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H1 compliance and construction R-values

Designers have several options for achieving construction R-values that prove compliance with clause H1 *Energy efficiency*.

At a glance

- Increases in construction R-value requirements to prove compliance with H1/AS1 and H1/VM1 have created challenges.
- Skillion roof structures can be particularly problematic when using the schedule method of proving compliance.
- The calculation and modelling methods of proving compliance are options that give designers more flexibility.
- The calculation and modelling methods allow a reduction in R-value of one building element when compensated for by increases in R-values of other elements.
- The calculation and modelling methods are also useful for designing buildings to perform beyond Code.

Recently introduced increases in construction R-value requirements when using H1/AS1 and H1/VM1 to prove compliance with Building Code clause H1 *Energy efficiency* have created some challenges in both design and construction.

Increase in construction R-values for roofs

One change that has caused much discussion is the increase in the construction R-value requirement for roofs (H1/AS1 Table 2.1.2.2B) to a minimum of R6.6 across all six climate zones in Aotearoa New Zealand.

The challenge in designing to meet this requirement lies in accommodating the thickness of common bulk insulation materials required to achieve the minimum thermal performance within common roof assemblies.

A concession for assemblies with roof spaces where the insulation is installed

over a horizontal ceiling – framed/truss roofs – has been incorporated into the new requirements.

This reduces the construction R-value to R3.3 for a distance of up to 500 mm from the outer edge of the ceiling perimeter where space restrictions within the roof structure make it difficult to incorporate the thickness of insulation required for R6.6.

However, no concession is made for skillion roof construction where incorporating the required insulation thickness is challenging and can lead to significant increases in the required depth of the roof structure.

The capacity for skillion roofs to incorporate the required thickness of insulation also varies with skillion roof typologies and depends on where the ceiling lining is.

If the ceiling is on the underside of the rafters, there is more capacity within the structure as the depth available for insulation is formed by the combination of rafter and purlin depth.

Where the ceiling is installed on top of the rafters – with the rafters exposed – the depth available for insulation is formed only by the purlin depth. This has led to a significant increase in the overall depth of skillion roof assemblies that use bulk insulation to meet the minimum construction R-value of R6.6 – often proving incompatible with design.

Options for designers

What is often overlooked, however, is that the minimum construction R-value figures for roofs, walls, exterior joinery and floors in Table 2.1.2.2B only need to be met when proving compliance using the schedule method.

Designers have the option to incorporate elements with different construction R-values when using the calculation or modelling methods to prove compliance.

These methods allow for a reduction in the construction R-value of one building element such as the roof when it is compensated for by increasing the construction R-value of other building elements such as the walls.

Let's have a look at each of the methods of proving compliance and the options they provide for varying construction R-values.

H1 compliance with H1/AS1 and H1/VM1

The schedule method is incorporated in H1/AS1 and uses the minimum construction R-values in Table 2.1.2.2B.

The calculation method is also incorporated in E2/AS1 and uses heat loss calculations to compare the thermal performance of the proposed building with a compliant reference building. This method allows different construction R-value combinations to those in Table 2.1.2.2B.

The modelling method is incorporated in H1/VM1 and is a more comprehensive methodology that compares the thermal performance of the proposed building with a compliant reference building. This method also allows different construction R-value combinations to those in Table 2.1.2.2B.

Schedule method

Using the schedule method, building elements must meet or exceed the minimum construction R-values in Table 2.1.2.2B. To use this method, you need to know the construction R-values of the building's roof, walls, exterior joinery and floor.

There are also some restrictions around the use of this method:

- Total glazing area must be 30% or less of the total exterior wall area.
- Total glazing area of the west, east and south-facing walls must be 30% or less of the total area of these walls.
- Skylights must be less than the greater of 1.5 m² or 1.5% of the total roof area.
- Opaque external door area must be less than the greater of 6 m² or 6% of the total wall area.

This method is often the default method for proving compliance as it is very straightforward to implement, requiring the building to be designed to the minimum requirements in the table.

However, it does not allow the designer to reduce the construction R-values below the tabulated figures, which can potentially be difficult to comply with – particularly with roof construction.

Calculation method

The calculation method uses heat loss calculations to compare the thermal performance of the proposed building with a compliant reference building where the heat loss of the proposed building must be less than that of the reference building.

The reference building must have the same external envelope area as the proposed building, and each building element in the reference building must have the minimum building element construction R-values from Table 2.1.2.2B.

However, the construction R-values for the proposed building can be different to those of the reference building if the proposed building performs at least as well as the reference building with respect to heat loss.

There are also some restrictions around the use of this method:

- The construction R-values for roofs, walls and floors of the proposed building must be at least 50% of the construction R-value for the corresponding building element in the reference building, which is based on Table 2.1.2.2B.
- The glazing area of the proposed building must be 40% or less of the total wall area
- Where building elements in the thermal envelope of the proposed building incorporate heating systems, the construction R-value of these elements can't be reduced below those in Table 2.1.2.2B.

This method allows the designer some flexibility. For example, the construction R-value for the roof could be reduced by increasing the R-value of other building elements such as walls, exterior joinery and floor to ensure the overall heat loss of the proposed building is less than that of the reference building.

The calculation method is useful where design and construction parameters make it difficult to comply with the minimum construction R-values in Table 2.1.2.2B.

It is also useful for looking at options incorporating higher levels of insulation to create buildings that perform beyond Code.

Modelling method

The modelling method uses computer modelling as described in H1/VM1 Appendix D to assess the energy performance of the proposed building. The computer model simulates the building's thermal performance to predict both heating and cooling loads.

The results are then compared with the space heating loads and cooling loads of a reference building. The reference building must be the same shape, dimensions and orientation of the proposed building and the same simulation method must be used as for the proposed building. The building elements of the reference building must have construction R-values from Table 2.1.2.2B (as per the schedule method).

To prove compliance, the simulation must show that the sum of the annual space heating load and annual cooling load of the proposed building does not exceed that of the reference building.

The modelling method is useful for getting a much more detailed understanding of the thermal performance of the proposed building and it also allows for defining the performance of different construction R-values for any of the building elements.

This enables a wider range of comparisons and gives the designer flexibility to lower some construction R-values and increase others to compensate.

It is also useful for looking at options incorporating higher insulation levels to create buildings that perform beyond Code.

Thermal modelling tools

There are several third-party thermal modelling tools available for proving compliance as well as organisations that will carry out modelling on behalf of the designer.

BRANZ tools

The H1 Hub on the BRANZ website has a range of information and incorporates several useful tools. These include the BRANZ calculation method tool, which provides a format for easy use of the calculation method for proving compliance, and the BRANZ *House insulation guide,* which can be used to find the construction R-value of common building elements and assemblies.

BRANZ Bulletin 684 *Thermal modelling tools for houses* looks at the thermal modelling tools that are available for residential dwellings.

Further information

While it may be difficult to design a compliant building using the schedule method, don't overlook the calculation and modelling methods as design and construction options allowing combinations of building elements with higher or lower construction R-values to be used.

Keep in mind, too, that Aotearoa's overall energy efficiency standards are relatively low in international terms and these methods can be used to design buildings to perform beyond Code.

FOR MORE

Visit the BRANZ H1 Hub

See the BRANZ *House insulation guide*