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# Plus side of prefab panels

The *Build* series on prefab continues, focusing this time on panel or two-dimensional systems. Both cost and time-effective, prefab panels can also have excellent thermal characteristics.

CLT panels go in on a residential construction on Waiheke Island.

PHOTO COURTESY OF XLAM

**PREFABRICATED PANEL** systems have been available in New Zealand for many years. They are produced using a variety of different materials, including compressed layers of timber to line and clad a structural frame, steel or wood insulated sandwich panels and precast concrete.

### *High insulation values*

Custom panels, the mainstay of domestic construction in places such as Sweden, are also available in New Zealand. These produce highly insulated homes, such as the near-passive house in Arrowtown designed by Kerr Ritchie Architects.

Panel systems are used in residential, commercial and industrial buildings as walls, floors and roofs and can also form part of a hybrid or mixed construction with modules. They are usually manufactured off site while on-site foundations and services are prepared, and require trained installers to manage the site-based assembly.

The benefits include:

- reduced on-site labour during installation
- reduced on-site material waste as panel systems are manufactured off site
- exact tolerances in finished product due to factory-controlled conditions
- fewer site deliveries, saving on transportation costs
- faster installation as panels are precision cut to finished design.

Panel systems can meet New Zealand building standards and Building Code compliance requirements.

### *Metal insulated panels*

A variety of rigid insulation cores are available in New Zealand, including polystyrene (EPS) or phenelic/EPS hybrid material, poly-isocyanurate (PIR) and mineral fibre. This forms a high-performance cladding system for roofs and walls with R-values of up to 10.0 available in some systems, depending on the panel thickness. The continuous nature of the core provides guaranteed thermal performance, irrespective of whether the external panel is flat or profiled.

While panels can span a considerable distance between supporting structure, most panels available are designed to be non-loadbearing. Panels are generally compatible with most other building systems (timber and steel-frame construction) and foundation materials.

Metal panels are designed with an overlapping edge that provides for a closed seal resulting in an airtight and therefore energy-efficient building envelope. The nature of the sealing and how the panels will be staged on site during installation is a key consideration.

Services, such as electrical can be installed through chases inside the core of the panel or in the cavity between the panel and the interior lining (where applicable).

The lightweight nature of the metal panels means the overall weight of a portal frame and metal panel building is significantly less than a traditional precast concrete-clad building.

While typically used in commercial construction, metal panels have also been successfully used in residential building to create affordable rapid-assembly housing. An example is the Fridge House in Nelson, designed by Irving Smith Jack Architects.

### *Timber SIPs*

A timber structural insulated panel (SIP) typically has the rigid urethane insulation core between two layers of oriented strand board (OSB). Soy-based foams can also be used in the place of urethane as a more environmentally friendly option. Timber SIPs are connected with timber tongue jointing systems and typically offer R-values between 5.5 and 6.0.

This structural composite panel provides predictable load responses and can be used for loadbearing and non-loadbearing walls, with wall surfaces exposed internally or lined with plasterboard.

All exterior walls require cavity, batten and cladding systems to be E2 compliant.

Services can be installed between the SIPs and treated timber battens and plasterboard, or a double layer of plasterboard, or chased or within surface-mounted conduit.

This type of panel system is commonly used in some parts of the world such as Scandinavia, with a typical home able to be closed in and weathertight in 2-3 days.

Northern hemisphere countries have been using timber SIPs for over 50 years, but the technology is still relatively new in New Zealand, and only a handful of houses have been built.

The New Zealand Building Code currently limits the exterior use of SIPs to 2-storey buildings. However, overseas, this type of system has been successfully used for multi-storey buildings.

### *Precast concrete panels*

Precast concrete panel systems can be manufactured in factory conditions or on site. The on-site casting option for tilt-up panels may be used on sites with difficult access. Precast panels can be made from standard concrete containing cement and heavy aggregates. However, there are lightweight options available, with Litecrete panels using a pumice aggregate.

These lightweight panels have a high weight to strength ratio, and are reinforced with polypropylene fibres and conventional reinforcing steel, offering a higher insulation value but lower thermal mass capacity than conventional concrete panels.

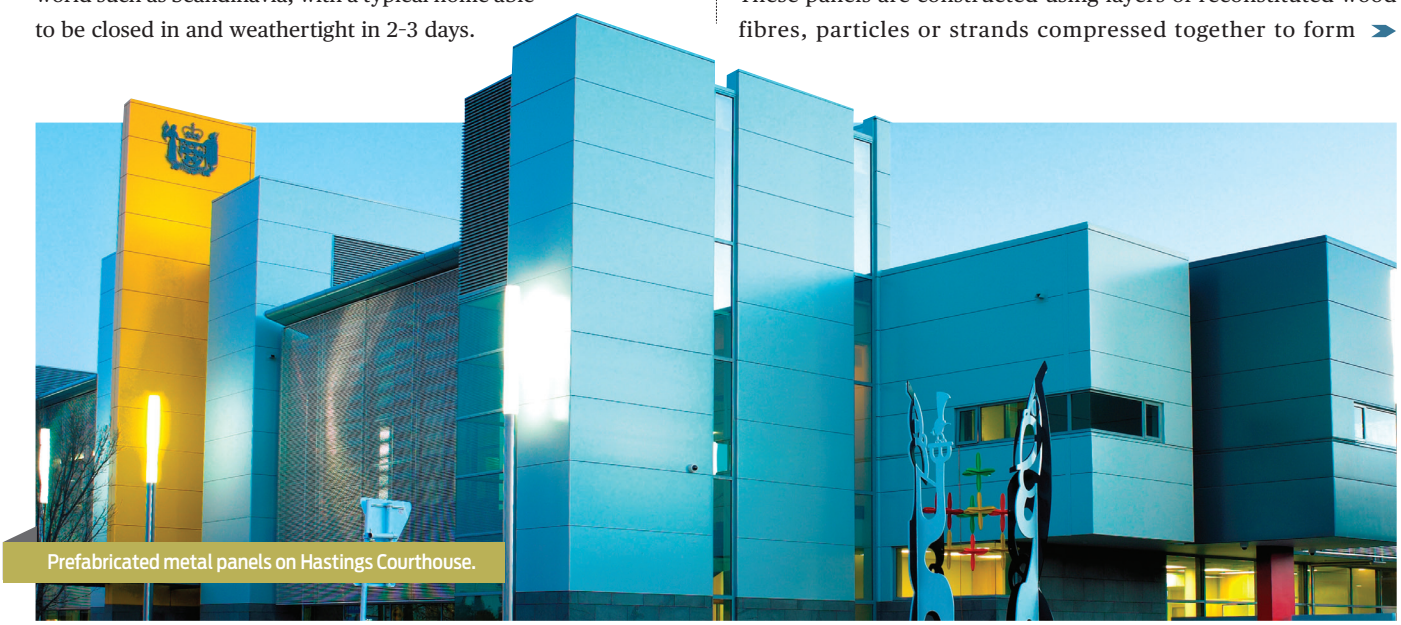
Precast panels can be finished using a range of options depending on the final construction and installation of insulation. In some cases, they can be produced in sizes up to 10 × 3.8 m, with a minimum thickness of 150 mm for exterior panels.

Installation of precast panels may differ between manufacturers. However, one system offers two installation options - Drossbach tubes or Reid inserts are cast into the panels during manufacture. Following installation on site, all exposed joint and corners on both sides.

Only 1% of precast concrete panels in New Zealand end up in residential construction. However, this is starting to change with promotion of precast systems and more repetitive design options.

### *Compressed wood panels*

These panels are constructed using layers of reconstituted wood fibres, particles or strands compressed together to form ➤



Prefabricated metal panels on Hastings Courthouse.

PHOTO COURTESY OF KINGSPAN.

structural and bracing elements. Panels that are 36 mm thick provide solid walls and can be precut to lengths of 4 m to over 7 m.

Compressed panels provide a level 5 finish to the wall surface, eliminating the need for plastering. With careful design, such as placing walls at right angles to butt joints between panels, the number of joints is reduced.

Different acoustic and fire protection solutions can be added to both internal and external walls to meet relevant Building Code requirements, depending on the building's final use.

On site, the panels are installed using specifically designed structural connectors to the ground floor. This system is constructed from the inside out, with internal walls first braced against each other, followed by external walls, ceiling diaphragm and then traditional roof structure. Foundations can be either concrete or timber framing. As with timber SIPs, all exterior walls require compliant cavity batten and cladding systems.

Because of the precise design and cutting processes, many compressed wood panel systems reduce wastage. Cut-outs from windows can be used for internal shelving and cut-outs from doors used for the door leaves in the finished building.

Solid panel construction provides a durable surface for rental or high-use situations. However, electrical services need to be chased or concealed in surface-mounted conduit and plumbing fixtures concealed by cabinetry.

### *Solid wood panels*

These panel systems are typically manufactured using *Pinus radiata* and produced in factory-controlled conditions. A number of systems are available in New Zealand (see *Build* 135, pages 76–78).

Some panel systems are manufactured with tongue and groove planks tied together with framing members and plates and lintels. The cavity between the tongue and groove allows some services to be installed.

Panels are joined using screws and other proprietary hardware that can be fixed to conventional floor foundations. Insulation and battens are fixed to the exterior, allowing a range of external cladding and roofing options to be installed.

Construction of these panels generally occurs as close to installation as possible, with any on-site storage requiring cover, ventilation and shade.

### *Cross laminated timber (CLT) panels*

CLT is a system new to New Zealand that is well suited to situations where foundations or seismic hazard dictates light building mass. Produced as roof, wall and floor panels, this type of system is manufactured up to 15.3 × 3.2 m and up to 350 mm thick (minimum 50 mm).

Because CLT panels can achieve such long spans, wider spacing of foundation supports can be utilised as well as greater floor cantilevers than a traditional joist system.

The strength of this system is in its outer core. A drained and vented cavity is usually required for external walls, with a damp-proof course where butting up to concrete. Thermal bridging is reduced by foam tape at panel joints that also ensures airtightness.

As CLT panels are not suitable for external exposure, a separate external cladding is required. The insulation properties are similar to other wood systems. However, with thickness comes better thermal insulation.

The panels can be used as internal wall surfaces or lined with plasterboard, depending on aesthetic requirements.

CLT use is increasing, with the world's tallest CLT building recently completed in Melbourne (see *Build* 135, page 40).

Installation of precast panels, Whitianga.

PHOTO COURTESY OF LITECRETE.

## Things to consider

Although there are many benefits to using panel systems, there are also several things to consider:

- Jointing and connection systems must be compatible when a panel system forms part of a hybrid or mixed construction with traditional.
- Care must be taken when transporting panels to site to avoid damage.
- Compliant design is needed to manage the flow of air and maintain weathertightness.
- Site-based tolerances must match those of the panels, for example an in situ concrete slab may need to be level or to have careful positioning of attachments to ensure accurate connections at site.
- The placement of electrical services either inside panels or as surface-mounted systems and the location of plumbing services to maximise visual aesthetics is key in the design process.