BRANZ

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BULLETIN

SPECIFYING FLOORS UNDER H1

October 2022

- The 5th edition of compliance documents for Building Code clause H1 *Energy efficiency* increases the minimum thermal performance requirements for floors.
- The 5th edition sets different requirements for slab-on-ground floors and for other types of floors.
- This bulletin guides architects and designers in specifying floor performance that complies with H1/AS1 and H1/VM1 5th edition amendment 1.

1 INTRODUCTION

1.0.1 On 29 November 2021, the Ministry of Business, Innovation and Employment (MBIE) announced changes to the minimum thermal performance requirements for compliance with New Zealand Building Code clause H1 *Energy efficiency*. The 5th edition of Acceptable Solution H1/AS1 and Verification Method H1/VM1 incorporates higher minimum construction R-values for roofs, floors and windows and minor increases for some walls.

1.0.2 The previous Acceptable Solution and Verification Method, H1/AS1 and H1/VM1 4th edition amendment 4, can still be used to show compliance until 2 November 2022. From 3 November 2022, the 5th edition amendment 1 must be used. However, where building consent applications for housing are submitted before 1 May 2023, roof, wall and floor construction R-values can be equivalent to the previous (4th edition) requirements. Up until that date, concrete slab-on-ground floors in housing will still be deemed to achieve a construction R-value of R1.3.

1.0.3 The new compliance requirements separate the minimum thermal performance of slab-on-ground floors from other floors and change the way the thermal resistance and construction R-value of slab floors are calculated.

1.0.4 The 5th edition of H1/AS1 and H1/VM1 has six climate zones, replacing the previous three climate zones.

1.0.5 The 5th edition retains three established methods of demonstrating compliance – the schedule and calculation methods are found in H1/AS1 and the modelling method in H1/VM1.

1.0.6 The new minimum requirements represent a significant change, partly from an increase in required R-values and partly from a change in the method of calculating R-values. Under the schedule method in the 5th edition amendment 1, the minimum thermal performance that applies from 3 November 2022 (for buildings up to 300 m², excluding housing) and from 1 May 2023 (for housing) is:

- for non-slab floors, R2.5 in climate zones 1–3, R2.8 in zone 4 and R3.0 in zones 5 and 6
- for all heated floors, the same as non-slab floors above
- for slab-on-ground floors (unheated), R1.5 in climate zones 1–4, R1.6 in zone 5 and R1.7 in zone 6.

1.0.7 Appendix F in the new H1/AS1 and H1/VM1 gives an acceptable method for determining the construction R-values of slab-on-ground floors, with extensive tables in H1/AS1 showing construction R-values for selected slab-on-ground floor scenarios. The generic types of slabs include raft foundation slabs for the first time. The calculations for the tables were carried out by BRANZ.

1.0.8 The scope of H1/AS1 and H1/VM1 5th edition has changed, now only applying to all housing, and small buildings up to 300 m².

1.0.9 For more details about compliance with clause H1, see MBIE's Building Performance website www.building.govt.nz.

2 FLOOR REQUIREMENTS UNDER H1/AS1 AND H1/VM1 5TH EDITION

2.0.1 The new minimum construction R-value requirements are shown in Table 1. (In H1/AS1, they are for the schedule method, and in H1/VM1, they are shown as construction R-values for the reference building used in the modelling method.) The construction R-value is the total thermal resistance of all the physical elements that make up a floor (including the insulating effect of the ground under slab-on-ground floors) but ignores the effects of floor coverings such as carpets.

2.0.2 Where part of a concrete floor is in contact with the ground and part suspended, the part in ground contact must be treated as a slab-on-ground floor and the other part treated as an 'other floor' type.

2.0.3 Designers using the schedule method must ensure that the floors (and walls, roof, windows and doors and skylights) meet or exceed certain minimum construction R-values.

2.0.4 The calculation method in H1/AS1, which compares a building with a reference building, allows greater flexibility. Using this method allows the floor insulation level to be different from the schedule method figures, but the building as a whole must perform at least as well as the reference building. For non-heated floors, the construction R-value must be at least 50% of the construction R-value for non-heated floors under the schedule method. The calculation method cannot be used to reduce the performance of floors with embedded heating systems – in these cases, the minimum construction R-values in the schedule method apply.

3 SLAB FLOOR REQUIREMENTS

3.0.1 The construction R-values for selected generic concrete slab-on-ground floors in accordance with their individual area-to-perimeter ratios are shown in a series of

Table 1. Minimum construction R-values required for floors in new building work under the schedule method for all housing, and buildings up to 300 m². Note that these minimum R-values apply to housing from 1 May 2023.

<table>
<tr><th></th><th colspan="6">Minimum construction R-values (m²K/W)</th></tr>
<tr><td></td><td>Climate zone 1</td><td>Climate zone 2</td><td>Climate zone 3</td><td>Climate zone 4</td><td>Climate zone 5</td><td>Climate zone 6</td></tr>
<tr><td>Slab-on-ground floors</td><td colspan="4">1.5</td><td>1.6</td><td>1.7</td></tr>
<tr><td>Other floors and all heated floors</td><td colspan="3">2.5</td><td>2.8</td><td colspan="2">3.0</td></tr>
</table>

tables in Appendix F in H1/AS1. The tables cover different:

- floor types – slab floors or concrete raft foundation floors
- floor insulation types – no insulation, R1.0 vertical edge insulation, R1.2 or R2.4 full cover underslab insulation, 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 – the slab under masonry veneer walls has a step-down, giving it different heat transfer characteristics compared to slab floors with other types of walls, so slabs under masonry walls are therefore treated separately.

3.0.2 The normal polystyrene pods in a concrete raft foundation floor are not considered to be insulation under H1. Raft foundation floors that have polystyrene pods but no additional insulation (such as edge insulation or continuous insulation that also covers the concrete ribs) are regarded as uninsulated.

3.0.3 To use the tables, you need to know the slab area-to-perimeter ratio (see 3.0.4) and the effective thickness of the external wall (see 3.0.8).

3.0.4 The slab area-to-perimeter ratio is the area of the slab inside the interior surfaces of the walls that form the thermal envelope divided by the perimeter, measuring along the interior surfaces of the walls that form the thermal envelope (Figure 1). Areas outside the thermal envelope such as porches or attached garages are not included in the measurements. (H1/AS1 gives a second option for measuring area-to-perimeter ratio (F1.2.4(b)) using the external slab dimensions. The result should be almost identical to the first method.)

3.0.5 Where the actual ratio of the proposed floor is not given in the table, select the construction R-value based on the nearest figure that is smaller. In other words, if the actual ratio is 3.5 but the table only gives 3.4 and 3.6, choose 3.4 to find the R-value.

3.0.6 The greater the area-to-perimeter ratio, the higher the slab-on-ground R-value, everything else being equal. Larger slabs have higher area-to-perimeter ratios and therefore higher R-values than smaller slabs of similar shape and insulation. Square or rectangular slabs have higher area-to-perimeter ratios and therefore higher R-values than irregularly shaped slabs of similar size and insulation.

3.0.7 The minimum ratio shown in the tables is 1.6. Houses with a ratio below this – such as house (b) in Figure 1 with its ratio of 1.24 – would not be able to use the tables as a means of demonstrating compliance with H1. Another approach is required. This could be the modelling method in H1/VM1. You could still use the schedule or calculation methods, but you would need to calculate the R-value of the slab floor using the method in Appendix F in H1/VM1, which is cited by H1/AS1 Appendix F. An Alternative Solution is also possible.

3.0.8 The effective thickness of an external wall on a slab also has a small impact on the thermal performance of the slab. A slab with thicker external walls will have slightly better thermal performance. The thickness of the external walls dictates the location of the interior lining, which forms part of the thermal envelope, in relation to the vertical edge of the floor slab. Thicker walls potentially mean that a reduced amount of heat transfer occurs (including through the slab), and the slab therefore has slightly better thermal performance. The thickness of the external wall is measured from the interior wall surface to the exterior concrete slab vertical edge face at floor level (Figure 2).

3.0.9 Some previous methods of calculating slab-on-ground floor R-values can no longer be used for H1 5th edition, including NZS 4214:2006 *Methods of determining the total thermal resistance of parts of buildings* and the 5th or earlier editions of the BRANZ *House insulation*

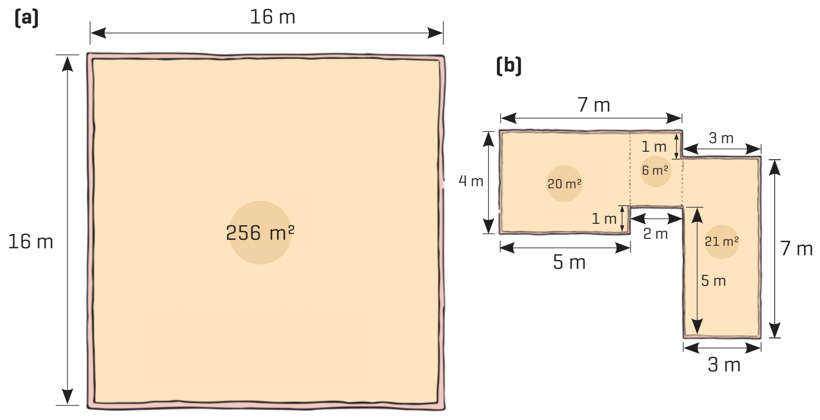

Figure 1. Area-to-perimeter ratio examples. (a) 256 m²/64 m gives a ratio of 4. (b) 47 m²/38 m gives a ratio of 1.24.

guide. The 5th or earlier editions of the BRANZ *House insulation guide* should not be used for calculating slab floor construction R-values under H1/AS1 5th edition because the nominal soil conductivity and internal surface heat transfer coefficient have changed. The 6th edition of the *House insulation guide* takes account of this. The calculation results will change slightly from earlier editions.

3.1 SLAB VERTICAL EDGE INSULATION

3.1.1 Some of the tables in Appendix F in H1/AS1 cover slab construction with R1.0 vertical edge insulation. This addresses the fact that, in some cases, a significant amount of the slab floor heat transfer can be through the slab's vertical edge. The edge insulation is assumed to be installed on all exterior exposed vertical faces of the concrete slab from the top edge and down to the bottom of the footing.

3.1.2 Construction R-values are only given in Appendix F in H1/AS1 for edge insulation of R1.0. BRANZ research has found that there are very limited benefits of installing edge insulation with a higher R-value than this [see BRANZ Study Report SR352].

3.1.3 Slab edge insulation, which is typically XPS (extruded) polystyrene, must be protected against impact damage, ultraviolet light exposure and water absorption.

4 OTHER FLOOR TYPE REQUIREMENTS

4.0.1 As Table 1 shows, the minimum construction R-value requirements for floors other than slab floors (which are likely to be predominantly timber-framed suspended floors) are R2.5 in climate zones 1–3, R2.8 in zone 4 and R3.0 in zones 5–6. In most cases, by far the largest part of this thermal performance will come from the insulation material. Floor coverings, including carpets, are not counted in the construction R-value.

4.0.2 Acceptable methods for determining the thermal resistance (R-values) of floors other than slab-on-ground floors are contained in NZS 4214:2006. (The standard is sponsored by MBIE and is freely downloadable from www.standards.govt.nz/shop/nzs-42142006.)

4.0.3 Because the insulation required under H1/AS1 5th edition is likely to be thicker than insulation that complied with the 4th edition, check that the subfloor framing timbers are of a sufficient size for the new insulation to be properly installed.

4.0.4 Underfloor insulation available in New Zealand includes polystyrene panels inserted between the floor joists and glass wool (fibreglass), wool or polyester sheets fitted between the floor joists and securely fixed or strapped in place. For very exposed subfloors, insulation should be protected by fixing a sheet lining material under the insulation.

4.0.5 Installing a vapour barrier on the ground under suspended timber floors is recommended to help prevent moisture/condensation problems under the flooring. All ground releases water vapour, even when it looks as if it is dry on the surface. This vapour barrier is usually a 0.25 mm (250 micron) thick polythene sheet over the whole subfloor area, lapped 150 mm at the joints, butted against foundation walls and piles (and taped if possible) and weighed down with bricks or rocks to stay in place. The ground under it must be shaped so that water drains to the outside and does not pond on the ground cover. NZS 4246:2016 *Energy efficiency – Installing bulk thermal insulation in residential buildings* has detailed instructions for ground vapour barriers. (The standard is also sponsored by MBIE and freely downloadable from www.standards.govt.nz/shop/nzs-42462016.)

5 VERIFICATION METHOD

5.0.1 While the schedule and calculation methods of demonstrating compliance with clause H1 are included in H1/AS1, the modelling method is set out in Part 2 of H1/VM1. Under this method, the energy use of the proposed building design must be shown not to exceed the energy use of the reference building using the computer modelling described in Appendix D in H1/VM1.

5.0.2 As with the calculation method, the modelling method may allow a designer to use floors that would not comply under the schedule method if the performance of other building elements such as the walls is enhanced to compensate.

5.0.3 As noted above, however, where a proposed building includes a heated ceiling, wall or floor, minimum construction R-values apply for that particular element.

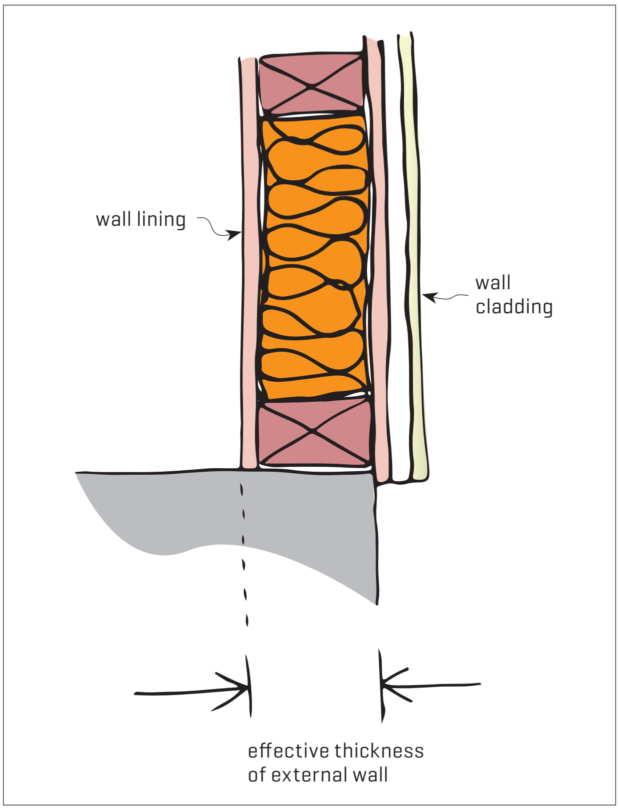

Figure 2. Schematic drawing showing the effective thickness of an external wall. This is the horizontal distance between the external concrete slab edge at floor level and the interior surface of the wall.

5.0.4 The construction R-value of slab floors is verified using Appendix F in H1/AS1 or H1/VM1. Appendix F is look-up tables in H1/AS1 while H1/VM1 involves calculation based on 2D or 3D computer simulation of the slab floor.

5.0.5 The construction R-value of other types of floors is verified using NZS 4214:2006.

6 OTHER RELATED DESIGN AND CONSTRUCTION CONSIDERATIONS

6.0.1 To allow greater flexibility of building use – for example, the possible conversion of an unconditioned garage space to a spare bedroom – it would be prudent to insulate the floor of any unconditioned space that may possibly be converted to a habitable space in the future.

6.0.2 Concrete New Zealand suggests that one way to achieve the elevated slab R-values required for heated floors can be applying thermal insulation and a floating unreinforced concrete screed on top of the slab. The screed encloses the underfloor heating system – a common construction practice overseas in countries such as Germany. Attention must be given to detailing at the screed-to-wall junction to avoid thermal bridging. Another approach suggested is thickening underfloor insulation.

7 INSTALLING INSULATION

7.0.1 NZS 4246:2016 has useful information about how to install insulation to slabs and under suspended floors (and is cited in H1/AS1 5th edition).

8 MORE INFORMATION

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BRANZ carbon tools

BRANZ *House insulation guide* (6th edition published in digital form in 2022)

Study Report SR352 *Perimeter insulation of concrete slab foundations*

BRANZ Bulletin 668 *Complying with H1 – housing, and buildings up to 300 m²*

BRANZ Bulletin 670 *Specifying windows and doors under H1*

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