

"Balloon to Platform Framing": a change of the 1880s?

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ABSTRACT: *Brett's Colonists' Guide and Cyclopaedia of Useful Knowledge: Being a Compendium of Information by Practical Colonists*, edited by Thomas W. Leys, was first published in 1883. Rated, in 1993 in a National Library Exhibition, as one of the 21 "Working Titles" that had shaped New Zealand, it provided "all Information of possible use" to new arrivals. This included how to build your own cottage – providing floor plans, a material list and an estimate of labour for four cottages (increasing to five cottages complete with a set of written specifications in the 1897 edition). These designs and quantities provide a unique opportunity to explore changes in the technology of New Zealand house construction.

It has been hypothesised that in the 1890s timber construction shifted from balloon to platform framing – the basic style still used for timber framed houses. The paper will report research that examined import statistics, business records and quinquennial national censuses to explore indirect measures of changes in construction technology. It is concluded that this change occurred in the previous decade, the 1880s.

Introduction

Balloon frame ... was coined by sceptical carpenters to denigrate the method because of its extraordinary lightness and presumed frailty.

Bryson *Made in America* p159.

Although the dream of many European settlers in the 1860s and '70s was for a future New Zealand built of masonry,¹ except for a few locations, the reality was wood. Although open to the ravages of fire and requiring ongoing maintenance to resist decay or rot, timber offered lighter materials to be transported to the construction site, ease of construction and greater flexibility. Timber, as was quickly found out in the geologically unstable new country, was also resistant to

¹ e.g. Blair *The Building Materials of Otago and South New Zealand Generally* pp iii-iv.

earthquakes. Brick, stone and even poorly reinforced concrete quickly succumbed to the movement of the earth. Flexible timber framing survived.

Timber-Framed Construction

In timber-framed construction, the weight of the roof and the rest of the building is carried on a timber frame.² The 1905 *Modern Carpenter and Joiner and Cabinet Maker*, divided timber framing into four classes:³

1. *Solid timber*: the complete structural wall is made of solid timber;
2. *Heavy timber framing*: the structural timber frame is designed to support the whole of the load;

² Salmond *Old New Zealand Houses 1800-1940* p 30.

³ *The Modern Carpenter Joiner and Cabinet Maker* v 6, pp 109-110.

3. *Light timber framing*: the structure relies on the cladding and linings as well as the framing to support the load; and
4. *Half-timber work*: the heavier and exposed-to-view studs bear their share, but the infill of brick also supports the load

Heavy timber framing requires a supply of large dimension timbers, placing greater demand on the forests, and ultimately leading more quickly to deforestation in the absence of new plantings. New Zealand did seem to widely adopt the American "log cabin" in early years as slab houses could be rapidly constructed from the then readily available large trees.

Instead, the indigenous forests provided an alternative approach – slab construction. The 1883 *Brett's Colonists' Guide and Cyclopaedia of*

Useful Knowledge advised: "If the settler is a new arrival, he will find it to his advantage to employ a good bushman to help in splitting and in the erection of his house – the size will depend on his family requirements."⁴ Doors and windows were more easily brought in than made in the bush, and could then be moved on the next house. The slab house was not expected to last forever, as *Brett's* reported "The following summer, if means will allow, a weatherboard house can be built, and the slab house devoted to other purposes; as a stable or cow house it should last 15 or 20 years."⁵

In the cities, light timber framing was the more common construction, with *Brett's* allocating 12 pages in the 1883 first edition,⁶ increasing to 17 pages (including a set of specifications prepared by "Michael and Watt, Architects to the Auckland Board of Education"), in the 1897 second edition.⁷

⁴ Leys *Brett's Colonists' Guide and Cyclopaedia of Useful Knowledge* p 16.

⁵ Leys *Brett's Colonists' Guide and Cyclopaedia of Useful Knowledge* p 16.

⁶ Leys *Brett's Colonists' Guide and Cyclopaedia of Useful Knowledge* pp 723-734.

⁷ Leys *Brett's Colonists' Guide and Cyclopaedia of Useful Knowledge* pp 1131-1147.

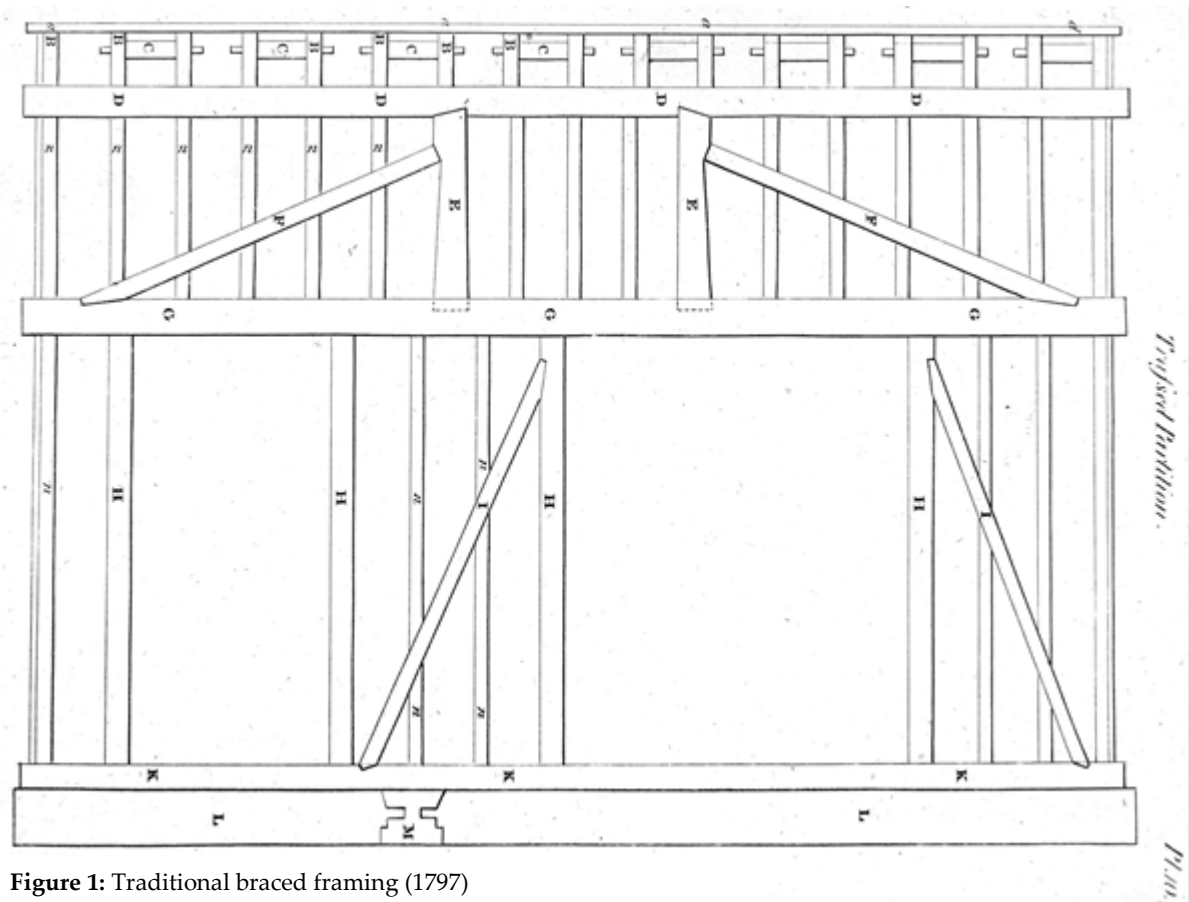


Figure 1: Traditional braced framing (1797)

Light Timber Framing

Internationally, the pressure on resources led to a need to develop more efficient ways of framing that minimised the need to discard the "smaller" 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 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 is a drawing for a trussed partition from the 1797 *The Carpenter and Joiner's Assistant* by Peter Nicholson.⁸ At the top of the diagram 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. Such construction was being used in the earliest European settlements in New Zealand (e.g. in Wellington's Nairn St cottage, built c1858, all the studs were tenoned and timber pegged into the plates and lintels⁹).

Balloon Framing

By the early to mid-1800s industrialisation was changing timber-frame construction. 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 all helped to make timber framed houses

⁸ Nicholson *The Carpenter and Joiner's Assistant* Plate 10. "Trussed partitions. Design for a trussed partition, with door-ways in it."

⁹ Hill "The Nairn Street Cottage" p 8.

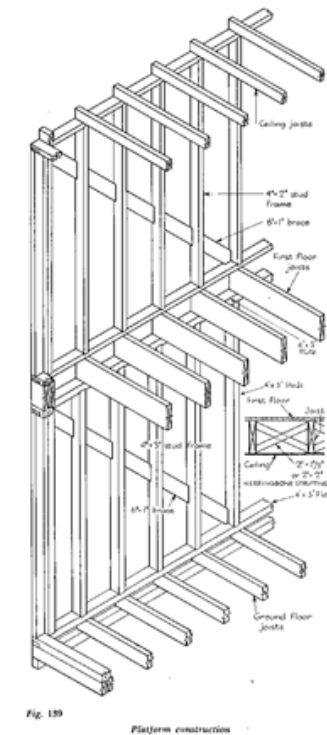
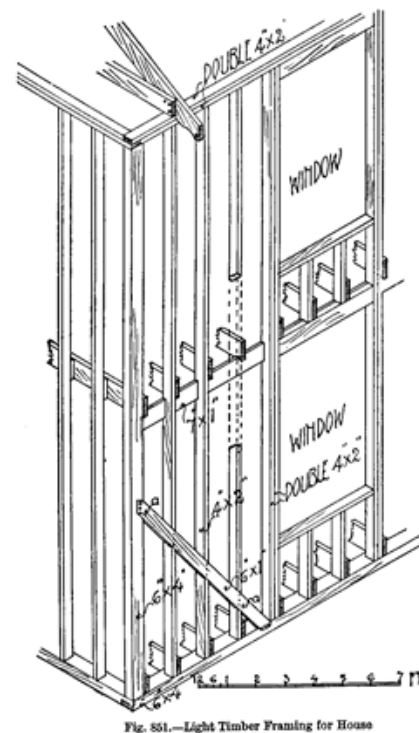


Figure 2: (a) Balloon Framing (1905 image); (b) Platform Framing (1958 image).

cheaper.¹⁰ Scantlings, timber less than 5 inches (125 mm) square,¹¹ whether built up 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.

¹⁰ Lewis "Stud and Balloon Frames" pp 48-73.

¹¹ Parker *A Concise Glossary of Architectural Terms* p 248.

Balloon framing (named reputedly as to denigrate its lightness and presumed frailty¹²) was one outcome. A 1905 schematic of balloon framing is given in Figure 2 (a).¹³ The most notable points are that that: the studs are continuous from the bottom to the top plate; while the ground floor joists are notched into

¹² Bryson *Made in America* p 159.

¹³ *The Modern Carpenter Joiner and Cabinet Maker* v 6, pp 109-110.

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.¹⁴ Although it has been argued since the 1980s that balloon framing started in Chicago about 1832,¹⁵ more recent research suggests it evolved not only in the general area of the American mid-west by the 1850s, but was fully developed in Australia and New Zealand by 1850.¹⁶

New Zealand newspapers used overseas sourced articles describing balloon framing. In 1866, the *Lyttelton Times* described the buildings in Oil City, Pennsylvania as "not only frame houses which exist here, but of the lightest description of structure, of that kind known as balloon frame."¹⁷ Balloon frame poultry houses were described in the *Tauapeka Times* of 1892¹⁸ while the *Otago Witness* provided considerable construction detail in 1908.¹⁹ Even in the 1950s, the Technical Correspondence School's *Carpentry in New*

Zealand provided a schematic of balloon framing,²⁰ describing it as only for "buildings of more than one storey." It is likely this was to provide historical background for carpenters likely to come across such framing when working on older buildings.

Platform Framing

As demand grew, the availability of continuous lengths of timber of longer than one floor was under pressure. Continuous timber also provided undesirable openings between the floors for the passage of vermin, draughts and fire. The first New Zealand adult carpentry training book was published in 1944 and included details for a two storey timber house of the "platform type of frame."²¹ The platform frame, illustrated in Figure 2(b),²² used shorter lengths of timber, with the walls for each floor being framed separately above and below the floor joists.

Salmond noted that 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.²³ By the 1930s the platform frame had taken over,²⁴ and is the timber frame system still in use today.

Similarities and Differences

Although a carpenter trained in light timber-framed construction in the early 1800s could be expected to recognise (and possibly even build) the more modern balloon or platform construction, some key differences would be apparent. The most obvious would be the method of fastening. As noted already, the traditional braced framing cut the timber to create joints. Balloon framing was based on timber that was joined using nails, a change that was only possible with the development of lower cost metal nails. Platform framing, using shorter lengths of timber, makes even greater use of metal nails. This increased use of metal nails provides an approach to explore when the shift occurred from balloon to platform framing.

¹⁴ Elliott *Technics & Architecture* p 18.

¹⁵ Sprague "The Origin of Balloon Framing" pp 311-319.

¹⁶ Lewis "Stud and Balloon Frames" pp 48-73.

¹⁷ "The Oil Regions of Pennsylvania" p 3.

¹⁸ "Poultry on the Farm" p 1.

¹⁹ "Balloon Frame in Building" p 9.

²⁰ Technical Correspondence School *Carpentry in New Zealand* p 100, Figure 140.

²¹ Smith *Carpentry: Study Course* pp 100-101.

²² Technical Correspondence School *Carpentry in New Zealand* p 100, Figure 139.

²³ Salmond *Old NZ Houses 1800-1940* p 113.

²⁴ Arden & Bowman *The New Zealand Period House* pp 38-39.

Nails

The technology for wire nails originated in France early in the nineteenth century, although there were French patents for wire nails beginning from 1806.²⁵ Machine-made wire nails (points de Paris) were exhibited at the 1844 and 1855 Paris Exhibitions and 1851 London Great Exhibition at the Crystal Palace.²⁶ Although wire nails were first made in USA the 1850s, these were smaller sizes and it was not until the 1870s that they were commonly made for construction.²⁷ In the USA, by 1888 wire nails were less than a fifth of total production (the rest being cut nails) but grew by 1895 to nearly three quarters. Wire nail production rose from 20,000 kegs in 1880 to 125,000 kegs in 1887, while prices fell from US\$ 20.00 per keg in 1875 to US\$ 10.00 in 1880 to US\$ 4.81 in 1887 – possibly below the cost of production.²⁸

It was not until the late 1880s that the first wire nails were manufactured in New

²⁵ Priess "Wire Nails in North America" pp 87-92.

²⁶ "Royal Commission for the Exhibition of 1851" pp 194-205.

²⁷ Varman. *Bricks and Nails Building Materials as Criteria for Dating in Sydney and Environs from 1788* p 164.

²⁸ Edgerton "The Wire-Nail Association of 1895-96" pp 246-272.

NZ Nail Imports (Weight and Value per head)

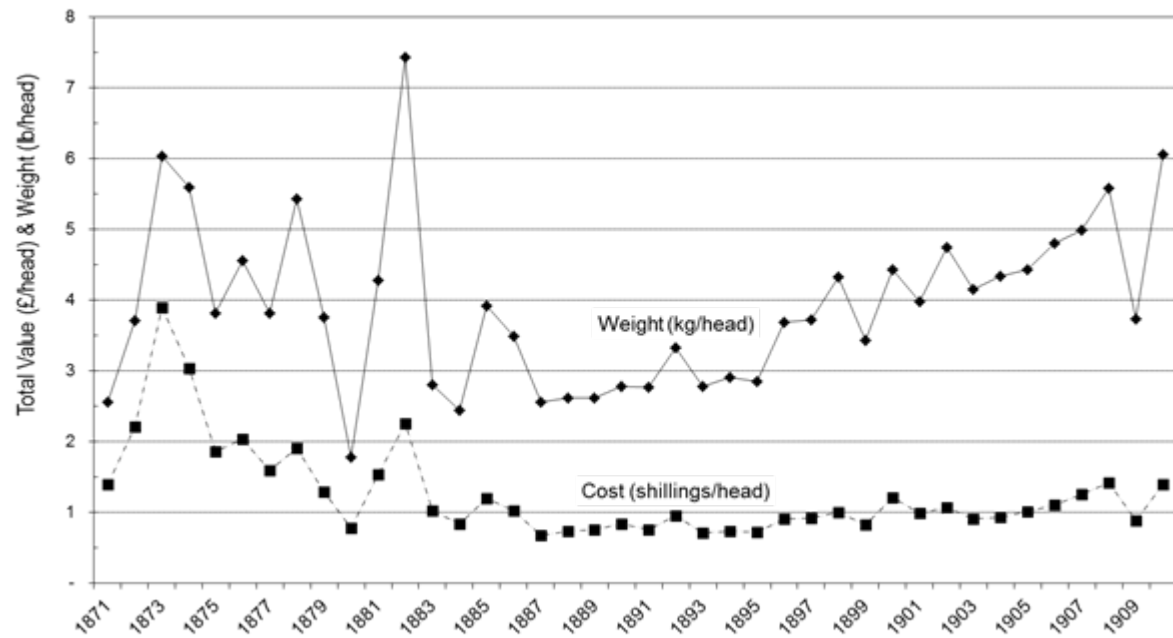


Figure 3: Nail imports per head -1871 - 1910 By Value & Weight

Zealand and not until after 1910 that the industry became established to any extent.²⁹ As a consequence, except for hand-made nails, nails were imported and from 1862 import value and quantity are available.³⁰

Figure 3 shows the nail imports from 1871 to 1910 in terms of weight per head and value

²⁹ Isaacs "Nails in New Zealand 1770 to 1910" p 83.

³⁰ Isaacs "Nails in New Zealand 1770 to 1910" pp 86-87.

per head.³¹ The population count is based on the census population (including Māori) assuming a linear increase between the census years. Although there are some large swings in imported weight per head between 1871 and 1885, it then settles to a slow increase. The cost per head also settles after this time, increasing far slower than the weight imported per head, suggesting the cost

³¹ Isaacs "Nails in New Zealand 1770 to 1910" p 88.

benefits of the improving international nail manufacturing technology.

Model Houses

By 1883 settlers desiring to build a house could be guided by *Brett's Colonists' Guide and Cyclopaedia*. This published a series of four cottage designs (see Figure 4) with from four to eight rooms, requiring on average 2.2 cwt [251 lb, 0.1 tonne] of nails in various sizes, at an average cost of 0.198 shillings per lb.³² For comparison, over the five years from 1882 to 1886 an average of 44,536 cwt (4,988,010 lb, 2,260 tonne) of nails were imported each year³³ – which using the average weight of nails for the larger of these cottages, would have been enough for 19,846 houses. Census data shows that between the 1881 and 1886 census there were an average of 3,774 houses built per year, or about one fifth of the possible number based solely on nail imports.

It is possible that if larger house sizes were being built in later periods, then significantly more nails would have been required. On average, based on Census data from 1881 to 1886, 69% of the new houses had from three to

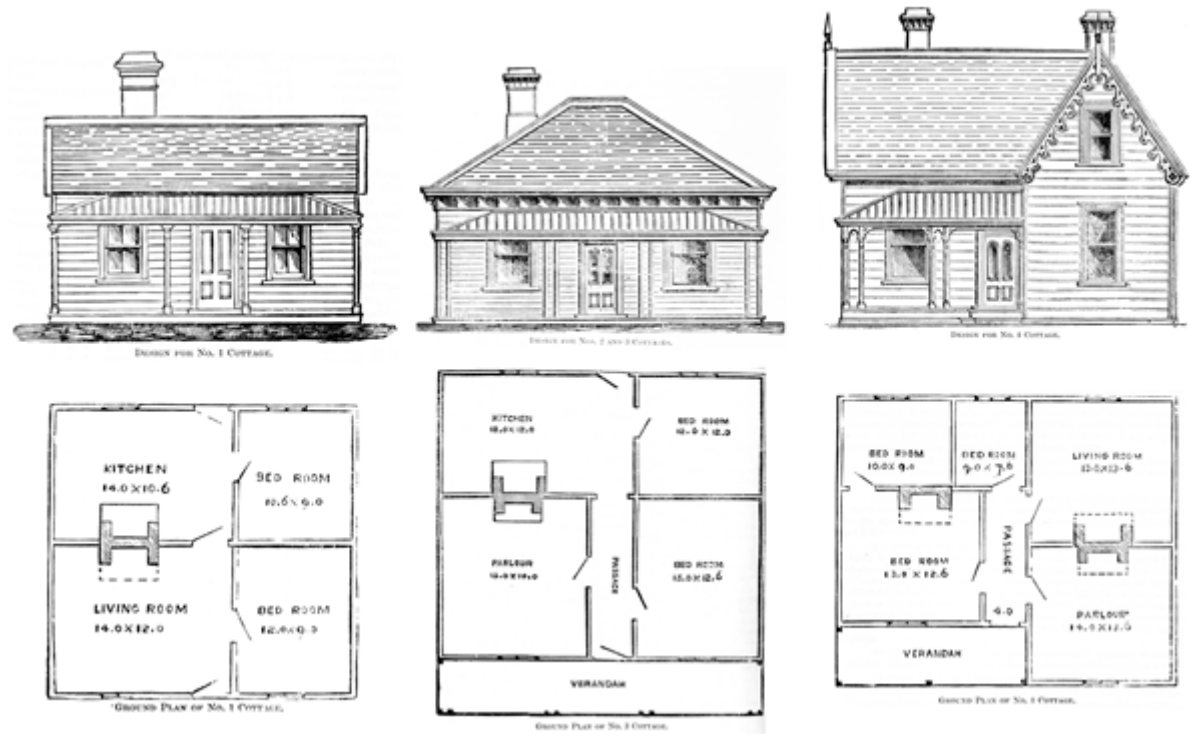


Figure 4: *Brett's Colonists' Guide* Model Cottages (1883)

six rooms and 30% with more than six rooms.³⁴ Using the 1883 designs from the *Brett's Colonists' Guide*, an eight-room cottage required only 20% more nails than the most complex four room cottage, so this would not appear to be the sole reason for the larger difference.

³⁴ Results of a Census of the Colony of New Zealand, taken for the night of the 3rd of April, 1881. Results of a Census of the Colony of New Zealand, taken for the night of the 28th March, 1886.

Figure 5 compares the average weight of nails per new wooden house and the average weight of nails based on *Brett's* model houses.³⁵ The units of weight are hundred-weight (cwt). The average weight of nails per wooden house was calculated by dividing the total imports of nails in each inter-census period by number of new wooden houses

³⁵ Leys *Brett's Colonists' Guide and Cyclopaedia of Useful Knowledge* pp 723-734.

³² Leys *Brett's colonists' guide and cyclopaedia of useful knowledge* pp 723-734.

³³ *Statistics of the Colony of New Zealand for the year 1883*

built over the same period. The average weight per house based on Brett's model houses takes into account the differing numbers of bedrooms in the houses built in each inter-census period. Although there are clear fluctuations, the trend is illustrated by the step change line, which plots the average weight of nails from 1864 to 1881 (left) and from 1886 to 1911 (right). The increase from 8.6 cwt per house to 15.5 cwt per house suggests there was a sizable change in the use of nails in the five years to 1886.

Although the 1880s saw a growth in the construction of town halls, railways and other public buildings as well as clubs, hotels and other commercial buildings, it does not seem likely that this was the sole reason for the increase in nails per wooden house.

Conclusion

It is proposed that the reason for the increased use of nails per wooden house, and hence increased imports of imports, was due to the change in construction style. Although *Brett's* does not specify the construction style, it was clearly not traditional mortise-and-tenon so is most likely to be balloon construction. Figure suggest that the shift from balloon to platform framing, with an even greater use of nails,

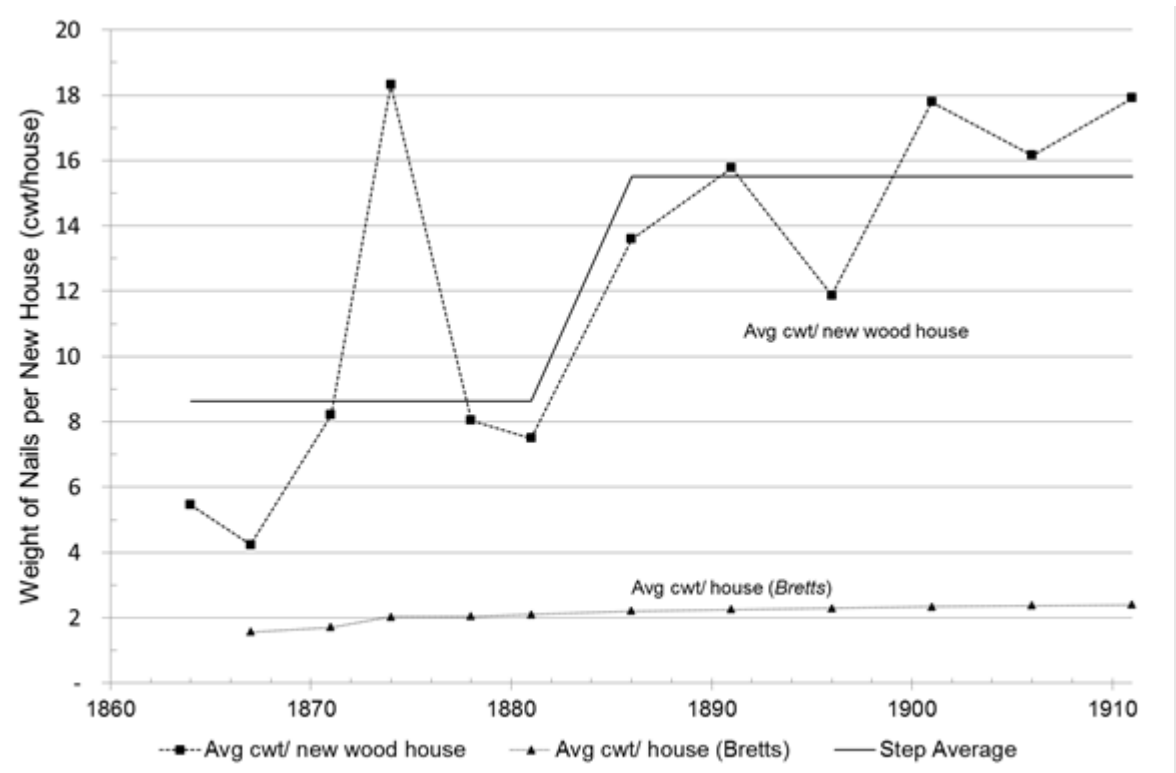


Figure 5: Average Nail Imports Per "New" House 1864-1911

occurred in the period 1881 to 1886, some five years earlier than suggested by Salmond.³⁶

This paper has brought together a diverse range of data sources – import statistics, quinquennial censuses of population and dwellings, and quantities of estimates for a

range of "Cottages for Settlers." *Brett's Colonists' Guide*, the source of the estimates, is a comprehensive "compendium of information by practical colonists."³⁷ Although not included in the first list of "One Hundred Representative New Zealand Books" prepared

³⁶ Salmond *Old NZ Houses 1800-1940* p 113.

³⁷ Leys *Brett's Colonists' Guide and Cyclopaedia of Useful Knowledge* title page.

by the Alexander Turnbull Library in 1925, it featured in the more recent 1993 selection of books that had shaped New Zealand.³⁸ It provided an invaluable resource when first published in 1883 (and in its two subsequent revised editions in 1897 and 1902), and today provides a unique opportunity to examine the best practice of those times. Even after considerable research and questions, no other source has been found of comparable estimates of quantities for any house designs from early in the nineteenth-century.

Perhaps the most appropriate conclusion comes from William Newsham Blair's 1879 publication exploring the building materials available in the lower South Island – although his hope for a shift from the "frail and ephemeral" to the "strong and enduring" did not take place in the following decade. Creating buildings on unsteady land was going to be a problem, but the strength and resilience of the platform frame may now be seen in a different light:

There was no time in the history of New Zealand when the choice of a building material had so much importance as the present. To borrow the plan adopted by ethnologists, we may divide the colonial architecture

into periods or ages: First the wattle-and-daub period, with its contemporaneous but more advanced varieties of fern-tree and totara-bark; second the timber period; and third the masonry period. On the gold-fields, timber is preceded by calico and corrugated iron. The Colony is now in a state of transition between the timber and masonry periods; we are exchanging the frail and ephemeral, for the strong and enduring. It is therefore our duty to spare no pains in selecting the materials that are most conducive to health and comfort, and that will remain for generations a record of our skill, forethought and good taste.³⁹

³⁸ Bartel et al. *Working Titles* p 11.

³⁹ Blair *The Building Materials of Otago and South New Zealand Generally* pp iii-iv.

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