting easier or harder to get the job done on time and on budget?
Computers and 3D visualisation have transformed how we work. Everything's a lot more complex – we don't even bat an eyelid now at what would have seemed impossible 20 years ago. We're able to take on more challenging jobs because we're far more efficient and pay a lot more attention to pre-construction – our pre-con department has grown from four to 25 in ten years. But the job never seems to get any easier – new problems always pop up. Clients are always pushing us to do things quicker and are never happy with the price, whatever it is – that will never change!

What are the biggest challenges facing the concrete industry?
It's still safety. Construction industry fatalities once topped 400 a year and are now about 60 or 70. But getting this down to zero is a huge challenge. One of the ways forward is thinking about how elements will be constructed during the initial design phase. Too often we're trying to make something safe to build that's been designed already.

What's the best advice you've ever been given?
I used to be a bit fiery early on in my career. I remember an old general foreman telling me that it's a very small industry and you are likely to meet everyone at least twice. Since I'd just had a blazing row and said some things I shouldn't, his advice was to apologise quickly, because otherwise the next time we met he might have the upper hand and he wouldn't forget it. I took his advice and the gentleman concerned became a great friend!

Above: The slipform core rises on the Shard at London Bridge

GOOD IDEA

"When we started doing slipform cores it was a game-changer. It's a lot quicker and safer and now everyone's doing it"

You've worked on many landmark buildings. Is there a dream project you'd like to do?
I've been saying 'only one more major project before I retire' for ten years now! I'd love to be involved in delivering HS2. It's one of the biggest global projects, and it's here on our doorstep. It's such a huge task with incredible structural challenges – I'd love to tackle it.

Don Houston is projects director at Byrne Bros (Formwork). His major projects include the Shard, Crossrail Paddington and Woolwich, and the New London Embassy

THE TIMELESS CASE FOR CONCRETE

The whole-life benefits that make concrete the perfect material for past, present and future

	ENVIRONMENTAL	SOCIAL	ECONOMIC
FIRE RESISTANCE	Concrete is non-combustible, helping to ensure its longevity and avoiding the need for additional fire-proofing materials.	Concrete reduces the spread of fire, helping to provide life safety and property safety. During construction, a concrete frame presents no fire risk to neighbours.	Regulations require the safe evacuation of occupants but do not ensure the survival of property. Concrete structures comply with life safety regulations but also resist fire to enable cost-effective repair and reuse.
THERMAL MASS	Concrete's thermal mass can reduce or avoid the need for mechanical cooling. This inherent property of concrete can save thousands of kilograms of CO_2 over a building's life.	The thermal mass inherent in concrete provides long-term resilience to the issue of overheating – a growing health and wellbeing issue, particularly among the very young and the elderly.	Using the thermal mass provided by concrete can lower the running costs of a building. It can also reduce the amount of M&E equipment needed, leading to lower operating and maintenance costs.
DURABILITY	The durability of concrete structures helps them to achieve a long life and maximise their performance, keeping their whole-life environmental impact to a minimum.	The durability of concrete structures means that, once built, they are rarely out of use for maintenance and hence cause minimal social disruption.	Concrete is a very stable and durable material with an extremely long life. As a result, maintenance costs are very low.
ACOUSTIC ISOLATION PERFORMANCE	Concrete offers good inherent acoustic performance, requiring very little in the way of additional finishes and materials, which often have a short lifespan. As a result, less material is used and potential waste is avoided over the life of the building.	Concrete's mass provides a good barrier to noise, improving quality of life, particularly in high-density housing or near busy roads.	Concrete provides good inherent acoustic separation. This can result in cost savings because minimal supplementary design measures are required.
ROBUSTNESS AND SECURITY	Concrete can provide a robust, finished surface, avoiding the need for additional materials, which would require maintenance and periodic replacement over a building's lifecycle.	Solid concrete and masonry party walls result in safe, secure buildings, preventing unwelcome intruders.	Concrete structures, particularly those with minimal finishes, will suffer less damage and cost less to repair and maintain.
FLOOD RESILIENCE	Concrete retains its structural integrity, resulting in minimal waste of materials following a flood.	Concrete and masonry structures can be designed to resist water penetration, keeping inconvenience and disruption to businesses, homeowners and the community to a minimum.	Downtime of businesses, homes and essential community services is minimised if flooded buildings have been constructed in concrete, as they will require less repair work.