

# Timber framing – rapid and reliable

Quick to go up and slow to come down, timber framing enabled New Zealand to house its rapidly growing population in the early 1900s and has proved to be an enduring building system.

By Nigel Isaacs, BRANZ Principal Scientist and Teaching/Research Fellow, Victoria University of Wellington

**A**lthough the dream of many European settlers in the 1860s and 70s was a New Zealand built of masonry, the reality, except for in a few locations, was timber. Despite being vulnerable to the ravages of fire and requiring ongoing maintenance to resist decay or rot, timber offered lighter materials for transport to the construction site, ease of construction and greater flexibility. Timber was also resistant to earthquakes, as was quickly discovered in the geologically unstable new country. Brick, stone and even poorly reinforced concrete quickly succumbed to the movement of the earth; flexible timber framing survived.

## Four classes of timber framing

In timber-framed construction, the weight of the roof and the rest of the building is carried on a timber frame. *The modern carpenter and joiner and cabinet maker*, published in London in 1905, divided timber framing into four classes:

- Solid timber: the complete structural wall is made of solid timber.
- Heavy timber framing: the structural timber frame is designed to support the whole of the load.
- Light timber framing: the structure relies on the cladding and linings as well as the framing to support the load.
- Half timber work: the heavier and exposed-to-view studs bear their share, but the infill of brick also supports the load.

Although New Zealand did not widely adopt the 'log cabin', in early years, slab houses could be rapidly constructed from the then readily available large trees (see *Build* 91, December 2005/January 2006). More recently, solid timber prefabricated housing has filled a market niche (see *Build* 108, October/November 2008). Heavy timber framing requires a supply

of large dimension timbers, placing greater demand on forests and ultimately leading to deforestation if there are no new plantings.

## Rapid increase in dwellings

For most of the 19<sup>th</sup> century, New Zealand had a ready supply of timber and, with a rapidly growing population to house, the need to create a large number of buildings relatively quickly and cheaply. Technology supported this development with improved tools and readily available machine-made nails.

From the beginning, timber was the predominant method of construction, increasing from 79% of houses in 1858 to 90% in 1911. The only dip in the upward path occurred around the

1860s, when the gold rushes led to the need for even quicker construction. In 1864, 18% of the recorded dwellings were tents or dwellings with canvas roofs. Throughout the period, less than 4% of dwellings were of brick or stone. Other wall materials included iron, concrete, cob, sod, clay and raupo. This early Census data excludes dwellings occupied by Maori or Chinese.

## Light timber framing

Internationally, the pressure on resources led to more efficient ways of framing that minimised the discarding of small pieces of timber. The traditional braced framing used mortise-and-tenon joints to create a rigid structure able to withstand the loads of the roof, house

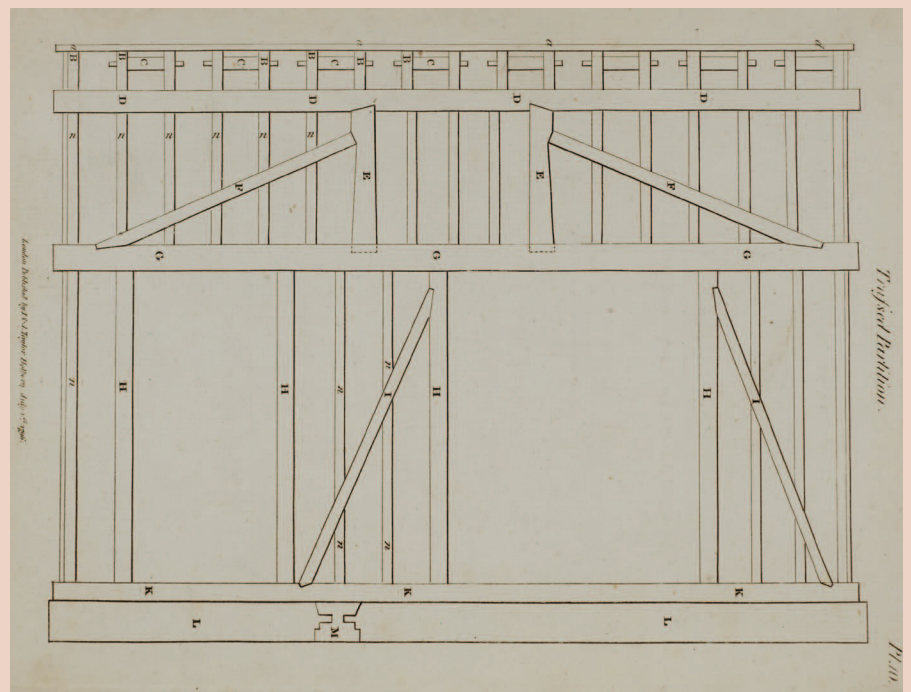


Figure 1: Trussed partition. (Source: *The carpenter and joiner's assistant*, 1797.)

contents, people, wind and accidental impact. The dangers of omnipresent New Zealand earthquakes were not of concern to the rest of the world.

Figure 1 shows a drawing for a trussed partition from the 1797 book, *The carpenter and joiner's assistant* by Peter Nicholson. At the top of the drawing, the 'end of the joists of the floor' are held in place by the 'keys put between the steady joists', while the diagonal 'braces to keep the building steady' are on both the top and bottom of the partition. Each piece of timber needs to be carefully cut into its neighbour – a skilled, complex and time-consuming job.

### Balloon framing helps cut costs

By the early to mid-1800s, industrialisation was changing timber frame construction, most notably in the USA. Timber-framed houses became cheaper due to smaller and standardised timber sizes from more efficient sawmills, simplified joints (due to the high cost

of skilled labour) and the extensive use of cut and then wire nails. Scantlings, timber less than 5 inches (125 mm) square, whether built from smaller timber pieces or a larger piece that had been cut to size, provided support for more walls than the previously used heavy timber framing.

Balloon framing (named reputedly to denigrate its lightness and presumed frailty) was an outcome. Figure 2 shows schematics of balloon framing – the studs are continuous from the bottom to the top plate. The ground floor joists are notched into the sill and nailed to the studs, while the first floor joists are supported by a plate cut into the stud and also secured with nails. Balloon framing tolerated inexperienced carpenters and could be assembled quickly.

Although it has been argued since the 1980s that balloon framing started in Chicago in about 1832, more recent research suggests it evolved in the general area of the American mid-west by the 1850s.

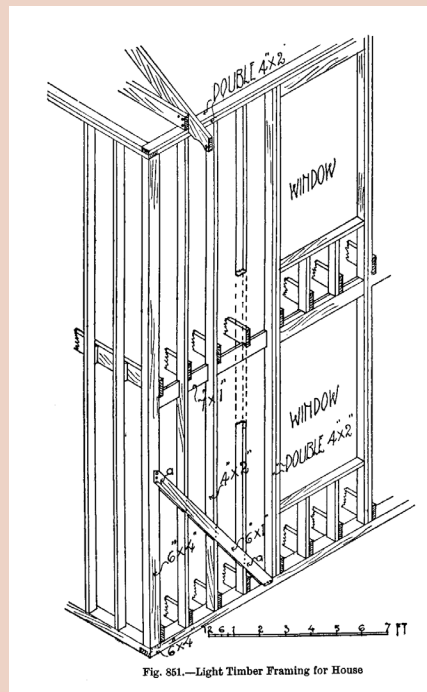


Figure 2: Balloon frame construction. (Source: *Modern carpenter & joiner*, 1905.)

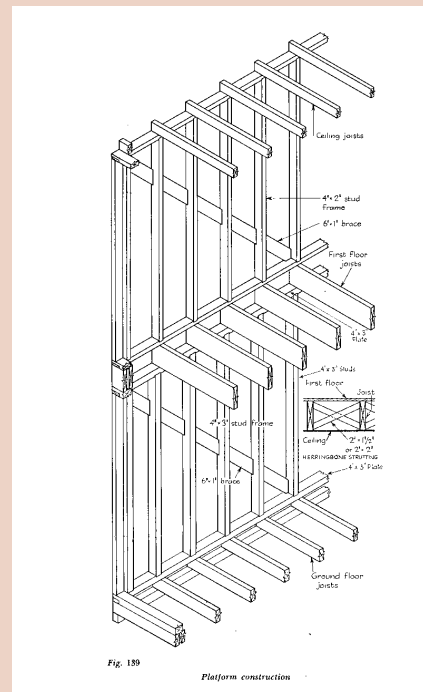


Figure 3: Platform frame construction. (Source: *Carpentry in New Zealand*, 1958.)

### Platform framing dominates

As demand grew, the availability of continuous lengths of timber able to stretch over one floor was put under pressure. The continuous timber also provided undesirable openings between the floors for the passage of vermin, draughts and fire.

The platform frame (see Figure 3) used shorter lengths of timber, with the walls for each floor being framed separately above and below the first floor joists. Features of the platform frame were being used in New Zealand from the 1890s – studs were butted and nailed instead of being mortised into the plates, and a separate bottom plate ('vermin plate') was placed on the floor joists before the wall frame was set up.

Analysis of import statistics matches this observation, showing a major change in the imports of nails about this time – increasing from an average of about 8 cwt/wooden house in the 5 years to 1881 to about 14 cwt/wooden house in the 5 years to 1886.

By the 1930s, the platform frame had taken over, and this timber frame system is still used today.

### Changing standards

The first standard for light timber frame construction was NZSS 95 Part IX *Light timber construction*, published in February 1944. This evolved into NZS 1900: Chapter 6.1:1964 *Construction requirements for timber buildings not requiring specific design*, part of the NZS 1900 *Model building bylaw series*, which in turn was replaced by the first NZS 3604, published in November 1978. It was revised in the 1990s and became NZS 3604:1999 *Timber framed buildings*, which is currently under review.

Today, the majority of timber-framed buildings are built to the requirements of NZS 3604:1999. It provides construction designs and methods that meet New Zealand's unique requirements. Since the 1970s, these have used the internal lining (for example, plasterboard) for structural strength, still an internationally unique approach. ◀