Modelling higher thermal performance

To get better thermal performance in new homes, designers should look at details such as junctions and penetrations with the use of readily available calculation tools for whole-of-building assessments.

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RECENT BRANZ-funded research by Beacon Pathway identified a consistent trend in the amount of excess framing we are seeing in new builds, with the average building in the sample having a total of 34% of the wall as framing (see *Moving beyond the bridge* in *Build* 182).

More timber framing, more heat loss

While it could be argued that simple measures like reducing the use of dwang/nogs will drastically reduce the amount of timber, the Beacon report indicates there is no magic bullet. It found much of the timber identified was there for valid reasons, and as a best case, this could be brought down to about 25% - still substantially more than current assumptions.

As timber has greater thermal conductivity than the surrounding insulation, this raises questions around the real-world thermal performance new builds are achieving. What are the options to do better?

Use realistic timber fractions in design

To deliver better buildings, the first step is measuring what is currently done, then changing practice to improve the situation.

This starts with more realistic timber fractions being used at the design stage, which allows for a more accurate assessment of what we're delivering. Should it fall short of the design intention, it's much more cost-effective to put it right at this stage than further through the build process.

Change coming

The recent MBIE Building Code clause H1 consultation and *Building for climate change* (BfCC) work have signalled the government's intentions over the coming years.

What is now needed is a clear roadmap for this change. From there, a set of tools and education is paramount to enable as smooth a transition as possible for industry - particularly given the affordability of housing at present.

Kāinga Ora - Homes and Communities has indicated its intention to lead the industry in this space by building dwellings that go significantly above Building Code (see *Latest evolution in state housing* on page 48). Given the size of their build programme, it could pave the way for many to follow.

High-performance details project

In parallel with the Beacon report, a Building Research Levy-funded research project is underway in conjunction with Passive House

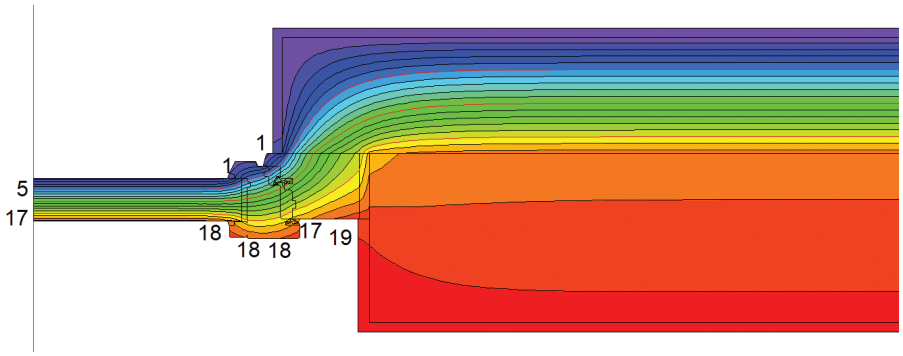

Figure 1: An example window/wall junction exported from the Flixo software package.

Institute New Zealand (PHINZ) to create a resource of practical ways to deliver better performance. This work is documenting a range of higher thermal performance details that will culminate in the PHINZ *High-performance construction details handbook* (a draft version is available on the PHINZ website).

This is going to be a useful resource for anyone looking to build assemblies that perform significantly above current Building Code. It will give several useful parameters to assess the performance of the whole building.

It's not just about R-values

While improving R-values will make some difference, there comes a point where the influence of other aspects of the building limit how far this can take you. Weak points in the building's thermal performance can undermine the performance of the building as a whole or create a point in the building at higher risk of condensation or mould growth.

Higher R-values mean that junctions and penetrations begin to have a larger influence on real-world thermal performance. Accounting for these will need to become the norm to meet the end goals of BfCC.

Thankfully, small changes can make a big improvement, so it doesn't need to be arduous. By building the thermal envelope well, the cost of heating and ventilating becomes much less, leading to a healthier building that costs less to run.

Whole-of-building assessment will become common

To achieve these outcomes, industry will need to think about heat loss in a different way to current practice. Heat losses through junctions (linear transmission or psi values, ψ) and penetrations (point transmittance or chi values, χ) are not too difficult to account for. Don't get hung up on the notation - the important thing to take away is the following.

Psi and chi are the heat loss coefficients per metre of length or per penetration. Given the length of a junction or the number of penetrations, the impact on the heat loss can be calculated. Both measures can be thought of like an R-value - though, in this case, smaller are better as they are a coefficient for heat flow, not a thermal resistance.

They are calculated for a junction using software like Therm or Flixo (see Figure 1) and, once calculated for a detail, can be used in a relatively straightforward way. Typically, this would be by following an ISO standard, a monthly balance tool (such as the Passive House Planning Package or Homestar ECCHO (Energy and Carbon Calculator for Homes) from the NZGBC) or even dynamic tools like the whole-of-building version of WUFI, WUFI Plus.

Need thorough performance assessment

If we are demanding a high-performance building, a detailed assessment is a must. Simply adding insulation does not provide heat - the balance of heat losses and gains is more important.

Assessing a design holistically - as opposed to using something like the schedule method - enables the risk of overheating to be tested. The risk of overheating - and therefore high cooling demand - is strong in our relatively mild climate, particularly in our northern cities. Mitigating this risk is critically important as we ramp up levels of insulation, especially given the prevalence of large amounts of glazing.

Result will be better outcomes

As we move towards assessing thermal performance in a more detailed way, it will demand some additional work by the industry. By providing the right tools, however, the impact on workflows can be minimised. That said, significant upskilling of industry will be needed to maximise the benefits.

Whole-of-building assessment will lead to much more comfortable, healthy buildings year round. The quicker these methods are adopted, the better the long-term outcomes for the nation.