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Moving beyond the bridge

Research has found the percentage of timber framing in walls of new houses is much higher than assumed in compliance calculations. This means more thermal bridging, less insulation and lower thermal performance. Why is this and what can be done?

THE CASE FOR HAVING a well-insulated house is now firmly established - there are proven health, energy efficiency and financial benefits. However, insulation effectiveness is compromised by thermal bridging where heat escapes through materials that conduct heat more easily. Timber is one of those materials.

Timber framing has a significantly lower thermal resistance than the bulk insulation materials typically used in walls of new houses. As framing content increases, the walls' thermal resistance as a whole decreases.

Framing in new builds investigated

Funded by the Building Research Levy, stage one of the Wall Project measured the extent of timber framing in 47 new-build dwellings in Auckland, Christchurch, Wellington and Hamilton (see Figures 1 and 2).

Frame and truss (F&T) manufacturers supply in excess of 90% of the framing to new residential builds in New Zealand. The research utilised hard copies of F&T panel elevations and plan layouts to assist with gathering data on site.

The team also interviewed major suppliers to industry, cladding manufacturers and representatives from F&T manufacturers, which proved crucial to understanding how the design process worked and what drove design decisions.

Over 34% of new walls is timber framing

The results show that the average percentage of timber framing compared to the area of the wall is above 34% - based on the 47-dwelling case study sample. This is much higher than the 14-18% framing content generally assumed by both regulators and the industry when undertaking compliance calculations.

When individual house levels across the sample were looked at, the minimum percentage of timber framing found was 24%, while the maximum was slightly over 57%.

Compromises thermal performance

As the amount of timber framing in the wall increases, less space is available for insulation.

The research indicates the content of timber framing in external walls in new builds is so high that the increased thermal bridging compromises the thermal performance of walls and may mean that designed R-values can not be achieved.

Why are framing ratios so high?

The research found that minimal additional framing was being added on site. In fact, the average additional site-added full-depth framing is just 2% by building level. Contrary to some people's views, builders and subtrades are not responsible for adding unnecessary framing.

There are also no indications that F&T manufacturers are adding unnecessary timber in the panels they construct - it is an efficient and competitive industry, and adding unnecessary timber would obviously cost.

Driven by regulations and new trends

Rather, the research highlighted evidence that increasing framing content is being driven by the requirements of various regulations, mostly in relation to structure and weathertightness - including cladding requirements.

Figure 1: Case study houses with a very high percentages of wall framing (left) and corner framing (right). These areas of walls will be almost completely uninsulated.

The increase in framing is likely to have several origins:

- Design requirements added to one area of regulations without consideration of other areas. For example, Acceptable Solution E2/AS1 requires cavities behind most claddings to improve weathertightness. Nogging at 800 mm centres is currently used to support cavity battens as required by E2/AS1. In addition, where internal corners are present, E2/AS1 requirements for cavity battens effectively increased the number of studs from three to five (refer Figure 79 in E2/AS1).
- Building in higher wind zones and how wind zone requirements are calculated and applied by local authorities and design and building professionals.
- Cladding trends such as increasing popularity of vertical profiles, which require 400 or 480 mm nog/dwang spacing depending on wind zone.
- Changing styles and preferences. For example, designers may want double sills or double studs at smaller centres based on their personal preferences. Other design choices such as double-height entranceways or stairwells mean the exterior wall may be 5–6 m high, requiring a corresponding increase in supporting timber.
- More multi-storey dwellings. Structural requirements may lead to higher framing content on lower floors to carry the weight of upper storeys.
- Less than optimal placement of openings such as windows and doors at the design stage. In some instances, shifting a window anywhere from a few mm to 300 mm to one side could negate the need for additional framing. There appears to be a lack of design thinking about minimising framing to achieve a better-performing thermal envelope.

Weak points and blind spots

In addition to the high level of thermal bridging reducing the effectiveness of the thermal envelope, the research also highlighted significant weak points and blind spots in key aspects of current house construction.

These defects include uninsulated corner junctions, uninsulated mid-floors, uninsulated interior to exterior wall junctions and areas of timber flashing, timber packing and

Figure 2: Although built to the Building Code, the high percentage of wall framing from close nogging, blocking and multiple studs next to a large window (left) leaves little space for insulation. The small toilet wall (right) is an area prone to condensation, but insulation will only be able to fit in a small percentage of this wall.

blocking. All of these further compromise the performance of the thermal envelope and are likely to lead to reductions in R-values and therefore houses that are colder and harder to heat and an increased risk of condensation and surface mould in new housing.

Exploring easily shared solutions

Discussions with the regulator, industry and research organisations during the original Wall Project stage one identified the potential for practical, cost-effective and innovative ways of constructing timber-framed walls that will have much more consistent and improved thermal performance.

The next stage of the research, which is currently under way, is exploring these practical and buildable advanced framing solutions, many of which have been constructed in New Zealand but are not widely used (see *High-performance details*, pages 29–30).

The focus is on solutions that can be shared and widely adopted among industry

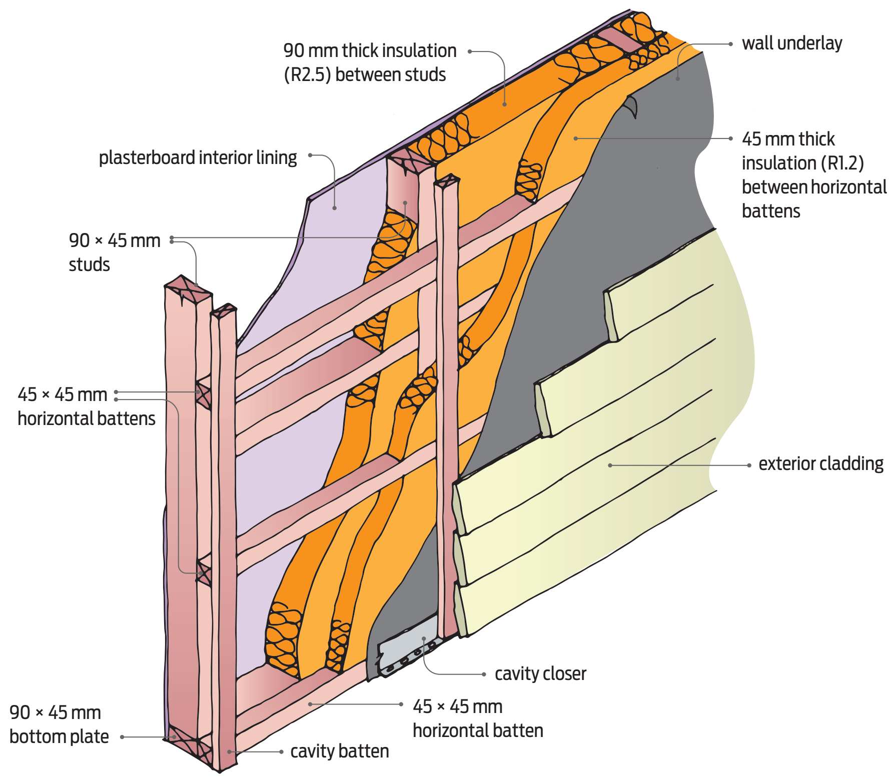

Figure 3: Example from the Beacon Pathway wall workshop – the Zero Energy House wall framing system. For more, visit zeroenergyhouse.co.nz/walls.

using familiar framing approaches with little complication and with as few changes as possible to current regulation and compliance regimens.

The aim is to explore whether current building techniques can be pragmatically modified to radically improve the thermal envelope.

Using a double wall system

A recent collaborative online advanced solutions workshop helped to identify some promising solutions to many of these issues. Several were explored during the 3-hour workshop. A video of this is available on the Beacon Pathway website, www.beaconpathway.co.nz.

The proposed solutions most commonly use an offset or battened-out double wall system based around either a standard 90 mm frame or 140 mm framing (see Figures 3 and 4, and *High-performance domestic walls*, pages 32–33).

There are a range of advantages in the proposed solutions, including the easy installation of services such as plumbing and wiring. This may result in time and cost savings as well as productivity increases during construction, which could help to offset the increased costs of battening and installing a second layer of insulation.

In addition, providing a near continuous layer of insulation on one side of the structural wall not only helps overcome thermal bridging but also potentially resolves many of the weak points and blind spots described. This leads to a higher-performing thermal envelope due to the reduced thermal bridging and improved thermal performance.

Collaboration for a better future

Ongoing collaboration is now required to ensure that the potential of these systems to overcome the issues of thermal bridging can be fully realised across the sector. Many of these solutions have been tested here, albeit in a few case studies, and there does not appear to be anything in the regulatory and industry environment to stop advanced framing solutions becoming a new industry standard.

With some industry and regulatory support, these solutions have the potential to become a set of Acceptable Solutions for construction of new higher-performance housing in New Zealand – perhaps providing a more positive type of bridge to the future we all deserve.

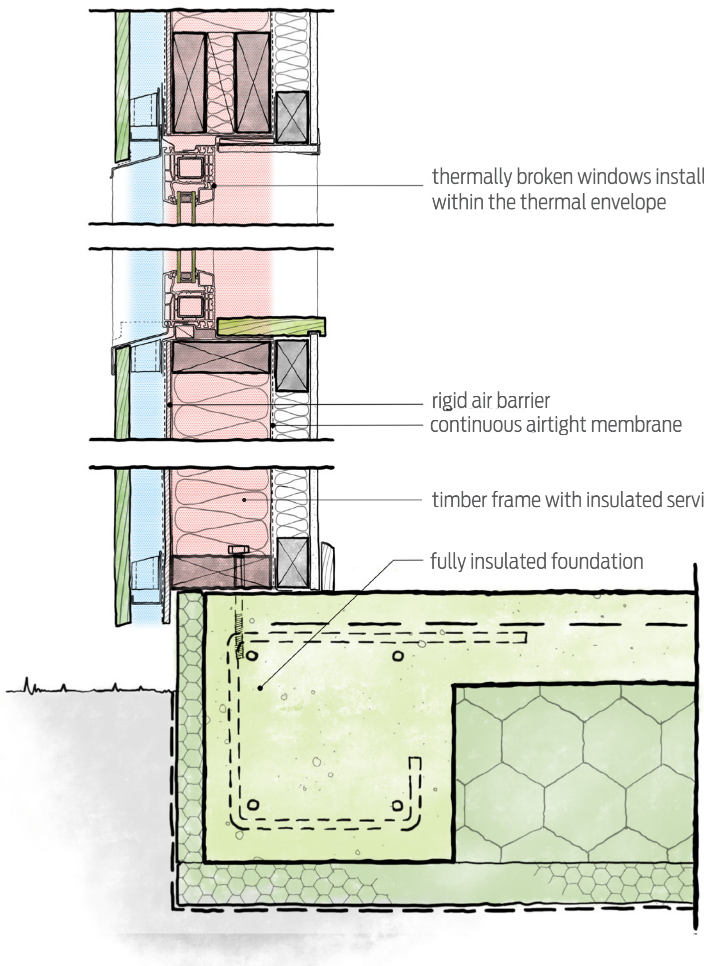

Figure 4: Details from Superhome showing common approaches to achieving higher performance in new-build housing. For more, visit www.superhome.co.nz and explore the newly released *Healthy Home Design Guide*.

For more Find report ER53 *Measuring the extent of thermal bridging in external timber-framed walls in New Zealand* at www.branz.co.nz/pubs.

For further information on how a house can achieve a high-performance and zero-energy status, see www.zeroenergyhouse.co.nz.

To keep up with the latest developments of this research, see www.beaconpathway.co.nz.