BRANZ

ISSUE 676 BULLETIN

COMPLYING WITH H1 – HOUSING, AND BUILDINGS UP TO 300M²

October 2022

- From 3 November 2022, anyone using H1/AS1 and/or H1/VM1 for building consent applications can no longer use the 4th edition but must use the 5th edition amendment 1.
- The way R-values are calculated for slab-on-ground floors and windows, doors and skylights has changed, and there are now six climate zones.
- This bulletin gives guidance around demonstrating compliance with H1 using H1/AS1 and H1/ VM1 5th edition amendment 1. It updates and replaces Bulletin 668.

1 INTRODUCTION

1.0.1 The Ministry of Business, Innovation and Employment (MBIE) is changing the minimum thermal performance requirements for compliance with New Zealand Building Code clause H1 *Energy efficiency*. From 3 November 2022, anyone using Acceptable Solution H1/AS1 and Verification Method H1/VM1 for building consent applications can no longer use the 4th edition documents but must use the 5th edition amendment 1.

1.0.2 The revised H1/AS1 and H1/VM1 apply to all housing (including medium-density housing, apartment buildings and other multi-unit housing) and buildings other than housing up to 300 m². For buildings other than housing over 300 m², a new H1/AS2 and H1/VM2 apply. This bulletin only covers the changes that apply to housing, and buildings other than housing up to 300 m². Where this bulletin refers to H1/AS1 and H1/VM1, it is referring to the 5th edition amendment 1.

1.0.3 The changes are significant, especially for roofs, windows and floors. MBIE says that the new insulation requirements aim to reduce the energy needed to heat new homes by up to 40% compared to the previous requirements.

1.0.4 There is a staged implementation for some of the new requirements – see section 2 and Table 1.

1.0.5 The updated H1/AS1 and H1/VM1 no longer cite NZS 4218:2009 *Thermal insulation – Housing and small buildings*. They now contain all the relevant content themselves.

1.0.6 Designers still have the schedule, calculation and modelling methods in these documents that they can use to demonstrate compliance with clause H1 in their building consent applications (see section 3). The schedule and calculation methods are found in H1/AS1 and the modelling method in H1/VM1.

1.0.7 The requirements for working out the thermal resistance and construction R-value of windows, doors, skylights and slab-on-ground floors have been revised. Guidance for windows and doors is given in Appendix E in the documents and guidance for slab-on-ground floors in Appendix F.

1.0.8 As before, the specific requirements vary around the country, with areas of colder climate typically requiring higher construction R-values than warmer locations. There are now six climate zones, outlined in Appendix C in H1/AS1 and H1/VM1. There is a map (Figure 1 in this bulletin) and also a table showing which climate zone applies to each territorial authority.

1.0.9 Calculating the building performance index (BPI) by itself will no longer be sufficient to demonstrate compliance with clause H1.3.1(a) (that the building envelope provides adequate thermal resistance).

1.0.10 Just specifying materials with the appropriate R-value is not enough to comply with the Building Code. Insulation must be installed in a way that achieves its intended thermal performance. NZS 4246:2016 *Energy efficiency – Installing bulk thermal insulation in residential buildings* sections 5, 6, 7 and 10 are directly referenced as providing acceptable methods for installing bulk thermal insulation in light timber-framed and steel-framed residential buildings.

1.0.11 BRANZ has produced a range of supporting material to help in compliance with the new H1 requirements. They include a 6th edition of the BRANZ *House insulation guide*. (The 5th and earlier editions of the BRANZ *House insulation guide* cannot be used for calculating construction R-values under H1/AS1 and H1/VM1 5th edition amendment 1 because of the way some methods of assessing R-values have changed.) For more details, see section 8.

1.0.12 For full details of the new requirements in H1/AS1 and H1/VM1, refer to MBIE's Building Performance website www.building.govt.nz/building-code-compliance/h-energy-efficiency.

2 THERMAL PERFORMANCE REQUIREMENTS

2.0.1 The new minimum construction R-values for the schedule method are shown in Table 1. (These are also the figures that apply to individual building elements of the reference building using the calculation method.)

2.0.2 Where building consent applications for housing are submitted before 1 May 2023, roof, wall and floor minimum construction R-values can be equivalent to the previous (4th edition) requirements. Take note, however, that the new H1/AS1 and H1/VM1 include new

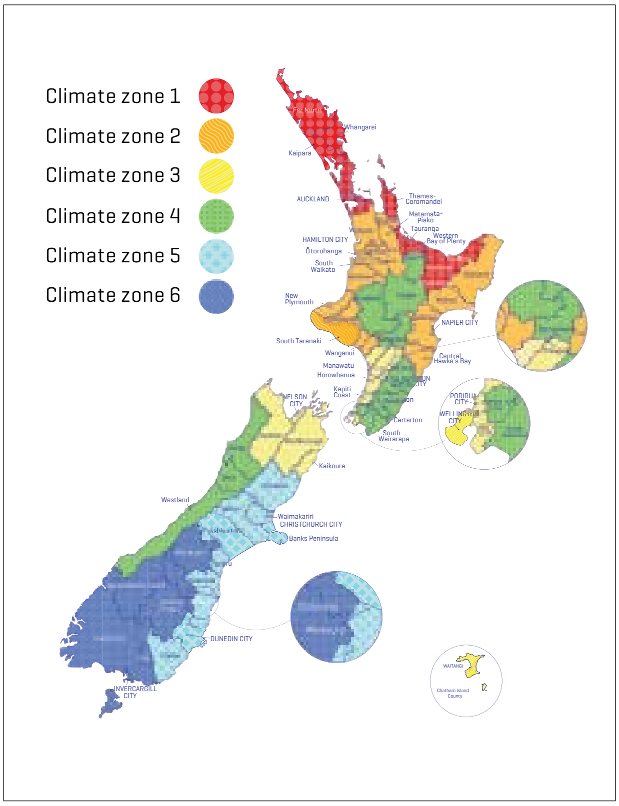

Figure 1. The six climate zones. © MBIE, H1/AS1 5th edition amendment 1.

methodologies for establishing the thermal resistance of windows, doors, skylights, curtain walling and slab-on-ground floors. With the exception of slab-on-ground floors, from 3 November 2022, only the new methodologies can be used.

2.0.3 All window and door construction in new housing has a two-step increase. The first step is a minimum construction R-value of R0.37 for the whole country from 3 November 2022. After that, the date of the second step varies by climate zone:

- From 1 May 2023, the minimum R-value rises to R0.46 in climate zones 3 and 4 and to R0.50 in climate zones 5 and 6.
- From 2 November 2023, the minimum R-value rises to R0.46 in climate zones 1 and 2.

2.0.4 For the period of 3 November 2022 to 1 May 2023, skylights in housing will have the same minimum R0.37 requirement as windows and doors. Starting on 1 May 2023, the minimum R-value for skylights will be R0.46 in climate zones 1 and 2, R0.54 in climate zones 3 and 4 and R0.62 in climate zones 5 and 6.

2.0.5 The new minimum R-values apply to all buildings up to 300 m² other than housing from 3 November 2022, with the exception of windows and doors in climate zones 1 and 2. With these, the requirement is R0.37 from 3 November 2022 and R0.46 from 2 November 2023.

3 SCHEDULE, CALCULATION AND MODELLING METHODS

3.1 SCHEDULE METHOD

3.1.1 Under the schedule method in H1/AS1, each element of a building (floor, walls, roof, windows and doors, skylights) must meet (or preferably exceed) a specific level of thermal performance, stated as a construction R-value (see Table 1). The schedule method can only be used to demonstrate compliance with H1 where:

- the glazing area is 30% or less of the total wall area
- the combined glazing area on east, south and west-facing walls is 30% or less of the total wall area of these walls
- the skylight area is no more than 1.5 m² or 1.5% of the total roof area (whichever is greater)
- the opaque door area is no more than 6 m² or 6% of the total wall area.

3.2 CALCULATION METHOD

3.2.1 The calculation method in H1/AS1 compares the thermal performance of the proposed building with that of a reference building. (The requirements for each building element in the reference building are the same as those in the schedule method, except for

Table 1. Implementation dates for new schedule method minimum R-values for unheated building elements for housing in H1/AS1 and H1/VM1 5th edition amendment 1.

<table>
<tr><th rowspan="2">Options</th><th colspan="6">Climate zone</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th></tr>
<tr><td colspan="7">Roofs</td></tr>
<tr><td>Current minimum requirements</td><td colspan="2">R2.9</td><td colspan="2">R2.9/3.3</td><td colspan="2">R3.3</td></tr>
<tr><td>From 1 May 2023</td><td colspan="6">R6.6↑</td></tr>
<tr><td colspan="7">Walls</td></tr>
<tr><td>Current minimum requirements</td><td colspan="2">R1.9</td><td colspan="2">R1.9/2.0</td><td colspan="2">R2.0</td></tr>
<tr><td>From 1 May 2023</td><td colspan="6">R2.0↑</td></tr>
<tr><td colspan="7">Floors</td></tr>
<tr><td>Current minimum requirements</td><td colspan="6">R1.3</td></tr>
<tr><td>Slab-on-ground from 1 May 2023</td><td colspan="4">R1.5↑</td><td>R1.6↑</td><td>R1.7↑</td></tr>
<tr><td>Other floors from 1 May 2023</td><td colspan="3">R2.5↑</td><td>R2.8↑</td><td colspan="2">R3.0↑</td></tr>
<tr><td colspan="7">Windows and doors</td></tr>
<tr><td>Current minimum requirements</td><td colspan="6">R0.26</td></tr>
<tr><td>From 3 November 2022</td><td colspan="6">R0.37↑</td></tr>
<tr><td>From 1 May 2023</td><td colspan="2">R0.37</td><td colspan="2">R0.46↑</td><td colspan="2">R0.50↑</td></tr>
<tr><td>From 2 November 2023</td><td colspan="2">R0.46↑</td><td colspan="2">R0.46</td><td colspan="2">R0.50</td></tr>
<tr><td colspan="7">Skylights</td></tr>
<tr><td>Current minimum requirements</td><td colspan="2">R0.26</td><td colspan="2">R0.26/0.31</td><td colspan="2">R0.31</td></tr>
<tr><td>From 3 November 2022</td><td colspan="6">R0.37↑</td></tr>
<tr><td>From 1 May 2023</td><td colspan="2">R0.46↑</td><td colspan="2">R0.54↑</td><td colspan="2">R0.62↑</td></tr>
</table>

skylights, which are assigned the roof R-value of R6.6 in the reference building. This effectively assumes that the reference building has no skylights.) The proposed building overall must perform at least as well as the reference building, but the roof, wall, floor, window, door and skylight R-value combinations can differ from those in the reference building. The calculation method therefore allows designers greater flexibility – it allows a slightly lower thermal performance in one area if this is offset with greater thermal performance in another.

3.2.2 There are limits to use of the calculation method:

- The calculation method can only be used where glazing is 40% or less of the total wall area. (This is a change from H1/AS1 4th edition where the limit was 50%.)
- The construction R-value for roofs, walls and floors in the proposed building must be at least 50% of the construction R-value of the corresponding building element in the reference building.
- The calculation method cannot be used to reduce the performance of floors, walls or ceilings that have embedded heating systems.
- Acceptable Solution E3/AS1 also specifies minimum R-values for walls, roofs and ceilings. The calculation method cannot be used to provide lower values than these.

3.2.3 BRANZ has spreadsheets available online to help designers use the calculation method and is currently developing an interactive tool. This will have save and store functions and will have validation guidance that will help users enter the appropriate data. It will allow users to produce a PDF with the details building consent authorities require for demonstration of compliance, but the tool goes beyond just demonstrating compliance to creating more-efficient buildings.

3.2.4 The New Zealand Green Building Council also has an interactive calculation method tool and other useful resources on its website www.nzgbc.org.nz.

3.3 MODELLING METHOD

3.3.1 The modelling method in H1/VM1 gives designers the greatest flexibility around demonstrating compliance with H1. Modelling is used to demonstrate that energy use of the proposed building does not exceed the energy use of a reference building in the relevant climate zone. The procedure used is set out in Appendix D in H1/VM1.

3.3.2 Again, there are limits to the use of this method:

- Where a proposed building includes a heated ceiling, wall or floor, minimum construction R-values apply for that particular element.
- Acceptable Solution E3/AS1 also specifies minimum R-values for walls, roofs and ceilings. The modelling method cannot be used to provide lower values than these.

3.3.3 Under H1/VM1 5th edition amendment 1, the modelling method allows use of single-zone monthly heat loss estimation tools such as the Passive House Institute PHPP or the NZGBC ECCHO tool in Homestar. Note that, with multi-unit dwellings, each household unit must be represented by at least one thermal zone.

4 FLOORS

4.0.1 Where building consent applications for housing are submitted before 1 May 2023, the construction R-values for all floors (and walls and roofs) can be equivalent to the 4th edition requirements (Table 1). Up until that date, concrete slab-on-ground floors in housing will still be deemed to achieve a construction R-value of R1.3. While they will still be deemed to comply with the requirement if the R-value is lower than R1.3, the actual R-value (if it is higher) can be used in the calculation or modelling methods.

4.0.2 H1/AS1 and H1/VM1 5th edition amendment 1 have different requirements for slab-on-ground floors and other floors (Table 1). Appendix F in H1/AS1 and H1/VM1 5th edition amendment 1 gives an acceptable method for determining the construction R-values of slab-on-ground floors, with extensive tables in H1/AS1 showing R-values for selected slab floor scenarios.

4.0.3 The tables in Appendix F cover different:

- floor types – slabs or concrete raft foundations
- floor insulation – no insulation, R1.0 vertical edge insulation, R1.2 or R2.4 full cover underslab insulation (under the floor but not under the footing of the external wall), 1.2 m wide strip of R1.2 or R2.4 underslab insulation along the slab perimeter, a combination of edge and underslab insulation
- external wall types – slabs under masonry veneer walls have a step-down, giving different heat transfer characteristics than slabs under other walls, so slabs under masonry walls are treated separately.

4.0.4 The polystyrene pods in a concrete raft foundation floor are not considered to be insulation. Raft floors that have polystyrene pods but no edge insulation and no insulation under the concrete ribs are regarded as uninsulated.

4.0.5 H1/AS1 and H1/VM1 do not require insulation under slab-on-ground footings. Specification of insulation under footings requires specific engineering design.

4.0.6 A significant amount of the slab heat transfer can sometimes be through its vertical edge, so H1/AS1 Appendix F tables include an option of construction with R1.0 vertical edge insulation. (BRANZ research has found that installing edge insulation beyond R1.0 has limited additional benefits.) The insulation, typically XPS (extruded) polystyrene, is assumed to be installed on all exterior exposed vertical faces of the slab from the top edge to the bottom of the footing.

4.0.7 To use the tables in Appendix F, you need to know the slab area-to-perimeter (A/P) ratio and the effective thickness of the external wall:

- The slab A/P ratio is the area of the slab inside the interior surface of the walls that form the thermal envelope divided by the perimeter. Areas outside the thermal envelope such as porches or attached garages are not included in the measurements. The minimum ratio in the tables in H1/AS1 is 1.6. Houses with an A/P ratio below this cannot use the tables and will have to use another approach such as the modelling method.

- The effective thickness of the external wall is measured from the interior wall surface to the exterior concrete slab vertical edge face at floor level. Thicker walls generally have reduced heat transfer, including through the slab, so thicker external walls mean that the slab itself has slightly better thermal performance.

5 WALLS

5.0.1 The minimum wall construction R-value using the schedule method is R2.0 for all climate zones. This effectively allows for continued use of 90 x 45 mm framing timber (albeit only with the best R-value 90 mm wall insulation products – R2.8 @ 90 mm – and a framing ratio of 25% or less).

5.0.2 Where building consent applications for housing are submitted before 1 May 2023, the construction R-values for all walls (and floors and roofs) can be equivalent to the 4th edition requirements (Table 1).

5.0.3 For framed walls, the R-value must include the effects of studs, dwangs, top plates and bottom plates. However, it can exclude the effects of lintels, sills, additional studs that support lintels and sills and additional studs at corners and junctions.

5.0.4 H1/AS1 no longer contains allowances for:
- walls with higher thermal mass, such as solid timber, concrete or masonry as MBIE considers that H1/VM1 provides a better way to determine insulation requirements in these types of buildings – designers of buildings with high-mass walls can still use H1/AS1, but there is no special treatment for high-mass walls
- curtain walling – compliance with this construction method can be demonstrated via H1/VM1 or an Alternative Solution.

5.0.5 A big challenge in the thermal performance of walls comes from high levels of framing that result in large areas of thermal bridging. (For details, see BRANZ research reports ER53 *Measuring the extent of thermal bridging in external timber-framed walls in New Zealand* and ER64 *Thermal bridging in external walls: Stage two*. Designers should aim to minimise thermal bridging in walls as much as possible or reduce its impact with the use of internal or external secondary insulation layers. ER64 includes examples of how thermal bridging can be effectively reduced.

5.0.6 One proven option for reducing thermal bridging and enhancing thermal performance is using battens to create a second wall cavity that can also be insulated (an internal secondary insulation layer or ISL). For more details, see ER70 *PHINZ High-performance construction details handbook*.

5.0.7 The 6th edition of the BRANZ *House insulation guide* now provides data for higher framing ratios than earlier editions of the guide.

6 ROOFS

6.0.1 Under the new H1/AS1, roof construction R-values of R6.6 are required in all climate zones (although, with the calculation and modelling methods, you can reduce the roof R-value by increasing thermal performance in other elements of the building).

6.0.2 Where building consent applications for housing are submitted before 1 May 2023, the construction R-values for all roofs (and walls and floors) can be equivalent to the 4th edition requirements (Table 1).

6.0.3 The requirements make allowance for the fact that the insulation required may be too thick to extend right to the ceiling edge under a sloping roof. In roof spaces where insulation is installed over a horizontal ceiling and under a sloping roof, the R-value may be reduced to R3.3 for up to 500 mm from the edge where there is not enough space for the thicker insulation required to achieve R6.6.

6.0.4 With the schedule method, the ceiling R-value of R6.6 does not need to be corrected for this situation provided the width is no more than 500 mm and the reduced R-value is at least R3.3. If the calculation method is used and different parts of the roof have different R-values, these can simply be included in the calculation as separate roof areas with their corresponding R-values – see H1/AS1 2.1.3.7. Note that, even with the calculation method, the R-value of any part of the roof must not be less than 50% of R6.6, or R3.3. This includes areas around the ceiling edges.

6.0.5 Design of skillion roofs may need to be rethought to ensure the R6.6 performance is achieved. For example, 290 mm rafters may be required rather than 240 mm. Alternatively, the calculation and modelling methods could be used to increase thermal performance of another building element to allow the performance of the roof to be reduced below R6.6.

6.0.6 With the increased roof R-values, designers and tradespeople on site must place significantly more attention to the quality of the ceiling air barrier. BRANZ is already seeing failures from internal moisture-laden air reaching the roof space. Raising the R-value is likely to raise the risk of condensation forming in the roof space due to reduced thermal losses into the roof space void. Condensation can lead to mould growth and potentially to corrosion. It is important to limit the air permeability of ceilings through ceiling linings and to minimise ceiling penetrations for recessed downlights, electrical and plumbing services and ceiling access hatches as much as possible. Where access hatches or recessed downlights are required, specify that they have good seals.

7 WINDOWS, DOORS AND SKYLIGHTS

7.0.1 As noted in 2.0.3, 2.0.4 and Table 1, there is a staged introduction for the new window, door and skylight requirements in housing.

7.0.2 The requirements for working out the construction R-value of windows, doors and skylights in H1/AS1 and H1/VM1 5th edition amendment 1 are given in Appendix E in the documents. Table E.1.1.1 in Appendix E in H1/AS1 is to be used for vertical insulating glazing units (IGUs – double or triple glazing) in housing only. For other building types, use the window calculation method in H1/VM1 Appendix E.

7.0.3 Table E.1.1.1. gives overall area-weighted average R-values from two houselots of windows for each of four different frame types and a range of glazing options. (The numbers were calculated by BRANZ.) The options are:

- framing material – aluminium, thermally broken aluminium, uPVC and timber
- glazing – double or triple pane (single glazing is not an option)
- spacer type – aluminium or thermally improved
- gas fill – dry air, argon or krypton
- glass – low-E (emissivity) with four performance levels or clear glazing
- U-values (in W/m²K) – for the thermal transmittance of the centre of the glazing unit only (U-values are the inverse of R-values)
- R-values (in m²K/W) – for the thermal resistivity of complete windows, accounting for both the glazing and the frames.

7.0.4 The Low-E_1 to Low-E_4 descriptions were developed for the purpose of the clause H1 window table in Appendix E. The numbers indicate different performance levels of low-E coatings from basic to very high.

7.0.5 Guidance for calculating the construction R-value of skylights is given in Appendix E in H1/AS1 and H1/VM1. There is no table showing construction R-values of generic skylights. H1/AS1 and H1/VM1 require skylight R-value calculations to consider the effects of horizontal or angled glazing on the heat transfer. The performance reduction for inclined IGUs means that the values in Table E.1.1.1 in H1/AS1 are not representative of performance values for skylight frame and glazing combinations. Designers and specifiers should check that R-values claimed by suppliers have been determined in accordance with H1/AS1 or H1/VM1 and that they do not represent vertical installation.

7.0.6 There are two minor changes regarding windows and doors using the schedule method in the 5th edition amendment 1 documents from the previous requirements:

- There is no longer a requirement that the total area of decorative glazing and louvres must be 3 m² or less. This is because decorative glazing and transparent/translucent louvres are now subject to the window and door minimum R-values.
- There is a new requirement that the opaque door area is no more than 6 m² or 6% of the total wall area (whichever is greater).

7.0.7 The increase in minimum R-values for windows addresses conductive heat flow, but there is currently no regulation around radiation of heat through glazing. The amount of heat that can pass through glazing by radiation is measured by the solar heat gain coefficient (SHGC). You can read more about SHGC in *Build 189*, April 2022. Architects and designers should pay particular attention to ensuring that the windows they specify do not contribute to a house overheating in summer. BRANZ Bulletin BU656 *Designing houses to avoid overheating* gives guidance.

8 RESOURCES

BRANZ

House insulation guide (6th edition)

Calculation method tool

Schedule method tool

ER70 PHINZ High-performance construction details handbook

BU670 Specifying windows and doors under H1

BU672 Specifying floors under H1

BU676 Specifying roofs under H1

BU678 H1 calculation method – housing, and buildings up to 300 m²

MBIE

Building Code clause H1 Energy efficiency

NZGBC

Calculation method tool

ECCHO (Homestar tool)

PHINZ

Passive House Institute NZ PHPP

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