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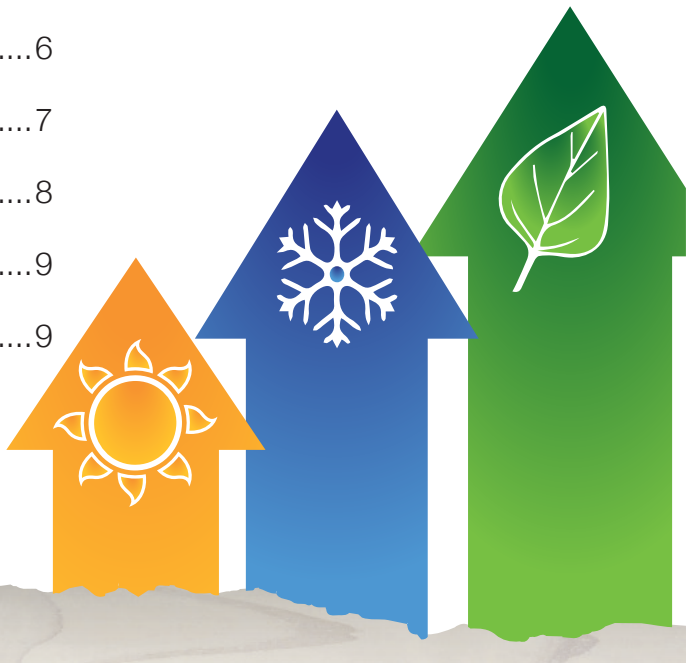
H1 Special Bulletin | November 2022



H1 Special Edition | 2022

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H1 Energy Efficiency - Our Challenges and Opportunities

The new H1 Energy Efficiency requirements herald an entirely new approach to how houses will be designed and built in New Zealand. What seems like a relatively simple lifting of insulation values is precipitating rapid change throughout the industry.

There are plenty of reasons to be critical of MBIE's introduction of the new H1 Energy Efficiency requirements. It is a classic case of changes leading to unintended consequences. New house construction is going to cost more, and there is a very real risk unhealthy, inefficient, and uncomfortable homes will be built. And actually, we were building warm, healthy homes before these changes.

While new rules for calculating thermal bridging creates a challenge for framed wall systems, the Lockwood 107 insulated wall system stands out for continuing to surpass the new requirements.

NZ Door and window joinery is experiencing a seismic industry shift. Thermally-broken doors and windows don't look very different from the outside, but the fabricating process is much more complex. Lockwood has had a fair amount of experience manufacturing thermally broken joinery, but plenty of NZ fabricators have not had any. The required upskilling is significant.

Don't mind the fact that NZ window and door joinery is for the most part installed outside the thermal envelope, greatly reducing the performance of thermally broken joinery. Lockwood joinery installation details mean our homes get the full benefit of thermally broken joinery. This is an important advantage we have over other building systems.

Significant investment is being made to establish uPVC joinery in NZ . The superior thermal performance and touted environmental advantage of uPVC has encouraged all the major aluminium joinery extruders to bring uPVC systems to market . It will be very interesting to see how the uptake of uPVC joinery goes in the next few years.

For reasonably standard trussed roofs, the new R6.6 requirements seem pretty straight forward, but the allowance to have less insulation around the exterior wall perimeter undermines the whole point of these changes and could have the unintended consequence of providing a pathway for moisture. Roof ventilation will need to be carefully considered and installed.

Warmer building elements may potentially create an ideal environment for mould, posing a whole new order of risk in new homes. It's the most talked-about topic amongst those in our industry who dabble in the dark art of building science. Failure to mitigate internal moisture in design and performance will easily lead to unhealthy homes.

The entire building envelope is affected by changes, the sum of which commands new attention to the details and design of new homes. Variables of location, orientation and exposure can show significant differences in thermal performance modelling.

For many homes, too much heat gain is likely, and the use of deeper eaves or shade battens on solar-exposed aspects will need to be considered. Mechanical ventilation is poised to be a more common option specified in new homes.

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Lockwood's biggest challenge is our H1 solution for skillion roofs. A tremendous amount of work has been put in, particularly from Jeff, Jack and Michelle to investigate and design a high-performance solution using I-Rafters. We're confident our solution will be cost effective and easy to build.

We've been very lucky to have Jeff Parker on board at this particular moment in our history as his contribution to the development of our I-rafters has been tremendous.

Our recently retired engineer Lindsay West lent his genius to lead the design and construction of our own I-rafter assembly machine. We've completed a proof-of-process run, and we are now ready for a production test run in the next few weeks.

Within the next few months, once we've completed our testing program to determine the strength of our I-Rafters , we'll be ready to go into full production.

Whilst our focus is on the supply of I-Rafters for Lockwood projects, there is a potential opportunity to supply I-beams to the rest of the market. Lockwood is only the third timber processor in NZ to set up I-Beam manufacturing, and with demand for I-beams set to grow exponentially, we are already fielding interest from merchants and construction suppliers.

Lockwood will continue our tradition of being a leader in high performance building. We are embracing these changes using building science and innovation as a basis for good solutions for warm, healthy homes.

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Using PIR foam insulation for skillion roofs

PIR foam board is an option for skillion roofs – but presents some challenges.

Using 240 x45 solid rafters @ 600 or 900 centres, coupled with 2 x 100mm PIR foam board will, on the face of it give you a compliant H1 roof structure. But thermal bridging through the rafters and nogs will undermine thermal performance.

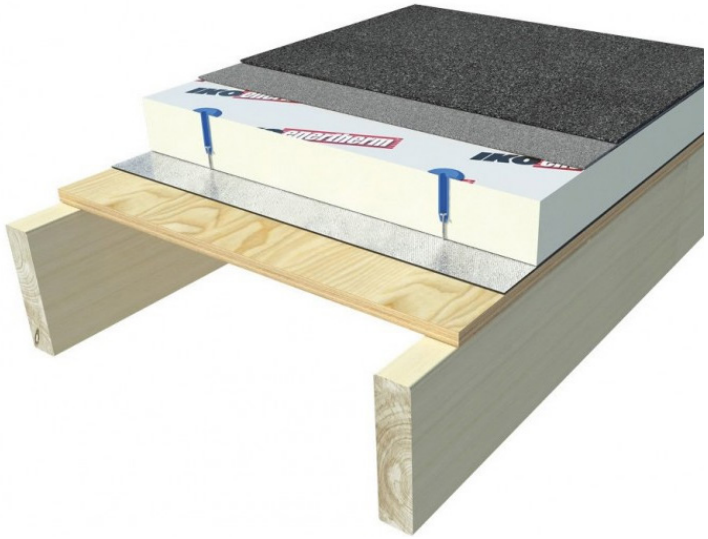
The cost of PIR foam board is significant. On a 135m2 Lifestyler, R7 Ultra batts will cost around $3,900; PIR Foam will cost around $14,000. Plus, whereas the cost of batts is ex-local merchant, PIR will incur ex-supplier freight costs.

The installation of PIR foam between solid rafters is a challenge. 240x45 rafters are heavy, and dimensional variations in the timber will make tight fitting of insulation tricky.

In fact, BRANZ has gone so far as to note this issue in its Issue 677 Bulletin “Specifying Roofs under H1” (October 2022):

5.0.3 *Rigid insulation products used with framed construction should be used in a continuous manner. It is too difficult to cut accurately and not create a pathway for moisture – air leaks around the perimeter – but very little drying capacity going back the other way.*

In other words, PIR foam boards need to be installed OVER the rafters, not between.



BRANZ cites a recent MBIE determination as an example of potential problems.

PIR foam board fitted between rafters for a skillion solution can be done. It is expensive, correct installation is tricky, and creates a risk of moisture, mould, and rot. BCA’s are likely to put such an approach to skillion roof design under intense scrutiny throughout the consenting and building process.

For these reasons, we are not supporting this approach as a Lockwood solution.

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The Blower Door Test

We recently commissioned Pro Clima to carry out a series of blower door tests on our Lifestyler show home to test the relative air-tightness of our building system.

The tests gave us some interesting results. Under negative pressure we could feel distinct drafts in certain places. Under positive pressure, and with the aid of a fog machine, we could see ventilation and air leaks.

Under negative pressure, we could feel drafts of air through power points.

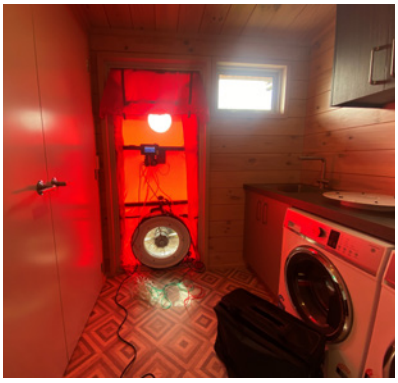
Under positive pressure we could see quite strong air leaks around particular downlights. In a couple of places, the air leak was so strong we could see a vortex form around the downlight.

Our designed passive ventilation at the window and door heads are working as intended (faint tendrils of fog could be seen passing through and out under the exterior head flashings).

We saw no leaks through wall boards or junctions.

The blower door test showed an average of 8 changes of air per hour. Whilst this proves we have a healthy level of passive ventilation in the system, it also highlighted we have a few unintended air leaks associated with power points and down lights / penetrations in the roof.

The leaks around downlights gives cause for some concern, as this could lead to moisture being trapped in the roof. Both power points and roof penetration leaks can be minimized with better detailing and installation of appropriate products, and this is an area we'd like to do some more work on.



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Schedule vs Calculation vs Modelling.

There are three methods to show compliance with the new insulation requirements outlined in the H1 revision.

The Schedule Method

This is the easiest method of compliance and just involves following the required R-Values listed in H1.

Pros – it is easily the most straight forward

Cons – Using the schedule method blindly without careful consideration of other design factors poses a risk of creating buildings that do not perform well and are at risk of moisture-related issues.

The Calculation Method

This Method calculates the average heat loss of your building based on its overall envelope and the R values listed.

The result is compared to the heat loss expected from a reference building constructed using the schedule method. The specified building will comply if the calculation method shows less heat loss than the reference building.

Pros – The H1 Calculators are relatively straight forward to use and are not time consuming. With appropriate use can create a desirable outcome.

Cons – the calculation method is exploitable. Improper use can lead to a building that complies on paper but would likely perform poorly.

The Modelling Method

This method requires the use of detailed software that models your building envelope, location, orientation and exposure to calculate the total energy usage for heating and cooling.

The result is compared to the energy use of a reference building using the schedule method. The modelled house will comply if it uses less energy than the reference building.

Pros – This method provides a detailed context of how your building performs through the year and lends itself to optimizing your building and its total energy consumption

Cons – This method is time consuming and would need to be adopted as part of the initial design stage. It also has a strong weighting on solar performance of glass, which renders some glazing options non-compliant.

We are using Speckel to gain a deeper understanding of the benefits and limitations of how different H1 solutions model. Modelling is likely to be more widely used in the future, especially if Building for Climate Change initiatives come in to effect.

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More about modelling

The modelling method produces results by calculating the total power usage on heating and cooling throughout the year. It runs this using the building layout and R-values reflective of the schedule method as a reference, then again using your proposed parameters. Your model is considered to meet compliance if the total power usage is lower than that of the reference building.

The Models

We used the Lakeview plan to model a variety of H1 solutions and scenarios and measured the effect of these variables.

These variables included location, orientation and exposure in tandem with different H1 solutions for floor, joinery, and roof R-values, as well as the Solar Heat Gain Coefficient (SHGC) of glazing. These were run in regular intervals individually and then to reflect each combination of our current joinery and glazing options.

Solar Heat Gain Coefficient (SHGC)

By far the most surprising result we found from Speckel modelling was how much SHGC effects the performance of the building.

Where changing other variables made a difference of between 0.8 and 2.4 Total Kilowatts/m², changing the glazing type made a total difference of 82.4 Total Kilowatts/m².

This result highlights how glazing is a significant factor in the total envelope performance. Performance glazing options can open up an opportunity of reducing R values in other areas of the envelope for a building that will still perform better than the reference building.
We are moving to the next stage where we will perform a more direct analysis on three different plans on three different sites (nine total) over zones 1, 4 and 5.

With that we will be able to provide well rounded advice to each of our contractors for their more specific conditions.

An issue with Low-E Xcel

One thing that must be noted by anyone looking to meet compliance with the modelling method is that the reference building specified by MBIE contains a glazing SHGC of 0.57.

This essentially renders Low-E Xcel (with an SHGC of 0.62) unusable as no model we have produced in this study could outperform the reference building while using an SHGC higher than the reference.

The Low-E Max and Low E Xtreme options from Metro glass have lower SHGC's than Low-E Excel and are a better option.

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Skillion Roof System

The Lockwood I-Rafter skillion solution offer clear advantages over solid timber rafters. We are taking on board what we learnt from building the Fieldays Lakeview using 300mm Rafters to further improve our detailing and buildability, and advance the development of a Lockwood skillion solution using I-Rafters.

We simply can't imagine future Lockwood homes without the distinctive high vaulted ceilings that are such an integral part of Lockwood architecture, and so highly valued by Lockwood owners.

- I-Rafters are considerably lighter than solid timber
- We can supply up to 12 metre lengths (less nogs and joins)
- We will manufacture house lots to specified lengths = less waste
- Dimensionally accurate and straight
- Thermal bridging is minimal in comparison to solid timber
- Big spans possible – over 6 metres is achievable, meaning fewer intermediate beams are possible
- I-rafters + R7 batts exceed R-6.6 at both 600 and 900 centres
- We should be able to manufacture I-Rafters to match the depth of the insulation (260mm for R7 Ultra batts), so overall roof depth will be less
- Metal barge and facsia can be used for lower maintenance

In addition, we are incorporating features to mitigate moisture and allow for roof ventilation.

One of the components we are interested in integrating is Solitex Mento 1000. This is a weathertight and airtight weather resistive barrier fitted over the insulation and I-rafters, protecting the roof and building envelope during construction whilst allowing any internal moisture to escape.

Pictured Right: Solitex Mento 1000 would replace self-supporting roof underlay and Thermakraft Vapourshield.

Ventilation will be provided by a 25mm batten over the Solitex Mento 1000 barrier and on the I-Rafters

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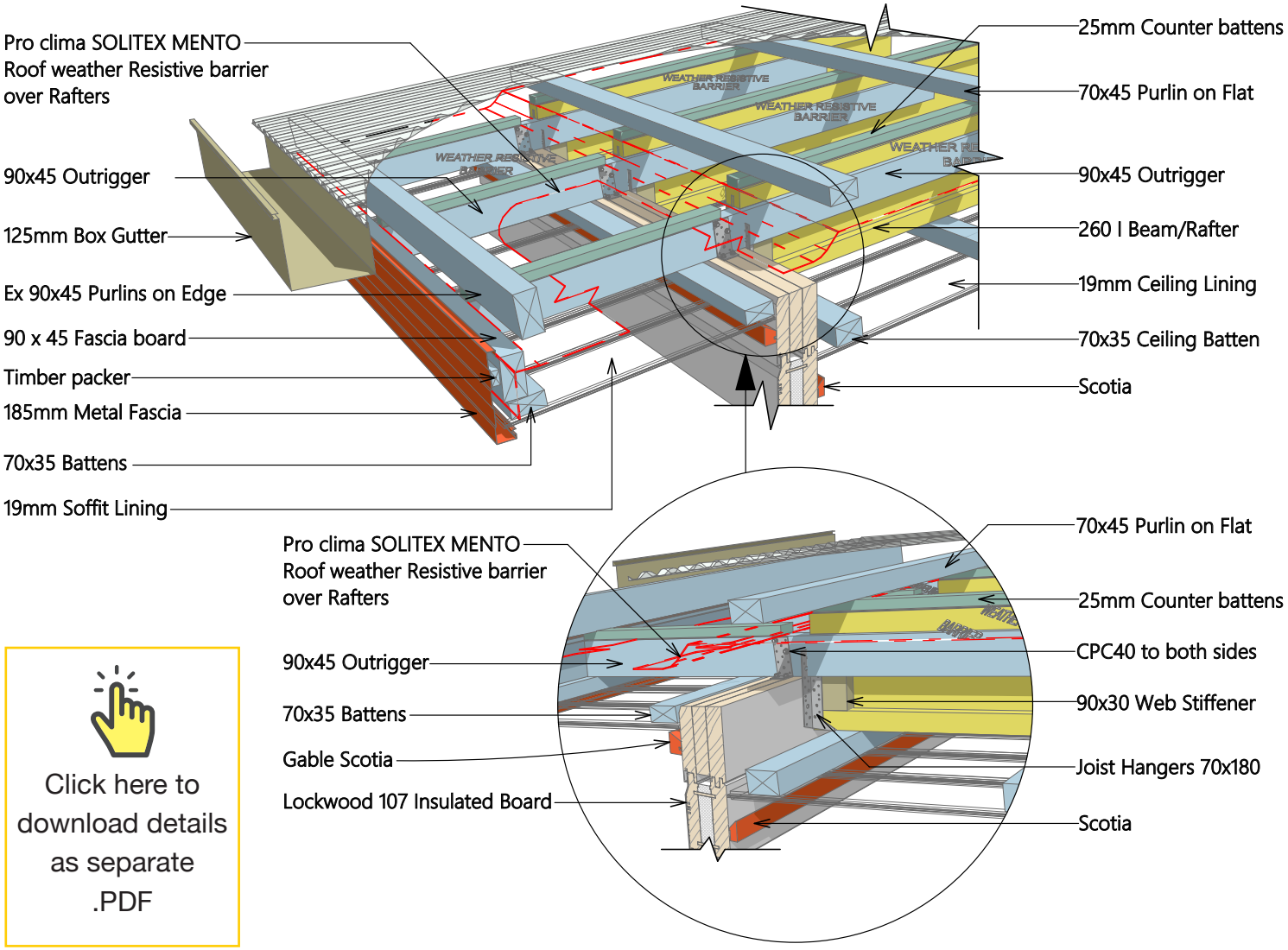
3D I-Rafter Soffit Detail



Click here to download details as separate .PDF

We want your feedback!

Please feel free to contact us if you have any questions concerns or suggestions. We can arrange to have a group Video Conference if there is enough interest to do so.

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