

Demystifying Prefabrication: The case for...



NZ Prefabrication: iPad (left) and K-Bach (right)

After covering prefabrication in a number of recent Pathfinder Projects, in our 27th Pathfinder, we take a departure from our usual project format to speak to PrefabNZ CEO, Pamela Bell, about the case for prefabrication and its use on New Zealand construction projects.

Background

There are many terms used to describe prefab. It is short for prefabrication and refers to any part of a building that is made away from the final building site, which is why it is also referred to as off-site construction.

It refers to structures built at a different location than the location of use. Off-site construction occurs in a manufacturing plant specifically designed for this type of process. Individual components, panels, modules or the complete building are constructed in the factory then transported to the site. Once on site, the building will be installed onto a permanent foundation by fastening it to the ground and to other modules and covering and sealing the seams. These buildings meet all applicable building codes and are indistinguishable from traditional site-built construction.

Prefab can also be used as a complimentary system to traditional construction. Prefab comes in all shapes and sizes, from small components such as pre-nailed wall frames, to panels (2D), larger modules (3D volumes) or even complete buildings. Hybrid prefab is a mixture of several prefab systems, or prefab with traditional construction. Prefab can be made of timber, concrete metals or plastics or any combination. It can also be used for a variety of purposes including residential, educational, health care and commercial applications. Buildings can range from a few modular

units to several hundred. They can be arranged in architecturally pleasing configurations and can be many stories in height.

Prefabrication has an important role in driving **innovation, research and marketing** for the wider design and construction industry. Background information from the PrefabNZ.com website and the research by Pamela Bell for her Master of Architecture thesis, “Kiwi Prefab: prefabricated housing in New Zealand” has contributed to the content of this article.

Why focus on prefab now?

You will have all heard about sustainability and the variety of targets being set by Government for new and existing buildings to meet. Now productivity is the new key joint Government and construction industry initiative. Prefabrication has a key role to play in improving industry efficiency, effectiveness and productivity in the design and construction process.

PrefabNZ is building on an innovative and rich history of prefabrication in NZ – from large-scale government investment in infrastructure projects (such as hydro-electric scheme housing) to some of the first one-piece fibreglass bathrooms (from Industrialised Building Systems in the 1970s). Today we are riding the wave of renewed interest in prefabrication through the



Prefab in-use: Pathfinder 19 Hopwood Clock Tower Restoration

sustainability agenda and 'off-site' movement around the world. NZ is home to a new generation of prefabs such as bachkit, port-a-bach, HABODE, ipad and k-bach, with many more in the wings.

There is no doubt that a lot is happening in the prefab world, but often it is happening in isolation. There is a clear need to coordinate, inform and in many cases, re-educate. The timing is right to create collaborations and market the benefits to the world.

Benefits

Until recently off-site fabrication, particularly in housing, has, rightly or wrongly, been associated with poor quality, a reduction in flexibility and choice, and with higher costs. Market resistance prevented significant uptake of such technology, despite examples here and from abroad illustrating its technical feasibility and benefits. But what are the society and sustainability impacts of prefab construction methods? Some of the benefits are covered below:

Reduced local impacts

A key feature of prefabrication is that much of the process is removed from the site to controlled factory conditions. This reduces the amount of time spent on site, which leads to reduced impacts on the locality. Experience shows that prefab hotel rooms can be assembled on site and completed ready to use in less than half the time of a traditionally built hotel of a similar size.

This means that the locality around the site is disrupted for a shorter period reducing noise, pollution emissions and local traffic disruption. Furthermore, the lightweight nature of the construction offers potential for smaller foundations and therefore less ground works, also reducing local disruption from moving spoil away from the site, and bringing concrete in to use in the foundations. Conversely, the large deliveries of volumetric or panel units to site can be disruptive to the area and needs careful logistics management to avoid problems. From a financial point of view the shorter construction period allows a quicker return on investment for the client, and reduced overheads.

Better quality and reduced defects

A construction site exposed to the climate does not offer particularly good conditions for high quality workmanship. Rain, wind, snow, mud and cold are not helpful to achieving quality construction, nor are they attractive working conditions for both the existing, and potential new, workforce. In other industries, such as car manufacture or electronics, we expect zero faults when we purchase their goods, yet in construction, defects in the buildings we produce are common at handover, and often take a long time and are costly to rectify.

Factory based activities allow better and safer working conditions and being protected from the climate, are more likely to lead to better quality. It is also easier in a factory to set up quality control procedures, with testing, prototyping and checking. For example, volumetric units can have electrical and water installations fully tested prior to leaving the factory. General feedback suggests that far less call backs are necessary to make good defects after completion of buildings using prefabrication. This is a significant cost and efficiency benefit to the builder and leads to satisfied customers. It also improves efficiency in the use of resources and reduces waste. Manufacture in a factory provides much better working conditions than a building site.

Collin Clench, Performance Assurance Manager at Hutt City Council advises 'This type of construction method allows for greater quality control, as faults can be identified early and easily managed and addressed placing more professionalism back into the industry'.



Prefab in-use: Pathfinder 15 Manukau Harbour Crossing Alliance

Less waste in manufacture

Waste from construction is one of the principle waste streams to landfill sites. Manufacture in a factory allows far better management of the waste stream. Materials can be used more efficiently, exact amounts of materials can be ordered and materials can be more carefully stored.

In addition, any waste that occurs in a factory can be more easily collected and reused or recycled. Many prefab manufacturers have recycling facilities installed so that waste is sent back to their source for recycling. This reduces the costs of disposal of waste. There is further potential for reducing waste when using prefab systems if the designer is prepared to co-ordinate sizes so that materials are used in their standard sizes without generating many off-cuts.

Assembly of prefabricated components on site should generate little waste at site as the components come to site pre-engineered to assemble together.

More about PrefabNZ

PrefabNZ is the hub for pre-built construction in New Zealand. It is passionate about how prefabrication can offer innovative high-quality buildings on time and within budget. There is a clear need for a radical paradigm shift to improve building quality in a sustainable way by decreasing defects, while also decreasing costs and timeframes. An increased uptake of prefabrication is for the good of New Zealand's wider design and construction industry.

PrefabNZ is a self-sustaining non-profit incorporated society representing the interests of a wide range of materials and stakeholders in the design and construction sector: from clients through to designers, specifiers, manufacturers, contractors and Government.

Visit www.prefabnz.com for more information about membership, events and email newsletters.

Enhanced Health & Safety

Construction work on site can be a dangerous activity and leads to significant numbers of casualties and even fatalities. More demanding health and safety requirements are pushing many builders to consider other ways of building including off-site manufacturing techniques. This allows much of the process to be carried out in more controlled and comfortable factory conditions where safety requirements can be more easily met and policed, and healthy and comfortable working conditions are more readily maintained. The use of scaffolding on site is a particular concern, and some off-site manufactured schemes have tried to eliminate the need for scaffolding completely by integrating claddings in the factory. Conversely, the use of heavy lifting equipment to locate the prefabricated components on site requires careful management.

Improved environmental performance of the final product

Thermal and acoustic performance is very dependent on the quality of workmanship and supervision. The correct installation of the elements of the fabric, in particular insulation materials and air tightness are important to the performance of the building in use. Factory manufacture allows operatives to be better trained and supervised in these tasks, and allows regular checking and testing of performance. Problems such as omitted insulation and badly fitted air barriers are less likely to occur. Reports from North America suggest that direct comparisons show higher thermal performance in homes that use off-site manufacturing techniques.

Social benefits from improved working conditions

Employment at a factory manufacturing prefabricated building component is generally more stable and long term than site based employment, which is intrinsically transient. As a result, factory based employers are often willing to invest in training for their workforce. Furthermore, to function efficiently off-site fabrication requires high levels of skill and flexibility in the workforce. This necessitates greater training by employers.

Building sites are temporary employment locations, so they generally offer little long term amenities for the local community. Manufacturers in factories are often closely linked with the local community, with much of the workforce coming from the locality. They provide a long term economic and often social service for the community. Many prefab manufacturers are well established in particular locations and have developed a highly trained local workforce, and stronger links with the local community.

Greater efficiency in the use of resources, both materials and labour

Building sites are notoriously inefficient in the use of labour and materials. Studies in the UK have shown that use of site labour is considerably less efficient compared to factory based activities. In some cases the useful activity on site can be 50% below full potential – a considerable amount of material delivered to site goes straight to waste.



Prefab in-use: Pathfinder 26 Middlemore Hospital



Prefab in-use: Pathfinder 20 Albany Senior High School

In addition, volumetric construction using prefabricated modules allows buildings to be potentially dismantled and the modules reused at a different location. This was the case in the thought process behind the design and construction of a previous Pathfinder Project at Middlemore Hospital.

Improved logistics and reduced vehicle emissions to site

Transport is a complex issue and monitoring of transport patterns relating to construction sites is difficult. In general, prefabrication leads to a reduction in the numbers of deliveries to site compared to traditional construction methods, particularly of the large number of small deliveries that occur at many sites. Some recent monitoring of a modular site suggests that deliveries were reduced by up to 90% compared to a similar traditional building nearby. However, these are generally large vehicle deliveries often coming considerable distances from the factory. In addition, the nature of the work means that less labour is required on site and for a shorter period. Thus, in general it is likely that a well-managed site using prefabrication can significantly reduce the amount of traffic generated.



Conclusion

Prefab, or prefabrication, offers an opportunity to improve both efficiency and sustainability. However, many of the benefits outlined above are not yet being fully realised, and the industry has much to learn to fulfil the potential of this technology. Issues still remain over scalability of use in NZ, the stigma of 1950s prefab and opportunities to customise, however, previous Pathfinder Projects have showcased the benefits of off-site manufacture and the importance of early contractor involvement in the design and construction process for clients to benefit from this form of delivery. There is much work still to do, as too often utilising prefabrication is still perceived as an innovation on a project rather than industry best practice.



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Pathfinder Projects visit
www.constructing.co.nz