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Webinar

Floors

About us

Ian Cox-Smith

Greg Burn

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Building Research Levy

Questions

There will be a moderated question and answer session at the end of the presentation

Put your questions in the chat box

Programme

R-values

Compliance:
- Requirements
- Methodologies

Slab-on-ground floors

Suspended timber floors

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H1 *Energy efficiency*

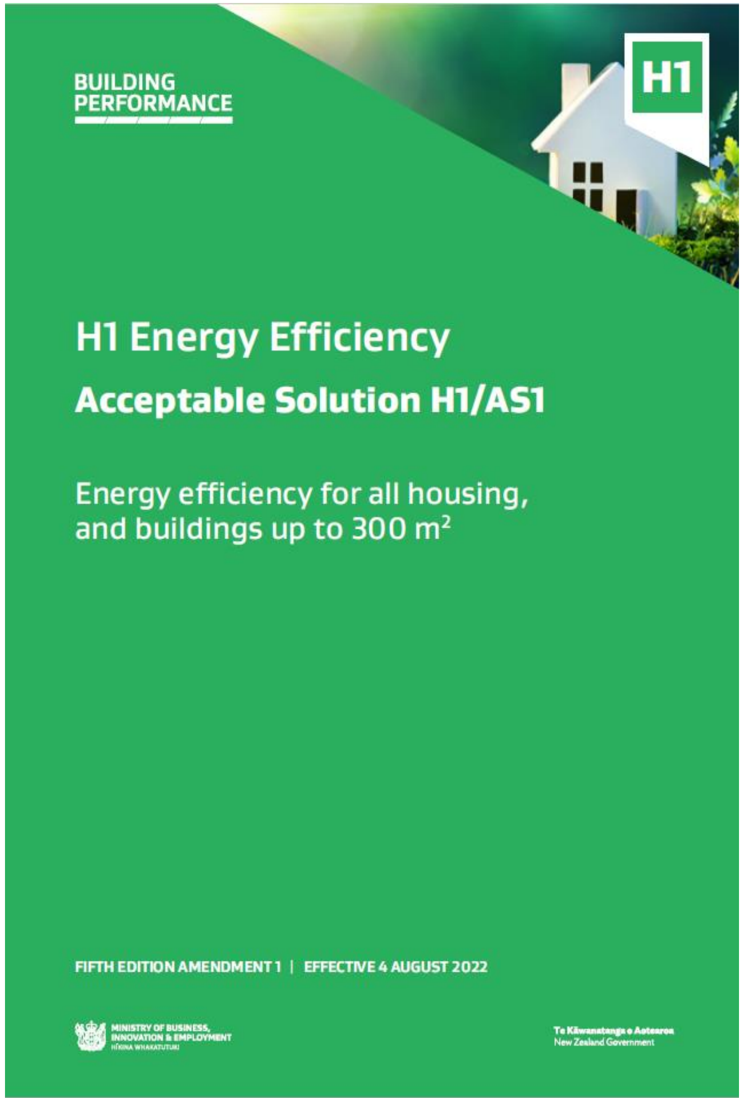
Demonstrating compliance using H1/AS1 and H1/VM1 5th edition amendment 1

"Energy efficiency for all housing, and buildings up to 300 m²"

Definition of "housing" in scope of documents

Effective 4 August 2022

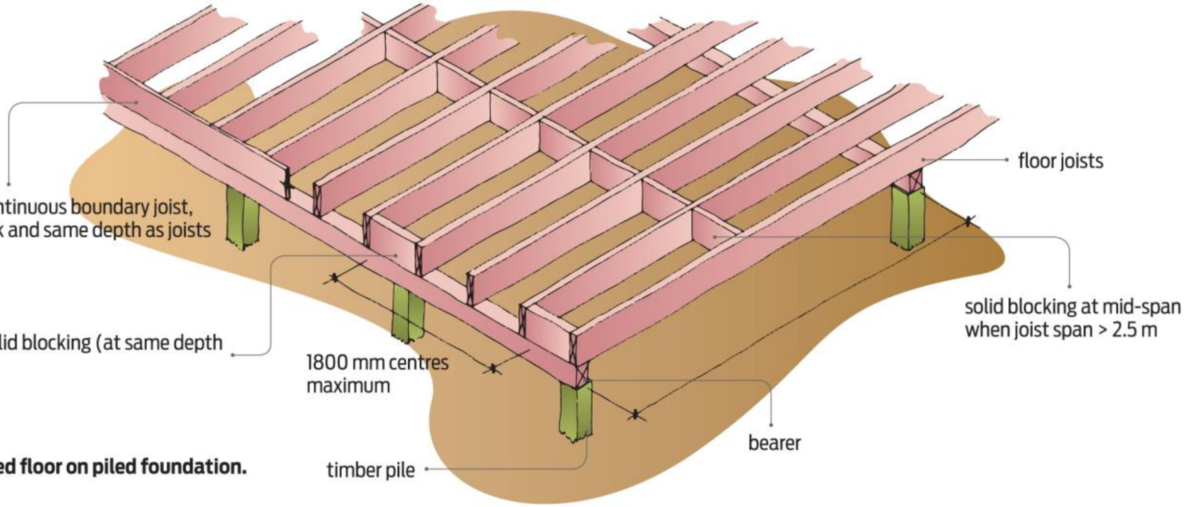
Building consents after 1 May 2023



Floor types covered

- Slab-on-ground floors
- Suspended timber floors (floors other than slab-on-ground floors)

Unheated floors only (H1/AS1 Table 2.1.2.2B)



a) Suspended floor on piled foundation.

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R-values

Thermal resistance measurement

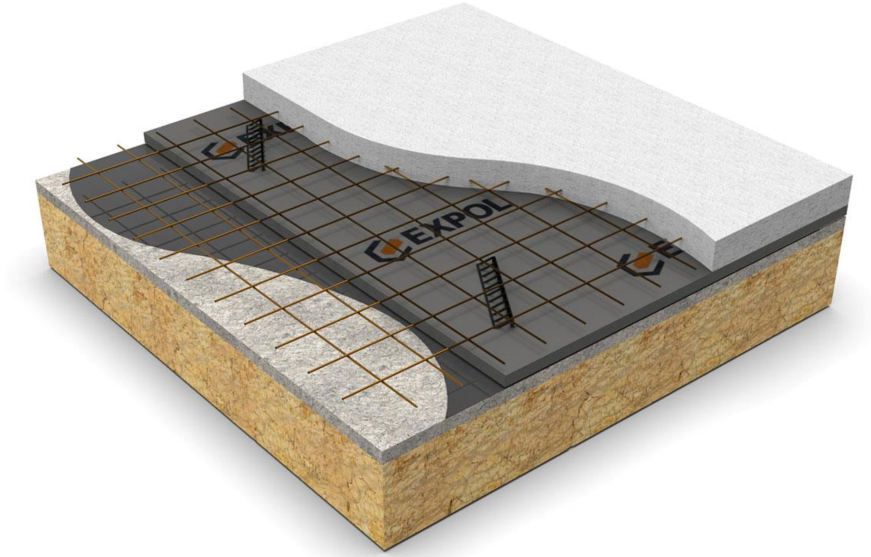
Component R-value:

- Thermal resistance of specific component within an assembly

Construction R-value:

- Thermal resistance of the built assembly – taking into account each of the components

Construction R-value could be higher *or* lower than the R-value of the insulation material used in the floor



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H1 floor compliance

H1/AS1

For building consents submitted prior to 1 May 2023, minimum floor construction R-value for compliance was lower

TABLE 2.1.2.2C: Alternative minimum construction R-values for building elements that do not contain embedded heating systems – for housing only where building consent applications are submitted before 1 May 2023

Paragraph 2.1.2.2 b)

Building element	Construction R-values ($m^2{\cdot}K/W$)	
	Region A [1]	Region B [2]
Roof	R2.9	R3.3
Wall	R1.9	R2.0
Floor	R1.3	R1.3
Windows and doors	R0.37	R0.37
Skylights	R0.37	R0.37

Notes:

(1) Region A comprises all of the North Island/Te Ika-a-Māui excluding the Taupo District, the Ruapehu District and the part of the Rangitikei District north of 39°50′S (-39.83), and all offshore islands north of 37°15′S (-37.25).

(2) Region B comprises the Taupo District, the Ruapehu District, the part of the Rangitikei District north of 39°50′S (-39.83), the South Island/Te Waipounamu, Stewart Island/Rakiura, the Chatham Islands, and all offshore islands south of 37°15′S (-37.25).

COMMENT: Region A in Table 2.1.2.2C and Table 2.1.3.4B is consistent with the previous climate zones 1 and 2 defined in NZS 4218: 2009. Region B is consistent with the previous climate zone 3 defined in NZS 4218: 2009. The NZS 4218 climate zones are different to the current six climate zones defined in Appendix C.

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H1 floor compliance

H1/AS1 minimum construction R-values (Table 2.1.2.2B)

Slab-on-ground floors

Suspended timber floors (floors other than slab-on-ground floors)

Building consents submitted after 1 May 2023

Options	Climate zone					
	1	2	3	4	5	6
Floors						
Current minimum requirements	R1.3					
Slab-on-ground from 1 May 2023	R1.5↑				R1.6↑	R1.7↑
Other floors from 1 May 2023	R2.5↑			R2.8↑	R3.0↑	

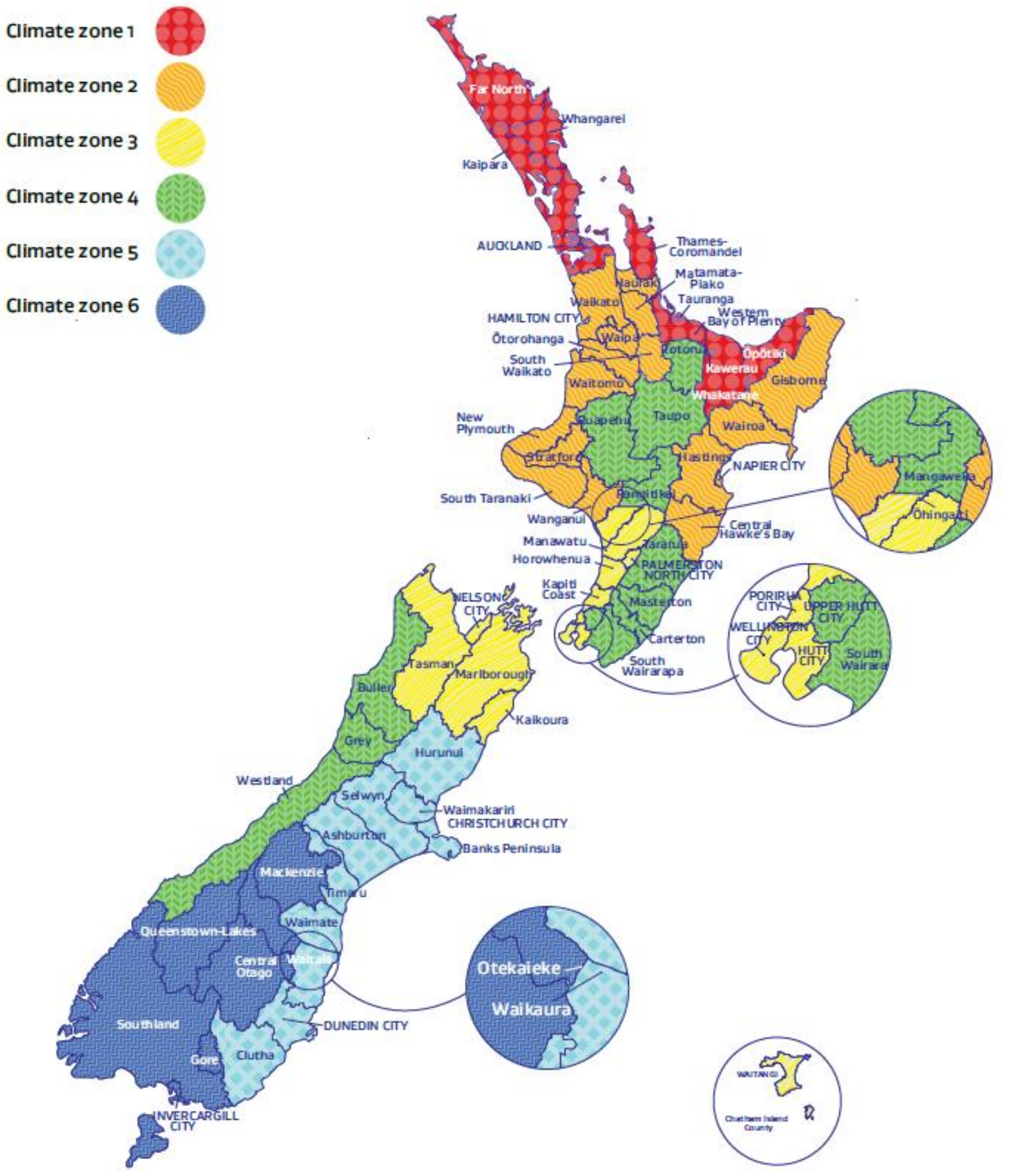
H1 floor compliance

Six climate zones

Zones more representative of regional climates

FIGURE C.1.1.2: Map of New Zealand climate zones

Paragraph C.1.1.2



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H1 slab-on-ground floor compliance

H1/AS1 Table 2.1.2.2B minimum construction R-values for slab-on-ground floors

TABLE 2.1.2.2B: Minimum construction R-values for building elements that do not contain embedded heating systems

Paragraph 2.1.2.2 b)

Building element	Construction R-values ($m^2 \cdot K/W$)[1]					
	Climate zone 1	Climate zone 2	Climate zone 3	Climate zone 4	Climate zone 5	Climate zone 6
Roof[2]	R6.6	R6.6	R6.6	R6.6	R6.6	R6.6
Wall	R2.0	R2.0	R2.0	R2.0	R2.0	R2.0
Floor						
Slab-on-ground floors	R1.5	R1.5	R1.5	R1.5	R1.6	R1.7
Floors other than *slab-on-ground*	R2.5	R2.5	R2.5	R2.8	R3.0	R3.0
Windows and doors[3]	R0.46[3]	R0.46[3]	R0.46	R0.46	R0.50	R0.50
Skylights	R0.46	R0.46	R0.54	R0.54	R0.62	R0.62

Notes:

(1) Climate zone boundaries are shown in Appendix C.

(2) In *roofs* with a *roof* space, where the insulation is installed over a horizontal ceiling, the *roof R-value* may be reduced to R3.3 for a distance of up to 500 mm from the outer edge of the ceiling perimeter where space restrictions do not allow the full-thickness of insulation to be installed.

(3) For *building consent* applications submitted before 2 November 2023, the minimum *construction R-values* for windows and doors in climate zones 1 and 2 are permitted to be reduced to R0.37 $m^2 \cdot K/W$.

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H1 suspended timber floor compliance

H1/AS1 Table 2.1.2.2B minimum construction R-values for floors other than slab-on-ground floors (suspended timber)

TABLE 2.1.2.2B: Minimum construction R-values for building elements that do not contain embedded heating systems

Paragraph 2.1.2.2 b)

Building element	Construction R-values ($m^2 \cdot K/W$)[1]					
	Climate zone 1	Climate zone 2	Climate zone 3	Climate zone 4	Climate zone 5	Climate zone 6
Roof[2]	R6.6	R6.6	R6.6	R6.6	R6.6	R6.6
Wall	R2.0	R2.0	R2.0	R2.0	R2.0	R2.0
Floor						
Slab-on-ground floors	R1.5	R1.5	R1.5	R1.5	R1.6	R1.7
Floors other than *slab-on-ground*	R2.5	R2.5	R2.5	R2.8	R3.0	R3.0
Windows and doors[3]	R0.46[3]	R0.46[3]	R0.46	R0.46	R0.50	R0.50
Skylights	R0.46	R0.46	R0.54	R0.54	R0.62	R0.62

Notes:

(1) Climate zone boundaries are shown in Appendix C.

(2) In *roofs* with a *roof* space, where the insulation is installed over a horizontal ceiling, the *roof R-value* may be reduced to R3.3 for a distance of up to 500 mm from the outer edge of the ceiling perimeter where space restrictions do not allow the full-thickness of insulation to be installed.

(3) For *building consent* applications submitted before 2 November 2023, the minimum *construction R-values* for windows and doors in climate zones 1 and 2 are permitted to be reduced to R0.37 $m^2 \cdot K/W$.

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H1 floor compliance methodologies

H1/AS1 schedule method

- Tabulated minimum construction R-values

H1/AS1 calculation method

- Simplified comparison methodology that permits different R-value combinations

H1/VM1 modelling method

- More comprehensive comparison methodology that permits different R-value combinations

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H1/AS1 schedule method

Must meet or exceed specific level of thermal performance (minimum construction R-values in Tables 2.1.2.2A or 2.1.2.2B)

Must know the R-values of all building elements in the proposed building

Can only be used where:

- Glazing area is 30% or less of total wall area
- Combined glazing area on east, south and west-facing walls is 30% or less of the total area of these walls
- Skylight area is no more than 1.5 m^2 or 1.5% of total roof area (whichever is greater)
- Opaque external door area is no more than 6 m^2 or 6% of total wall area (whichever is greater)

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H1/AS1 calculation method

Compares thermal performance of the proposed building with a reference building using heat loss equations

Can only be used where glazing area is 40% or less of total external wall area

The requirements for each building element in the reference building are the same as those in the schedule method (minimum construction R-values in Tables 2.1.2.2A or 2.1.2.2B)

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H1/AS1 calculation method

Construction R-value combinations for the proposed building can differ from those in the reference building, but the proposed building overall must perform at least as well as the reference building

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 equation

(Note: Where building elements that are part of the thermal envelope include heating systems, the construction R-value may not be reduced when using the calculation method – to be as per schedule method)

$HL_{Proposed}$ shall be calculated as the sum of all the *building element* heat losses according to Equation 2.

Equation 2: $$HL_{Proposed} = \frac{A_{roof}}{R_{roof}} + \frac{A_{wall}}{R_{wall}} + \frac{A_{floor}}{R_{floor}} + \frac{A_{glazing}}{R_{window}} + \frac{A_{door,\ opaque}}{R_{door,\ opaque}} + \frac{A_{skylight}}{R_{skylight}}$$

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H1/AS1 calculation method

To help designers, BRANZ has an Excel-based H1 calculation method tool available online and is currently developing an interactive tool

Previous BRANZ webinars available online

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H1/VM1 modelling method

Modelling compares thermal performance of proposed building with a reference building of the same shape, dimensions and orientation

The requirements for each building element in both the reference building and the proposed building are the same as those in the schedule method (minimum construction R-values in Tables 2.1.2.2A or 2.1.2.2B)

Construction R-value combinations for the proposed building can differ from those in the reference building

Appendix D. Modelling method – Building energy use comparison

D.1 Modelling requirements

D.1.1 Overview

D.1.1.1 This modelling method is used to assess the energy performance of a proposed *building* by using a simulation of the *building* to predict its space *heating loads* and *cooling loads*. This is compared with the space *heating loads* and *cooling loads* of a reference *building* that is the same shape, dimensions, and orientation as the proposed *building*, but has *building elements* with *construction R-values* from:

a) For *building elements* that contain embedded heating systems, Table 2.1.2.2A; or

b) For *building elements* that do not contain embedded heating systems,

i) Table 2.1.2.2B or

H ii) alternatively, for **housing** only, for *building consent* applications submitted before 1 May 2023, those in Table 2.1.2.2C.

D.1.1.2 Both *buildings* shall be simulated using the same method.

D.1.2 Modelling principles

D.1.2.1 The proposed *building* and reference *building* shall both be analysed using the same techniques and assumptions except where differences in energy efficiency features that are specified in this appendix require a different approach.

D.1.2.2 The specifications of the proposed *building* used in the analysis shall be as similar as is reasonably practicable to those in the plans submitted for a building consent.

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H1/VM1 modelling method

Verification achieved by demonstrating that the energy use of the proposed building does not exceed the energy use of the reference building (using computer modelling described in Appendix D)

The sum of the calculated annual space heating load and annual cooling load of the proposed building shall not exceed that of the reference building

D.6 Documentation

D.6.1 Documentation of analysis

D.6.1.1.1 Documentation of computer modelling analysis shall contain:

a) The name of the modeller;

b) The thermal modelling program name, version number, and supplier;

c) Technical detail on the proposed *building* and reference *building* designs and the differences between the designs;

d) The sum of the *heating load* and *cooling load* for the proposed *building* and reference *building*;

e) Where possible, the *heating load* and *cooling load* for the proposed *building* and the reference *building*.

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H1 compliance methodologies

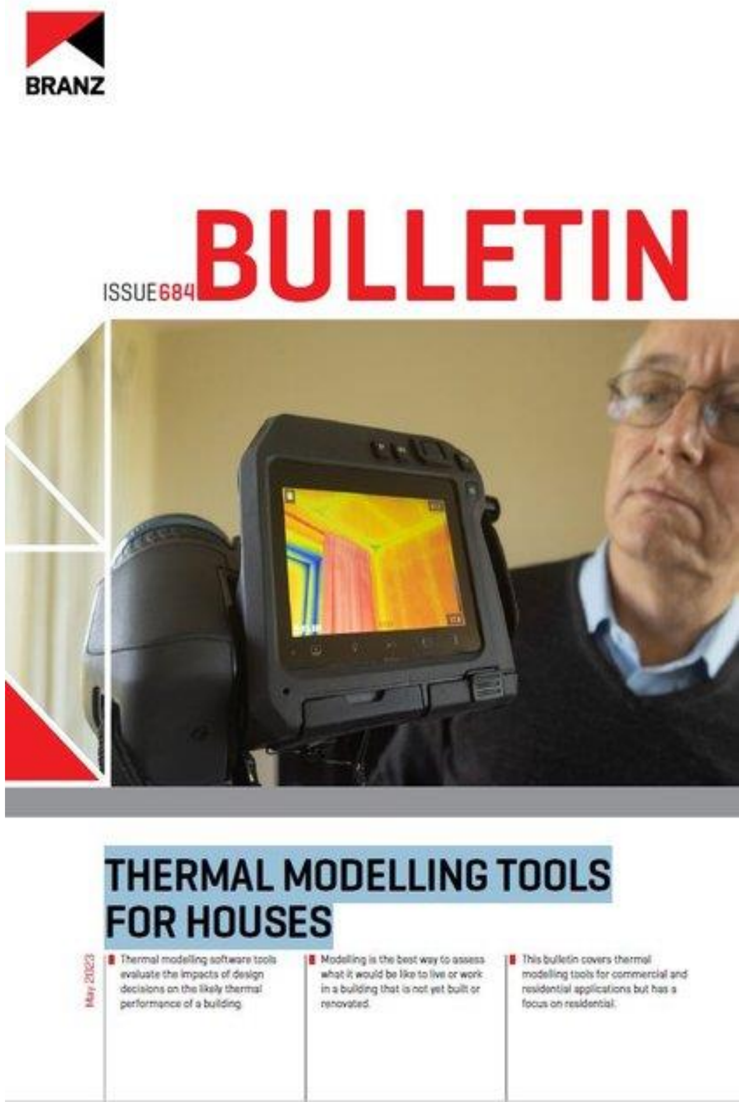
Preference for using:

- Calculation method
- Modelling method

Good tools available for both that allow comparison of thermal performance solutions

Commercial modelling services also available

BRANZ Bulletin BU684 *Thermal modelling tools for houses*



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BRANZ *House insulation guide*

Updated 6th edition (24 May 2023 version)

Used to help demonstrate compliance

Excel format/text guidance

Tables in the guide can be used to:

- Find the construction R-value of a built system for a given level of insulation
- Find the level of insulation required to achieve a specific construction R-value

Assists with design of buildings that exceed Building Code minimum performance

Design and build *warm, dry, healthy homes*

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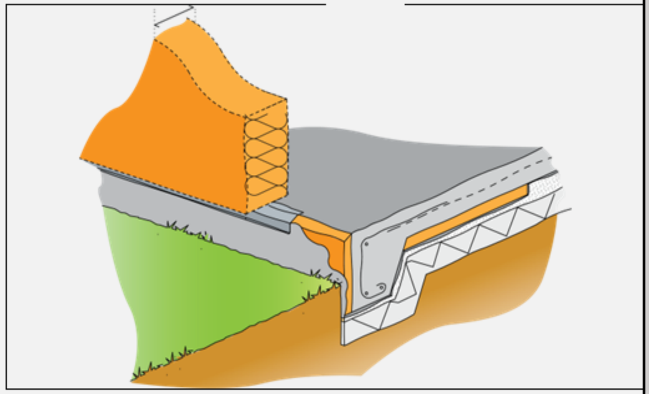
BRANZ *House insulation guide* (slab-on-ground floor)

BRANZ Thermal resistance of slab-on-ground floor (m^{2}K/W) www.branz.co.nz/terms-conditions/ ActiveX Controls 10/05/2023

Target floor thermal resistance m²K/W	2.5
Wall type	other than masonry veneer
Floor topper insulating layer	R 1.0 m2.K/W topper
Vertical edge insulation	R1 edge, under, & inner vert.
Floor type and underslab insulation style	Slab floor with 1.2m wide strip of R1.2 unders
Wall depth (mm)	90 +
A/P ratio	1.6
Floor thermal resistance m²K/W	2.31



A/P fraction	Wall depth (mm) from outer edge of slab to edge of internal floor					A/P fraction					
	90 + 90 ≤ < 140	140 + 140 ≤ < 180	180 + 180 ≤ < 250	250 + 250 ≤ < 300	300 + 300 ≤		90 + 90 ≤ < 140	140 + 140 ≤ < 180	180 + 180 ≤ < 250	250 + 250 ≤ < 300	300 + 300 ≤
3.8	3.1	3.1	3.1	3.2	3.2	10.0	5.2	5.3	5.4	5.5	5.6
3.7	3.0	3.1	3.1	3.2	3.2	9.5	5.0	5.1	5.2	5.3	5.4
3.6	3.0	3.0	3.1	3.1	3.2	9.0	4.9	5.0	5.0	5.1	5.2
3.5	3.0	3.0	3.0	3.1	3.1	8.5	4.7	4.8	4.8	5.0	5.0
3.4	2.9	3.0	3.0	3.1	3.1	8.0	4.5	4.6	4.7	4.8	4.8
3.3	2.9	2.9	3.0	3.0	3.1	7.5	4.3	4.4	4.5	4.6	4.6
3.2	2.9	2.9	2.9	3.0	3.0	7.0	4.2	4.2	4.3	4.4	4.4
3.1	2.8	2.9	2.9	3.0	3.0	6.5	4.0	4.1	4.1	4.2	4.2
3.0	2.8	2.8	2.9	2.9	2.9	6.0	3.8	3.9	3.9	4.0	4.1
2.9	2.8	2.8	2.8	2.9	2.9	5.5	3.6	3.7	3.7	3.8	3.9
2.8	2.7	2.8	2.8	2.8	2.9	5.0	3.5	3.5	3.6	3.6	3.7
2.7	2.7	2.7	2.8	2.8	2.8	4.9	3.4	3.5	3.5	3.6	3.6
2.6	2.7	2.7	2.7	2.8	2.8	4.8	3.4	3.5	3.5	3.6	3.6
2.5	2.6	2.7	2.7	2.7	2.8	4.7	3.4	3.4	3.5	3.5	3.6
2.4	2.6	2.6	2.7	2.7	2.7	4.6	3.3	3.4	3.4	3.5	3.5
2.3	2.6	2.6	2.6	2.7	2.7	4.5	3.3	3.4	3.4	3.5	3.5
2.2	2.5	2.6	2.6	2.6	2.7	4.4	3.3	3.3	3.4	3.4	3.5
2.1	2.5	2.5	2.5	2.6	2.6	4.3	3.2	3.3	3.3	3.4	3.4
2.0	2.5	2.5	2.5	2.6	2.6	4.2	3.2	3.2	3.3	3.4	3.4
1.9	2.4	2.5	2.5	2.5	2.5	4.1	3.2	3.2	3.3	3.3	3.4
1.8	2.4	2.4	2.4	2.5	2.5	4.0	3.1	3.2	3.2	3.3	3.3
1.7	2.3	2.4	2.4	2.5	2.5	3.9	3.1	3.1	3.2	3.2	3.3
1.6	2.3	2.3	2.4	2.4	2.4	3.8	3.1	3.1	3.1	3.2	3.2

Correction for when there is no vertical edge insulation between house and garage slabs

These tables and the ones for slab-on-ground floors in H1/AS1, are based on the assumption that the insulation is full coverage, i.e under all of the slab (underslab insulation) or along all of the perimeter (vertical or horizontal edge insulation). If the insulation is not full coverage such as when there is no vertical perimeter insulation between a house and garage a correction will need to be made to account for the extra heatloss.

Floor R-value without vertical edge insulation	0.97	m^{2}K/W
Fraction of total perimeter length that has no vertical edge insulation	0 %	
Approximate overall floor R-value	2.31	m^{2}K/W

Calculation uses H1/AS1 2.1.3.7 except using perimeter length instead of area to proportionally weight the (same area) 'perimeter edge insulated' and 'perimeter edge un-insulated' U-values (linear thermal transmittance).

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BRANZ *House insulation guide* (suspended timber floor – joist)

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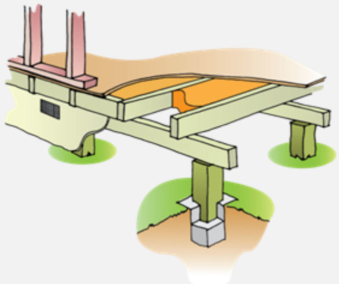
Thermal resistance of suspended timber floor (m^2K/W) www.branz.co.nz/terms-conditions/ ActiveX Controls 10/05/2023

Target floor thermal resistance m^2K/W	2.5		
Joist or I-beam & height	joist 290 mm	Joist spacing mm	600
Insulation thermal conductivity W/m.K	0.042	Insulation thermal resistance m^2K/W	2.8
Bottom of joists lined or unlined	un-lined	Floor thermal resistance m^2K/W	2.89

Insulation		joist spacing (m)					Insulation		joist spacing (m)				
thickness	R-value	400	450	500	550	600	thickness	R-value	400	450	500	550	600
172	4.1	3.9	4.0	4.0	4.0	4.1							
168	4.0	3.8	3.9	3.9	4.0	4.0							
164	3.9	3.7	3.8	3.8	3.9	3.9							
160	3.8	3.6	3.7	3.7	3.8	3.8	290	6.9	6.3	6.4	6.5	6.5	6.6
155	3.7	3.6	3.6	3.7	3.7	3.7	286	6.8	6.2	6.3	6.4	6.5	6.5
151	3.6	3.5	3.5	3.6	3.6	3.6	281	6.7	6.1	6.2	6.3	6.4	6.4
147	3.5	3.4	3.4	3.5	3.5	3.5	277	6.6	6.0	6.1	6.2	6.3	6.3
143	3.4	3.3	3.3	3.4	3.4	3.4	273	6.5	6.0	6.0	6.1	6.2	6.2
139	3.3	3.2	3.3	3.3	3.3	3.3	269	6.4	5.9	6.0	6.0	6.1	6.1
134	3.2	3.1	3.2	3.2	3.2	3.3	265	6.3	5.8	5.9	5.9	6.0	6.1
130	3.1	3.0	3.1	3.1	3.1	3.2	260	6.2	5.7	5.8	5.9	5.9	6.0
126	3.0	3.0	3.0	3.0	3.1	3.1	256	6.1	5.6	5.7	5.8	5.8	5.9
122	2.9	2.9	2.9	2.9	3.0	3.0	252	6.0	5.5	5.6	5.7	5.7	5.8
118	2.8	2.8	2.8	2.9	2.9	2.9	248	5.9	5.4	5.5	5.6	5.7	5.7
113	2.7	2.7	2.7	2.8	2.8	2.8	244	5.8	5.4	5.4	5.5	5.6	5.6
109	2.6	2.6	2.6	2.7	2.7	2.7	239	5.7	5.3	5.4	5.4	5.5	5.5
105	2.5	2.5	2.6	2.6	2.6	2.6	235	5.6	5.2	5.3	5.3	5.4	5.4
101	2.4	2.4	2.5	2.5	2.5	2.5	231	5.5	5.1	5.2	5.2	5.3	5.3
97	2.3	2.4	2.4	2.4	2.4	2.4	227	5.4	5.0	5.1	5.2	5.2	5.3
92	2.2	2.3	2.3	2.3	2.3	2.3	223	5.3	4.9	5.0	5.1	5.1	5.2
88	2.1	2.2	2.2	2.2	2.2	2.3	218	5.2	4.8	4.9	5.0	5.0	5.1
84	2.0	2.1	2.1	2.1	2.2	2.2	214	5.1	4.8	4.8	4.9	4.9	5.0
80	1.9	2.0	2.0	2.0	2.1	2.1	210	5.0	4.7	4.7	4.8	4.9	4.9
76	1.8	1.9	1.9	2.0	2.0	2.0	206	4.9	4.6	4.7	4.7	4.8	4.8
71	1.7	1.8	1.8	1.9	1.9	1.9	202	4.8	4.5	4.6	4.6	4.7	4.7
67	1.6	1.7	1.8	1.8	1.8	1.8	197	4.7	4.4	4.5	4.5	4.6	4.6
63	1.5	1.7	1.7	1.7	1.7	1.7	193	4.6	4.3	4.4	4.5	4.5	4.5
59	1.4	1.6	1.6	1.6	1.6	1.6	189	4.5	4.3	4.3	4.4	4.4	4.4
55	1.3	1.5	1.5	1.5	1.5	1.5	185	4.4	4.2	4.2	4.3	4.3	4.3
50	1.2	1.4	1.4	1.4	1.4	1.4	181	4.3	4.1	4.1	4.2	4.2	4.3
46	1.1	1.3	1.3	1.3	1.3	1.3	176	4.2	4.0	4.1	4.1	4.1	4.2
42	1.0	1.2	1.2	1.2	1.2	1.2	172	4.1	3.9	4.0	4.0	4.0	4.1



Excludes thermal resistance of subfloor space and ground beneath.
Assumed blocking at 1.2m centres.

A sheltered subfloor space will provide addition thermal benefit

Changing the thermal conductivity of the insulation material has an impact on the overall R-value. The 90 & 140 mm joist cases have lower conductivity selections for the insulation.

An enclosed subfloor space is recommended when there is no lining to the underside of the floor joists. Alternatively, use either higher density or faced insulation, incl. rigid & semi-rigid foams.

H1/AS1 5th ed. Schedule method R 2.5 in climate zones 1-3
R 2.8 in zone 4
R 3.0 in zones 5& 6

Ground / airspace under suspended timber floor	floor area (m^2) / floor perimeter length (m)				
	1.0	2.0	3.0	4.0	5.0
	R-value of subfloor space and ground				
Continuous perimeter wall, sheltered from wind (e.g. garage or foundation wall with vents)	0.1	0.2	0.3	0.4	0.5
Continuous perimeter wall, exposed to wind (e.g. slats with gaps between slats)	0.05	0.11	0.17	0.22	0.28
Exposed floor (e.g. pole house)	0	0	0	0.01	0.01

thickness (mm)	160	=	0.0421	conductivity (W/m.K)
R-value ($m^2.K/W$)	3.8			

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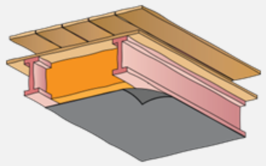
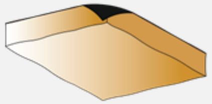
BRANZ *House insulation guide* (suspended timber floor – I-joist)

BRANZ | Thermal resistance of suspended timber floor (m^2K/W) | www.branz.co.nz/terms-conditions/ | ActiveX Controls | 10/05/2023

Target floor thermal resistance m^2K/W	2.5	Joist or I-beam & height	I-beam 225 mm
		Insulation thermal conductivity W/m.K	0.032
		Bottom of joists lined or unlined	un-lined
Joist spacing mm	600		
Insulation thermal resistance m^2K/W	7.0		
Floor thermal resistance m^2K/W	6.79		

Insulation		joist spacing (m)					Insulation		joist spacing (m)				
thickness	R-value	400	450	500	550	600	thickness	R-value	400	450	500	550	600
131	4.1	4.0	4.1	4.1	4.1	4.2							
128	4.0	4.0	4.0	4.0	4.1	4.1							
125	3.9	3.9	3.9	3.9	4.0	4.0	224	7.0	6.5	6.6	6.7	6.7	6.8
122	3.8	3.8	3.8	3.8	3.9	3.9	221	6.9	6.4	6.5	6.6	6.6	6.7
118	3.7	3.7	3.7	3.8	3.8	3.8	218	6.8	6.3	6.4	6.5	6.6	6.6
115	3.6	3.6	3.6	3.7	3.7	3.7	214	6.7	6.3	6.3	6.4	6.5	6.5
112	3.5	3.5	3.5	3.6	3.6	3.6	211	6.6	6.2	6.3	6.3	6.4	6.4
109	3.4	3.4	3.5	3.5	3.5	3.5	208	6.5	6.1	6.2	6.2	6.3	6.3
106	3.3	3.3	3.4	3.4	3.4	3.4	205	6.4	6.0	6.1	6.2	6.2	6.3
102	3.2	3.2	3.3	3.3	3.3	3.3	202	6.3	5.9	6.0	6.1	6.1	6.2
99	3.1	3.2	3.2	3.2	3.2	3.2	198	6.2	5.8	5.9	6.0	6.0	6.1
96	3.0	3.1	3.1	3.1	3.1	3.2	195	6.1	5.8	5.8	5.9	5.9	6.0
93	2.9	3.0	3.0	3.0	3.0	3.1	192	6.0	5.7	5.7	5.8	5.9	5.9
90	2.8	2.9	2.9	2.9	3.0	3.0	189	5.9	5.6	5.7	5.7	5.8	5.8
86	2.7	2.8	2.8	2.8	2.9	2.9	186	5.8	5.5	5.6	5.6	5.7	5.7
83	2.6	2.7	2.7	2.8	2.8	2.8	182	5.7	5.4	5.5	5.5	5.6	5.6
80	2.5	2.6	2.6	2.7	2.7	2.7	179	5.6	5.3	5.4	5.5	5.5	5.5
77	2.4	2.5	2.6	2.6	2.6	2.6	176	5.5	5.3	5.3	5.4	5.4	5.4
74	2.3	2.4	2.5	2.5	2.5	2.5	173	5.4	5.2	5.2	5.3	5.3	5.4
70	2.2	2.3	2.4	2.4	2.4	2.4	170	5.3	5.1	5.1	5.2	5.2	5.3
67	2.1	2.3	2.3	2.3	2.3	2.3	166	5.2	5.0	5.1	5.1	5.1	5.2
64	2.0	2.2	2.2	2.2	2.2	2.2	163	5.1	4.9	5.0	5.0	5.1	5.1
61	1.9	2.1	2.1	2.1	2.1	2.1	160	5.0	4.8	4.9	4.9	5.0	5.0
58	1.8	2.0	2.0	2.0	2.0	2.0	157	4.9	4.7	4.8	4.8	4.9	4.9
54	1.7	1.9	1.9	1.9	1.9	1.9	154	4.8	4.6	4.7	4.7	4.8	4.8
51	1.6	1.8	1.8	1.8	1.8	1.8	150	4.7	4.6	4.6	4.7	4.7	4.7
48	1.5	1.7	1.7	1.7	1.7	1.7	147	4.6	4.5	4.5	4.6	4.6	4.6
45	1.4	1.6	1.6	1.6	1.6	1.7	144	4.5	4.4	4.4	4.5	4.5	4.5
42	1.3	1.5	1.5	1.5	1.6	1.6	141	4.4	4.3	4.3	4.4	4.4	4.4
38	1.2	1.4	1.4	1.5	1.5	1.5	138	4.3	4.2	4.3	4.3	4.3	4.4
35	1.1	1.3	1.4	1.4	1.4	1.4	134	4.2	4.1	4.2	4.2	4.2	4.3
32	1.0	1.3	1.3	1.3	1.3	1.3	131	4.1	4.0	4.1	4.1	4.1	4.2





Excludes thermal resistance of subfloor space and ground beneath. Assumed blocking at 1.2m centres.

A sheltered subfloor space will provide addition thermal benefit

Changing the thermal conductivity of the insulation material has an impact on the overall R-value. The 90 & 140 mm joist cases have lower conductivity selections for the insulation.

An enclosed subfloor space is recommended when there is no lining to the underside of the floor joists. Alternatively, use either higher density or faced insulation, incl. rigid & semi-rigid foams.

H1/AS1 5th ed. Schedule method R 2.5 in climate zones 1-3
R 2.8 in zone 4
R 3.0 in zones 5& 6

Ground / airspace under suspended timber floor	**floor area (m^2) / floor perimeter length (m)**				
	1.0	2.0	3.0	4.0	5.0
	R-value of subfloor space and ground				
Continuous perimeter wall, sheltered from wind (e.g. garage or foundation wall with vents)	0.1	0.2	0.3	0.4	0.5
Continuous perimeter wall, exposed to wind (e.g. slats with gaps between slats)	0.05	0.11	0.17	0.22	0.28
Exposed floor (e.g. pole house)	0	0	0	0.01	0.01

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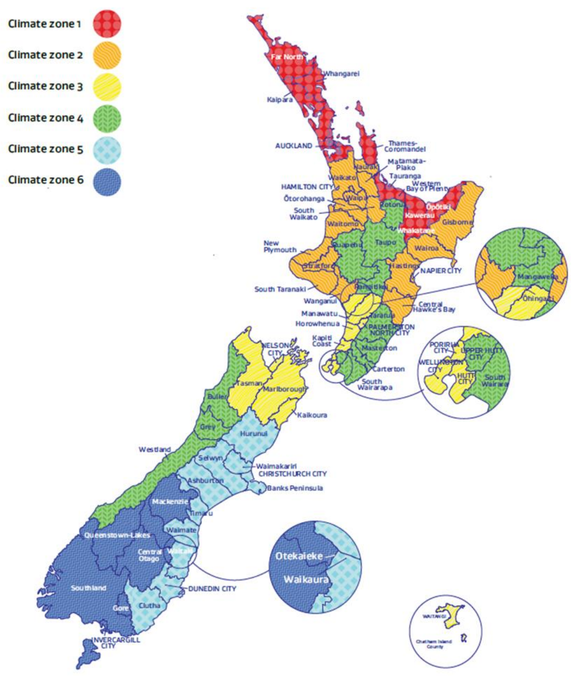
Slab-on-ground floors

H1/AS1 Table 2.1.2.2B minimum construction R-values:

- R1.5 (zones 1–4)
- R1.6 (zone 5)
- R1.7 (zone 6)

FIGURE C.1.1.2: Map of New Zealand climate zones

Paragraph C.1.1.2



Options	Climate zone 1	2	3	4	5	6
Current minimum requirements	R1.3					
Slab-on-ground from 1 May 2023	R1.5↑				R1.6↑	R1.7↑
Other floors from 1 May 2023	R2.5↑			R2.8↑	R3.0↑	

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Methods for determining construction R-values for slab-on-ground floors

H1/VM1 Appendix F includes a method for calculating slab-on-ground floor construction R-values

Thermal resistance of slab-on-ground floors

Appendix F. Thermal resistance of slab-on-ground floors

F.1 Construction R-values

F.1.1 Methods for determining construction R-values for slab-on-ground floors

F.1.1.1 The *construction R-values* for concrete *slab-on-ground floors*, including floors of basements that contain *conditioned* spaces, shall be determined using:

a) The calculation method described in Section F.1.2; or

b) The performance tables in Acceptable Solution H1/AS1 Appendix F.

H F.1.1.2 For **housing** only, for *building consent* applications submitted before 1 May 2023, concrete *slab-on-ground floors* are deemed to achieve a *construction R-value* of R1.3.

i

COMMENT:

1. The *thermal resistances* for *slab-on-ground floors* provided in the BRANZ House Insulation Guide, 5th edition or earlier, should not be used for determining compliance with the requirements of this verification method. This is because they are based on a different calculation method and different assumptions than those specified in this Appendix.
2. Where a concrete floor is only partially in contact with the ground, with other parts being suspended, the part that is in contact with the ground shall be treated as a slab-on-ground floor, and the other part be treated as a suspended floor.

F.1.2 Calculating slab-on-ground floor R-values

F.1.2.1 The *construction R-value* of *slab-on-ground floors* shall be calculated from the inside air to the outside air. The effect of floor coverings (including carpets) shall be ignored.

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Methods for determining construction R-values for slab-on-ground floors

H1/VM1 Appendix F also refers to performance tables in H1/AS1 Appendix F

Tables provide construction R-values for a range of slab-on-ground floor typologies

Table F.1.2.2B: Construction R-values for concrete raft foundation floors without insulation, where the external walls do not have masonry veneer cladding

Paragraph F.1.2.2 b)

Insulation type	Slab area-to-perimeter ratio [1]	R_{floor} ($m^2 \cdot K/W$) for different effective thicknesses of external walls on slab [2]				
		≥ 90 mm to < 140 mm	≥ 140 mm to < 180 mm	≥ 180 mm to < 250 mm	≥ 250 mm to < 300 mm	≥ 300 mm
No vertical edge insulation	1.6	R1.0	R1.0	R1.1	R1.1	R1.1
	1.8	R1.1	R1.1	R1.2	R1.2	R1.2
	2.0	R1.2	R1.2	R1.3	R1.3	R1.4
	2.2	R1.2	R1.3	R1.3	R1.4	R1.4
	2.4	R1.3	R1.4	R1.4	R1.5	R1.5
	2.6	R1.4	R1.4	R1.5	R1.5	R1.6
	2.8	R1.4	R1.5	R1.5	R1.6	R1.6
	3.0	R1.5	R1.6	R1.6	R1.7	R1.7
	3.2	R1.6	R1.6	R1.7	R1.8	R1.8
	3.4	R1.6	R1.7	R1.7	R1.8	R1.9
	3.6	R1.7	R1.8	R1.8	R1.9	R1.9
	3.8	R1.8	R1.8	R1.9	R2.0	R2.0
	4.0	R1.9	R1.9	R2.0	R2.0	R2.1
	5.0	R2.2	R2.3	R2.3	R2.4	R2.5
	6.0	R2.5	R2.6	R2.7	R2.7	R2.8
	7.0	R2.8	R2.9	R3.0	R3.1	R3.2
	8.0	R3.2	R3.3	R3.3	R3.5	R3.5
	9.0	R3.5	R3.6	R3.7	R3.8	R3.9
	≥ 10.0	R3.9	R4.0	R4.1	R4.2	R4.3

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Performance tables for slab-on-ground floor construction R-values

H1/AS1 Appendix F

Construction R-value tables cover different:

- Slab-on-ground floor types – slab-floor or raft foundation
- Floor insulation:
  - None
  - R1.0 vertical slab edge
  - R1.2 or R2.4 full cover underslab
  - 1.2 m wide strip of R1.2 *or* R2.4 underslab along the slab perimeter
  - Combination of slab edge and underslab

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Slab-on-ground floors external wall types

H1/AS1 Appendix F

Construction R-value tables also cover different external wall claddings

Slab-on-ground floors with masonry veneer cladding incorporate a step-down (which gives different heat transfer characteristics) so these are treated differently

Table F.1.2.2A: Construction R-values for concrete raft foundation floors without insulation, where the external walls have masonry veneer cladding

Paragraph F.1.2.2 a)

Insulation type	Slab area-to-perimeter ratio [1]	R_{floor} ($m^2 \cdot K/W$) for different effective thicknesses of external walls on slab [2]				
		≥ 90 mm to < 140 mm	≥ 140 mm to < 180 mm	≥ 180 mm to < 250 mm	≥ 250 mm to < 300 mm	≥ 300 mm
No vertical edge insulation	1.6	R1.2	R1.2	R1.2	R1.3	R1.3
	1.8	R1.3	R1.3	R1.3	R1.4	R1.4
	2.0	R1.3	R1.4	R1.4	R1.4	R1.5
	2.2	R1.4	R1.5	R1.5	R1.5	R1.6
	2.4	R1.5	R1.6	R1.6	R1.6	R1.7
	2.6	R1.6	R1.6	R1.6	R1.7	R1.7
	2.8	R1.7	R1.7	R1.7	R1.8	R1.8
	3.0	R1.7	R1.8	R1.8	R1.9	R1.9
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Slab-on-ground floors vertical slab edge insulation

H1/AS1 Appendix F

A significant amount of heat transfer can occur through the vertical slab edge

Construction R-value tables include an option for R1.0 vertical edge insulation

Tables are based on insulation installed on all exterior exposed vertical faces of the slab from the top edge to the bottom of the footing

Raft foundation floors

H1/AS1 Appendix F

Polystyrene pods in raft foundation floors are not considered to be insulation

Raft foundation floors that have polystyrene pods but no other insulation are regarded as uninsulated

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Slab area-to-perimeter ratio and effective thickness of external walls

H1/AS1 Appendix F

To use the construction R-value tables, you need to know the slab area-to-perimeter (A/P) ratio and the effective thickness of the external walls of the building

Table F.1.2.2B: Const tion R-values for conc
external walls do not ve masonry veneer cla

Paragraph F.1.2.2 b)

Insulation type	Slab area-to-perimeter ratio [1]	R_{floor} (m²·K/W) fo ≥ 90 mm to < 140 mm
No vertical edge insulation	1.6	R1.0
	1.8	R1.1
	2.0	R1.2
	2.2	R1.2
	2.4	R1.3
	2.6	R1.4
	2.8	R1.4
	3.0	R1.5
	3.2	R1.6
	3.4	R1.6

-values for concrete raft foundati floors without insulation, where the
sonry veneer cladding

R_{floor} (m²·K/W) for different effective thicknesses of external walls on slab [2]				
≥ 90 mm to < 140 mm	≥ 140 mm to < 180 mm	≥ 180 mm to < 250 mm	≥ 250 mm to < 300 mm	≥ 300 mm
R1.0	R1.0	R1.1	R1.1	R1.1
R1.1	R1.1	R1.2	R1.2	R1.2
R1.2	R1.2	R1.3	R1.3	R1.4
R1.2	R1.3	R1.3	R1.4	R1.4
R1.3	R1.4	R1.4	R1.5	R1.5
R1.4	R1.4	R1.5	R1.5	R1.6
R1.4	R1.5	R1.5	R1.6	R1.6
R1.5	R1.6	R1.6	R1.7	R1.7
R1.6	R1.6	R1.7	R1.8	R1.8
R1.6	R1.7	R1.7	R1.8	R1.9

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Slab area-to-perimeter ratio

H1/AS1 Appendix F

Slab area-to-perimeter ratio of the proposed building is determined by using either:

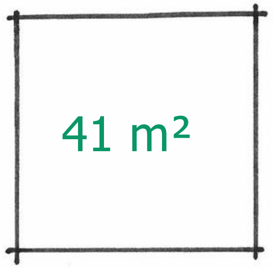
- Overall internal slab dimensions in accordance with Equation F.1
- External slab dimensions in accordance with Equation F.2

$$\text{Equation F.1:} \quad \text{slab area-to-perimeter ratio} = \frac{A_{\text{slab, internal}}}{P_{\text{slab, internal}}}$$

$$\text{Equation F.2:} \quad \text{slab area-to-perimeter ratio} = \frac{A_{\text{slab, external}}}{P_{\text{slab, external}}} - \frac{W}{2}$$

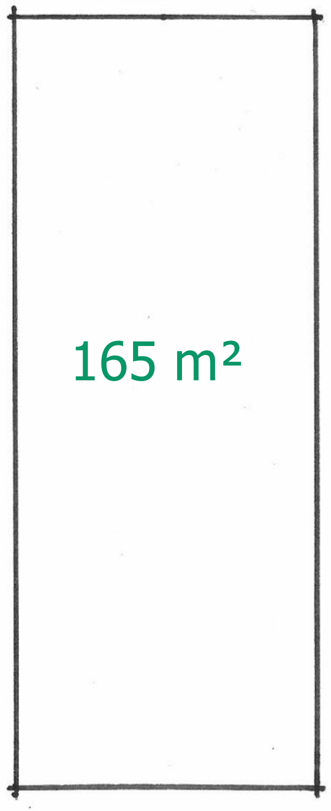
Slab area-to-perimeter ratio

Areas outside the thermal envelope such as porches or attached garages are not included in the measurements



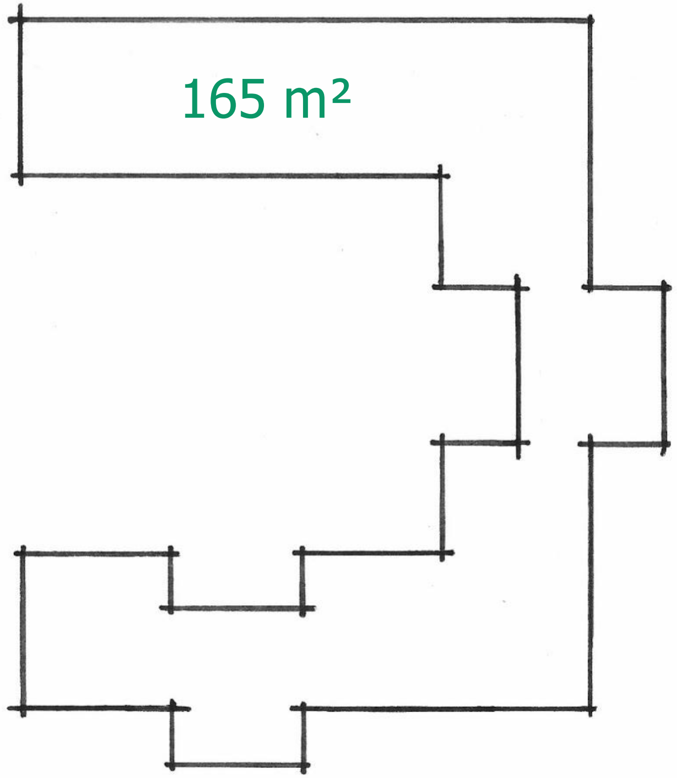
floor area = 41 m²
perimeter = 25.60 m

area-to-perimeter ratio = 41/25.60 = 1.60



floor area = 165 m²
perimeter = 57.25 m

area-to-perimeter ratio = 165/57.25 = 2.88



floor area = 165 m²
perimeter = 103 m

area-to-perimeter ratio = 165/103 = 1.60

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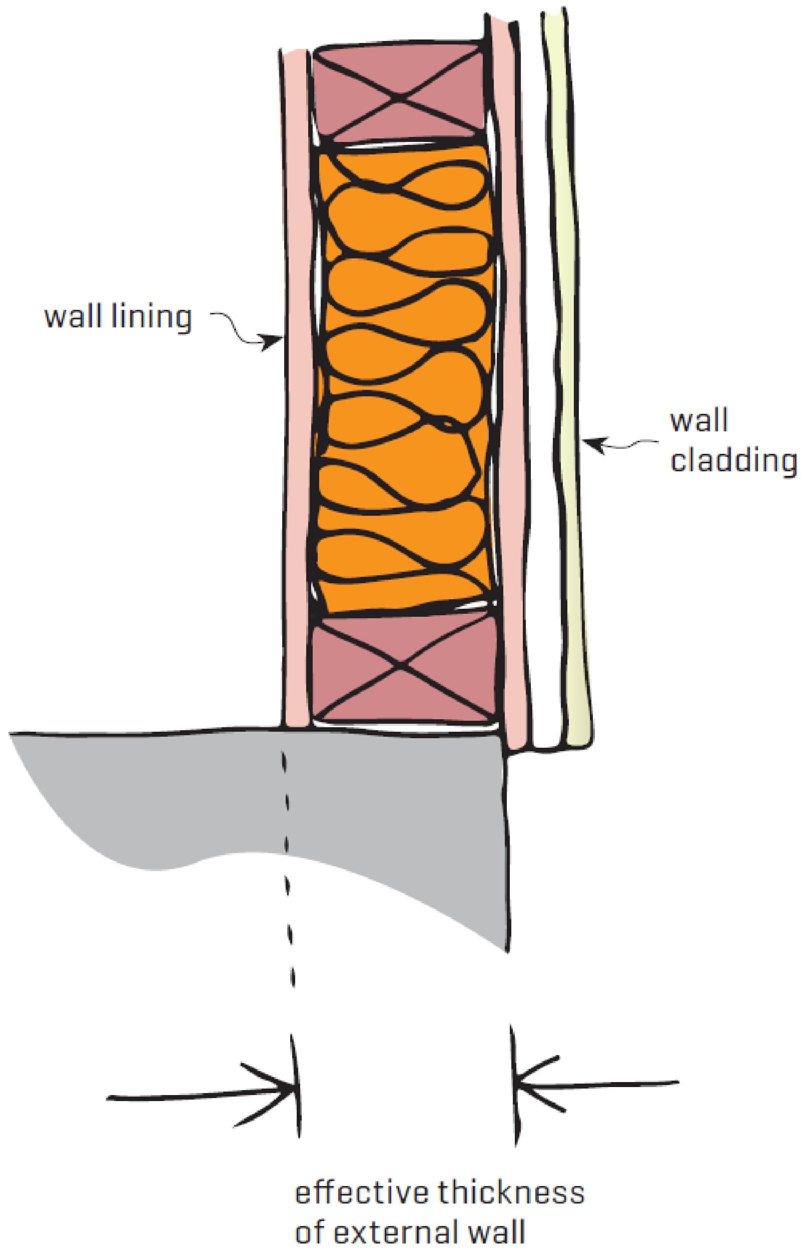
Effective thickness of external walls on slab

Measured from the interior wall surface to the outer face of the exterior vertical slab edge at floor level



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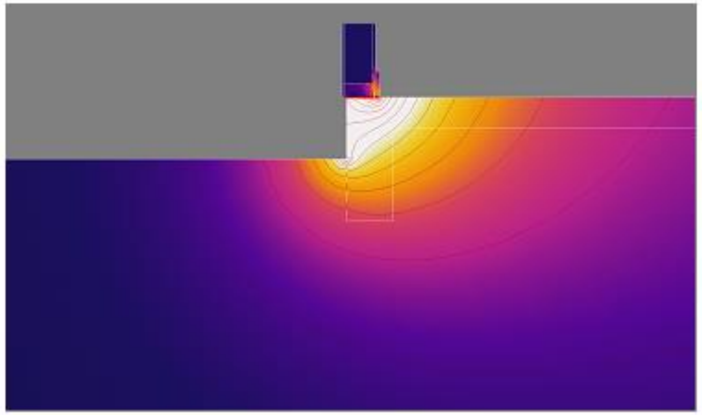
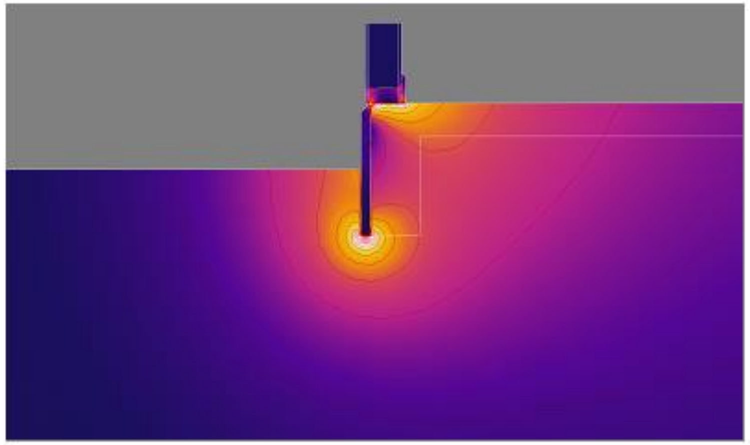
Slab-on-ground floor – heat flux magnitude

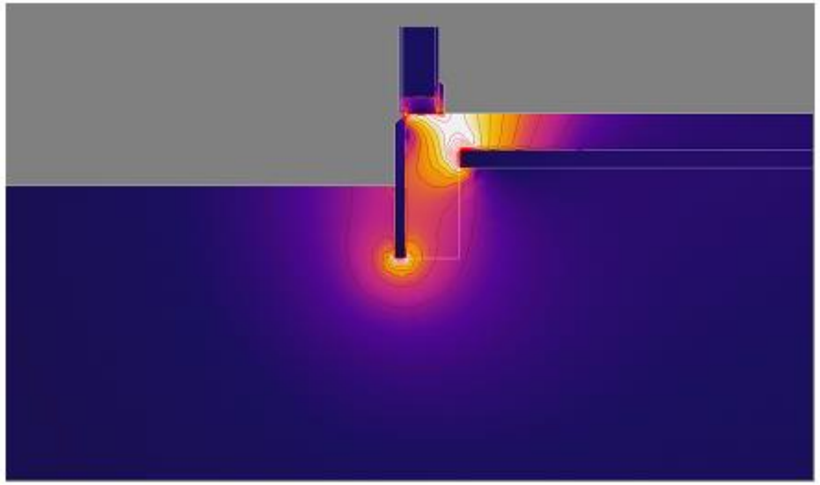
no insulation



vertical edge insulation



vertical edge
& under-slab insulation



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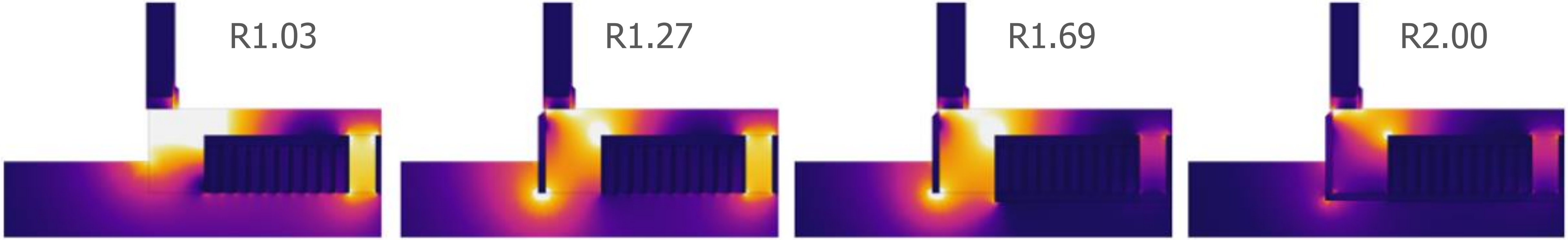
Slab-on-ground floor insulation options – standard claddings

Plain slab

Raft slab



no insulation

slab vertical edge

slab vertical edge, under slab

slab vertical edge, under slab, under footing, inner vertical edge

Slab-on-ground floor insulation options

Adding both vertical edge insulation and under-slab insulation deals with most of the heat loss

Under-footing insulation has much more impact with the raft slab

The plain slab requires the inner vertical edge of the footing to be insulated to get the full benefit of the under-footing insulation

Under-footing insulation requires SED

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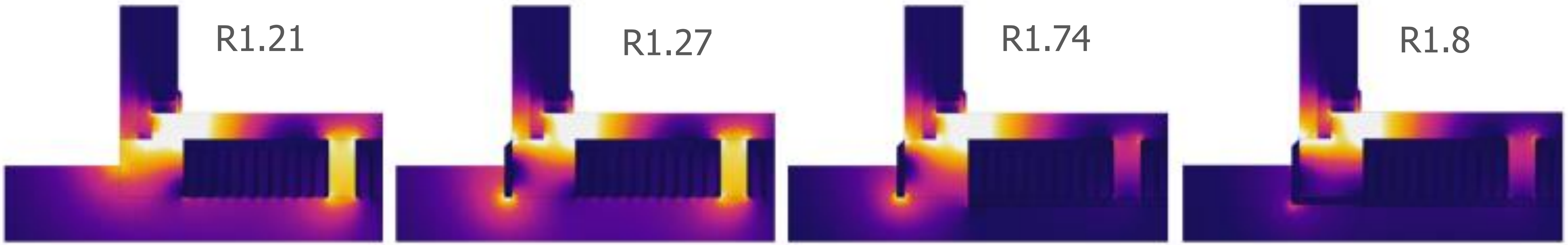
Slab-on-ground floor insulation options – masonry veneer cladding

Plain slab

Raft slab



no insulation

slab vertical edge

slab vertical edge, under slab

slab vertical edge, under slab, under footing, inner vertical edge

Slab-on-ground floor insulation options – masonry veneer cladding

Adding only vertical edge insulation is much less effective for masonry veneer as there is less edge to insulate and heat is conducted through the veneer

Combining the vertical edge insulation with under-slab insulation is correspondingly much more effective

Under-footing insulation is much less effective for masonry veneer – including for raft foundations

As with the non-masonry veneer examples, R1.5 is achieved by the combination of vertical edge insulation and full cover under-slab insulation

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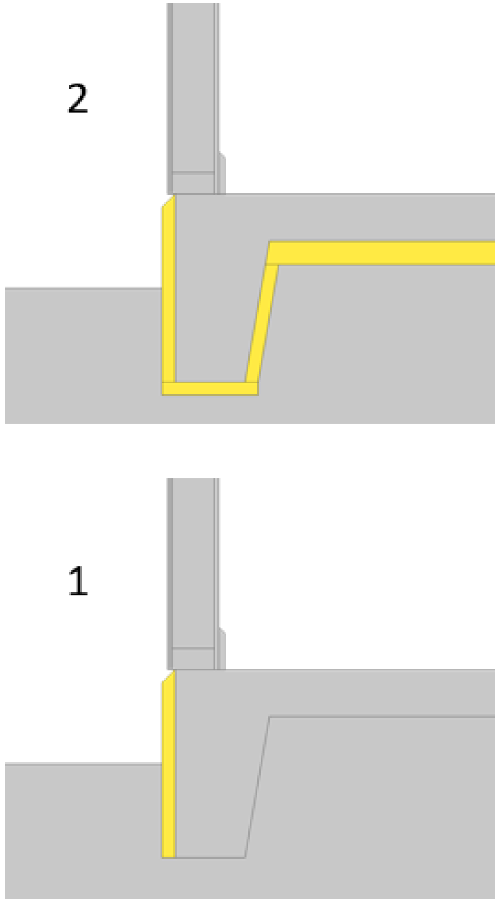
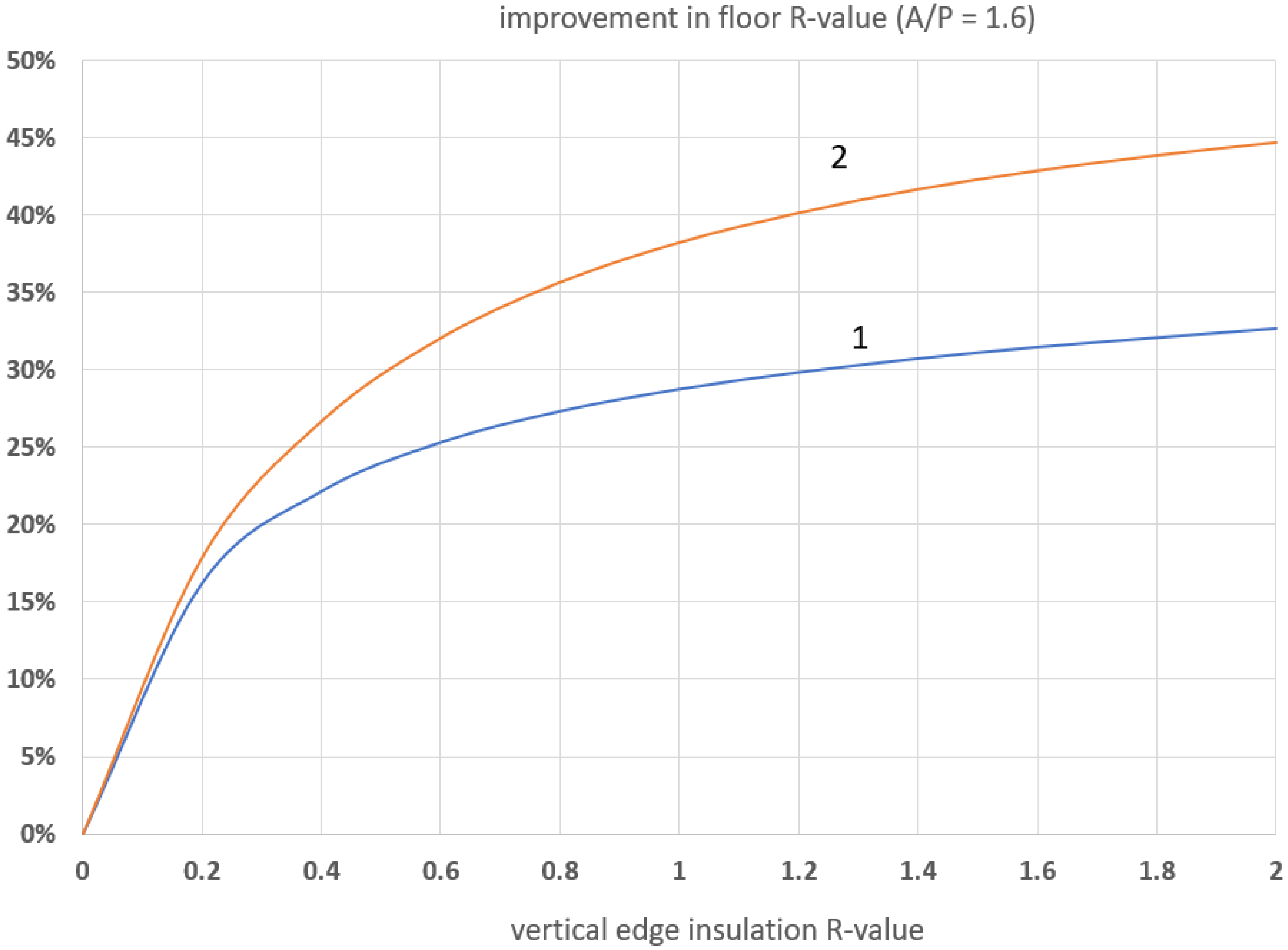
Slab floor insulation – construction R-value % improvement





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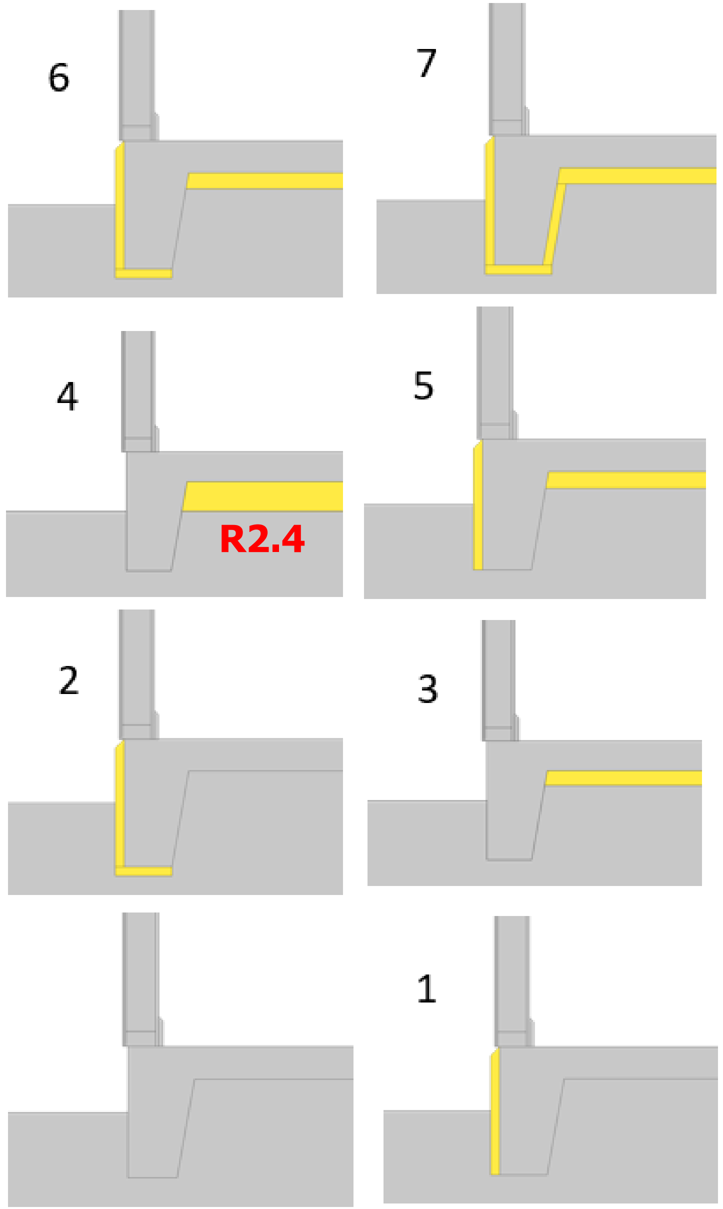
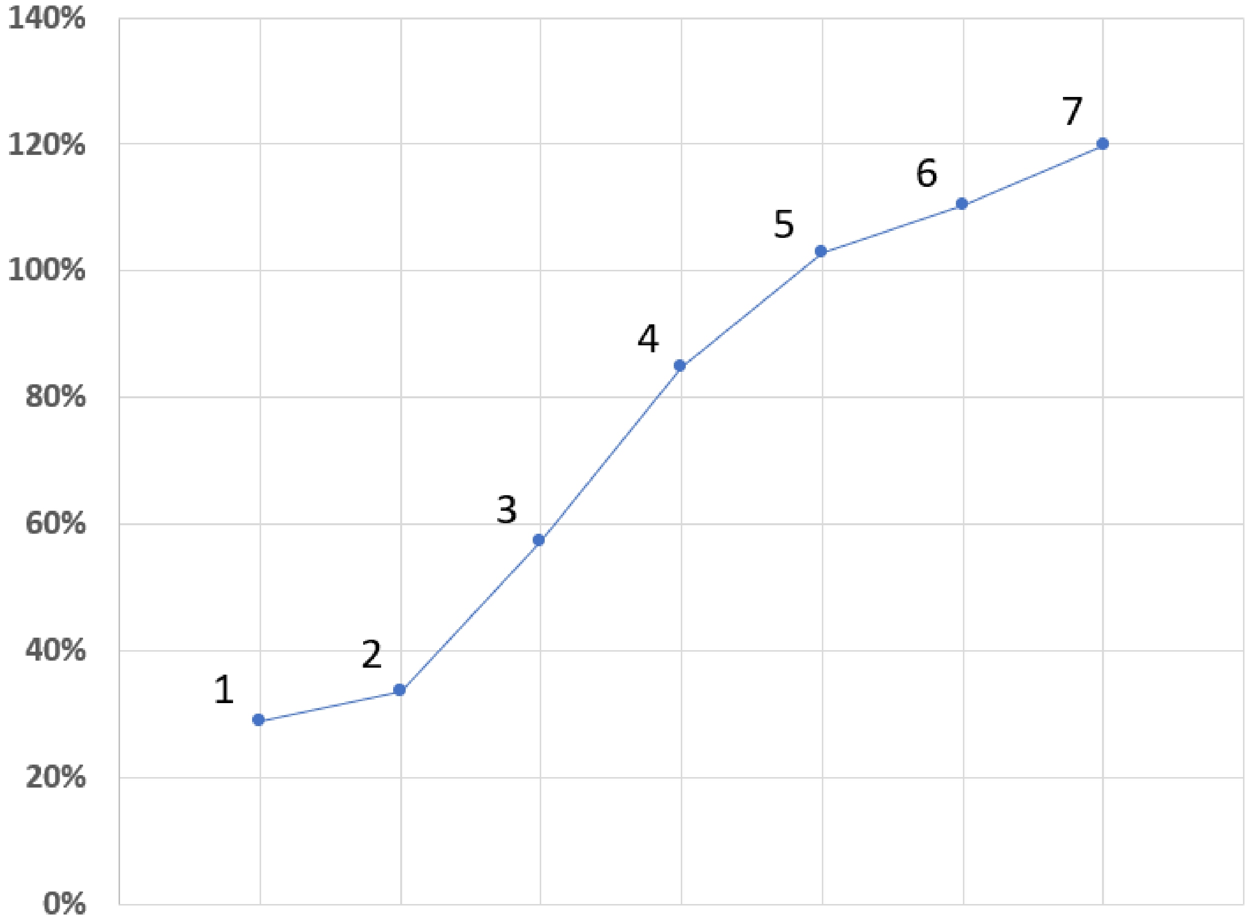
Slab floor insulation – construction R-value % improvement





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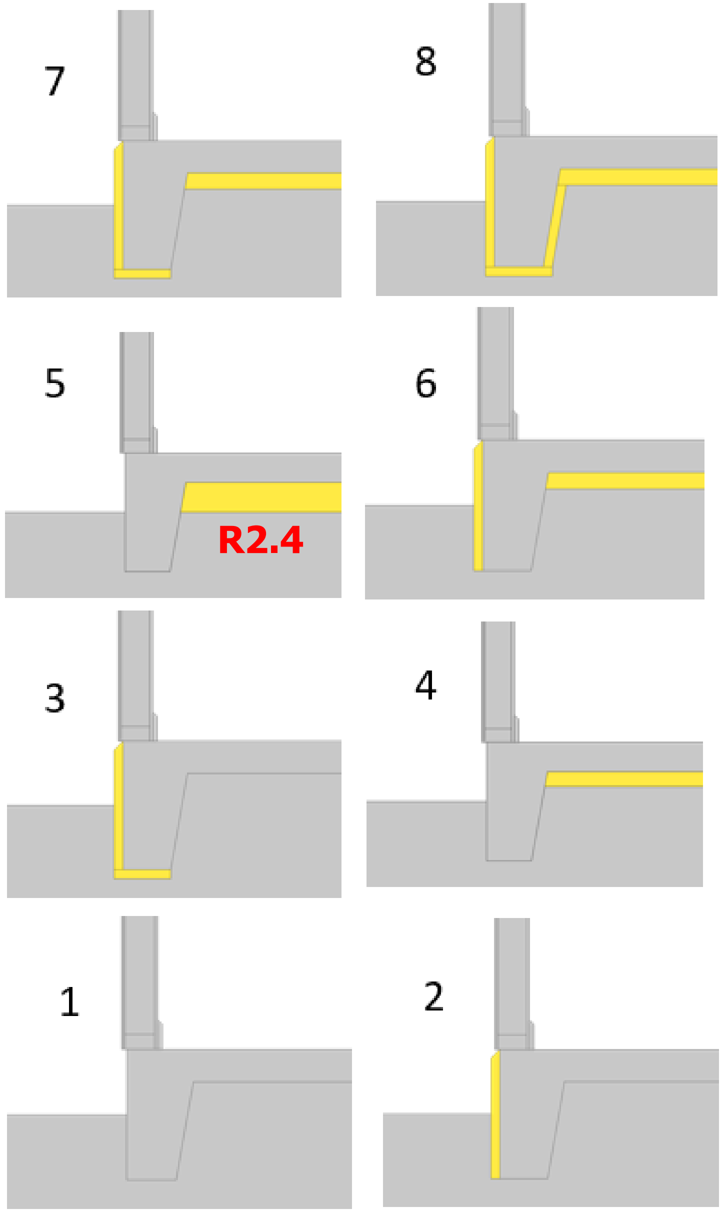
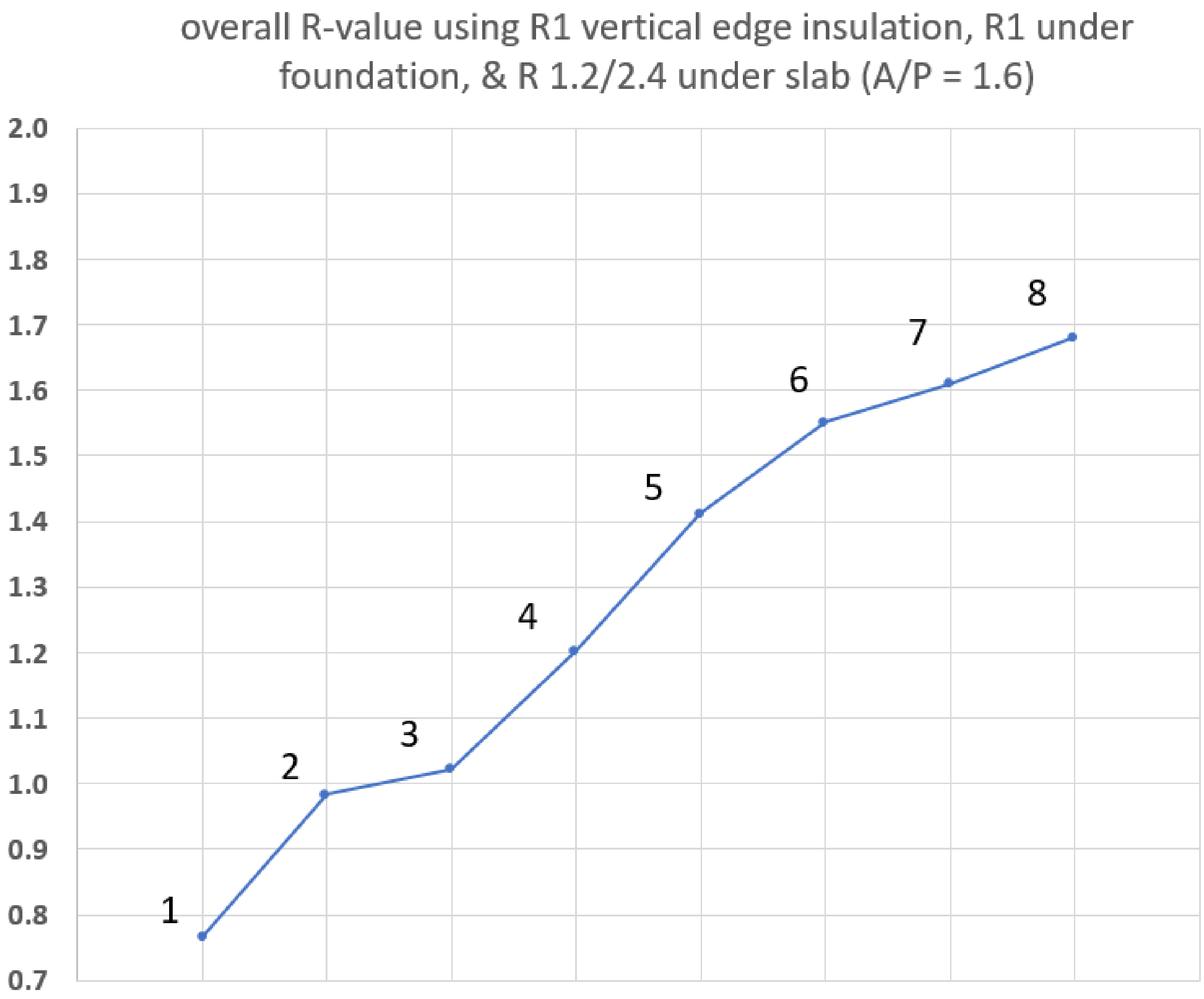
Slab floor insulation – construction R-value





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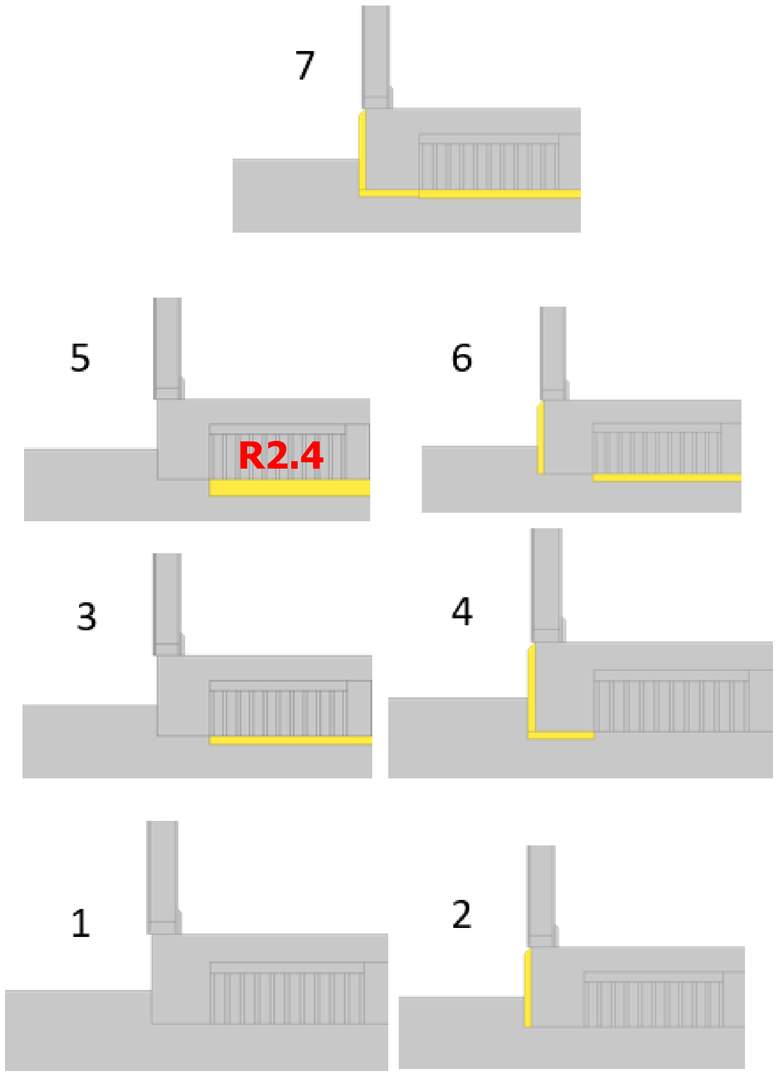
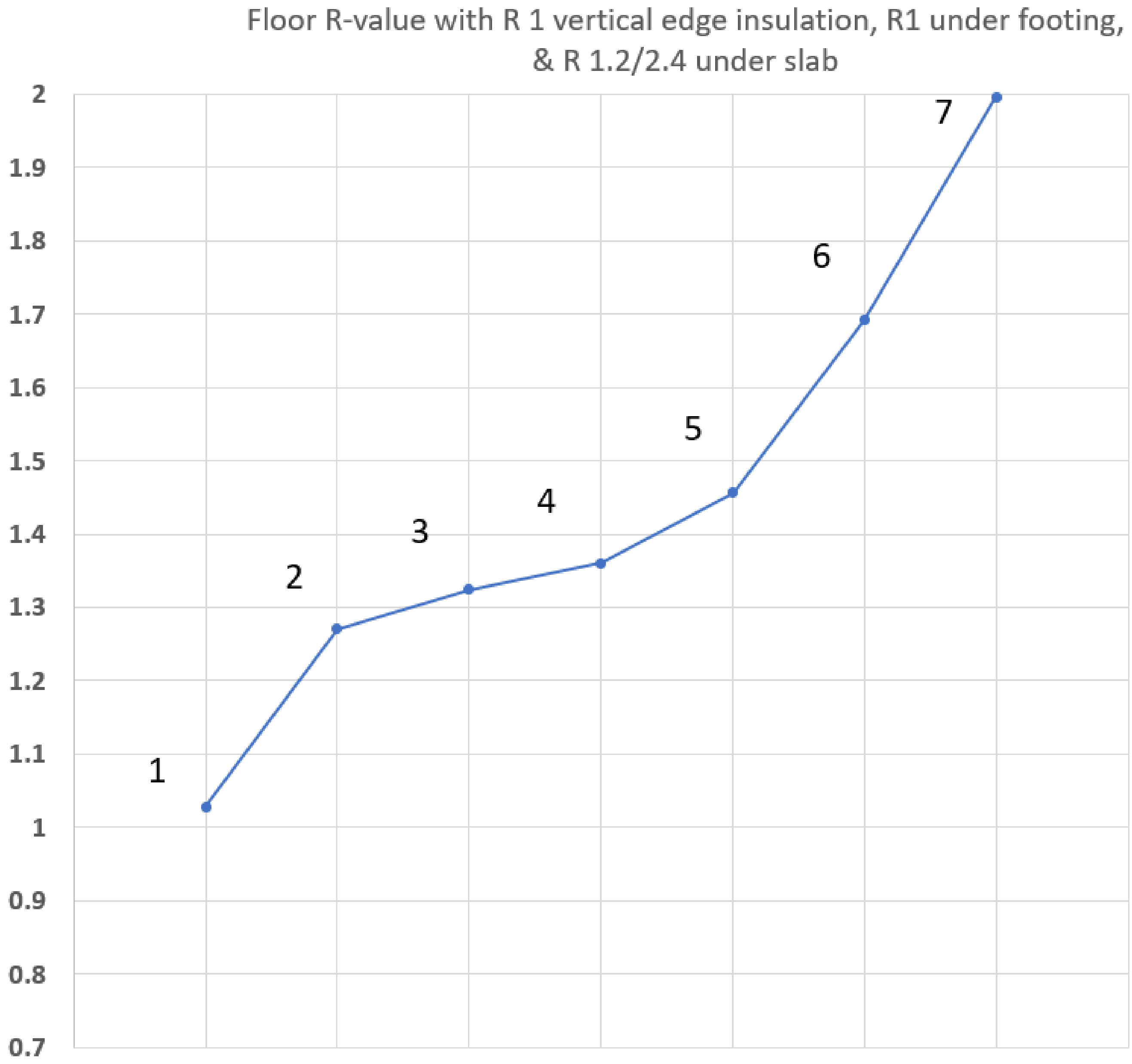
Raft foundation insulation – construction R-value





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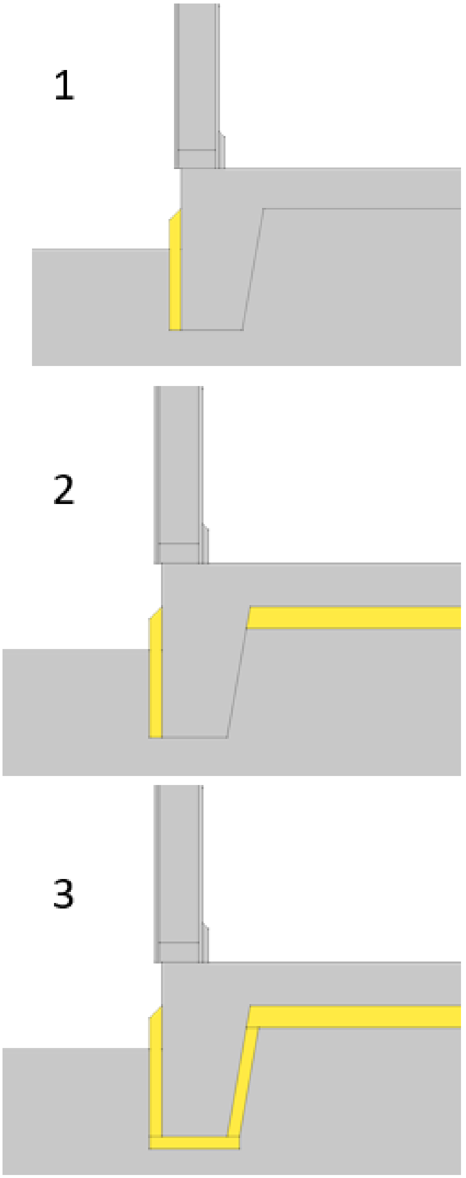
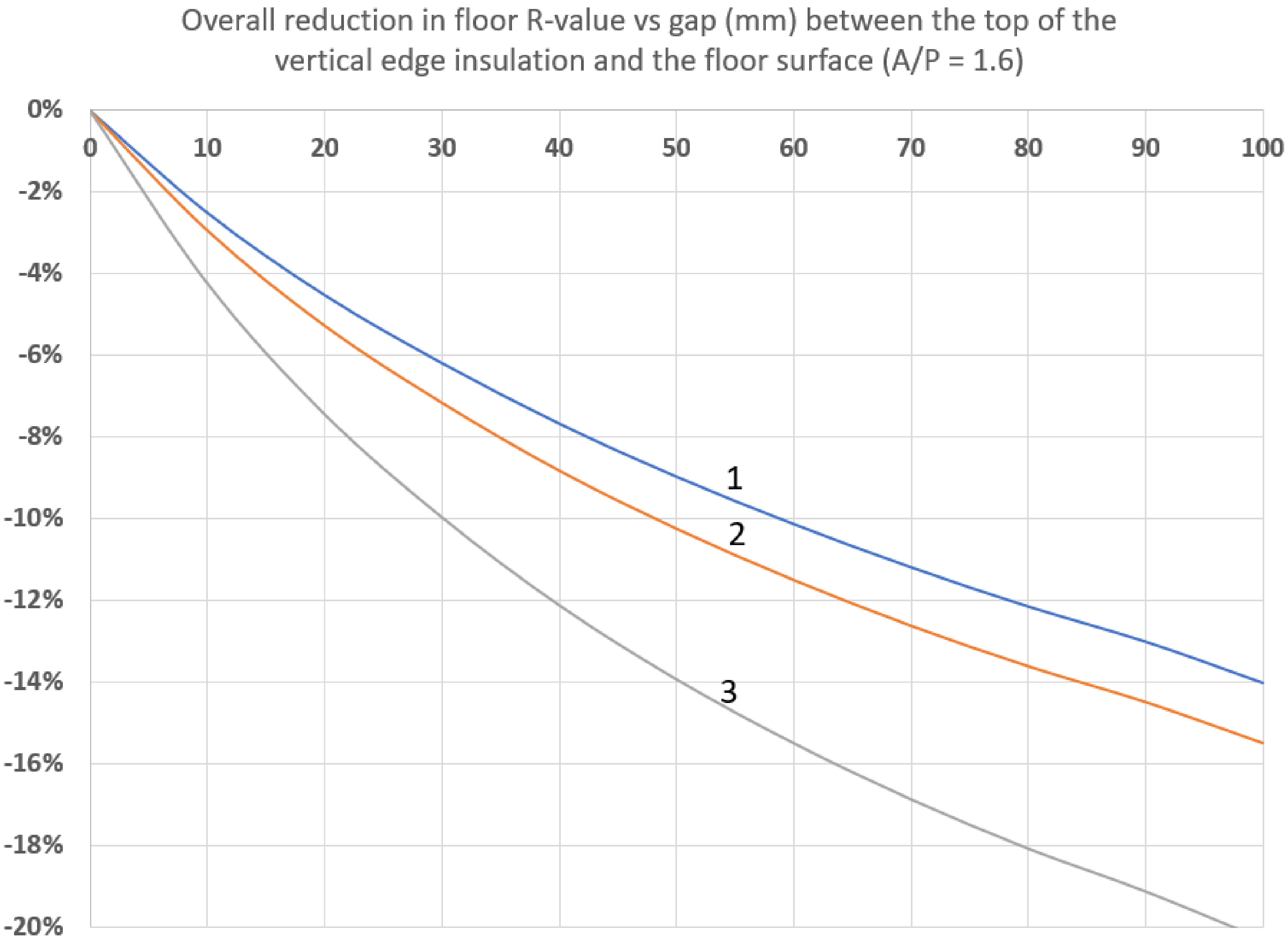
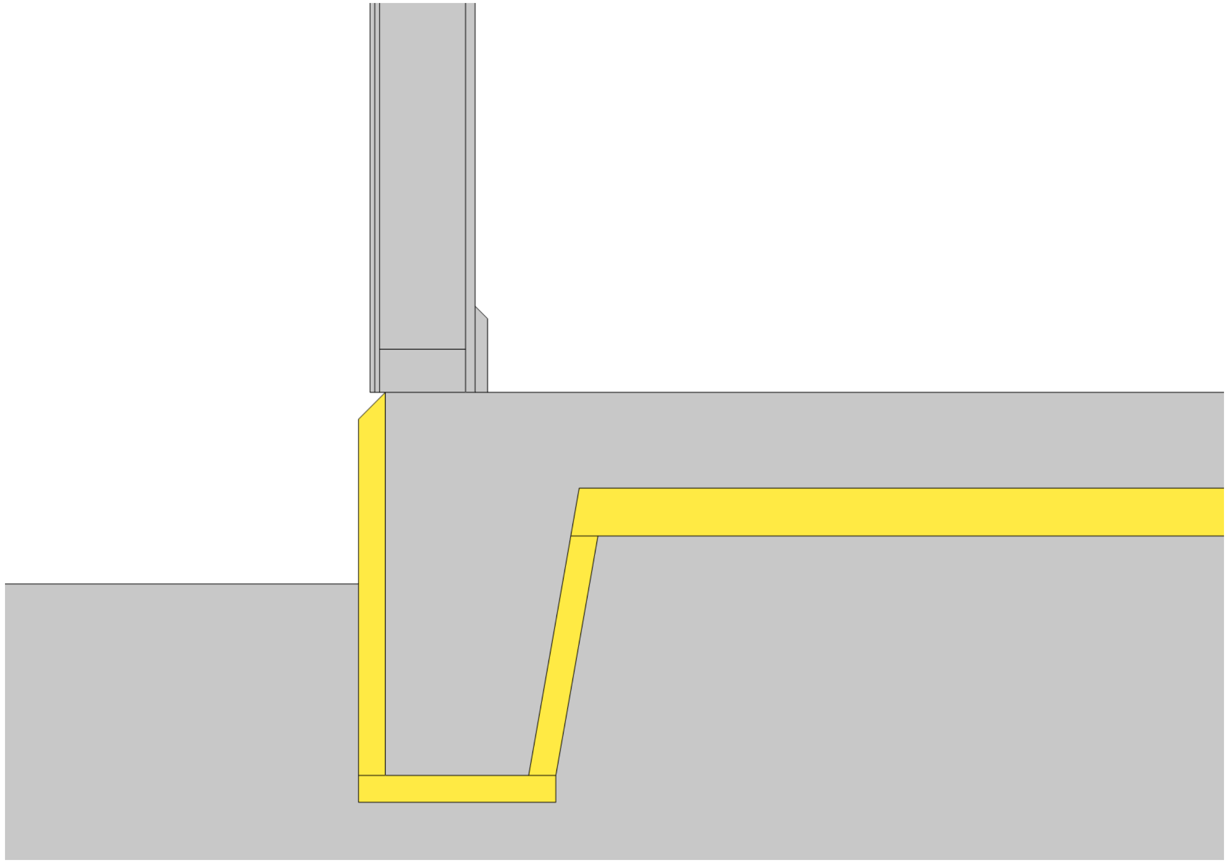
Slab edge insulation

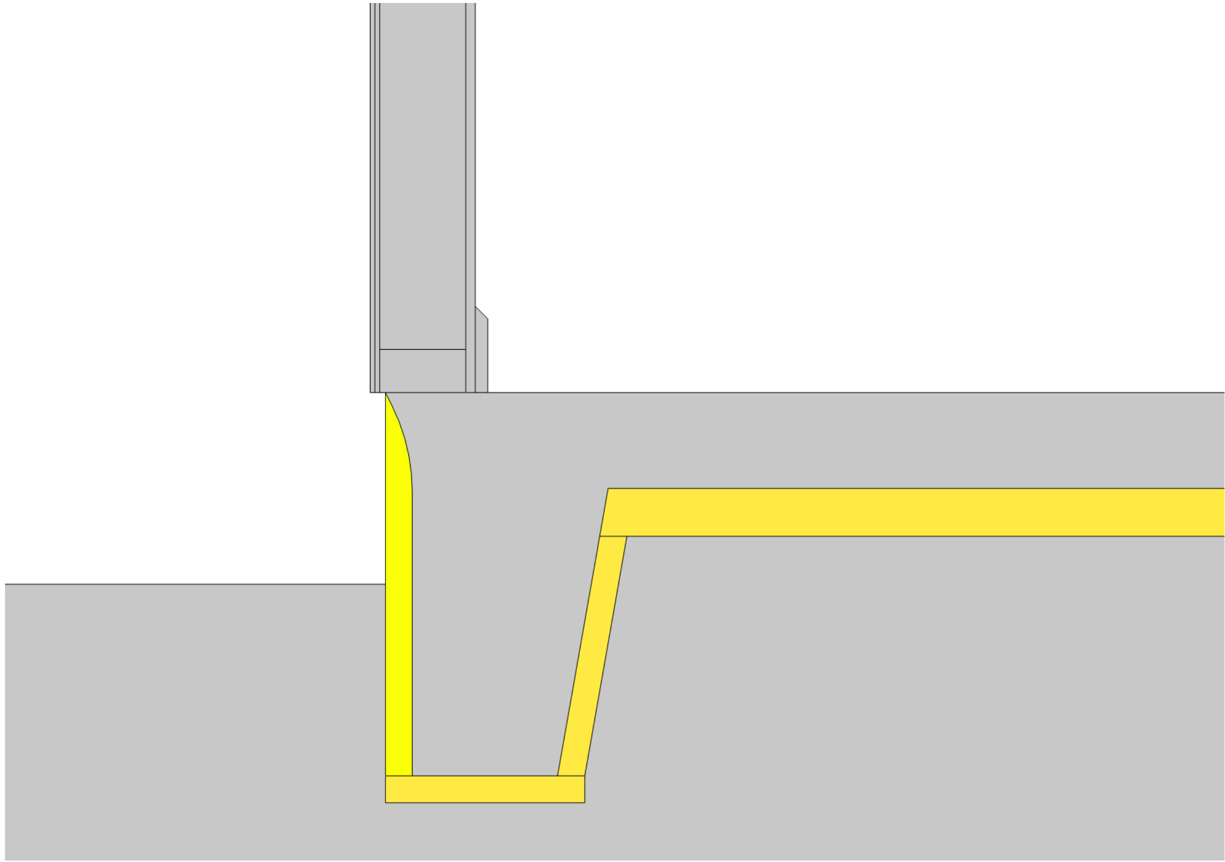




Slab edge insulation interface with exterior cladding

Reduces construction R-value (slab for A/P ratio 1.6) from R1.68 to R1.65





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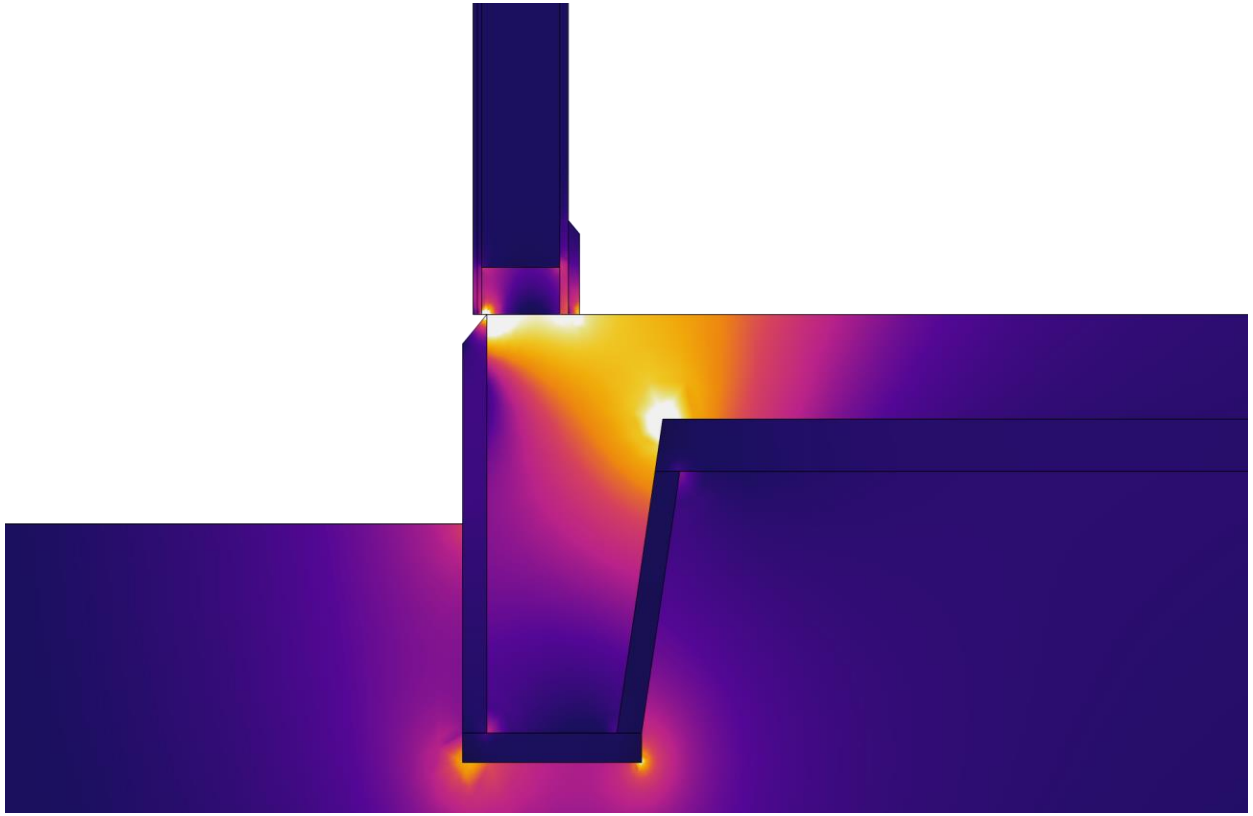
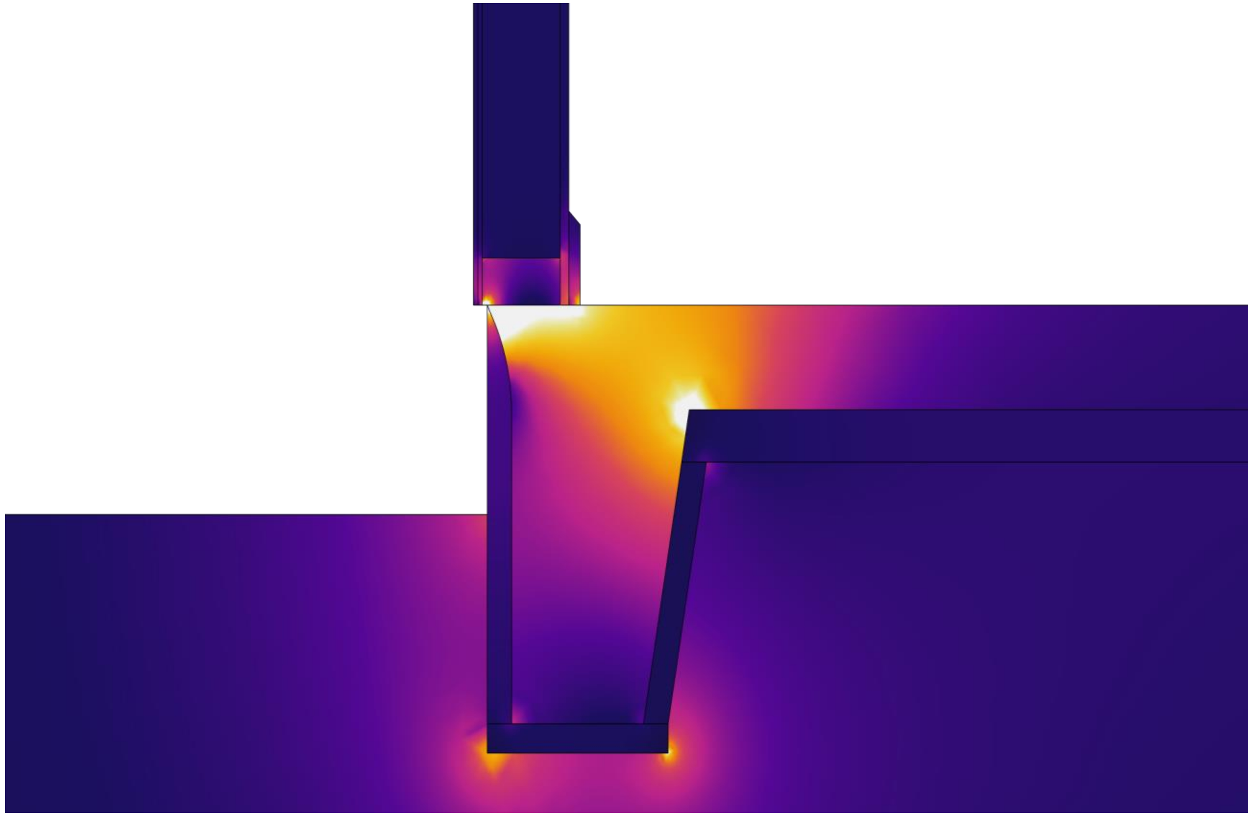
Slab edge insulation interface with cladding

Not much visible difference in the heat flux





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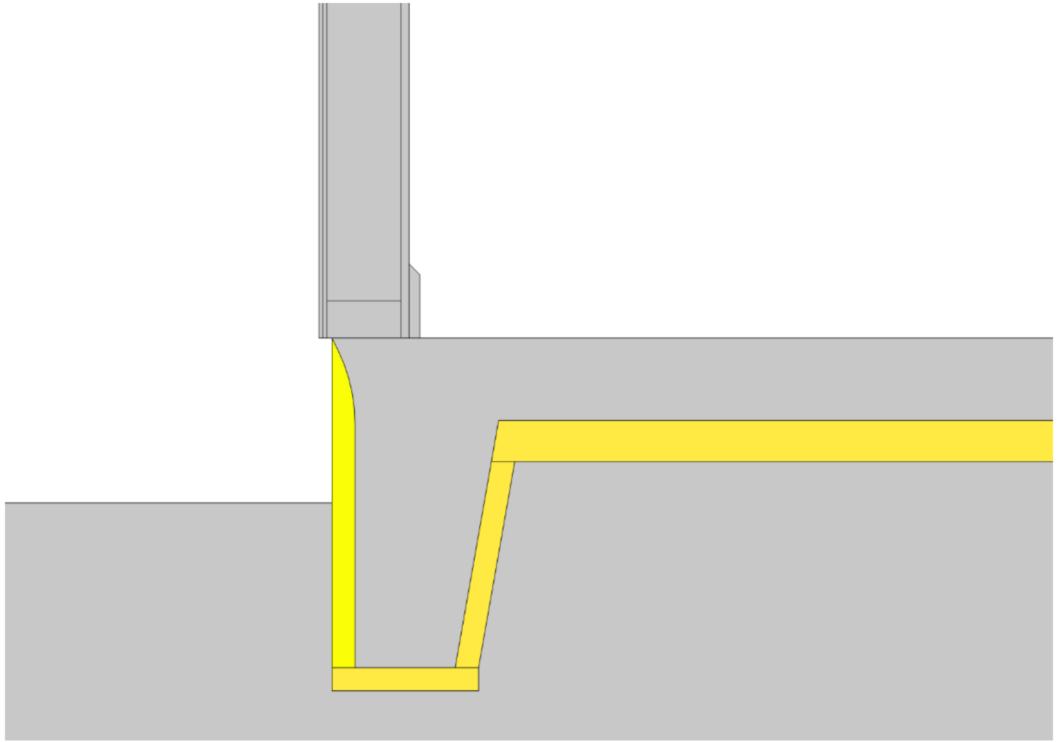
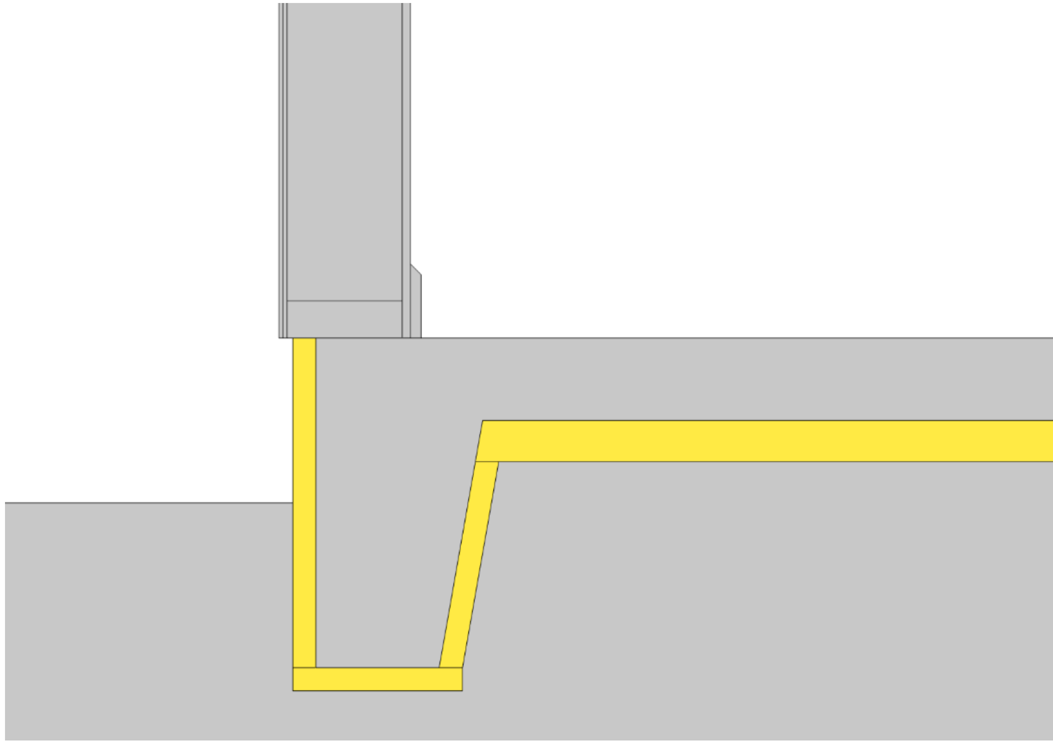
Increase wall thickness and remove edge insulation taper

Increases construction R-value (for slab A/P ratio 1.6) from R1.65 to R1.78

Changing wall to 140 mm framing adds R0.04 and removing the taper at the top edge of the insulation adds a further R0.09





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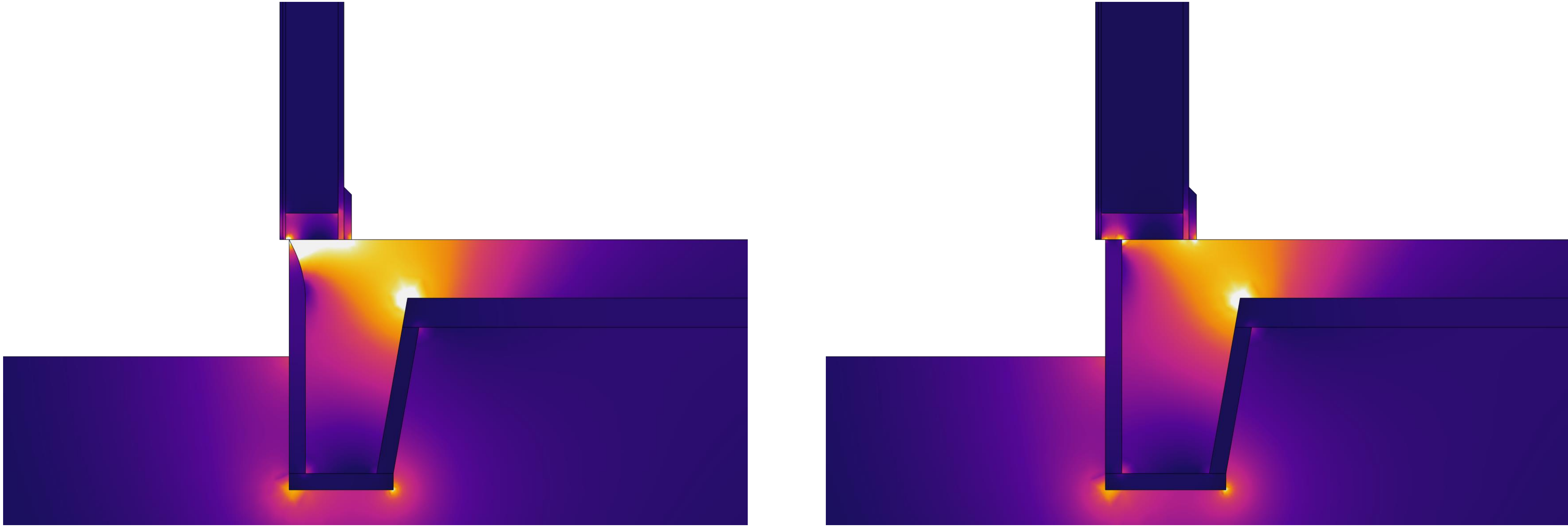
Increase wall thickness and remove edge insulation taper

Now a visible difference in the heat flux



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Proprietary slab-on-ground floors

Range of proprietary insulated slab-floor and raft foundation systems available

Insulation options:

- Slab edge
- Under slab
- Under foundation
- Top insulated
- Combination

Look for BRANZ Appraisal

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Considerations for slab-on-ground floor insulation

- Type/position of insulation
- Durability of slab edge insulation
- Bottom plate connections
- Construction R-values provided by system suppliers

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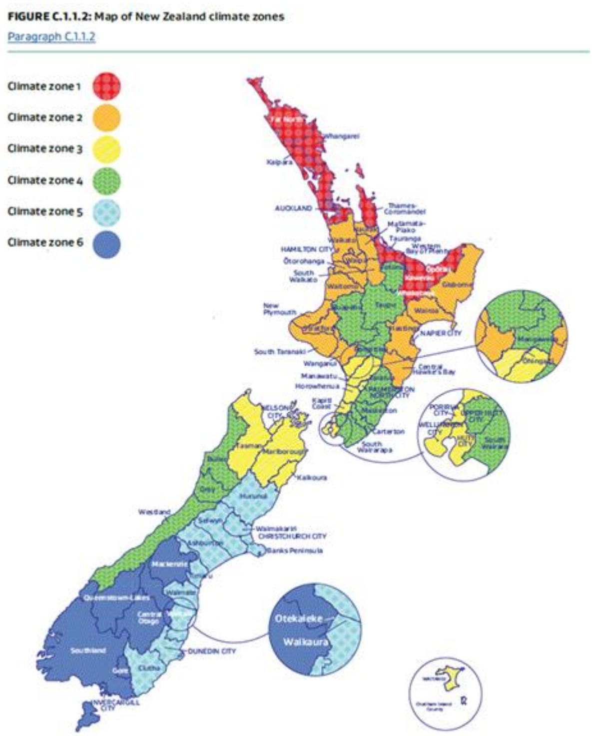
Suspended timber floors

H1/AS1 Table 2.1.2.2B minimum construction R-values:

- R2.5 (zones 1–3)
- R2.8 (zone 4)
- R3.0 (zones 5 and 6)



<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>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>
</table>

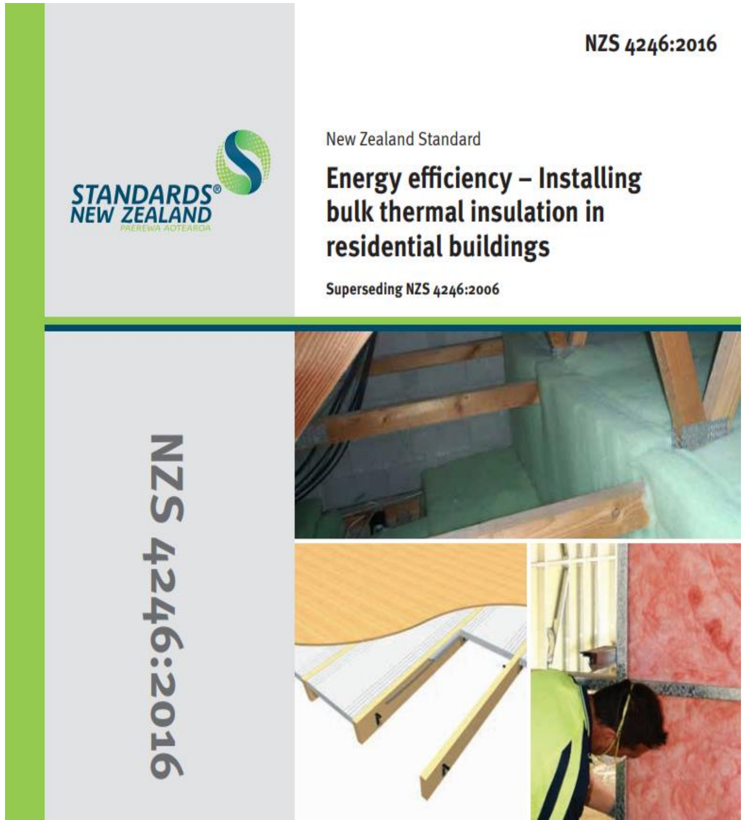
Suspended timber floors

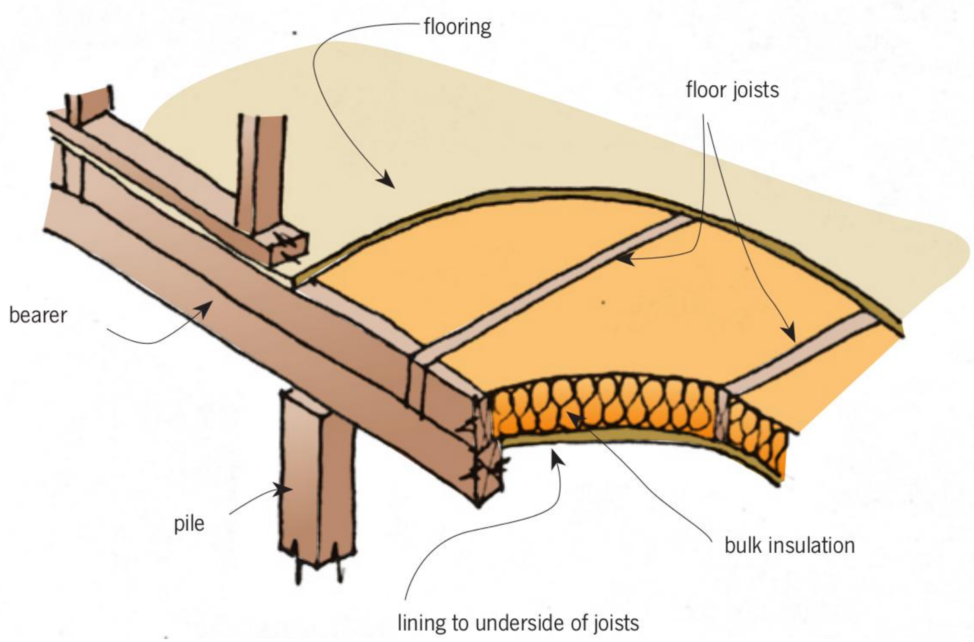
Range of high R-value under-floor insulation products available

Look for BRANZ Appraisal

Considerations for suspended timber floor insulation

- Floor framing depth – insulation capacity
- Amount of floor framing – minimise thermal bridging
- Durability of insulation – subfloor location
- Installation critical re performance – NZS 4246:2016
- Follow manufacturer's installation instructions





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Other considerations

Combined insulation types:

- Position of different materials
- Compatibility
- Installation sequence

Decreased floor framing drying potential once high levels of insulation installed

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Subfloor moisture and ventilation

40 L per day ground evaporation (bare ground)

NZS 3604 ventilation opening 3500 mm^2/m^2 – BRANZ research shows more than sufficient

Ground might look and feel dry but still be damp just below the surface

Increased subfloor insulation means higher relative humidity as the temperature coupled to ground temperature – therefore ventilation and ground cover are more important than ever

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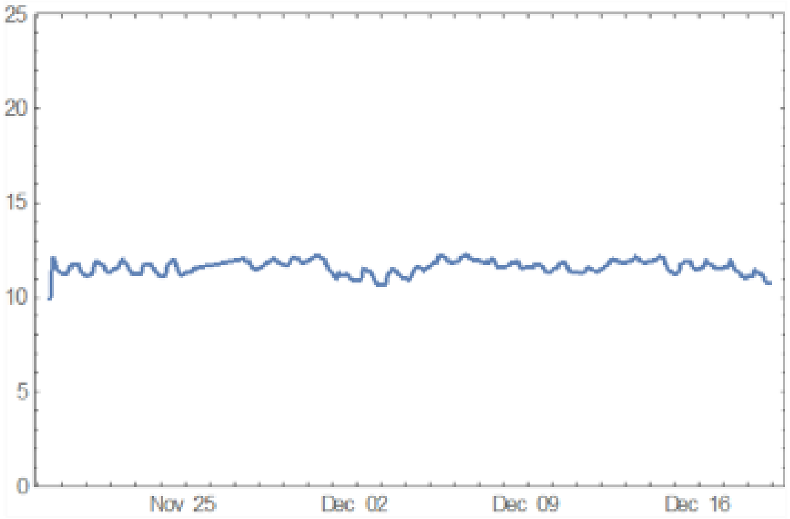
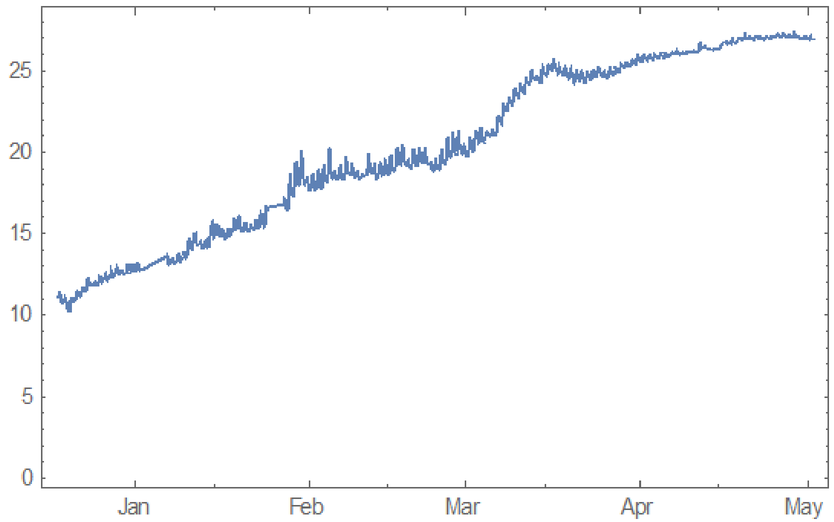
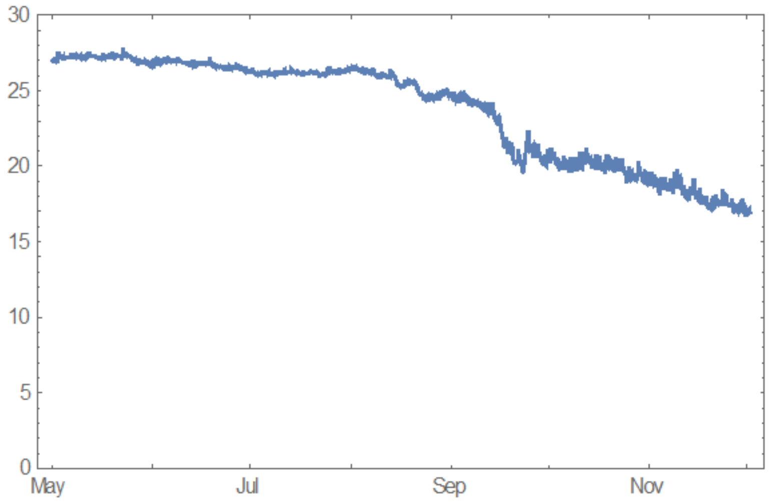
Subfloor moisture



Mean moisture content for the 3 weeks prior to enclosing



Moisture accumulation in south subfloor framing timber after enclosing



Drying of framing timber after the addition of 20% of NZS 3604 ventilation openings

Subfloor ground cover

Effective way to manage moisture risk – cover ground with 250 micron polyethylene with taped joins

Rate limiting effect of moisture is evaporation not ventilation so good installation is important

Benefits access to subfloor (installation of insulation, services and inspection/repair)

Vapour barrier (such as polyethylene) at joist level is not advised – not an alternative to ground cover (which prevents the moisture evaporating into the air in the first place)

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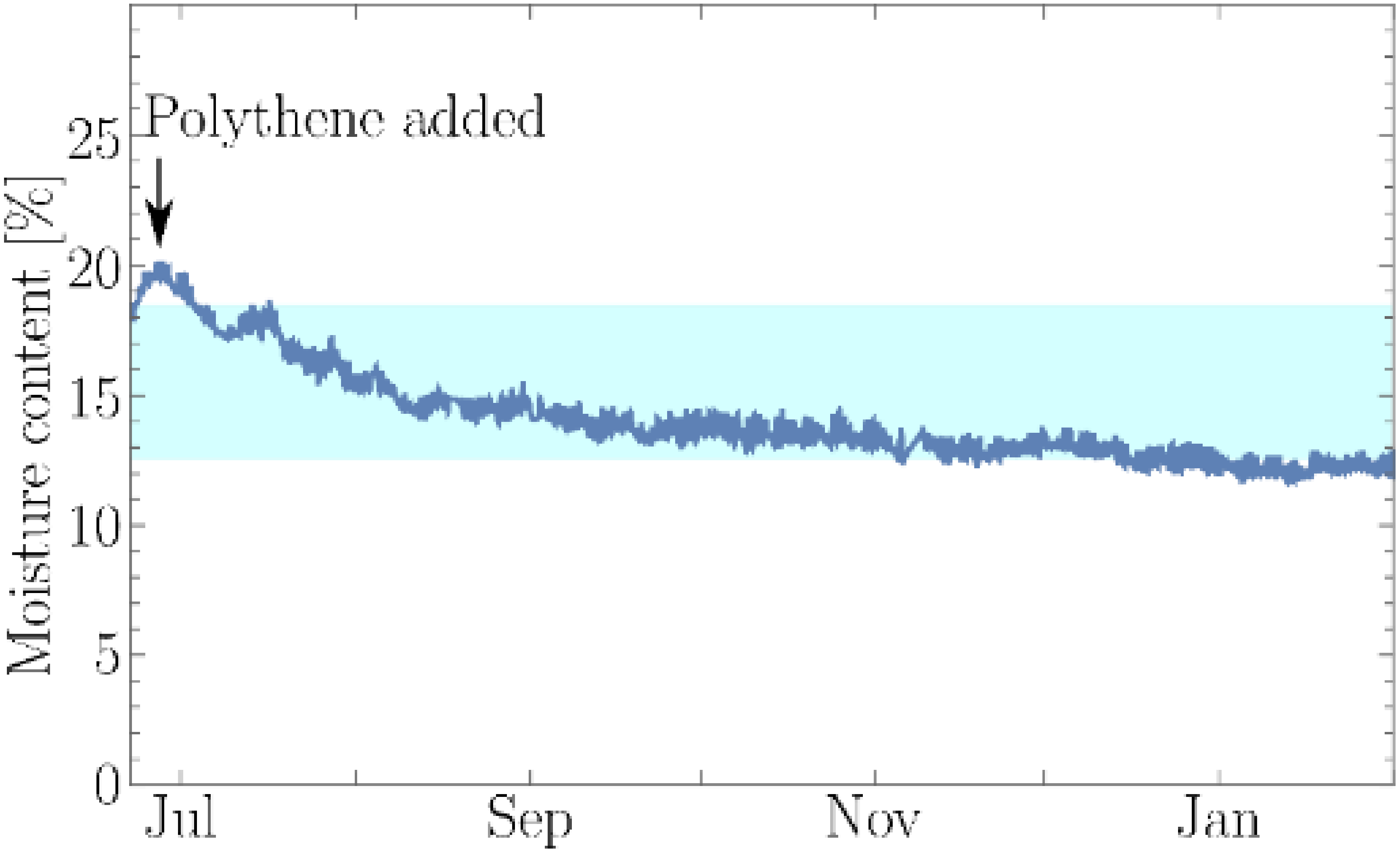
Subfloor moisture reduction



Moisture content of south bearer after polythene laid and all vents to the space closed off

Subfloor wind-wash

Enclosed subfloor with NZS 3604 vents, almost no measurable wind-wash

Lining the underside of insulation is an option but take advice as lining is at the point where condensation is most likely to form

Could specify lined insulation product or boost R-value of insulation to compensate

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Insulation retention

Options:

- Rigid foam insulation with clips or fasteners
- Strapping or battens
- Lining membrane/underlay (high permeability)

In an exposed subfloor, the retention needs to be much more robust than for an enclosed subfloor

Friction fitting insulation is often appropriate for enclosed subfloors

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Useful links

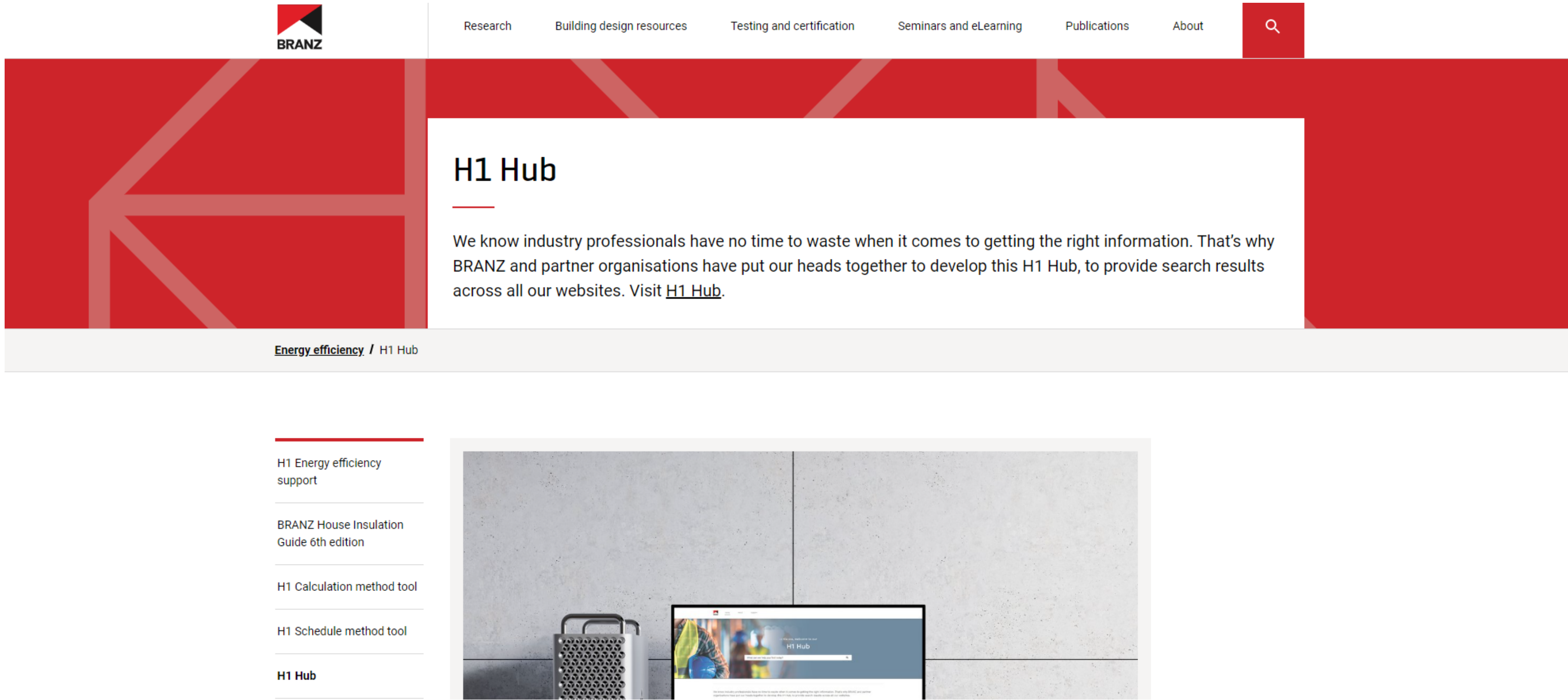
H1 *Energy efficiency* support

H1 Hub

H1 calculation method tool

House insulation guide

Previous H1 webinars



Thanks

We really appreciate the effort you have made to attend

Questions

We will now answer questions

If we don’t get to respond to all questions, BRANZ will provide answers at a later date