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Concrete pavilion transforms the visitor
experience at Jodrell Bank Observatory

PRINTING A NEW HOUSING FUTURE

How 3DCP is slowly advancing into
mainstream housing construction

HAPPY HEALTHY WORKFORCE

A programme to provide education and
tools to protect operatives from dust



MAIN IMAGE:

ICON 'House Zero' prototype
3DCP home – interior shot.

(Photo: Casey Dunn.)



3DCP is fast, with Texas-based company ICON building two eye-catching houses in just eight days in 2022, honing the technology ahead of its 100-home Wolf Ranch development, now taking shape in nearby Georgetown. As well as slashing build times, 3DCP is also spurring the development of new forms of low-emission concrete, promising to reduce construction's major environmental impacts. The result is that a global 3DCP construction market worth just US\$3 million in 2019 (£2.36m) is expected to reach \$1.6 billion (£1.26bn) this year, according to the World Economic Forum⁽¹⁾.

This year will also see the first major 3DCP residential project in the UK – and the largest such development in Europe. Not-for-profit net-zero housing provider Building For Humanity will create 46 eco-homes for homeless veterans and low-income families at Charter Street in the Lancashire town of Accrington, with testing of the technology taking place in collaboration with Accrington and Rossendale College – which is also set to begin offering courses in 3D concrete printing.

The Accrington development will combine individual two-storey houses with three-storey apartment blocks, with estimates that using 3DCP will bring a 60% reduction in waste and 25% reduction in cost compared with a traditional construction process.

"At Accrington, we are using highly mobile machines that will

3D PRINTING A NEW HOUSING FUTURE

3D concrete printing (3DCP) is slowly but surely advancing into mainstream housing construction. From early single-home test builds a decade ago, the bar is now set at large-scale developments built quickly and efficiently with a technology capable of transforming the construction landscape. **Norman Miller** reports.



(Photo: Casey Dunn)

be positioned on each structural floor plate to print the walls from inside the building,” says Iain Hulse, commercial manager at Building For Humanity. “The only limitations are the reach of the machine at 13.8m, the maximum height it can print, which is 3.85m, and the distance to the mobile materials silo, which can be up to 26m. The machine is entirely waterproof and able to operate in winds up to 37mph and temperatures between -5 and 50°C. It also requires zero tea breaks!”

The Accrington development – due to begin printing in September – will be able to draw on knowledge gained on projects in several other countries. In Ireland, for example, Harcourt recently completed an award-winning collaboration with Roadstone for two houses completed with a world-first combination of 3DCP on-site printing using EN 206⁽²⁾-compliant ready-mixed concrete. Meanwhile, residents have been living in 3DCP houses since 2021 at Project Milestone in the Dutch city of Eindhoven, home to a cluster of bold architecturally intriguing dwellings. Traditional building regulations are also not a significant hurdle. “The current International Building and Residential Model Codes (IBC and IRC) permit the use of alternative materials and construction methods,” points out David Langefeld, ICON’s senior regulatory affairs programme manager. “In accordance with the provisions for alternative methods, designs

are backed by a suite of material and full-scale structural testing confirmed by third parties.”

The same applies to the Accrington project in the UK. “While in many ways, we are blazing a trail with this development, we are shaping 3DCP to comply with existing Standards,” explains Hulse. “The project team includes an approved building inspector and building warranty provider, who are aware of the 3DCP element and happy to offer their guarantees.”

The steady development of 3DCP practice has also led to a maturity in the technology. “The rigs and machines are reasonably standardised – we are purchasing off-the-shelf machines from Constructions-3D, based in France,” adds Hulse.

DESIGN CHOICES

One intriguing question around 3DCP housing developments is to what extent homes will reflect the flexibility of the giant printers to create eye-catching forms, with many 3DCP homes – such as those in Eindhoven – dominated by curves, in contrast to standard rectangular forms.

“While we could easily create complex shapes and forms, we are keen – for now – to ensure our developments look familiar to residents and the neighbouring community,” says Hulse. “But we have been much more organic with our community hub building, which will showcase 3DCP’s talents.”

This contrasts with the US experience, according to Langefeld at ICON, where home buyers are directed towards their AI ‘architect’ Vitruvius. “This helps anyone design a home in minutes based on their own desires and budget,” he says. “And feedback from home buyers says how much they prefer the organic shapes and curves in ICON homes versus rectilinear boxes.”

MATERIAL DEVELOPMENTS

3DCP is also driving invention in bespoke materials as well as bespoke architecture, thanks to machines that can print with mixes containing various types of mortar and plastic, natural materials like clay, are recycled materials.

3DCP developers are, however, also finding ways

LEFT:

ICON prototype ‘House Zero’ 3DCP home.

INSET BELOW:

Artist’s illustration of Accrington development.

(Image: Building for Humanity.)

to adapt traditional concrete for the new technology by overcoming past issues such as clogging and material not adhering properly to previous printed layers. Advances include cement giant CEMEX creating a substance christened D.fab that turns ready-mixed concrete into a malleable material suitable for many 3DCP printers.

Although being able to adapt standard concretes for 3DCP developments may spur interest from building firms, there are also key developments being made by 3DCP companies that could have a more long-term impact on global construction.

In the US, for example, ICON has teamed up with MIT’s Concrete Sustainability Hub to create a formulation dubbed CarbonX, which offers the lowest carbon ready-to-use residential building system in the world. The company has also recently signed a \$57m (£45m) contract with NASA to test how to build 3DCP structures in a low-gravity environment such as on the Moon. Perhaps it’s time for 3DCP home construction ambitions to be as bold as those behind space exploration. **C**

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