

HDB looking at 3D-printing tech in Tengah, Bidadari estates

It's among projects the board is embarking on to improve productivity amid sluggish productivity growth in construction industry.

Singapore

FOR the first time, 3D-printing could be used to build landscape furniture and architectural features in a Housing and Development Board (HDB) estate, such as a bench or a pavilion, in the upcoming Tengah and Bidadari estates.

Using such technology would not only allow for faster, cheaper and less labour-intensive construction, it could also increase the potential for more unconventional designs than traditional precast methods.

This is among projects that the HDB is embarking on to improve productivity amid sluggish productivity growth in the construction industry.

Ongoing testing in 3D-concrete printing is being done at the HDB Centre of Building Research in Woodlands, where a printer capable of building components up to 9 metres long by 3.5m wide by 3.8m tall is located.

Billed as the largest 3D-printer in South-east Asia, it successfully printed a room measuring 3.6m by 3m by 2.75m in 13 hours in August. The printer and the work involved in installing it cost about S\$900,000.

However, further research and fine-tuning are needed to determine whether 3D-printed high-rise flats could be a possibility in future.

For example, studies are needed to ascertain if the structural integrity of 3D-printed components remains intact over a long period and in Singapore's climate.

Heru Soedarsono, deputy director of Building Design & Precast System at HDB, said: "The use of 3D-concrete printing has opened up new and exciting possibilities for the future of construction. Architect and designers would have more free play in their designs, greater flexibility, and since the printing process is highly automated, that reduces the dependency on manual labour."

He added that 3D-printing is still relatively new, and HDB will continue to work with industry experts to explore its potential.

The whole process of building the 3D-printed room, including the manual insertion of steel reinforcement bars into the structure and fitting in windows and a door, took about six days.

In comparison, it would take more than two months to build a similar room using the conventional method of precast production. Just fabricating the precast mould alone takes up to two months, said HDB, and this does not include the time taken to design it.

It is costly to fabricate new moulds, which have to be done as each mould set will lose its form over time. With 3D-printing, such moulds will no longer be needed.



An artist's impression of part of Tengah estate. At the HDB Centre of Building Research in Woodlands, a special 3D-printer successfully printed a room measuring 3.6m by 3m by 2.75m in 13 hours in August. The printer and the work involved in installing it cost about S\$900,000. BT FILE PHOTO

HDB said that for a start, it will trial the use of 3D-concrete printing for smaller components used in precinct designs such as landscape furniture and architectural features in common areas at selected projects in Tengah and Bidadari.

These include items such as customised sun and rain screens, and 3D-artwork panels. Theme precinct furniture and curvilinear precinct pavilions are among other possibilities.

The Bidadari estate is scheduled to be completed by 2022, while the first of five housing districts to be developed in Tengah is slated for completion by 2023.

Minister for National Development Lawrence Wong said last week at the HDB Awards 2019 that it is currently more expensive to use the 3D-printer.

"But if over time, if the cost can come down, this will be a possible game changer in construction productivity in the coming years."

He said that HDB achieved 17.8 per cent improvement in productivity in 2018 compared to 2010 levels. This is on track to achieve 25 per cent productivity improvement by 2020 – a target that HDB set for itself.

HDB now takes 174 man days to build a 90 sq m space – the equivalent of a four-room flat, compared to 205 man days in 2010, said Mr Wong.

But it is still pushing boundaries with new technologies, for example, by collaborating with local prefabrication company Robin Village Development, Dutch engineering firm Witteveen+Bos and the Nanyang Technological University to explore 3D-concrete printing's potential. This tie-up was announced in July 2018.

Besides 3D-printing, HDB is also exploring the use of video analytics and artificial intelligence (AI) to improve safety at construction sites, by automatically detecting high-risk situations and sending alerts to the person in charge.

There are two scenarios currently being tested – when workers are within 1m of a non-barricaded building edge with a fall height of more than 2m, and when they are directly under the fall path of heavy loads lifted by tower cranes.

When such situations arise and are caught by closed-circuit television (CCTV) cameras at work sites, alerts will be sent to the safety supervisor's mobile phone via the Telegram app, allowing him to take action if there are lapses.

Such a surveillance system, to complement manual inspections, would enable round-the-clock supervision, and reduce human errors that occur due to fatigue, said HDB.

The project is in collaboration with the National University of Singapore's School of Design and Environment, with support from AI Singapore.

Ng Peck Nah, deputy director of Building Construction Management, said that the project could lead to higher construction productivity with fewer delays due to safety-related incidents.

She added that HDB will trial the system later in September in one of its Build-To-Order projects, Clementi Peaks. The trial is expected to end in the last quarter of 2020.

HDB said if successful, HDB could potentially scale up the tool to cover other areas to enhance worksite safety, such as workers standing on vehicular pathways, and entering confined spaces without permission.

HDB is also looking into using drones with its partner H3Zoom.ai for the inspection of building facades, to improve worker safety and reduce dependence on manual labour. Currently, workers are deployed on suspended gondolas to perform this task.

The inspection of one block may take up to several days when done manually. In a pilot trial conducted at Yuhua and Sembawang from July to

October 2018, the inspections took between a half day and full day to complete.

Residents were notified in advance during the trials and the area below the flight path was cordoned off for safety during the inspection. The drone inspection system taps on a cloud software platform to conduct a visual scan of building facades captured during inspection.

Using AI, the system is able to process thousands of photos to identify building defects and categorise them. The platform then delivers a report to highlight the severity of the defects and recommend possible remedies.

While town councils are responsible for the maintenance of building facades of HDB blocks, HDB complements these efforts, auditing about 1,000 buildings per year.

The necessary rectification work can be shared with the town council to help them in their building maintenance works.

HDB said it will continue to refine the system to overcome limitations, such as when inspection involves entering building recesses and air-wells which could interfere with GPS signals. The presence of tree foliage could also hamper the clarity of images captured on lower floors.