Modular building – a model method

The Build series on types of prefab continues, this time focusing on modular construction. On some projects, this method can reduce build time by up to 50%.

REDUCED LAND availability and complex accessibility to infill urban sites are key challenges facing New Zealand’s building and construction industry. Modular construction offers a way to address these challenges while also delivering an end product 30–50% faster than traditional building methods.

Beginnings in the 1980s
New Zealand’s history of modular construction stretches back to the early 1980s with the development of bathroom modules.

Recently, it has gained increased attention with projects such as the addition of bedroom modules to state houses.

Two types of 3D modules
Prefabricated modular construction refers to a three-dimensional (3D) unit that is built off site and can be combined with other modules or systems to create a complete building. It should not be confused with systems offering repetitive and standardised sizing.

3D modular construction types are:
- structural, which relates to rooms or large parts of the building
- non-structural, typically referred to as cores or pods, which are used inside conventional buildings to contain utilities.

Examples of both types can be seen throughout New Zealand in multi-unit dwellings such as student accommodation, residential housing, hospitals, school classrooms and hotel projects.

Early, integrated planning needed
The decision to build using 3D modular prefab needs to be made early in a project, as it is critical to align and integrate key elements of the design, build and installation.
Typically, half to three-quarters of a module is constructed in factory-controlled conditions, including the installation of utilities, fixtures and fittings. The factory-controlled conditions allow for more effective setting of adhesives and finishes, as well as for utility testing prior to assembly on site. The end use of the module also dictates what type of fire strategy is employed and the acoustic and thermal insulation elements necessary to meet the design and New Zealand Building Code performance.

**Benefits of factory assembly**

The factory-controlled conditions also enable the use of computer numerically controlled (CNC) machinery to provide precision cutting and more accurate and consistent tolerance levels during manufacture, helping to minimise material waste. The modules are built in an assembly line process that enables greater trade specialisation, ensures a higher level of quality assurance and requires less on-site labour.

When large numbers of similar modules are needed, a prototype module may be produced to enable changes to be made before full production.

Once the module is completed, it can be transported to the site or, as with the 468 modules for The University of Auckland student accommodation project, modules can be shrink-wrapped to protect the building envelope and stored ready for transporting.

**Work on site**

The siteworks and foundations begin in parallel with the production of modules, saving considerable overall project time. The nature of the module - whether it is structural or non-structural - determines how foundations are prepared.

For example, where a utility pod is installed as part of a traditional structure, the foundation may need to be lower than the rest of the structure to accommodate the pod and avoid the need for a step. Where the building may be temporary, such as a school classroom, the foundation design should enable future relocation to be easily achieved.

**Urban sites and accessibility**

The challenges of urban development may mean that time and noise restrictions dictate the hours of work on site.

When much of the construction occurs off site, there is less labour on site, commercial deliveries are kept to a minimum and work can continue outside traditional hours to ensure deadlines are met.

Site accessibility is also a key consideration for modular prefab use. Site access was difficult for The University of Auckland student accommodation project, which was located along the ridge to the Grafton Bridge. The installation of furnished accommodation modules was carefully managed to ensure minimal disruption in this high-density area of Auckland.

**Just-in-time delivery**

The modules or pods are typically transported to the site by truck with the modules craned into place. Just-in-time management is key to ensuring modules are delivered as they are needed and do not require storage on site.

**Installation and safety**

Using this type of installation can improve the overall health and safety environment of the construction site.

However, managing the large loads of modules on site has its own health and safety considerations.
Typically, modules are installed by crane and bolted into place. Where modules join existing structures, processes are needed to ensure minimal impact to the building envelope of the existing structure and a seamless finish.

With the modules in place, the final exterior and roofing cladding is installed to design specifications.

**Forward thinking**

Modular construction offers economies of scale by repeating spaces. This does not mean deliberate standardisation, but consideration of how the spaces within the building are designed and what the end use will be.

To achieve this, the modular team must be involved right at the front end of the design and development phase.