

Alternatives to Timber Framed Construction

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Introduction

When you think house construction in New Zealand, you think timber framed construction. Since the days of early European settlement in New Zealand, house construction has been predominantly of timber framed construction, timber being one of New Zealand's largest primary resources.

This is still the case today.

The question we must ask ourselves is...."Will this be the case in the future?"

The issues are.....

- What drives the choice of building material in New Zealand
- What other forms of construction are there competing with timber framed construction.
- What is their market share now and what might it be in the future.
- What are the likely trends?
- Potential future directions for timber construction in New Zealand.

What drives the choice of building material?

It comes down to.....

- Historical systems
- Performance
- Cost
- Ease of design

Depending on whom has the power to make the decision, the end user, specifier or builder, one or the other or a combination of all four will govern the choice of the building material used.

Historical systems

Domestic construction has historically been of timber framed construction. This gives timber an enormous advantage over other construction materials in this market, as often the thought of making a choice in building material is not even considered....timber is the natural choice.

However the situation is quite different in other markets such as multi unit residential, commercial and industrial, whereby the choice of material is influenced by these and other factors.

Performance

Performance is playing a more significant role in the decision process in determining the material to use in construction. End user expectations are increasing where material stability and surface finish are of high priority, especially in higher priced markets.

Cost

Cost is often a key factor in the choice of a building material. Timber at present generally has a distinct advantage in this area, with the exception of commercial interior partitions where light steel framing wins every time.

Ease of Design

The availability of design tools, software, charts and manuals has an influence on the choice of material used in design, if the end user is leaving this decision entirely up to their design professional. The faster a design can be carried out, the greater the profit margin in the fees. This is becoming more important as competition for work increases amongst designers.

Having available such basic design-information such as reliable characteristic stresses to carry out design work. Materials, other than timber, have reliable design properties available to the designer, whereas timber does not. This lack of published reliable data at the fingertips of designers tends to steer them towards other materials.

Alternatives to timber framed construction, in the domestic market, do not have a significant history in New Zealand, but as performance issues become increasingly important, over time this may change.

Alternatives to timber framed construction are playing the superior performance card, and rightly so in many cases.

Timber framed construction in general is having to face up to some performance issues in order to stave off the competition.

The main performance issue associated with timber is the *dimensional stability*, which if it is lacking will result in cracking of gib board surfaces, visible bowing, ill fitting joinery and cabinets, all of which result in a high dissatisfaction factor for the end user.

The timber industry has moved to kiln dried timber framing in an attempt to solve these problems, and with significant success.

The other factor influencing quality is the skill level required to construct quality timber buildings. There was a time until very recently where the carpentry apprenticeship schemes were virtually non-existent, resulting in a gap in the work force of qualified experienced carpenters. This still exists today, with the majority of qualified experienced carpenters either reaching retirement age, or they have moved into management positions.

Alternatives to timber framed construction do not necessarily need to compete directly on cost alone, when performance may be the driving factor in the choice of material. Some alternative forms of construction will compete on both cost and performance in certain applications, most notably the light steel framing for commercial interior partitions.

Alternatives to timber framed construction are providing comprehensive design manuals, design software and even design services as they recognise the role of the designer in choosing their material or system.

Alternatives to timber framed construction are providing comprehensive construction systems, not just materials.

The provision of a comprehensive construction system which meets all the requirements of the Building Code takes away some of the design effort and risk, from the designers and removes the need to 'reinvent the wheel'.

We can see this process in action in the Firth masonry villa construction system and the light steel frame construction system, being the two higher profile examples.

Timber in effect has been doing this for some time by means of NZS3604.

Winstones Gib board 'living solutions' systems are also providing systems, and we are beginning to see emerge floor construction systems using engineered wood products in the form of I beams and plywood from the two main players Carter Holt Harvey and Fletcher Challenge Forests.

What are the alternatives to timber framed CONSTRUCTION?

- **Light gauge steel frame.**
Light gauge galvanised steel C sections, riveted or screw fixed together forming frames which support gravity and face loads in a way similar to timber framed construction. It is effectively a substitution of timber studs and plates with light gauge steel C-sections. Bracing is provided by gib board linings, much the same way as for timber framing, however diagonal members can be utilised for bracing. The gravity load capacity is generally limited to three stories due to the limit on the strength of the stud to bottom plate connection
- **Concrete filled Polystyrene blocks**
These are commonly referred to as ICF's (Insulated Concrete Forms). The hollow polystyrene blocks are glued together to create a form for a reinforced concrete core. The ICF are not structural but provide thermal insulation. The finish applied to the surface is a reinforced plaster. Earlier versions of ICF's had an internal metal tie, which tied each side of the form together to prevent bulging under the hydrostatic pressure of the wet concrete. This created a thermal bridge reducing the insulating efficiency of the system. Later versions of these ICF's are using a plastic internal tie, which has removed this problem and provides a true thermal insulation barrier in the polystyrene form.
- **Reinforced concrete filled Masonry blocks**
Low density masonry block forms for a reinforced concrete core. The masonry forms are an integral part of the structural system and do contribute to the strength of the wall. These systems can be finished in a variety of ways, from no finish, paint finishes or solid plaster finishes.
- **Twin skin reinforced concrete filled clay masonry brick construction**
Traditionally a European form of construction, not commonly seen in New Zealand, whereby a twin skin of clay bricks create the formwork for a reinforced concrete core.
- **Light weight concrete panel and block "Hebel" system**
The Hebel system is construction in aerated autoclave lightweight concrete in the form of panels or blocks. The panels can be reinforced or unreinforced. The blocks are generally unreinforced. The blocks are glued together to form a monolithic wall which can have plastered or paint finishes. The panel systems can be used as a structural panel or just as a cladding system over conventional framing systems.
The lightweight concrete with its encapsulated air bubbles provides good acoustic and thermal insulation properties.
- **Lockwood and others solid timber panel systems**
There are a few solid timber 'panel' systems on the market, Lockwood being the best known. Most of these systems use a solid timber horizontal plank with some form of interlocking joint component. Thermal insulation is best provided via a secondary external cladding system.

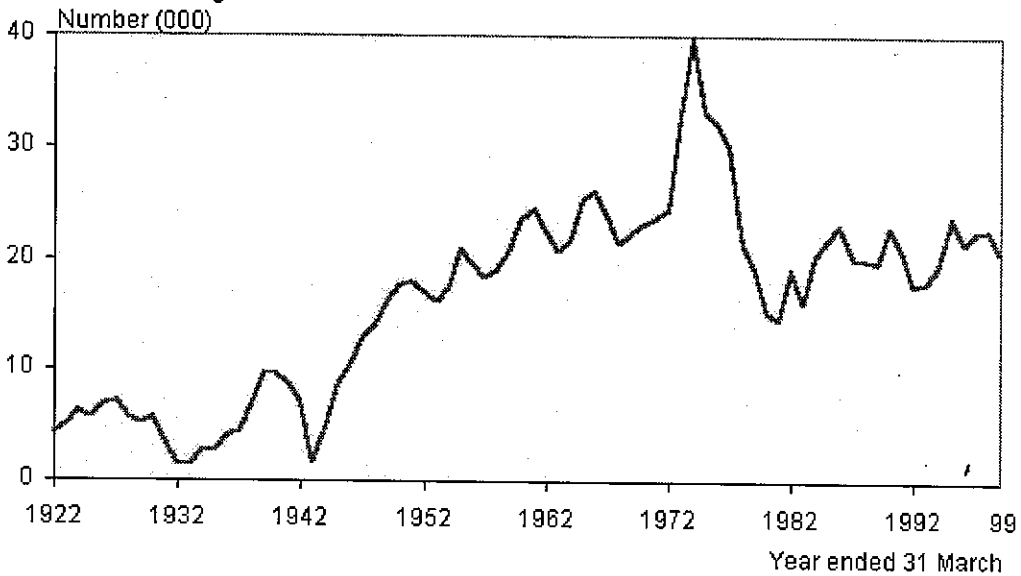
- **Triboard**
Triboard is a timber-based product consisting of an internal layer of strand board (similar to particleboard) sandwiched between two thinner layers of medium density fibreboard (MDF), to create a panel. Construction using Triboard uses these panels for both load bearing walls and shear walls or braced walls combined. Triboard has excellent bracing properties and is very resilient to impact damage hence its use often in tough environments.
- **Tilt slab or precast reinforced concrete panels.**
Not commonly used in general domestic construction, but is being used increasingly at the upper end of the domestic market. Tilt slab or precast panel construction is used extensively in the multi residential and industrial market.

What is the market share now and what might it be in the future?

The graph below (1) shows the number of Building Consents issued for new dwellings between 1922 up until 1999. This includes domestic houses and motels etc. Domestic house construction takes up most of these figures.

New dwellings, 1922-99

Number of building consents⁽¹⁾ issued



(1) Called building consents from 1 January 1993, before that called building permits.

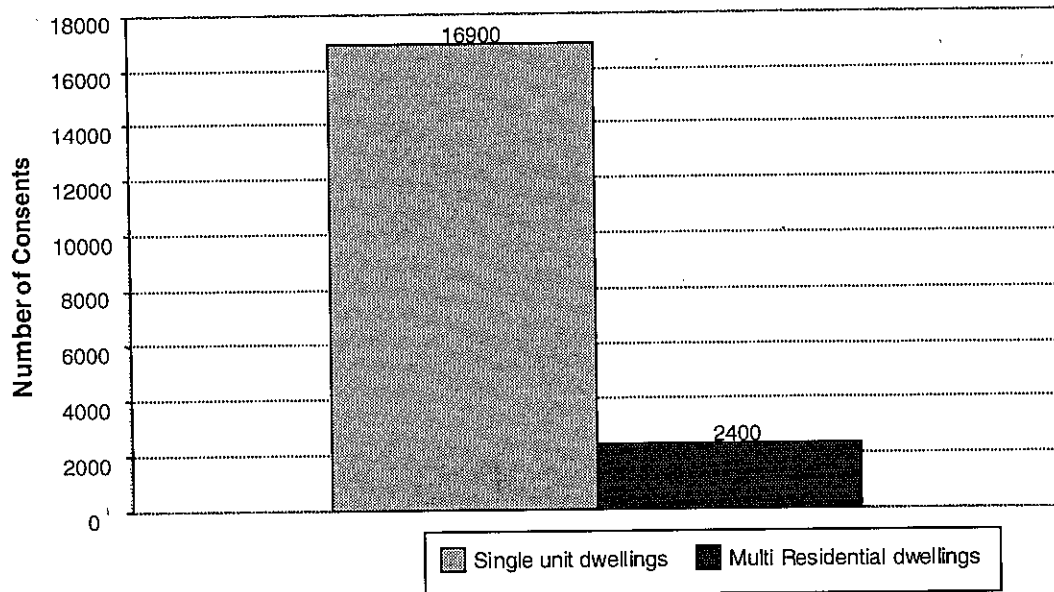
Statistics New Zealand

The figures for 2000, which are yet to be officially released will be close to the following.

Domestic dwelling Building Consents	16,900
Multi Residential Building Consents	<u>2,400</u>
	19,300 (2)

Since the mid 1980's the number of Building Consents has been hovering about the 20,000 mark.

Residential Building Consents 2000



Single unit dwellings

Of the 16,900 single unit dwellings 95% are of light timber framed construction. (3)
The remaining 5% are made up of

- 2% Masonry block construction
- 1% Light steel frame
- 0.5% ICF
- 1.5% Other (Triboard, Hebel, Tilt slab, Solid timber) (5)

Multi Residential dwellings

Of the 2,400 multi residential dwellings 50% are of light timber framed construction (5)

The other 50% are made up of masonry block, tilt slab or precast panel, light gauge steel frame, heavy steel frame and reinforced concrete frame/wall construction.

Why such a significant difference in market share between the single unit dwelling and the multi residential dwelling markets?

This comes down to the reasons for material choice outlined previously, but predominantly....

Historical systems

Traditionally the single unit dwellings have been constructed by small to medium sized construction companies with smaller gangs of experienced teams working on individual homes. These companies specialise in single unit dwelling residential homes, with a history of timber framed construction.

A recent trend in higher density living has resulted in residential apartment construction, generally in or around the city centres. The larger nature of these projects has meant that the projects are suited to the larger construction companies whom do not necessarily have the experienced staff or history in light timber framed construction, so the decision the build in timber frame is not automatic, or necessarily desired.

What are the likely trends?

To try to predict trends we must look towards countries that have a history in timber framed construction similar to New Zealand.

The United States, North America and Canada have a similar background in timber framed construction.

The US Portland Cement Association provided the following table of Market penetration data. (4)

Market Penetration Mix	1993 %	1994 %	1995 %	1996 %	1997 %	1998 %	1999 %	2000 %	2001 % *	2002 % *	2003 % *
Timber framing	96.5	95.6	93.3	92.0	90.4	89.1	86.0	81.0	75.7	70.3	65.0
Insulated Panels	0.0	0.1	0.3	0.3	0.2	0.3	1.0	2.0	3.0	4.0	5.0
Steel Stud	0.5	0.8	0.6	0.3	0.5	0.6	1.0	2.0	3.0	4.0	5.0
All concrete and masonry systems	3.0	3.5	5.9	7.5	8.9	10.0	12.0	15.0	18.3	21.7	25.0
ICF's	0.0	.01	0.2	0.4	0.7	1.0	1.3	3.0	5.2	7.3	9.5
Masonry Block	3.0	3.4	5.5	7.0	8.1	8.8	10.5	11.5	12.0	12.5	13.0
Lightweight concrete 'Hebel' system	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.5	0.7	1.0
Other	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.7	1.1	1.5

* Future projection.

As can be seen, the situation in the United States in 1994 is very similar to the New Zealand situation, present day, with timber framed construction enjoying 95% market share of single unit dwellings.

The trend in the US is clear with concrete and masonry systems taking an extra average 1.5% market share per annum up until the late 1990's at which point the increase in market share is accelerating.

The concrete industry in New Zealand is aiming to do the same thing here, so it is the timber industry from which the market share will be taken. The timber industry can ill afford this with its huge resource about to come on line.

What are the key drivers?

What causes shifts in market share?

There are external forces or customer driven changes and there are internal forces such as industry research and marketing efforts. Both of these actions are present simultaneously. Sometimes they work together in the same direction; sometimes they work against each other in opposite directions.

To achieve the fastest change, research and marketing efforts need to be aligned with customer wants and needs. This is not always possible. Sometimes research and marketing needs to be aimed at educating the customer in an effort to change their wants and needs.

Excellent examples of this can be seen in the steel industry where they have taken a significant slice of the commercial and industrial markets away from the concrete industry by using a combined industry approach in setting up HERA (Heavy Engineering Research Association). HERA is funded by a combination of an industry levy and government funding for which they must apply and compete for with other research organisations.

The concrete industry is targeting the New Zealand domestic construction market with an aggressive marketing campaign, which will succeed, unless the timber industry has a reply.

In order to succeed you need to not only protect your own patch but also to develop it by use of technology, and expand it by exploring other markets, both geographically and by looking at totally different markets to compete in.

Potential future directions for timber construction.

✓ A unified front

The timber industry consists of around 16 different organisations, which need a coordinated research and marketing approach.

✓ Protecting the 'Patch' but also expand into new markets.

With an increasing level of technology and new, engineered wood products becoming available, such markets as commercial and industrial are now feasible to enter on a large scale.

With products like LVL (laminated veneer lumber) which has a compressive strength approaching that of concrete, high rise construction is most definitely feasible if these products are used in conjunction with more conventional structural steel and reinforced concrete components. There are of course some design issues to resolve, but with research and development input from the industry, entire new markets could be opened up which could make use of some of the world wide surplus of timber.

Conclusion

Timber framed construction enjoys 95% of the single unit dwelling construction market and about 50% of the multi residential market.

Concrete and masonry systems are predicted in the US in 2001 to have reached 18.3% of the single unit dwelling market, whereas in New Zealand this share is likely to be about 2% for the same period. This trend in the United States

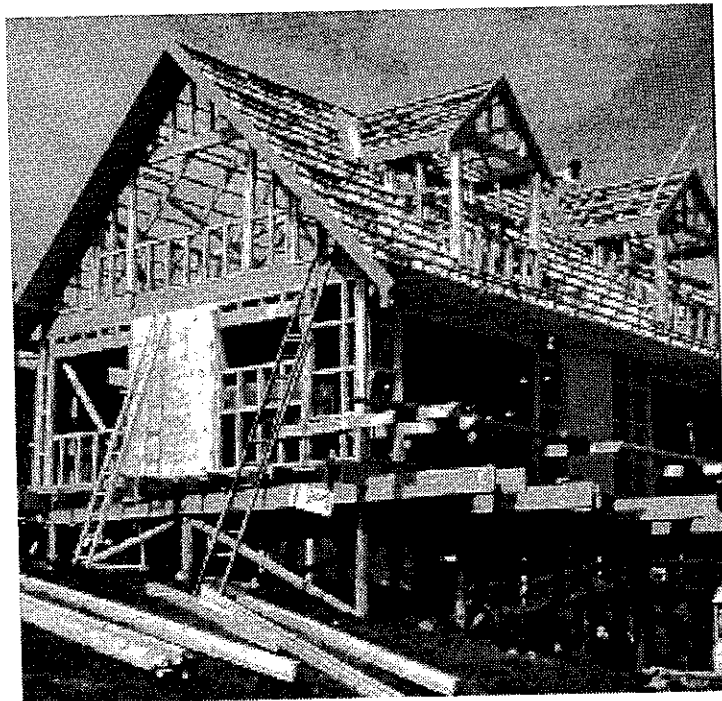
indicates that concrete and masonry systems will increase their market share in New Zealand to the detriment of timber framed construction.

The timber industry in New Zealand requires a unified research and marketing approach in order to maintain its market share and to enable expansion into different markets.

With a worldwide increasing timber resource, market expansion, not only geographic but also by market type will be essential, or the value of the resource will decline.

References

1. Statistics New Zealand Web site
2. BRANZ economist (Ian Page) telephone conversation.
3. Alternatives to light timber frame for house wall construction. *Mike Collins, Kelly McNab, Frances Maplesden, Forest Research, March 2000.*
4. United States Portland Cement Association market penetration data.
5. Various Industry sources.



A Wood framed house on a pole foundation