Residential halls at North Hill	
Size	▪ Six blocks
Floors	▪ 13 storey public high rise buildings which includes three storeys of common facilities *(ie common study areas, sky lounges, gym)*
Expected completion date	▪ First quarter 2016
Capacity and features	▪ Over 1,850 students ▪ Common study areas and lounges ▪ Sky lounges ▪ Approx 580 sq m gymnasium *(largest gym in NTU's campus)* ▪ One multi-purpose hall ▪ Reading rooms ▪ Music/dance rooms ▪ Rooftop barbecue terraces ▪ F&B and shops
Eco features	▪ Around 480 solar-powered energy systems, which will power lighting for common areas and hot water dispensers. ▪ Motion sensor LED system ▪ Dual refuse system *(for recycling)* ▪ "Low-E" glazed windows – special coating that reflects heat and UV rays ▪ Specially designed louvres for enhanced ventilation ▪ "Green cement" *(reused industrial by-products such as ash, silica and slag)* used for foundation.
Construction method	▪ "Lego-style" prefabricated pre-finished volumetric construction *(PPVC)*

AN OFF-SITE REVOLUTION

MORE SMEs IN THE CONSTRUCTION SECTOR ARE ADOPTING NEW TECHNOLOGIES TO SAVE COSTS AND BOOST PRODUCTIVITY

AT A FACILITY in Malaysia, a room is being fitted with air-conditioning and lighting fixtures. Once done, the unit meant to house students from Nanyang Technological University (NTU) will be almost ready to be inhabited; except for the fact that it has to be transported wholesale to its eventual location at the university grounds in Singapore and hoisted into place.

NTU's new residential halls at North Hill will be Singapore's first high-rise buildings using a unique construction method that allows individual rooms to be stacked on top of each other. Whole rooms complete with internal finishes, fixtures and fittings are built from scratch in a factory, before being transported to a construction site for installation just like a Lego block.

Known as Prefabricated Pre-Finished Volumetric Construction (PPVC), this method saves up to 25-40 per cent in manpower and 15-20 per cent in construction time. It also reduces noise and dust pollution on-site as more activities are done off-site.

Comprising six 13-storey blocks, the new residential complex will be a one-stop integrated hub with eateries, shops and common spaces such as lounges and study rooms, all located within the first three floors. The North Hill halls will accommodate over 1,850 students, who will get to enjoy a host of facilities, including the university's largest fully-equipped gym which is about five times the size of a four-room HDB unit.

Ready in 2016, the project has already clinched the Green Mark Platinum – the highest award for sustainable building design in Singapore awarded by the Building Construction Authority (BCA).

NTU awarded the North Hill project to Singapore Piling & Civil Engineering. Construction started in July 2014. The project is set to be the first in Singapore to be completed using PPVC.

DRIVING PRODUCTIVITY GAINS

PPVC is just one of several emerging technologies that is changing the face of the built environment sector, and helping to boost the productivity of industry players.

BCA is pushing for greater adoption of such technologies as it seeks to wean the industry off its reliance on foreign workers. The Second Construction Productivity Roadmap that was unveiled earlier this year aims to drive the sector towards meeting the national productivity target of an average 2-3 per cent improvement annually from 2011 to 2020.

A big part of that push involves promoting labour-efficient construction methods such as PPVC, where as much work as possible is done off-site. PPVC can be used for a variety of developments, including residential, mixed-use and hotels, and contractors and service providers here are already starting to employ this exciting technology.

One SME that has adopted PPVC is mechanical and electrical (M&E) engineering services company Sing Moh Electrical Engineering. The firm is responsible for installing all the fittings in the units of the North Hill project at the off-site location.

Apart from the cost and productivity benefits, being able to do its work at the ground level also increases worker safety, says Sing Moh director Kenneth Teo. "If we didn't use PPVC, we might have to work as high as 12 or 13 floors up, where there is the risk of working at height. Now, the risk is reduced and there is no value you can put on that – it is priceless," he says.

The North Hill project is Sing Moh's first experience with PPVC, and required some changes in thinking initially. "Being something new, there was a learning curve for us. It required everyone to change their mindset. But once we overcame that, we recognised the benefits of working this way," remarks Mr Teo.

Sing Moh had earlier adopted other construction technologies such as Building Information Modelling (BIM), which can be used to model everything from graphics, drawings and reports to design analysis, schedules and facilities management. This helps to surface problems before actual work begins and allows building teams to make better-informed decisions as well as foster greater collaboration among team members.

Says Mr Teo: "Before it happens on-site, we can already visualise problems using the software and coordinate with other teams on how to correct it."

CHAMPIONING SUSTAINABLE CONSTRUCTION

NTU's North Hill residential complex will also leverage technology to build in sustainable features that take advantage of its natural surroundings. Using computer modelling of the sun and wind patterns on-site, the buildings' designers aim to harness natural winds so that students will enjoy good ventilation with average wind speeds of about 0.5 metre per second.

Meanwhile, to reduce the need for air-conditioning, all rooms in the residential halls will have windows that reflect heat using a special coating, and louvres that shield any direct sunlight.

All these sustainable features are in line with NTU's emphasis on sustainability and its ambition to achieve a 35 per cent reduction in energy, water and waste by 2020 under its EcoCampus initiative. ■

GAME CHANGING TECHNOLOGY

IN Prefabricated Pre-finished Volumetric Construction (PPVC), entire flats or modules complete with internal finishes, fixtures and fittings are manufactured in factories, and then transported to site for installation in a Lego-like manner. PPVC can be considered for residential and mixed developments, institutional and other projects as well as other accommodation type of developments such as hotels, hostels and nursing homes.

BENEFITS OF PPVC:

- PPVC can significantly speed up construction. It can potentially achieve productivity improvement of up to 50 per cent in terms of manpower and time savings, depending on the complexity of the projects.
- Minimised dust and noise pollution as more activities are done off-site.
- Improved site safety with bulk of the installation activities and manpower moved off-site to a factory controlled environment.

PPVC IN SINGAPORE

Other PPVC projects in Singapore include OUE's extension of the Crowne Plaza Hotel at Changi Airport, which was awarded to Dragages Singapore in June 2014.

Dragages is working with Unitised Building, which is prefabricating the modules for the Crowne Plaza extension at its Shanghai factory before being shipped to Singapore for installation.

Meanwhile, City Development Limited (CDL) is the first developer in Asia to use PPVC to develop a large-scale residential development – an executive condominium (EC) at Canberra Drive.

The EC comprises eight 10 to 12-storey blocks with 638 units constructed using some 5,000 building modules. This is likely the largest application of PPVC in a large-scale residential project in the world.

Since November 2014, selected projects under Government Land Sales (GLS) programme are required to adopt high-impact productive technologies. Three GLS sites at Yishun, Jurong West and West Coast Vale will use PPVC technology.