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Less labour, less time – S'pore builds its first 3D-printed childcare centre

Printable concrete now matches quality of structural concrete in strength, stability

Sarah Koh

Nestled in a Woodlands condominium stands Singapore's first 3D-printed childcare centre, where young charges are soon expected to engage in play and study.

All the exterior walls, including the curved ones, on the first floor of the two-storey building were printed on-site in Norwood Grand, a 348-unit development which is expected to be completed in July.

These walls were built within two days, pumped from the nozzle of a large-scale 3D printer. The second floor was constructed the traditional way.

Built in August 2025, this centre is a demonstration of Singapore's first on-site 3D concrete printing of structural elements, which could be load-bearing structures such as walls, beams, and floors.

This newest development stems from a collaboration between researchers from the National University of Singapore (NUS) and construction firm Woh Hup, with support from the Building and Construction Authority (BCA) and National Additive Manufacturing Innovation Cluster.

Compared with traditional construction, on-site 3D-printed concrete significantly reduces the amount of manpower and time needed to construct complex designs, as the printer can lay concrete without the need for formwork, said senior lecturer Du Hongjian of the NUS College of Design and Engineering.

Formwork – used to contain and shape wet concrete – can be wooden or steel boards.

"(It) needs to be set up one day before casting, and can only be removed one to two days after concrete is cast," said Dr Du at an interview with the media on Feb 5, alongside Associate Professor Pang Sze Dai.

Metal formwork is a lot more expensive and can only be used a handful of times, he noted.

"3D concrete printing can reduce the amount of manpower involved, and offer a higher degree of design freedom for architects and structural consultants."

The walls on the first level of the centre were printed in two days, and required a team of around six construction workers tasked with responsibilities such as monitoring the sensors that track the quality of the concrete mixed on-site.

Three additional checkers were also deployed to ensure that the novel process went smoothly.

The work took a total of 170 manhours, whereas manual building would have required nearly 400 manhours and a larger team of 11.

While 3D printing has been used for construction, it has been mostly limited to non-structural elements. They include benches and pavilions built via 3D printing, which can be found in Housing Board estates such as Tengah and Bidadari.

Research to improve the materials used in printable concrete mix has now allowed it to match the requirements of structural concrete, said Prof Pang, adding that the new mix was put through a series of tests required by BCA to ensure its strength and stability.

For instance, a 3m-tall wall was assessed in compression and bending tests for its ability to withstand the loads it is expected to carry. Shear bonding – the ability of printed concrete to bond with regular concrete – was also tested.

Printing of three curved feature walls along the entry foyer of the condominium also began in January, which The Sunday Times observed on Jan 28.

The large-scale printer can rise to 5m with a 10m-long retractable arm, and a base that can move along tracks. When in use, it emitted a low humming noise.

"Part of the reason why construction cannot be done past a certain hour is because of noise pollution," said Prof Pang.

"If automation can help to reduce that, I believe that there's a potential that works can go on into later hours. Workers also would not need to climb heights to cast concrete, making it safer."

But, compared with regular concrete, printable concrete has a much higher concentration of cement, which is tied to higher carbon dioxide (CO_2) emissions. To combat this, the team is researching the use of alternative materials that are more environmentally friendly.

A study published in late January by the NUS team found that replacing 60 per cent of cement with glass powder would still retain the concrete's structural performance and printability.

Using glass powder would also halve CO_2 emissions, and has been shown to improve the printable concrete's resistance to chloride penetration from groundwater, giving it a longer shelf life and lower maintenance demands.

Using greener materials will help to push down the costs of 3D concrete printing, which might encourage industry players to adopt the technology, said Prof Pang.

But while it is technically possible to construct HDB flats with 3D concrete printing, it will still cost more than using precast technology, where manufacturing is done off-site by pouring concrete into moulds.

"HDB flats are typically made of regular flat walls, which is still best done by precast," said Prof Pang, adding that 3D printing is better suited for more custom-made, complex designs.

These designs can include corrugated walls and tiles, which are fitted onto seawalls to act as a natural habitat for marine life.

Moving forward, NUS will also be working closely with BCA to develop a technical reference that sets out design guidelines and evaluation criteria for the structural design of printable concrete.

"Once you have that, there will be a confidence within the industry that (the technology) is approved and published, so that there will be higher adoption."

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A 3D printer making a curved feature wall at the Norwood Grand condo. The technology is better suited for complex designs, as it costs less to construct flat walls with precast concrete, said Associate Professor Pang Sze Dai of the NUS College of Design and Engineering. ST PHOTOS: NG SOR LUAN

The exterior walls on the first floor of the childcare centre in Norwood Grand were built within two days, pumped from the nozzle of a large-scale 3D printer. The second floor was constructed the traditional way.

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