

“Free-Standing, Wooden, Upright”: The Evolving Cladding and Structure of the New Zealand House, 1858–1981

NIGEL ISAACS

Abstract

The timber-framed, weather-board-clad, corrugated-iron-roofed, stand-alone building has become the image of New Zealand housing. Its evolution is explored using census data from 1858 to 1981 for walls and from 1961 to 1981 for the roof. Four wall claddings (wood, brick, boards and concrete) were used in two-thirds or more of dwellings. The 1981 census reported 46 percent had timber cladding but analysis shows 85 percent had timber framing (structure). Timber cladding has been replaced by materials including brick-veneer and fibre-cement boards. From the 1970s, concrete walls became more widely used, replacing both structure and cladding. In 1981, 90 percent of roofs were corrugated, galvanised iron or tiles, while 55 percent of all dwellings had both a corrugated-iron roof and timber framing. While popular opinion considered timber construction as little better than temporary, the ready availability of timber and industry creativity in these seismically active islands have ensured the ongoing importance of timber housing.

Introduction

... one of those multi-coloured suburbs in the sun on a gentle slope that make perhaps our unique contribution to architecture, although built in wood that won't last more than thirty or forty years.¹

On 14 September 1792 a sealing gang landed at Luncheon Cove, Dusky Sound. By the end of November 1792, “they had completed a dwelling house, 40ft long, 18ft broad, and 15ft high” (12.1m x 5.5m x 4.6m).² This was probably the first European house constructed in New Zealand, built and clad in the tradition of boat builders in wood cut or split from trees growing nearby. In early December the crew experienced an earthquake, the first for a New Zealand European-style house.³ Over the following years, New Zealand house building evolved, but by the 1870s the basic structure of the New Zealand house was largely established. It comprised a timber frame, weatherboard cladding and corrugated iron roofing.

Glover in the twentieth century, quoted above, was very much aware of wooden house construction and its lack of permeance.⁴ The idea that wooden housing was both temporary and yet embedded in the New Zealand tradition was confirmed when in 1981, after 25 censuses, the census report drew attention to fact that now “fewer than half of the country's dwellings were clad in timber.”⁵ Although statistically correct, did this statement appropriately reflect the nation's long love affair with wood? Does the change in cladding also meant a change in the structure? For this paper “cladding” is defined as the material(s) or cladding visible to the census respondent from the outside, while “structure” is defined as the materials holding up the roof, including the frame. In some cases, notably earth and concrete (monolithic or blocks), the structure is the same as the cladding.

To answer that question requires either a detailed investigation of a limited sample of buildings or the use of comprehensive data collected for some other purpose, such as census or construction statistics. The sample option is fraught with difficulties, as large areas of housing can be developed over a small number of years, making the creation of a random sample frame

complex. Of the other options, it was not until 1925 that the annual collection of statistics on building and construction activity commenced.⁶ However, the regular national censuses from 1858 to 1981 collected data on house wall construction, and from 1961 to 1981 asked about the roof materials.⁷ These census reports provide a valuable resource to assist in understanding the evolving construction of the New Zealand house.

This paper provides a review of the data available from the regular censuses not only as presented in the census reports, but also through new analysis. As a starting point, it is necessary to understand what data the censuses collected on house construction.

Using Census Data

When using census results to understand houses and their construction, it is important to be clear what data is (and is not) collected and reported⁸:

1. The census is concerned with dwellings, not buildings (or houses). A dwelling is defined as “any accommodation unit which is self-contained at least in respect of sleeping cooking and dining facilities,”⁹ so is not necessarily a building. A house may be one dwelling; but a block of flats is a number of dwellings. When only a very small proportion of buildings contain more than one dwelling, it is not unreasonable to ignore this issue,¹⁰ but it was not until the 1976 census that a “not applicable” roofing category was introduced to categorise dwellings with another dwelling overhead.¹¹
2. Occupants report on the dwelling which exists on census day. The census does not consider demolitions or changes in use, e.g. a single house dwelling being converted to two or more dwellings.
3. The census results tabulate respondent answers which may, or may not, be correct. In addition, census nonrespondents (whether deliberate nonparticipation or accidental, e.g. due to forms not being delivered) are not counted. A census respondent who does not report on the wall (or roof) material is enumerated as “not specified.”
4. Confidentiality requirements must be maintained, normally with a count of three (of anything) being the minimum published value. For example, the 1966 census reported a national total of five dwellings with slab walls, so no regional breakdown was provided.
5. Society and terminology change over time, leading to changes in census content and question wording. These can make it difficult to compare responses between censuses, highlighting the unyielding tension between change and continuity.¹²

To add to the complexity of analysis, the published data was also subject to category change. In the report of the 1858 census, the first in which questions about dwelling cladding materials were asked, the results were only reported under three category headings (“wood”; “stone or brick”; and “other materials”), with an additional heading added in 1861 (“raupo”) and another in 1864 (“tents”). These headings remained unchanged until 1874, when a further two were added (“cob,” “huts”), and “wood” became “wood, iron or lath-and-plaster.” In 1878 “stone or brick” became “stone, brick or concrete.” The published headings then remained mostly constant until 1916, when “brick,” “concrete,” “iron,” “stone,” and “wood” were separately enumerated. Consequences include a lack of data on the numbers of different materials in the 1858 census, and the impossibility of separate analysis for most materials in the nine censuses from 1871 to 1916.

These materials headings remained constant from 1916 until 1926, when 36 variations were reported, including the previously single “wood, iron or lath-and-plaster” becoming three headings: “wood,” “wattle and daub,” and “wood and iron.” In this paper, for the purpose of

analysis, all types of weatherboard (whether made of wood, cement board, or plastic) are included under the heading “wood and iron,” while “sheet” includes asbestos cement, plaster and other types of sheet boards.

Reclassification of materials and changes in the reported combinations of materials may also have had an impact on their apparent use. For example, for the 1971 census, imitation stone was reclassified from being counted as “stone” to being part of “brick.” The numbers of stone dwellings had increased from 3,478 (0.5 percent of dwellings) in 1961 to 10,362 (1.4 percent) in 1966, but then fell in 1971 to 2,475 (0.3 percent) due to this reclassification.¹³

Other reporting decisions can also change apparent dwelling numbers. For example, in the 1921 census dwellings with a wooden front but corrugated iron sides were included under “wood,”¹⁴ but in later years they were reported as “wood and iron.”

For this paper the census data has been treated as a consistent time series. This has little impact on analysis from 1858 to 1921, but from 1926 finer divisions have been amalgamated to permit the exploration of the overall trends for the full 123 years. Future analysis could explore the detail available from the 1926 to 1981 censuses, which would provide an exploration of the evolution of housing cladding, construction, local manufacture and architectural styles, and their use of materials. To support such future analysis, Table 1 provides the data for the analysis reported in this paper. A full copy of the raw census data is available on request from the author.

Census Coverage

When using the census data, it is important to note that while Māori dwellings were excluded until 1951, the coverage of non-Māori dwellings was also not constant. In summary, data was collected for:

- 1858 to 1911: inhabited dwellings, excluding those occupied solely by Māori.
- 1916 to 1921: inhabited private dwellings and tenements, excluding Māori.
- 1926 to 1945: inhabited private dwellings, excluding Māori.
- 1951 to 1971: inhabited permanent private dwellings, including Māori.
- 1976 to 1981: occupied permanent private dwellings, including Māori.

A private dwelling could be a house, apartment, etc., while nonprivate dwelling types include a hotel, hostel, boarding house, club, ship, train, etc. Temporary dwellings include mobile residences (e.g. caravans), tents, etc.

From 1874 to 1921 wall cladding was reported not only for inhabited private dwellings and tenements, but also separately for unoccupied or under-construction private dwellings.¹⁵ Pre-1926 reported numbers also included temporary dwellings,¹⁶ although the numbers were small. For example, in the 1936 census, temporary dwellings numbered only 2,864 (0.8 percent) out of 339,846 private dwellings, while for comparison 15,222 (4.5 percent) baches or holiday houses were recorded.

The questions on wall and roof materials were dropped after the 1981 census as reportedly little use had been made of the data, coupled with reported response coding difficulties. House occupants often reported brand (e.g. Fibrolite) rather than material names (in this case, asbestos cement sheet), which required additional processing to prepare the census tables. The 1986 census report suggested the data from this question could be supplanted by data from valuation records, which include details of roof and wall materials.¹⁷ However, previous experience with valuation records found that while they provide a snapshot at the time the records are analysed,

they are of limited historical value as they do not maintain records for demolished dwellings (e.g. a house built in 1890 and demolished in 1950 will not appear in the current valuation records). Additionally, approximately 10 percent of residential valuation records lack a decade of construction.¹⁸ That study did not analyse valuation records for residential wall or roof materials, but later analysis noted that for commercial buildings the construction coding was based on the visible roof or wall appearance, and hence could suffer the same limitations as found from the census data.¹⁹

Census or Societal Attitudes towards Timber?

The language used in census reporting leaves no doubt as to changes in the wider attitude to the use of different materials, notably timber, in house construction.

The 1896 census reported that the percentage of population living in “houses of the best material” had increased from 92.92 percent in 1881 to 96.74 percent in 1896, with the best material being stated as “houses of brick, stone, wood, iron, and lath and plaster.”²⁰

The 1916 Census recognised the importance of local conditions as depending “not on the kindliness or niggardliness of nature but ... [arising] from the prudential considerations affecting the minds of would-be builders.” This resulted in the citizens of Wellington having “a marked penchant for wooden homes” due to “the tendency to earthquakes,” while in other areas, close to metropolitan centres, wooden houses had been prohibited due to the danger of fire.²¹

By the 1961 census, descriptive terminology had changed, concrete and brick being referred to as “permanent materials.”²²

In 1966, the terminology had become explicitly dismissive, concluding that the “southern areas of New Zealand showed a preponderance of permanent building materials while buildings of a more temporary nature such as wood and asbestos were more characteristic of the north.”²³

In the 1971 census the language, but not attitudes, had changed with brick and concrete becoming “durable materials.”²⁴

Given such attitudes, it is perhaps a wonder that timber was even considered for use as a cladding for houses.

Wall Materials Over Time

Although the censuses asked questions about house construction, the requested answers concerned the materials, or claddings, used for the external walls.

The data suggests no simple chronologically based groupings, although some materials have declined in (or disappeared from) use. From 1858 to 1981, as shown in Figure 1, just four types of cladding (alone or mixed) were used in most dwellings. These accounted for a minimum of 67 percent (in 1864) to a maximum of 97.2 percent (in 1926) of dwellings. Even in 1981, these four types of cladding were found on 92.4 percent of dwellings.²⁵

- “Brick” walls first appeared separately in 1878, with 3.6 percent of dwellings increasing to a maximum 19.4 percent in 1971.
- “Asbestos sheet” cladding first appeared in 1921 in 0.2 percent of dwellings, with the generic “board” reaching a maximum of 15.4 percent in 1981.

- “Concrete” walls first appeared in 1916 with 0.7 percent of dwellings, with a maximum of 13.6 percent in 1981. It was not specified whether this was monolith (also known as poured) concrete, or concrete block.
- “Wood” was used as cladding in a maximum of 92.2 percent of dwellings in 1916, reducing to a minimum of 45.8 percent in 1981.

Figure 1 also shows the percentage of “not specified” dwellings has always been low, peaking at 1.8 percent (8,807 dwellings) in 1951.

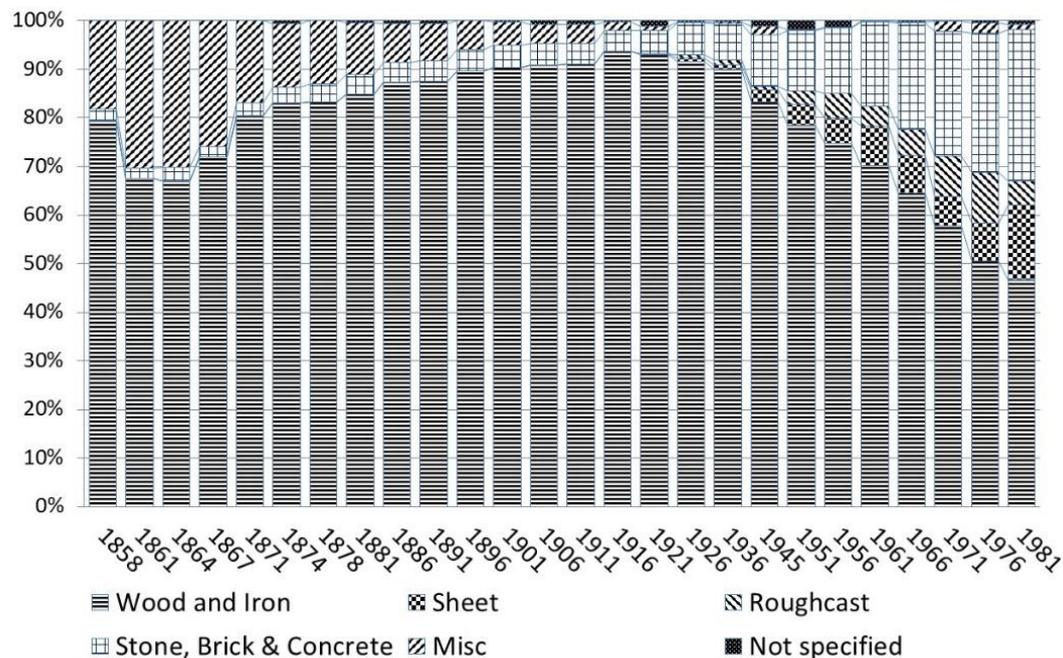


Figure 1: Wall Claddings 1858 to 1981

These four claddings, plus four other cladding types, will be considered before a discussion of changes in the way New Zealand houses were built.

Raupo

The earliest European settlers made use of the mature Māori construction technologies. *Brett's Colonists' Guide* was clear: “in the majority of cases it is advisable to build first a temporary house; this is often built with raupo walls and nikau roof, the framework round saplings from the bush.”²⁶ Raupo (*Typha orientalis*) becomes brittle after long exposure to the weather and requires extra protection from damage. Although 150 mm raupo wall exceeds modern NZ Building code levels of thermal insulation, it fails requirements for durability, moisture or fire performance.²⁷

The Raupo House Ordinance 1842 was in place early in the European settlement to limit potential fires²⁸; it applied solely in built up areas, and then only when adopted by the local government. It was enforced in Auckland from 16 November 1842, Wellington from 1 October 1843, Dunedin and Port Chalmers from 1 January 1851, and finally in Lyttelton and Christchurch from 1 February 1853.²⁹

Harman provides an overview of colonial use of raupo housing from the 1840s to 1867,³⁰ but censuses record that raupo dwellings were in use into the twentieth century. Figure 2 plots the census reported numbers of raupo dwellings from 1861 to 1971. (Raupo was not reported in the 1858 census, so estimates must be treated with caution as the small number of raupo houses suggests a simple pro rata extrapolation is unlikely to be valid.³¹) As discussed above, these counts exclude Māori housing until 1951 so are expected to be a significant underestimate of the total number of this construction.

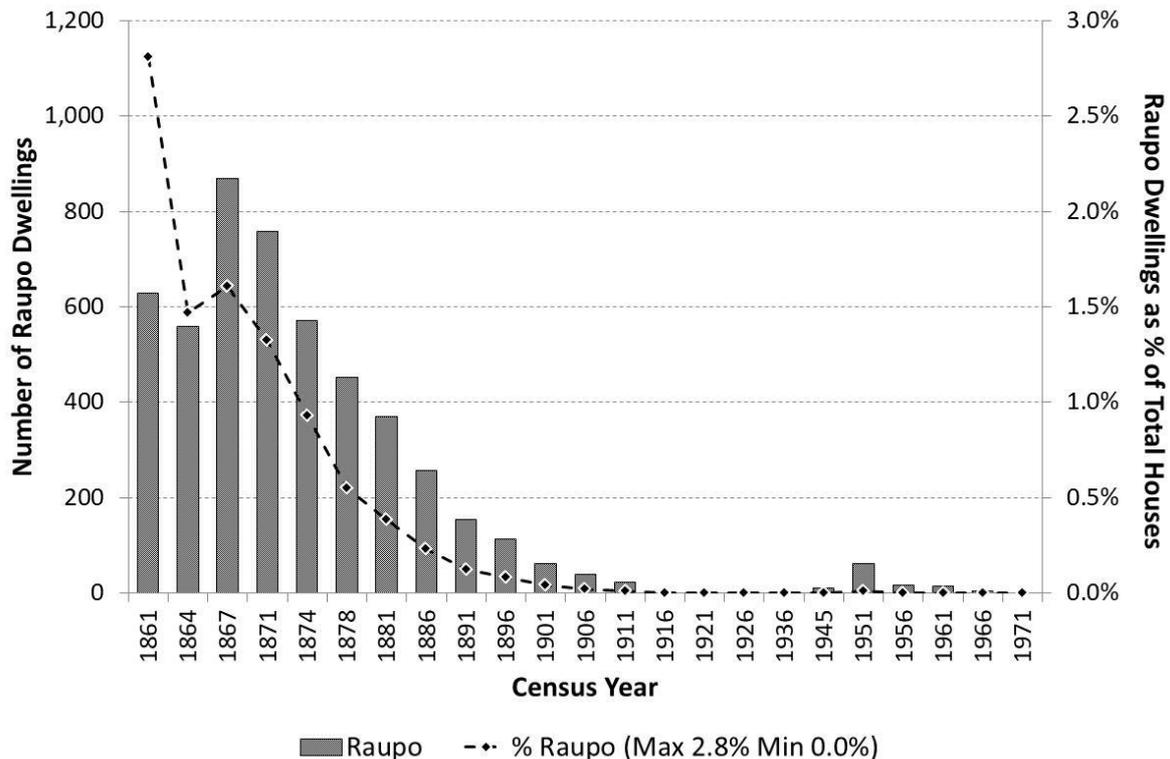


Figure 2: Raupo Houses 1861 to 1971

Raupo houses were first recorded in the 1861 census with a count of 630, reaching their maximum number of 870 in 1867. The numbers fell to 23 in 1911, then to zero from 1916 to 1936, before 12 raupo dwellings appeared in the 1945 census. The jump to 63 raupo houses in 1951 may have been due to the inclusion of Māori dwellings in the census. The 1966 census was the last to report any raupo housing, with just 5 dwellings.

Canvas and Miscellaneous Claddings

Canvas has played an important role in the provision of temporary housing for many years, as well as more recently for holidays. The category “tents & dwellings with canvas roofs” was reported from 1864 to 1921, accounting for over 2,000 dwellings in each census. No canvas category was reported in the 1926 and 1936 censuses, but when “canvas, calico, sacking, etc.” was listed in 1945, only 71 dwellings were counted, falling to a single permanent dwelling in 1966 when it was last reported.

The highest percentages of unnamed or “miscellaneous” materials are in the three censuses from 1861 to 1867. These covered the gold rushes in Central Otago (Gabriels Gully, 1861) and the West Coast (Hohonu, 1864),³² when large numbers of dwellings were required for transient miners and their services. For example, in the 1864 census, out of 37,996 dwellings, there were

6,742 tents (18 percent) and 4,150 of unknown construction (11 percent) presumably of a temporary nature.

Earth

Earth is cheap, readily available in most areas, does not require a high level of construction skill, and provides acceptable thermal and acoustic insulation, although seismic resistance must also be considered.³³ A Māori tradition of piling earth on the side of the wooden whare for warmth, presumably to reduce infiltration (uncontrolled air movement), was still used in the late nineteenth century.³⁴ Earth construction does not appear to have been a choice for settlers, with *Brett's Colonists' Guide* not including earth construction, although raupo and slab—both temporary wall materials—were included.³⁵

Water, the other key component of earth construction, is also freely available but at the same time it is the enemy. Falling from the sky as rain, rushing past the building as a stream or just wicking up from the ground, water leads to short term deterioration or long-term ruin. In wetter climates, such as Westland and Southland, there is difficulty in drying out the construction.³⁶ As a consequence, almost all the older remaining earth buildings are in places of relatively low rainfall or have been well maintained. Regardless of the wall or roof materials, early European settlers commonly used earth for the fireplace and chimney, and in timber houses it could be used to block draughts between the boards.

It was not until 1874 that earth construction appeared in the census, with “huts of sod, clay, wood, stone &c” (“hut” is a single room dwelling) along with “cob or sod” totalling 5,483 dwellings (8.9 percent of total dwellings) reducing to 4,019 in 1911. No buildings were reported in these categories in 1916 and 1921, but from 1926 seven categories were reported. Earth construction counted 619 dwellings in 1926, reducing to a minimum of 77 in 1971 and increasing to 534 in 1976. It is possible that these fluctuations are due to some construction categories being merged to meet confidentiality or other requirements, as it is very unlikely that 278 earth houses were demolished between 1966 and 1971, and then 457 built between 1971 and 1976.

Brick

The manufacture of quality bricks required good clay, careful preparation and uniform firing, while an experienced brickmaker provided additional certainty. From the earliest days of European settlement, bricks were made manually on a small local scale—the wet clay was pressed into a mould, dried, and then fired. Thornton and Salmond provide limited national overviews of the early brick industry: for example, Thornton lists 84 brickworks in 28 locations that were active between 1840 and 1906.³⁷ The NZ Historic Brick Database provides a start for a future national history of the brick industry,³⁸ but to date there is no comprehensive overview of the development of brick making in New Zealand.

Even if not initially used for walls, bricks provided essential fireproof chimneys. Unsurprisingly, it did not take long to discover the poor performance of stone, and its man-made replacement brick, in an earthquake-lively country. For example, following the 5 June 1869 Christchurch earthquake, Edward Bishop (later Mayor of Christchurch) questioned the “probable additional danger to life” through the requirements for stone buildings and brick chimneys in the then proposed Building Ordinance.³⁹

Following the 1931 Napier earthquake, NZSS 95: 1935 Standard Model Building Bylaws included requirements for reinforcing,⁴⁰ and brick company publications started to promote the

benefits of brick veneer (a single external layer of bricks supported by an internal timber frame) over traditional cavity brick walls (interior and exterior brick with a cavity between).⁴¹ The impact of these changes can be seen in the census reporting increasing numbers of brick (veneer) houses.

The combined “stone, brick and concrete” census category accounted for less than one in twenty (5 percent) of dwellings from 1858 until 1921, but then increased to over one in four (29 percent) in 1976, although many of these were most likely concrete rather than brick. Stone was reported separately from 1858 to 1874, reaching 1,540 dwellings (3.1 percent). The categories were combined until 1916 but it was not until after 1926 that any combinations were also listed, e.g. “brick and wood.” In 1916 there were 1,284 “stone”-walled dwellings, increasing slowly until 1961 when the terminology changed to “stone veneer,” resulting in a jump to 3,478 dwellings, and to 10,362 (1.4 percent) in 1966, but fell to 2,475 (0.3 percent) in 1971. Given the low numbers of stone-walled dwellings, later censuses only reported the combined category.

In 1926 there were 8,874 brick-walled dwellings, with a 50 percent increase to 13,303 in 1936 which represented 4.6 percent of all dwellings. The number of brick dwellings continued to increase, reaching 155,874 (19.4 percent) in 1971, increasing to 175,611 in number but just 17.5 percent of all dwellings in 1981.

Sheet Products and Roughcast

“Asbestos” sheet was first advertised in New Zealand in 1904,⁴² but not until the 1921 census was listed as the wall material in 466 dwellings. The main increase in use occurred post-World War Two, with 21,163 dwellings in 1951 (up from 1,999 in 1945) using “asbestos sheet” alone or in combination with other materials. The numbers grew steadily to 72,319 dwellings in 1976 (7.8 percent of dwellings), but the category was dropped in the 1981 census and replaced by the generic “board,” which was used in 154,488 dwellings (15.4 percent). It is possible the census numbers underestimate the use of asbestos board, as a householder not knowledgeable about the material could easily report it as being a proprietary brand of wallboard or confuse it for “roughcast.”⁴³ The use of asbestos in any products was banned in New Zealand in 1984, since which time wood fibres have been used in fibre-cement sheets.

Roughcast, or stucco, was initially a decorative plaster finish for brick and concrete wall construction but became a popular surface finish for timber-frame buildings as it appeared to have the solidity of masonry.⁴⁴ The underlying cladding could be rigid sheet materials (e.g. asbestos cement board), close boarded timber, or a nonrigid backing such as waterproofed building paper or felt impregnated with bitumen.⁴⁵ Roughcast is not listed until the 1926 census results, as previously it was recorded as being “wood” or a “surface n.o.d.” [not otherwise defined]. From then on numbers (including the mixed “brick and roughcast” and “roughcast and other”) grew strongly, in 1976 reaching 96,196 or 10.4 percent of dwellings, although falling to 45,590 (4.9 percent) in 1981, suggesting some reconsideration of the category.

Concrete

Concrete is made from cement, nowadays Portland cement, mixed with appropriate proportions of aggregate and/or sand to provide a dimensionally-stable and cost-effective filler, water and selected additives as required to modify its properties, and the mix left to harden for some days.

Monolithic or in situ concrete was available in New Zealand from the 1840s, although reportedly the earliest remaining evidence of concrete construction is a “rather crude retaining

wall at Fyffe House in Kaikoura” built by 1857.⁴⁶ The modern hollow concrete block was patented in New Zealand in 1905, with a two-storey house built in Wellington soon after.⁴⁷

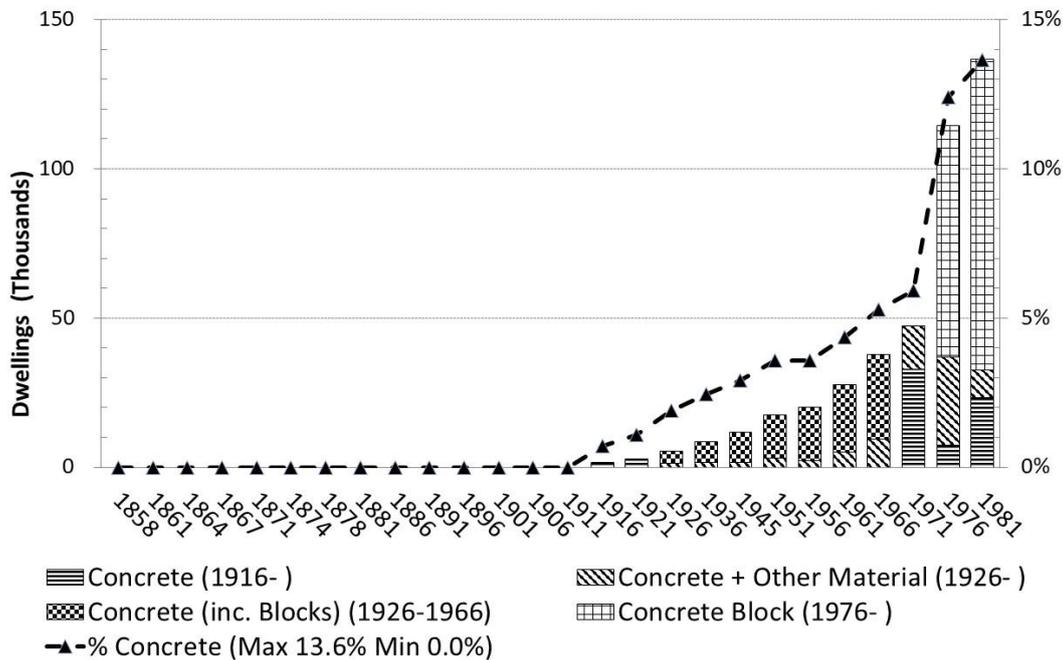


Figure 3: External Wall Concrete Construction 1858 to 1981

Census data plotted in Figure 3 shows increasing use of concrete wall construction from the 1920s to the 1950s, although the combination of monolithic “concrete” and hollow “concrete blocks” as well as “concrete and other material,” makes it impossible to allocate the growth. From the 1976 census, “concrete blocks” were separated from “concrete,” and from “concrete and other material.” In 1981 the total of 136,794 (13.6 percent of all dwellings) concrete wall houses included 23,334 (2.3 percent) with walls made of concrete, 9,105 (0.9 percent) of concrete and some other material, and 104,355 (10.4 percent) of concrete blocks.

Wood

The earliest European-style timber houses used either split or round logs as these minimised processing. Pit sawing (described by an old bushman as “next to a funeral, pit sawing is about the slowest thing I know of”⁴⁸) could be set up close to the forest, but water or steam powered mills were established around the country in the 1840s.⁴⁹ Although the first steam power mill was operating in Port Nicolson in 1840,⁵⁰ from the 1850s there was increasing use of steam power machinery, not just for cutting timber but also for shaping, turning and carving.⁵¹ Steam power allowed the production of a range of weatherboard styles—permitting a shift from the simple plain horizontal weatherboard and vertical board and batten of the 1840s, to rusticated weatherboards from the 1860s, to the rebated bevel-back board from the 1910s and the splayed or bevel-back from the 1920s. Native timbers proved to be ideal for weatherboards, able to be used without (heart rimu, matai, totara, and miro) or with preservative treatment (tawa, tanekaha, pukatea and totara).⁵² Imported American redwood, western red cedar and Australian eucalypts were also used, and in later years with the reduction in the native timber resource, treated pine.⁵³

From the 1858 census, “wood” cladding was reported separately. The “wood, iron or lath-and-plaster” combined category was reported from 1874, but only in 1916 was “iron” reported separately as a cladding. It is assumed galvanised, corrugated iron was included in the “other materials” category for 1858 and 1861, and then under “canvas, misc. or not specified” from 1864 to 1871. The number of houses clad in “galvanised iron” or “iron” averaged just 3,600 from 1916 to 1981.

Figure 1 shows that from 1858 through to 1926, ignoring the impact of the gold rushes in the 1860s and early 1870s, wood was the predominant cladding. From the 1920s, sheet, roughcast, and stone, brick and concrete started to make noticeable inroads into timbers supremacy.

Cladding or Structure?

By 1971 the proportion of wooden homes was down to 58 percent, and the 1981 Census was the first in New Zealand’s history to report that fewer than half of the country’s dwellings were clad in timber.⁵⁴

As discussed above, census data is based on house occupant reports of the appearance of their dwelling walls, and later the roof. While such data is useful, it does not provide information on the relative importance of the different structural systems—or to rephrase the question, what is holding up the roof? This question can be explored by a technical reconsideration of the census data.

As it was not until the 1970s that the light steel-frame industry offered any competition for timber framing,⁵⁵ it is not unreasonable to assume that until 1981 any cladding material that required a structural frame would be supported by a timber structure. Wood (including weatherboard), corrugated iron, and sheet cladding all require a frame. Materials such as masonry (stone or concrete block) and earth (cob, pisé, adobe), and possibly those materials reported as “not specified,” do not require a structural frame.

For some construction types, whether a supporting structural frame is used is not always clear. Prior to the 1931 Napier earthquake, cavity brick (a wall built of two brick skins with an air cavity between) was not uncommon, but after 1931 brick veneer (a nonstructural brick wall tied to a load-bearing timber frame⁵⁶) became standard. For this analysis, it has been assumed that all brick dwellings reported after 1931 are brick veneer. Roughcast, although initially a plaster finish over masonry, soon became a surface coating on a sheet product supported by a frame, assumed to be a timber frame.

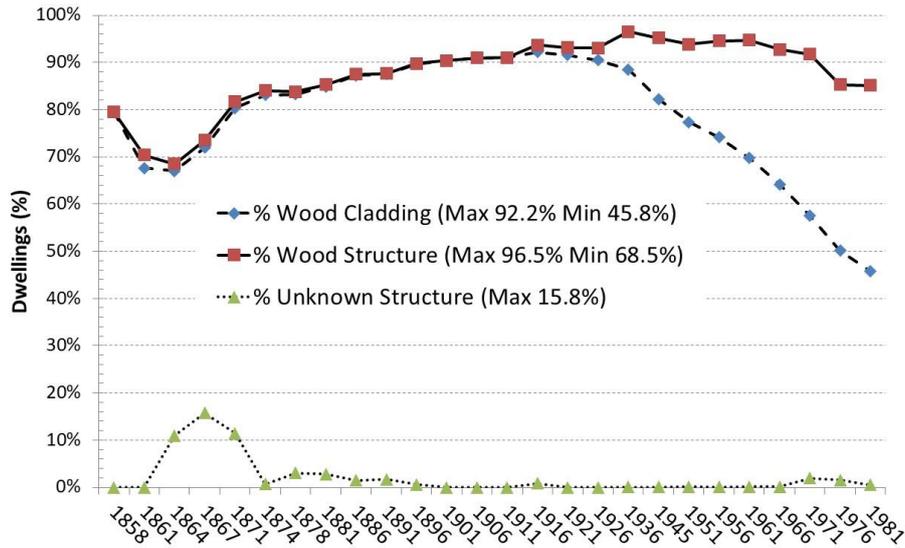


Figure 4: External Wall Cladding and Structure 1858 to 1981

Figure 4 reanalyses the census data based not on its reported appearance (cladding), but on the structure. It plots the percentage of dwellings with external walls of wood cladding and those with a wood structure. Although the two track each other closely until 1911, from 1936 there is a divergence. The lowest line in Figure 4 gives the percentage of dwellings with unknown framing. Apart from the 1864 to 1871 period, it was possible to allocate a structure for all but a very small percentage of dwellings (under 2 percent). This suggests that this analysis of the relative importance of timber framing is robust.

Thus, while the census reporting has focused on the wall appearance (cladding), which by 1981 was wood in under half of all dwellings, wooden framing (structure) largely maintained its primacy, only declining below 90 percent of all dwellings after 1971.

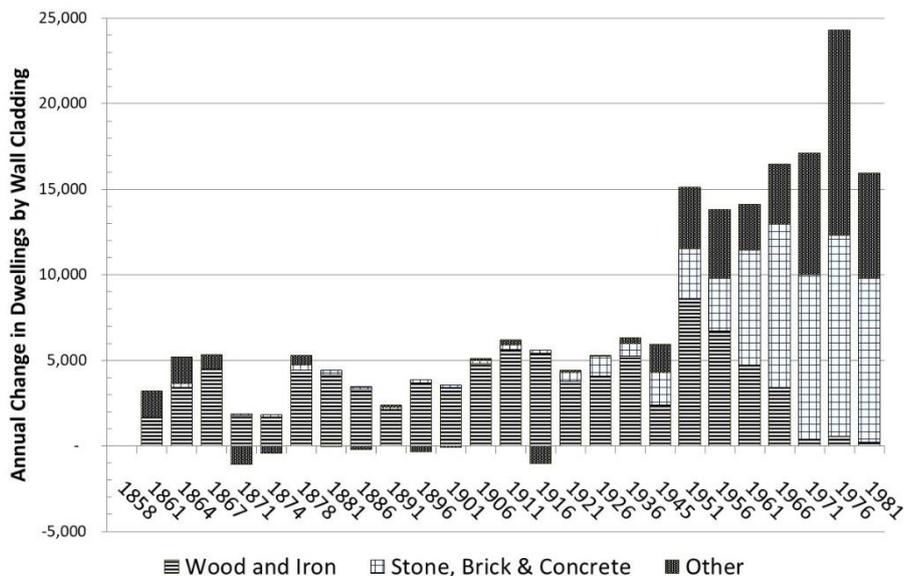


Figure 5: Annualised Change in Dwelling Numbers by Wall Cladding 1858 to 1981

The census data also provides a method to examine the use of different claddings and structures between censuses. Figure 5 gives the annualised change in the number of dwellings by wall cladding type between censuses from 1858 to 1981. A positive number is a net increase and a negative number a net decrease. To maintain consistency over the entire period, it has been necessary to combine stone, brick and concrete cladding into a single category. The decrease shown in Figure 5 for the “other” category in 1871 and 1873 was due to the reduced number of canvas dwellings, while in 1896 and 1916 the fall was in dwellings reported as “sod, clay, cob and huts.”

Figure 5 shows that although the number of dwellings with “timber and iron” cladding grew very strongly post WWII, it fell from 1951 to 1971 as timber was replaced by other claddings (mainly roughcast on cement board and plain asbestos cement board) and concrete construction.

The annualised change in dwelling numbers by wall structure from the 1858 to 1981 censuses are shown in Figure 6. Comparing Figures 5 and 6 shows that new timber structure dwellings remained dominant for almost every census period, except for the single 1976 census when the use of concrete (in situ or block) structure was higher than timber.

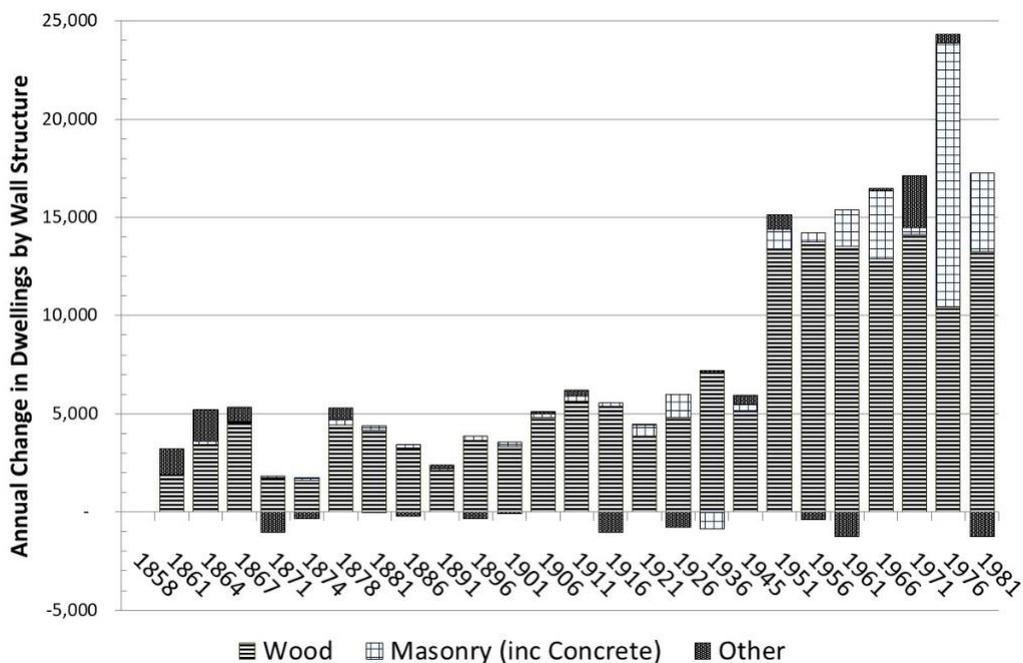


Figure 6: Annualised Change in Dwelling Numbers by Wall Structure 1858 to 1981

Roof Materials Over Time

Data on roof materials were collected by the 1961 to 1981 censuses. The reported roofing material terminology remained reasonably constant from 1961 to 1981. In 1961 and 1966 nine roofing materials were listed (“iron,” “aluminium,” “asbestos,” “other metals,” “tiles,” “slates,” “bituminous fabric,” “other material,” and “not specified”). Additions or changes made in the following years were: 1971, one additional material (“tile-shaped roofs”); 1976, two new categories (“combination 2 or more” and “not applicable”); while in 1981 tiles were divided into two (“pressed metal tiles” and “tiles of clay or concrete”). Pressed metal tiles were first made in New Zealand in 1955.⁵⁷

In each of the five censuses where this question was asked, only two roof materials were reported as being on more than 100,000 dwellings or over 10 percent of all dwellings, Galvanised “iron” (including sheet and corrugated) and “tiles” (including concrete, clay and asbestos), as shown in Figure 7. In 1981 when reported separately, “pressed metal tiles” (11.3 percent) and “tiles of clay or concrete” (21 percent) were each present in over 10 percent of dwellings.

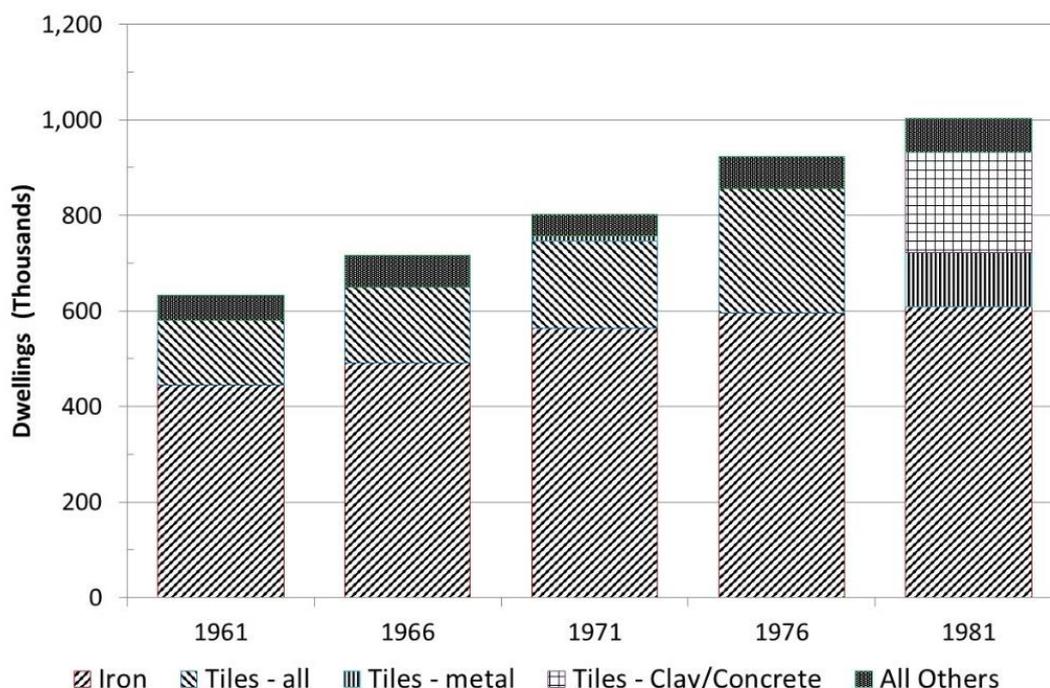


Figure 7: Roof Material Count 1858 to 1981

Iron roofing (normally corrugated iron) fell from a high of 70 percent of dwellings in 1961 to a low of 61 percent in 1971, while tiles increased from 21 percent in 1961 to 32 percent in 1981, at least in part due to the increased use of pressed metal tiles. The total for all other materials ranged from 5.4 percent in 1971 to 9.2 percent in 1966, suggesting a small growth in new types of roofing.

Unfortunately, although a “not applicable” roof category was included in 1976, census reports did not provide the number of residential buildings as the number of dwellings per building was not reported. In 1981 only 1.8 percent of dwellings (17,877) reported the roof question was not applicable, suggesting they were in a vertical multiunit building.

Wall and Roof Material Combinations

From 1961 to 1981 the collection of both roof and wall claddings allowed reporting and analysis of the combinations. From the first report, the most popular dwelling was timber clad with a corrugated iron (sometimes referred to as “tin”) roof.⁵⁸

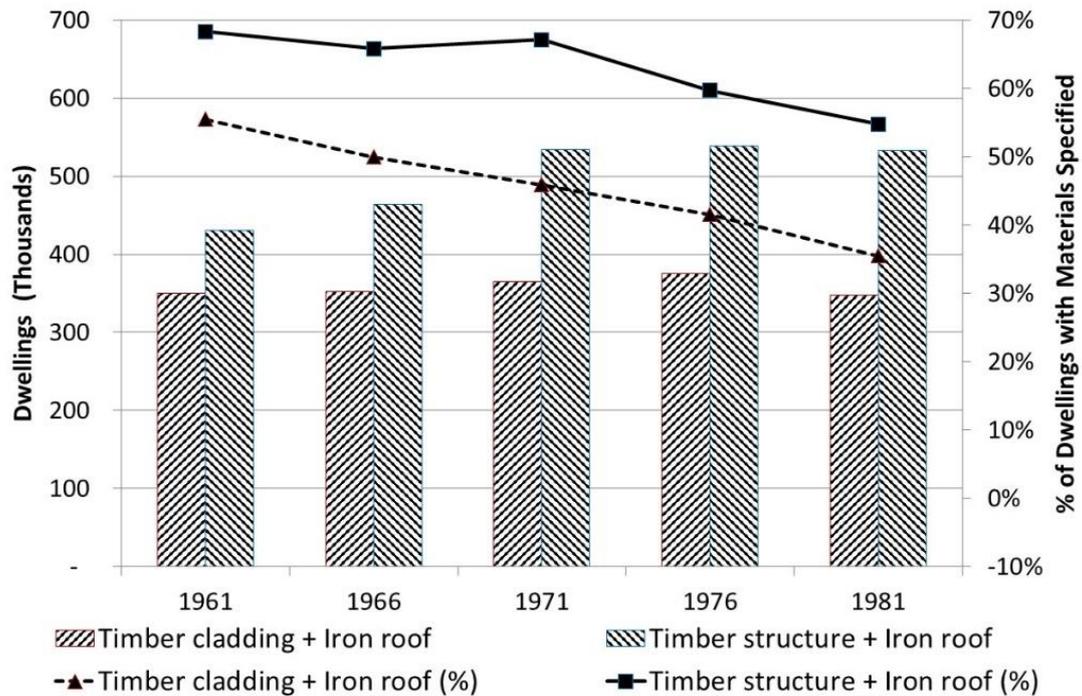


Figure 8: Wall and Roof Combinations 1961 to 1981

Figure 8 gives the number of dwellings and the percentage of dwellings reporting a specified wall and roof material, constructed with timber wall and iron roof, or with a structure of timber wall frame and iron roof. In the five censuses, fewer than 1.5 percent of dwellings failed to provide this information. In 1961 the combination of timber wall and iron roof accounted for 55 percent of dwellings but this combination fell to 36 percent in 1981. However, when considering the structure, timber-frame structures with iron roofs in 1961 accounted for 68 percent of all dwellings, falling to 55 percent in 1981. This structural combination (timber frame and iron roof) set in place in the 1870s was still in the majority over a hundred years later, even though other wall and roof materials were starting to become significant.

Discussion

This paper has explored, using census data, the cladding and structure of New Zealand dwellings from 1858 to 1981. Census data is limited for this type of analysis as it is concerned with dwellings rather than residential buildings. The evidence suggests that over this period comparatively few of these dwellings formed part of a vertical multiunit (apartment) building, so most dwellings were houses.

Although a census is subject to considerable care over its geographical coverage and completeness, the data it provides relies on house occupant reports. The quality of the house occupant responses to the wall cladding and roof appearance questions was being questioned in 1981 by the Department of Statistics, leading to the removal of these questions from the following censuses. As a result of this decision, future historians will be unable to readily develop a reliable time series for house construction post-1981. As there is no other data source with a comparable longevity or coverage, the pre-1981 censuses provide at best an accurate overview of the development of the construction of New Zealand houses, or at worst merely a comprehensive overview.

Due to their historical and more recent public interest, three materials used in only a limited number of houses have been explored:

- Raupo construction is based on the use of natural plant materials, which although providing a warm and comfortable dwelling, performs poorly under conditions of sustained water. Its dangerous fire performance led to the Raupo House Ordinance 1842, which was enforced in a limited number of cities through to the 1850s. Although used before European settlement, and providing ready shelter for early European settlers, it was last recorded in the census in 1966.
- Canvas reached its peak numbers of around 2000 during the gold rushes of the 1860s, when temporary dwellings were included, declining to a single occupied permanent private dwelling in 1966 when it was last reported.
- Earth construction did not appear in the census reports until 1874 with 5,483 dwellings or 8.9 percent of all dwellings. The count reduced to a low of 77 in 1971 before inexplicably rising to 534 in 1976. No dwellings of earth construction were reported in the 1981 census.

Over this 123-year period, just four types of cladding (wood, brick, board or sheet material, and concrete) accounted for a minimum of two thirds (67 percent in 1864) to a maximum of almost all (97.2 percent in 1926) dwellings. Even in 1981, these four were found on 92.4 percent of all dwellings.

Bricks were made throughout New Zealand in the nineteenth century, although interestingly there is no comprehensive history of brickmaking in this country. Cavity brick walls were widely used, although their poor earthquake performance had been noted in the 1869 Christchurch earthquake. The replacement, brick veneer, became widely used following the 1931 Napier earthquake. Brick walls were found in 17.5 percent of all dwellings in 1981.

Sheet products, including asbestos cement and fibre-cement boards, were being advertised from 1904 but first appeared in the census in 1921. The numbers grew steadily, until by 1981 it was used in 15.4 percent of dwellings. Roughcast was first reported separately in the 1926 census, where its numbers also grew steadily to reach 96,196 dwellings in 1976 (10.4 percent), although the numbers more than halved to just 45,590 in 1981, possibly due to reallocation into other categories.

Concrete has a long history of use in New Zealand dwellings, although it first appeared as a wall construction material in the 1916 census. The numbers grew steadily until by 1981 there were 136,794 houses (13.6 percent) with concrete walls, the majority being hollow concrete block. There was a strong growth in dwellings constructed of concrete from the 1961 census.

Wood has been the majority cladding since the 1858 census, only losing its primacy in 1981. The earliest European housing used slabs split from native timber, but with the development of power saw mills and machinery, a range of native timber weatherboards were produced and used. “Iron” (corrugated iron) was used as a wall cladding but only in a small number of dwellings.

Although the percentage of dwellings with wood cladding fell below 50 percent in the 1981 census, this paper has shown that timber framing has remained the main structural material throughout the entire period, from 1858 to 1981. Wood’s principal competitors are materials which provide both wall cladding and structure—notably concrete and hollow concrete block.

The final five censuses (1961 to 1981) which reported on wall cladding also included roofing materials, which were reported alone and in conjunction with wall cladding. Only two roof materials were reported as being on more than 100,000 dwellings or over 10 percent of all dwellings:

- galvanised “iron” (including sheet and corrugated), which reached its peak of 70 percent in 1961, falling to 61 percent in 1971; and
- “Tiles” (including concrete, clay and asbestos), which increased from 21 percent of dwellings in 1961 to 32 percent in 1981. In 1981, when reported separately, “pressed metal tiles” (11.3 percent) and “tiles of clay or concrete” (21 percent) were each present in over 10 percent of dwellings.

Other roofing types were less than 9.2 percent (the maximum in 1966), suggesting the market interest in different types of roofing was not large.

Conclusions

The analysis confirms that at least in 1981, dwellings with timber wall cladding and a corrugated iron roof were no longer in the majority—the combination having lost its lead around 1966. Even so, the majority of dwellings had a timber structure with a corrugated iron roof. It can only be concluded that the apparent decline in the use of wood as a construction material has been exaggerated by the focus on its use for cladding rather than any consideration of its use for structure (framing)

Interestingly, this finding raises even more questions, such as:

- How did wood become the predominate cladding material in a country where its impermanence was not only recognised but disliked?
- Does the ongoing use of wood indicate a lack of innovation in the construction sector?
- Has the ongoing use of wood excluded other construction materials, whether for cladding or structural roles?

The answers to these questions may lie in the readily available supplies of a material (wood) able to suitably respond to the seismic nature of the land, coupled with the ability of the building industry to creatively deal with the many different problems faced over the period from 1858 to 1981. These questions, and others which may result from this first analysis of New Zealand census house material data, offer many opportunities for future research.

Acknowledgements

Much of the census data came from the reports held by Statistics New Zealand prior to the destruction of their library in the November 2016 earthquake—the library and the reports are sadly missed. Census reports from 1871 to 1916 have now been digitised and are available from the Statistics NZ website (www.statistics.govt.nz).

Census	Cladding						Structure (holds up the roof)					TOTAL Dwellings (millions)	
	Stone, Brick & Concrete	Wood and Iron	Roughcast	Sheet	Misc.	Not specified	Masonry (incl. brick pre-1931)	Unknown	Earth	Canvas	Other		Timber (incl. brick post-1931)
1858	307	10,179	-	-	2,326	-	307	-	-	-	2,326	10,179	12,812
1861	477	15,139	-	-	6,782	-	477	-	-	-	6,152	15,769	22,398
1864	1,082	25,463	-	-	11,451	-	1,082	4,150	-	6,742	-	26,022	37,996
1867	1,182	38,844	-	-	13,989	-	1,182	8,524	-	4,595	-	39,714	54,015
1871	1,540	45,951	-	-	9,691	-	1,540	6,528	-	2,404	-	46,710	57,182
1874	1,901	51,003	-	-	8,022	430	1,901	430	5,483	1,967	-	51,575	61,356
1878	3,001	68,771	-	-	10,816	-	3,001	2,482	4,950	2,931	-	69,224	82,588
1881	3,752	81,317	-	-	10,277	404	3,752	2,705	4,689	2,917	-	81,687	95,750
1886	4,749	97,695	-	-	8,871	656	4,749	1,609	4,157	3,504	-	97,952	111,971
1891	5,241	108,390	-	-	9,546	674	5,241	2,065	3,914	4,085	-	108,546	123,851
1896	6,155	126,764	-	-	8,420	-	6,155	789	2,852	4,664	-	126,879	141,339
1901	7,194	143,618	-	-	7,568	518	7,194	-	2,389	5,116	518	143,681	158,898
1906	7,949	167,741	-	-	7,135	1,632	7,949	-	1,714	5,381	1,632	167,781	184,457
1911	9,135	196,004	-	-	8,733	1,553	9,135	-	4,019	4,691	1,553	196,027	215,425
1916	10,026	223,010	-	-	4,442	588	10,026	2,051	-	2,391	588	223,010	238,066
1921	12,693	241,915	-	466	2,158	2,997	12,693	-	-	2,158	2,997	242,381	260,229
1926	18,543	262,192	1,974	2,193	840	658	18,543	14	619	-	658	266,566	286,400
1936	26,150	314,580	3,487	3,354	1,340	994	10,049	268	616	-	1,364	337,608	349,905
1945	43,252	336,157	2,488	9,829	6,599	5,009	13,247	113	507	71	5,659	383,737	403,334
1951	60,727	387,774	14,280	21,079	1,345	8,807	19,479	609	544	29	9,565	463,786	494,012
1956	76,053	421,327	28,445	28,862	851	7,514	21,846	259	503	13	8,015	532,416	563,052
1961	109,432	445,056	25,958	50,955	1,348	958	31,039	784	465	6	1,361	600,052	633,707
1966	157,485	461,878	37,283	56,025	1,503	1,930	48,270	881	355	1	2,168	664,429	716,104
1971	205,786	463,628	66,784	47,976	16,522	990	49,912	15,555	77	-	990	735,152	801,686
1976	264,529	466,415	96,196	72,319	19,813	3,985	116,940	14,352	534	-	3,985	787,446	923,257
1981	312,405	467,502	49,590	154,488	11,790	7,329	136,794	5,241	-	-	7,329	853,740	1,003,104

Table 1: House Cladding and Structure by Census 1858–1981

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