BUILDING PERFORMANCE

H1 Energy Efficiency

Verification Method H1/VM1

Energy efficiency for all housing, and buildings up to 300 m^2

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MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Te Kāwanatanga o Aotearoa
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Preface

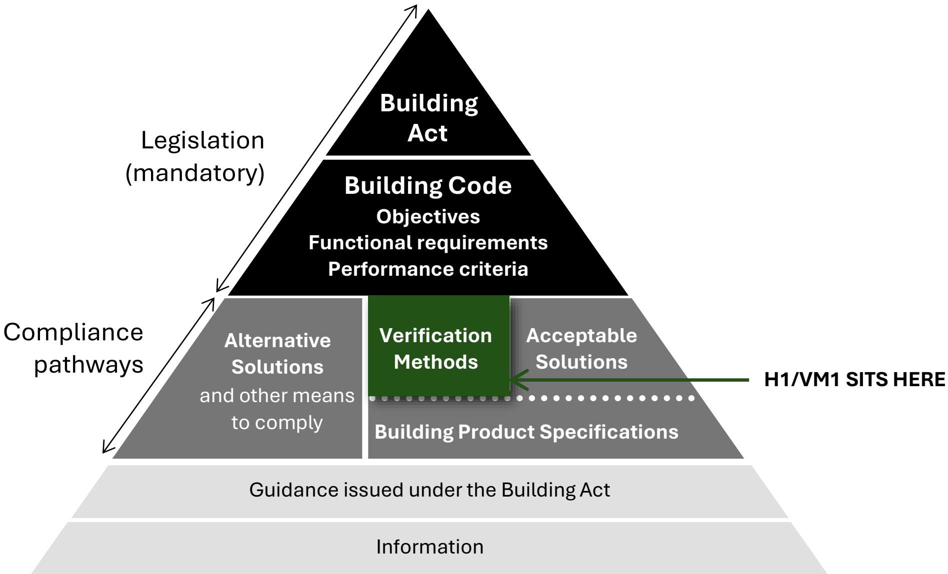
Document status

This document (H1/VM1 Sixth Edition) is a verification method issued under section 22 (1) of the Building Act 2004 and is effective on 27 November 2025. It does not apply to building consent applications submitted before 27 November 2025. The previous Verification Method H1/VM1 Fifth Edition, as amended, can be used to show compliance until 26 November 2026 and can be used for building consent applications submitted before 27 November 2026.

Building Code regulatory system

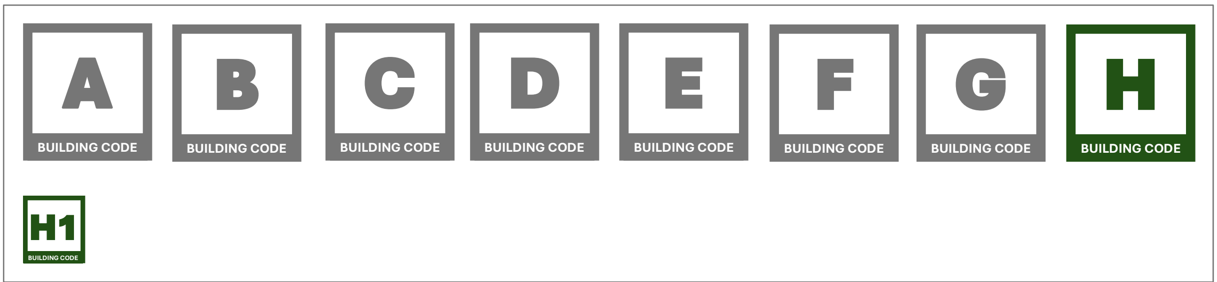
Each verification method outlines the provisions of the Building Code that it relates to. Complying with an acceptable solution or verification method are ways of complying with that part of the Building Code. Other options for establishing compliance are listed in section 19 of the Building Act.

Schematic of the Building Code system



A building design must take into account all parts of the Building Code. The Building Code is located in Schedule 1 of the Building Regulations 1992 and available online at www.legislation.govt.nz.

The part of the Building Code that this verification method relates to is clause H1 Energy Efficiency. Information on the scope of this document is provided in Part 1 General.



Further information about the Building Code, including objectives, functional requirements, performance criteria, acceptable solutions, and verification methods, is available at www.building.govt.nz.

Main changes in this version

This verification method is the sixth edition of H1/VM1. The main changes from the fifth edition amendment 1 are:

- The requirements of the modelling method have been clarified and updated. This includes changes to requirements relating to climate data used for the modelling, and changes to modelling assumptions for the solar heat gain coefficient of glazing in the reference building model, for the operation of ventilation for passive cooling in housing, and for internal gains from occupants and plug loads in housing. A new requirement has been added for deviations from default modelling assumptions to be documented and justified.
- For multi-unit dwellings and for mixed-use buildings, the building may now be treated as having either a single thermal envelope, or multiple thermal envelopes, when demonstrating compliance using the modelling method.
- The citation of NZS 4214 has been modified to enhance clarity of requirements for determining the thermal resistance of building elements containing thermal bridges.
- The method for determining the thermal resistance of framed walls has been revised to better address typical levels of thermal bridging caused by wall framing members. As a consequence, the wall R-value in the reference building has also been reduced.
- The application of minimum construction R-values of heated ceilings, heated walls and heated floors has been clarified, and these minimum construction R-values no longer apply where heated ceilings, heated walls or heated floors are installed solely in rooms that contain a shower, bath or toilet.
- The method for determining the areas of roofs, walls and floors now requires the overall internal dimensions to be used.
- References have been revised to reflect the documents cited in this verification method in Appendix A.
- Definitions have been revised to reflect the terms used in this verification method in Appendix B.
- The verification method now refers to the Building Product Specifications for determining the thermal resistance of insulation materials. As a consequence, reference to AS/NZS 4859.1 has been removed from the verification method with the applicable specifications located within the Building Product Specifications.
- Portions of text have been re-written to enhance clarity in the document and provide consistent language with other acceptable solutions and verification methods.
- Minor amendments have been made to correct typos, grammar, cross-references, punctuation, wording, and formatting of the document. This includes changes to headings, paragraphs, tables and figures, table and figure notes, and definitions. These amendments do not affect the level of performance required in the document but may assist in the interpretation of the requirements.

People using this document should check for amendments on a regular basis. The Ministry of Business, Innovation and Employment may amend any part of any acceptable solution or verification method at any time. Up-to-date versions of acceptable solutions or verification methods are available from www.building.govt.nz.

Features of this document

- For the purposes of Building Code compliance, the standards and documents referenced in this verification method must be the editions, along with their specific amendments listed in Appendix A.
- Words in *italic* are defined at the end of this document in Appendix B.
- Hyperlinks are provided to cross-references within this document and to external websites and appear with a blue underline.
- Appendices to this verification method are part of, and have equal status to, the verification method. Figures are informative only and the wording of the paragraphs takes precedence. Text boxes headed 'COMMENT' occur throughout this document and are for guidance purposes only.
- A consistent number system has been used throughout this document. The first number indicates the Part of the document, the second indicates the Section in the Part, the third is the Subsection, and the fourth is the Paragraph. This structure is illustrated as follows:

2	Part
2.5	Section
2.5.3	Subsection
2.5.3.1	Paragraph
2.5.3.1(a)	Paragraph (as a portion of the relevant paragraph)
2.5.3.1(a)(i)	Paragraph (as a portion of the relevant paragraph)

- Classified uses for *buildings*, as described in clause A1 of the Building Code, are printed in bold in this document. These requirements are also denoted with classified use icons.

H **Housing**

Com **Commercial**

Out **Outbuildings**

CR **Communal residential**

Ind **Industrial**

Anc **Ancillary**

CN **Communal non-residential**

Contents

Part 1. General

1.1 Introduction

1.1.1 Scope of this document

1.1.1.1 This document applies to:

H

a) **housing**; and

CR

CN

Com

b) other *buildings* with an area of *occupied space* less than or equal to 300 m^2, that are **communal residential**, **communal non-residential** (assembly care only), and **commercial** *buildings*.

> COMMENT:
>
> 1. **Housing** includes detached dwellings, multi-unit dwellings such as *buildings* which contain more than one separate *household unit* or family (such as an apartment *building*), and group dwellings (such as a *wharenui).*
> 2. For mixed-use *buildings* that include **housing**, this document applies to the parts of the *building* containing *housing*. This document also applies to any parts of the *building* containing **communal residential**, **communal non-residential** (assembly care only) and **commercial**, provided their combined area of *occupied space* is less than or equal to 300 m^2. Acceptable Solution H1/AS2 or Verification Method H1/VM2 may be used for the parts of the *building* other than **housing** if their combined area of *occupied space* is greater than 300 m^2.

1.1.1.2 For *buildings* that do not meet these characteristics, refer to the Acceptable Solution H1/AS2 or Verification Method H1/VM2 as a means to demonstrate compliance or use an alternative means to demonstrate compliance.

1.1.2 Items outside the scope of this document

1.1.2.1 This verification method does not apply to *buildings* with *foil insulation*.

1.1.3 Compliance pathway

1.1.3.1 This verification method is one option that provides a means of establishing compliance with the functional requirements and some of the performance criteria in Building Code clause H1 Energy Efficiency. It can be used to demonstrate compliance with clauses:

a) H.1.3.1(a) for the *adequate thermal resistance* of the *building envelope*; and

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b) H1.3.2E for the building performance index for **housing**; and

c) H1.3.3 for the physical conditions to be taken into account for the energy performance of *buildings* including:

   i) the *thermal mass* of *building elements*, and

   ii) the *building* orientation and shape, and

   iii) the airtightness of the *building envelope*, and

   iv) the heat gains from services, processes, and occupants, and

   v) the local climate, and

   vi) heat gains from solar radiation.

1.1.3.2 Compliance with Building Code clause H1.3.1(a) (*adequate thermal resistance*) satisfies clause H1.3.2E (Building Performance Index or BPI).

> COMMENT: The modelling method described in Part 2. is a verification method for Building Code clause H1.3.1(a) (*adequate thermal resistance*). However, compliance with clause H1.3.2E (Building Performance Index or BPI) is not sufficient for demonstrating compliance with clause H1.3.1(a) (*adequate thermal resistance*).

1.1.3.3 This verification method does not include requirements to comply with Building Code clauses H.1.3.1(b) for limiting uncontrollable airflow, and H1.3.4 for the energy efficiency of hot water systems. For these clauses, use Acceptable Solution H1/AS1 or an alternative means to demonstrate compliance.

Com 1.1.3.4 For **commercial** *buildings*, this verification method does not include requirements to comply with clause H1.3.6 of the Building Code for the energy efficiency of *HVAC systems*. For this clause, use Verification Method H1/VM3 or use an alternative means to demonstrate compliance.

1.2 Using this verification method

1.2.1 Determining the classified use

1.2.1.1 Classified uses for *buildings* are described in clause A1 of the Building Code. Where a specific classified use is mentioned within a subheading and/or within the text of a paragraph, this requirement applies only to the specified classified use(s) and does not apply to other classified uses.

1.2.2 Determining the area of the building

H 1.2.2.1 For **housing**, use the *floor area* of the *building*.

1.2.2.2 For *buildings* other than **housing**, calculate the area based on the *occupied space* of the *building* but exclude any parts with a classified use of **industrial, communal non-residential** (assembly service), **outbuildings**, or **ancillary**.

H 1.2.2.3 For mixed-use *buildings* that include **housing**, exclude the *floor area* of the parts of the *building* containing **housing** when calculating the area of *occupied space*.

1.2.3 Building Product Specifications

1.2.3.1 This verification method refers to the Building Product Specifications for *building* product standards and specifications in relation to their manufacture, fabrication, testing, quality control, physical properties, performance, installation, and/or maintenance.

1.2.3.2 The Building Product Specifications cannot be used in isolation to demonstrate compliance with any requirements of the Building Code. To comply with H1/VM1, *building* products conforming to the Building Product Specifications must be used within the scope, limitations, and other applicable requirements set out in this verification method.

Part 2. Building thermal envelope

2.1 Thermal resistance

2.1.1 Overview

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2.1.1.1 To provide *adequate thermal resistance*, the *thermal envelope* of *buildings* or parts of *buildings* with classified uses of **housing**, **communal residential**, **communal non-residential** (assembly care), and **commercial** shall meet the requirements of either:

a) the modelling method described in Sections 2.2, 2.3, 2.4, 2.5 and 2.6; or

b) the calculation method in Acceptable Solution H1/AS1.

> COMMENT:
>
> 1. For **housing** and **communal residential** *buildings*, to satisfy the Building Code performance requirement E3.3.1 for internal moisture, it may be necessary to provide more insulation (greater *R-value*) than that required to satisfy H1 energy efficiency provisions alone.
> 2. Passive measures to prevent overheating from excessive solar heat gains through the *building envelope* should be taken to reduce dependence on active cooling systems. Such measures should include a combination of:
>
> a. providing *adequate thermal resistance* to the *thermal envelope* of the *building*; and
>
> b. avoiding excessive window areas (particularly on the east, north, and west facing facades); and
>
> c. avoiding excessive *skylight areas*; and
>
> d. selecting glass types with appropriate *solar heat gain coefficients* (*SHGC*); and
>
> e. providing external shading for windows and *skylights*; and
>
> f. providing the ability to ventilate the *building* at a sufficient rate to maintain comfortable indoor temperatures in summer.

2.1.1.2 The *construction R-values* of individual *building elements* shall be determined in accordance with Subsection 2.1.2.

2.1.1.3 Insulation materials shall be installed in a way that achieves the intended thermal performance in *buildings* without compromising the durability and safety of insulation or *building elements* and the health and safety of installers and *building* occupants. NZS 4246 sections 5, 6, 7 and 10 provide acceptable methods for installing bulk thermal insulation in light-timber and steel-framed residential *buildings*.

> COMMENT: Slab perimeter insulation should be protected against water absorption, ultraviolet (UV) exposure, and impact damage. However, deviating from step 2 in section 10.3 in NZS 4246, encapsulation of slab perimeter insulation is not recommended as it can result in moisture getting trapped.

2.1.2 Determining the thermal resistance of building elements

2.1.2.1 The *construction R-values* of *building elements* shall be determined by:

a) for walls, *roofs*, and floors other than *slab-on-ground floors*, using NZS 4214 as modified by Paragraph 2.1.2.2; and

   i) for framed walls, a *wall framing fraction* of no less than 38% shall be assumed unless it can be demonstrated that a lower *wall framing fraction* is appropriate for the *building*, and

   ii) for earth walls in *buildings* that meet the requirements of NZS 4299, by using a thermal conductivity for the earth material determined in accordance with NZS 4299 Figure 2.10, and

   iii) for floors other than *slab-on-ground floors*, ignoring the effect of floor coverings (including carpets), and

b) for windows, doors, *skylights*, and *curtain walling*, using Appendix D. Windows, doors, skylights and curtain walling; and

c) for *slab-on-ground floors*, using Appendix E. Thermal resistance of slab-on-ground floors.

> COMMENT: The BRANZ House Insulation Guide 6th edition provides *construction R-values* of common *building* components and is based on calculations consistent with the requirements of Paragraph 2.1.2.1. However, the previous BRANZ House Insulation Guide, 5th edition or earlier, should not be used for determining the *construction R-values* of *slab-on-ground floors*, windows, and doors due to differences in calculation methods and assumptions compared to Appendix D. and Appendix E.

2.1.2.2 In NZS 4214, replace clause 5.7.1 a) with:

"(a) The bridged portion of a building envelope component encloses the layers within which thermal bridging occurs. Where multiple bridged layers are immediately adjacent, they shall all be included in the bridged portion. Where multiple bridged layers are separated by homogenous layer(s) other than pliable membranes and pliable underlays, they shall be treated as separate bridged portions.

On each side, a bridged portion is defined to end at the nearest face of the next homogenous layer (parallel to the plane of the building envelope component), except where:

i) that next homogenous layer is an insulation material or air cavity, in which case the insulation material or air cavity is to be included in the bridged portion, or

ii) that next homogenous layer is in between two bridged layers, in which case half of the intermediary homogenous layer is included in each of the adjacent bridged portions, or

iii) that next homogenous layer is a pliable membrane or pliable underlay, in which case the pliable membrane or pliable underlay shall be treated as if it was not present".

2.1.2.3 The *thermal resistance* (*R-values*) of insulation materials shall be determined by using the methods in Subsection 4.5.1 of the Building Product Specifications for the given type of insulation.

2.2 Modelling method – General requirements

2.2.1 Overview

2.2.1.1 Verification of the design is achieved by comparing the proposed *building* with a reference *building* using the modelling method.

2.2.1.2 The modelling method uses computer simulation to calculate the annual *heating loads* and *cooling loads* of the proposed *building* and of the reference *building*.

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

> COMMENT: The results of the thermal modelling should not be construed as a guarantee of the actual energy use of the *building*.

2.2.1.4 For *buildings* containing multiple classified uses that require a *thermal envelope* with *adequate thermal resistance* (refer Paragraph 2.1.1.1), the *building* may either be treated as having a single *thermal envelope*, or as having multiple *thermal envelopes*, with different classified uses having their own *thermal envelopes*.

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2.2.1.5 For **housing** with multi-unit dwellings, the *building* may either be treated as having a single *thermal envelope*, or as having multiple *thermal envelopes*, with different *household units* having their own *thermal envelopes*.

> COMMENT: Where a *building* is treated as having multiple *thermal envelopes*, the modelling method is used separately for each *thermal envelope* as if they were separate *buildings*.

2.2.1.6 The *thermal envelope* shall not include any walls and floors/ceilings that separate adjoining *conditioned spaces*, including between adjoining *building* parts with different classified uses and between adjoining *household units*.

> COMMENT: Any walls and floors/ceilings that are common between *conditioned spaces,* including between adjoining *building* parts with different classified uses, and between adjoining *household units:*
>
> 1. do not require *construction* that provides *adequate thermal resistance*; and
> 2. are not included in the *gross wall area* that is used for determining the *wall glazing area,* and the *construction R-value* of opaque doors, in the reference *building* model. See Subsections 2.3.3 and 2.3.5 for details.

2.2.1.7 The requirements of the modelling method are prescribed according to the relevant climate zone of the *building*. A list of the New Zealand climate zones is provided in Appendix C.

2.2.1.8 In the proposed *building*, *heated ceilings, heated walls* and *heated floors* that are part of the *thermal envelope* shall have *construction R-values* no less than those in Table 2.2.1.8. They do not apply where *heated ceilings*, *heated walls* or *heated floors* are installed solely in rooms that contain a shower, bath or toilet.

Table 2.2.1.8: Minimum construction R-values for heated ceilings, heated walls, and heated floors

Paragraph 2.2.1.8

Building element	Climate zone 1 (1), (2), (3)	Climate zone 2 (1), (2, (3)	Climate zone 3 (1), (2), (3)	Climate zone 4 (1), (2), (3)	Climate zone 5 (1), (2), (3)	Climate zone 6 (1), (2), (3)
Heated ceiling (4)	R6.6	R6.6	R6.6	R6.6	R6.6	R6.6
Heated wall	R2.9	R2.9	R2.9	R2.9	R2.9	R2.9
Heated floor (5)	R2.5	R2.5	R2.5	R2.8	R3.0	R3.0

Notes:

(1) The *R-values* shown are *construction R-values* measured in m^2·K/W.

(2) No thermal insulation shall be placed between the heated plane and the inside air.

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

(4) In *roofs* with a *roof* space, where the insulation is installed over a horizontal ceiling, the *roof R-value* of the proposed *building* 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 full-thickness insulation to be installed.

(5) Floor coverings, for example carpet or cork, will reduce the efficiency of the *heated floor*.

2.2.2 Modelling principles

2.2.2.1 The proposed *building* and reference *building* shall both be analysed using the same techniques and assumptions except where differences in energy efficiency features are specified in this document.

2.2.2.2 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.

2.2.2.3 The reference *building* shall have the same number of storeys, *floor area* for each storey, orientation and three-dimensional form as the proposed *building*. Each floor shall be orientated exactly as the proposed *building*. The geometric form shall be the same as the proposed *building*. The floor(s) that form part of the *thermal envelope* shall be of the same type (*slab-on-ground floor* or other types of floors) in both the reference *building* and the proposed *building*.

2.2.2.4 Features that may differ between the proposed *building* and the reference *building* are:

a) wall *construction R-value* and *thermal mass*; and/or

b) floor *construction R-value*; and/or

c) *roof construction R-value* and *thermal mass*; and/or

d) window, door, and *skylight* size and orientation, *construction R-value*, *solar heat gain coefficient* (*SHGC*), and external shading devices; and/or

e) heating, cooling, and ventilation plant (sizing only).

2.2.3 Modelling software

2.2.3.1 If the application for which the software is to be used has been documented according to the ANSI/ ASHRAE Standard 140 procedure, then the method shall pass the ANSI/ASHRAE Standard 140 test. If the application for which the software is to be used has not been documented according to the ANSI/ ASHRAE Standard 140 procedure, the method shall be tested to the BESTEST and pass the BESTEST.

2.2.4 Default values

2.2.4.1 The *default values* and schedules included in this document shall be used unless it can be demonstrated that different assumptions better characterise the *building*'s use over its expected life. Any modification of default assumptions shall be used in simulating both the proposed *building* and the reference *building* and shall be substantiated in the documentation of the analysis (refer to Subsection 2.6).

2.2.4.2 Other aspects of the *building*'s performance for which no *default values* are provided may be simulated as is most appropriate for the *building*, but these aspects must be the same for both the proposed *building* and the reference *building*.

2.2.4.3 In all the following cases, modelling is to be identical for both the proposed *building* and the reference *building*. Some of these items have limitations on the input values and others have default schedules that may be used when actual figures are not known. In all cases these values shall be reasonable approximations of the requirements of the *building* and its use during its expected life:

a) heating set points and schedules; and
b) cooling set points and schedules; and
c) passive cooling ventilation set points and schedules; and
d) fresh air ventilation air change rates and schedules; and
e) internal gains loads and schedules; and
f) occupancy loads and schedules; and
g) the location and *R-values* of carpets and floor coverings; and
h) incidental shading.

2.2.5 Climate data

2.2.5.1 Both the proposed *building* and the reference *building* shall be simulated using either:

a) the NIWA Typical Meteorological Year weather file specified in Appendix C.2 for the location of the *building* site; or
b) climate data that has been converted from that weather file into the format required by the modelling software.

2.2.6 Thermal zones

2.2.6.1 For *buildings* with multi-unit *dwellings*, the model of the proposed *building* and the reference *building* shall be identically and suitably divided into separate thermal zones. Each *household unit* shall be represented by at least one thermal zone.

2.2.6.2 For all other *buildings*, the model of the proposed *building* and the reference *building* shall be identically and suitably divided into separate thermal zones if the modelling software is capable of dividing the model into multiple thermal zones. If the modelling software is only capable of modelling a single thermal zone, the requirements in Paragraphs 2.2.6.3, 2.2.6.4, 2.2.6.5, 2.2.6.6, 2.2.6.7, 2.2.6.8, and 2.2.6.9 do not apply.

2.2.6.3 Spaces that are likely to have significantly different space conditioning requirements shall be modelled as separate zones.

2.2.6.4 The *conditioned space* shall be divided into a minimum of three thermal zones.

2.2.6.5 *Roof* spaces and enclosed subfloor spaces shall be modelled as thermal zones.

2.2.6.6 The model shall have a representation of internal conductive heat flows between thermal zones. Internal partitions between thermal zones require modelling and shall be described in terms of their location, surface area, pitch, and *construction R-value*. Internal doors need not be modelled.

2.2.6.7 The same internal partitions as modelled in the proposed *building* shall be modelled in the reference *building*.

2.2.6.8 Internal partitions within a thermal zone that may affect the thermal performance of the *building* shall be modelled.

2.2.6.9 Airflow between thermal zones need not be modelled unless desired.

2.2.7 Adjoining spaces

2.2.7.1 *Building elements* that separate adjoining *conditioned spaces* of dwellings may be assumed to have no heat transfer.

2.2.8 Thermal mass

2.2.8.1 Except as provided in Paragraph 2.2.2.3, the *thermal mass* may either be modelled:

a) as proposed for both the proposed *building* and the reference *building*; or

b) as proposed for the proposed *building* and modelled as lightweight for the reference *building*.

> COMMENT:
>
> 1. Examples of lightweight *construction* include *roofs,* walls and floors *constructed* with timber or steel structural framing and internal plasterboard or timber-based linings, or structural insulated panels.
> 2. Paragraph 2.2.2.3 requires that the floor(s) that form part of the thermal envelope are of the same type (slab-on-ground floor or other types of floors) in both the reference building and the proposed building.

2.2.9 Thermal mass of contents

2.2.9.1 The *thermal mass* of the contents shall be the same for both models and may be regarded as zero for modelling purposes.

2.2.10 Floor coverings

2.2.10.1 Floor coverings shall be modelled as proposed in both the proposed *building* and the reference *building*. If no floor coverings are specified, ceramic tiles shall be modelled in wet areas (kitchens, bathrooms, toilets, and laundries) and carpet to all other areas. Any *thermal resistance* provided by carpets or floor coverings shall be in addition to the *R-values* specified in Paragraphs 2.2.1.8 and 2.3.1.2.

2.2.11 Shading

2.2.11.1 Exterior shading such as eaves and balconies shall be modelled as proposed in both the proposed *building* and the reference *building*, except for dedicated shading features such as fins and overhangs which need not be modelled in the reference *building*.

2.2.11.2 No account shall be taken of internal shading devices such as blinds, drapes, and other non-permanent window treatments.

2.2.12 Incidental shading

2.2.12.1 Shading by structures and terrain that have a significant effect on the *building* shall be modelled in the same way for the proposed *building* and the reference *building*.

2.2.12.2 No account shall be taken of trees or vegetation.

2.2.13 Infiltration

2.2.13.1 Infiltration assumptions for the proposed *building* and the reference *building* shall be the same, and shall be reasonable for the *building construction*, location, and use.

2.3 Thermal envelope modelling

2.3.1 Thermal envelope building elements

2.3.1.1 All *building elements* shall be described in terms of surface area, orientation, pitch, and *construction R-value*. Glazing areas shall have their *solar heat gain coefficient* (*SHGC*) specified.

2.3.1.2 In the reference *building*, *building elements* that are part of the *thermal envelope* shall have *construction R-values* from:

a) for *heated ceilings, heated walls* and *heated floors*, except where *heated ceilings*, *heated walls* or *heated floors* are installed solely in rooms that contain a shower, bath or toilet, Table 2.2.1.8; and

b) for other *building elements*, Table 2.3.1.2.

Table 2.3.1.2: Reference building construction R-values for other building elements

Paragraph 2.3.1.2

Building element	Climate zone 1 (1), (2)	Climate zone 2 (1), (2)	Climate zone 3 (1), (2)	Climate zone 4 (1), (2)	Climate zone 5 (1), (2)	Climate zone 6 (1), (2)
Roof	R6.6	R6.6	R6.6	R6.6	R6.6	R6.6
Wall	R1.6	R1.6	R1.6	R1.6	R1.6	R1.6
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	R0.46	R0.46	R0.46	R0.46	R0.50	R0.50

Notes:
(1) The *R-values* shown are *construction R-values* measured in $m^2·K/W$.
(2) Climate zone boundaries are shown in Appendix C.

2.3.1.3 For the *net roof area*, *thermal envelope floor area*, and *net wall area*, use overall internal dimensions measured on the finished internal face of all relevant *building elements*, including the thickness of any internal partitions.

2.3.1.4 The solar absorptance of external *building elements*, except as specified in Paragraph 2.3.6.4, shall be modelled in both the proposed *building* and reference *building* as proposed. If the proposed *building's* solar absorptance is not known, it shall be modelled in both the proposed *building* and reference *building* as 0.5.

2.3.1.5 When the modelling program calculates and adds its own surface resistances to the input resistance, the input resistances shall be the *R-values* derived as specified for the proposed *building* in Subsection 2.1.2, and for the reference *building* in Paragraph 2.3.1.2, less the standardised surface resistances of 0.03 $m^2·K/W$ outside and 0.09 $m^2·K/W$ inside (0.12 $m^2·K/W$ total). The same method of calculation shall be used for the proposed *building* and the reference *building*.

2.3.2 Slab-on-ground floors

2.3.2.1 When using a modelling program that uses inputs for describing the *thermal resistance* of *slab-on-ground floors* that are different to the *construction R-value* of *slab-on-ground floors* as defined in Paragraph 2.1.2.1c) (e.g. not from the inside air to the outside air):

a) in the reference *building*, any *slab-on-ground floor* shall be simulated with a *construction* type selected from Tables E.1.2.1A to E.1.2.1X in Acceptable Solution H1/AS1 Appendix E. For the slab area-to-perimeter ratio, *external wall* cladding type and *external wall* effective thickness of the reference *building*, the selected *construction* type must have a *construction R-value* that is equal to or greater than the minimum *R-value* for *slab-on-ground floors* specified in Paragraph 2.3.1.2; and

b) in the proposed *building*, using the methods specified in Appendix E. , any *slab-on-ground floor* must, as a minimum, meet the *construction R-value* for *slab-on-ground floors* in:

   i) for *heated floors*, except where *heated floors* are installed solely in a room with a shower, bath or toilet, Table 2.2.1.8; or

   ii) for other floors, Table 2.3.1.2.

2.3.3 Glazing

2.3.3.1 If the *wall glazing area* in the proposed *building* is more than 30% of the *gross wall area*, then the *wall glazing area* of the reference *building* shall be 30% of the *gross wall area*.

2.3.3.2 If the *wall glazing area* of the proposed *building* is 30% or less of the *gross wall area*, then the *wall glazing area* of the reference *building* shall either:

a) be the same as the proposed *building;* or

b) 30% of the *gross wall area*.

2.3.3.3 If the *wall glazing areas* in the proposed *building* and the reference *building* are different, then the *wall glazing area* in the reference *building* shall either:

a) be distributed evenly around all *external walls* that are part of the reference *building's thermal envelope,* to achieve a *wall glazing area* equal to 30% of the *gross wall area*; or

b) have glazed units in the same locations and with the same head heights as the glazed units in the proposed *building's thermal envelope* but have the size of each glazed unit in the reference *building's thermal envelope* changed proportionally, to achieve a *wall glazing area* equal to 30% of the *gross wall area*.

2.3.3.4 Glazing for the reference *building* shall be simulated with a *solar heat gain coefficient (SHGC)* of 0.55. Glazing for the proposed *building* shall be simulated with a *solar heat gain coefficient (SHGC)* as proposed.

2.3.4 Skylights

2.3.4.1 In the reference *building*, the *net roof area* (A_{roof}) shall be set equal to the *gross roof area,* and the *skylight area* ($A_{skylight}$) shall be set to zero.

2.3.5 Door area

2.3.5.1 In the reference *building*:

a) the *opaque door area* that is no more than either 6 m^2 or 6% of the *gross wall area* (whichever is greater) shall be modelled with a *construction R-value* as specified for windows and doors in Table 2.3.1.2; and

b) any remaining *opaque door area* shall be modelled with a *construction R-value* as specified for walls in Table 2.3.1.2.

2.3.6 Internal building elements

2.3.6.1 *Building elements* separating different thermal zones, or *conditioned space* and *unconditioned space,* shall be modelled as proposed in the proposed *building* model. Other internal *building elements* need not be modelled.

2.3.6.2 The same internal *building elements* as modelled in the proposed *building* shall be modelled in the reference *building*.

2.3.6.3 In the reference *building*, internal *building elements* that are modelled shall have the following *construction R-values:*

a) for internal *building elements* that separate *conditioned space* and *unconditioned space,* as specified in Paragraph 2.3.1.2, with:

i) internal floors/ceilings that form the upper boundary of the *thermal envelope* assigned a *construction R-value* as if it was a *roof*, and

ii) internal floors/ceilings that form the lower boundary of the *thermal envelope* assigned a *construction R-value* as if it was a floor, and

b) for other internal *building elements*, as proposed.

2.3.6.4 Where an adjacent *unconditioned space* is not modelled as a thermal zone, *building elements* separating *conditioned space* from adjacent *unconditioned space* (for example, a garage) may be modelled with a *construction R-value* that is 0.5 $m^2 \cdot K/W$ higher than the actual *construction R-value* and with zero solar absorptance. This adjustment to the *construction R-value* takes into account the insulation from the still air in the *unconditioned space*.

2.4 Space conditioning modelling

2.4.1 Control temperatures and schedules

2.4.1.1 H For **housing**, a minimum temperature of 18°C or higher at any time, and a maximum temperature of 25°C or lower at any time, is required to be modelled. Prior to the use of artificial cooling, passive cooling via openable windows, doors, *skylights* or vents shall be modelled whenever the indoor temperature is between 22°C and the maximum temperature, provided the indoor air temperature is higher than the outdoor air temperature. The passive cooling ventilation rate shall be reasonable for the amount of venting area available for each zone (considering the effect of any window restrictors) and shall be the same for the proposed *building* and reference *building*.

2.4.1.2 For *buildings* other than **housing**, a minimum temperature of 18°C and a maximum temperature of 25°C from 8am – 6pm, five days a week, shall be modelled unless it can be demonstrated that a different schedule is appropriate for the foreseeable life of the *building*.

2.4.2 Fresh air ventilation

2.4.2.1 The fresh air ventilation rate and schedule shall be the same for both the proposed *building* and the reference *building*. The minimum fresh air ventilation rate shall be:

H a) 0.5 air changes per hour for **housing**; and

b) as specified in NZS 4303 for other *buildings*.

2.4.3 Conditioning system modelling

2.4.3.1 The calculation of the annual loads for space heating and cooling does not include an assessment of the energy efficiency of heating, cooling, and ventilating equipment. A simulation of the heating, cooling, and ventilating equipment is not required, but shall be the same for the proposed *building* and reference *building* if modelled. Sizing is the only feature that may be changed in response to load requirements.

2.5 Internal gains modelling

2.5.1 Lighting

2.5.1.1 Lighting, including internal gains from lighting, need not be modelled. However, if it is, it shall be the same for both the proposed *building* and the reference *building*.

2.5.2 Domestic hot water

2.5.2.1 For both the proposed *building* and the reference *building*, the internal gains of domestic hot water cylinder(s) located inside the *thermal envelope* shall be modelled as 100 W constant per cylinder, unless a different value specific to the proposed *building* is shown to be more appropriate and is used in both the proposed *building* and the reference *building* models.

2.5.3 Occupants and plug loads

2.5.3.1 For both the proposed *building* and the reference *building*, *default values* for internal gains into a *building* from occupants and *plug loads* at different times of the day and week are provided as power densities in Table 2.5.3.1 that are to be multiplied with the modification factors provided for:

H
CR
CN
Com

a) **housing** in Table 2.5.3.1A; and
b) **communal residential** including hotels, motels, and health consultancies in Table 2.5.3.1B; and
c) **communal non-residential** (assembly care) including schools in Table 2.5.3.1C; and
d) **commercial** including offices, restaurants, and retail shops in Table 2.5.3.1D.

2.5.3.2 These *default values* shall be used unless other suitable parameters specific to the *building*'s use are shown to be more appropriate. These internal gains shall be the same for both the proposed *building* and reference *building*. All internal gains are regarded as sensible heat.

> COMMENT: For **housing**, other suitable *default values* are available in the Passive House Planning Package (PHPP), version 10, 2021 or the New Zealand Green Building Council Energy and Carbon Calculator for Homes (ECCHO), 2021. These tools can be accessed from www.passivehouse.com and www.nzgbc.org.nz.

2.5.3.3 *Unconditioned spaces* shall be assigned zero internal gains

2.5.4 Process loads

2.5.4.1 Process loads are internal gains that result from the production of goods within a *building*.

2.5.4.2 Only in circumstances where process loads are significant, and it can be shown that they will continue for the expected life of the *building*, may they be modelled. Process loads shall be the same in both the proposed *building* and reference *building*.

Table 2.5.3.1: Default power densities for internal gains from occupants and plug loads

Paragraph 2.5.3.1

Classified use	Applies to[1]	Occupancy (W/m^2)	Plug load (W/m^2)
H	**Housing**	2.5	13.5
CR	Community service – hotels and motels	2.9	2.7
	Community care – Unrestrained - health/institutional	3.6	10.7
CN	Assembly care – schools	9.7	5.4
Com	Office	2.7	8.1
	Restaurant	7.3	1.1
	Retail shop	2.4	2.7
	Car park	N/A	N/A

Notes:

(1) If an activity for the proposed *building* is not specifically described, use the nearest description for both the proposed *building* and the reference *building*.

H **Table 2.5.3.1A: Default schedules for internal gains from occupancy and plug loads – Modification factors for housing**

Paragraph 2.5.3.1

Load	Day of the week	12 am to 8 am	8 am to 11 am	11 am to 6 pm	6 pm to 10 pm	10 pm to 12 am
Housing occupancy	Monday to Friday	0.7	0.6	0.6	1.0	1.0
	Saturday	0.7	1.0	0.5	0.7	1.0
	Sunday	0.7	1.0	0.5	0.7	1.0
Housing *plug load*	Monday to Friday	0.03	0.23	0.23	0.27	0.2
	Saturday	0.03	0.23	0.23	0.27	0.2
	Sunday	0.03	0.23	0.23	0.27	0.2

CR

Table 2.5.3.1B: Default schedules for internal gains from occupancy and plug loads – Modification factors for communal residential

Paragraph 2.5.3.1

Load	Day of the week	12 am to 8 am	8 am to 11 am	11 am to 6 pm	6 pm to 10 pm	10 pm to 12 am
Community service hotel and motel occupancy	Monday to Friday	0.9	0.4	0.2	0.7	0.9
	Saturday	0.9	0.5	0.3	0.6	0.7
	Sunday	0.7	0.7	0.3	0.6	0.8
Community service hotel and motel *plug load*	Monday to Friday	0.1	0.4	0.25	0.6	0.6
	Saturday	0.1	0.4	0.25	0.6	0.6
	Sunday	0.1	0.3	0.3	0.5	0.5
Community service – residential care (e.g. retirement villages) occupancy	Monday to Friday	0.7	0.9	0.9	0.85	0.7
	Saturday	0.7	0.9	0.9	0.85	0.7
	Sunday	0.7	0.9	0.9	0.85	0.7
Community service – residential care (e.g. retirement villages) *plug load*	Monday to Friday	0.2	0.9	0.85	0.8	0.2
	Saturday	0.2	0.9	0.85	0.8	0.2
	Sunday	0.2	0.9	0.85	0.8	0.2
Community service – health/medical specialist occupancy	Monday to Friday	0	0.8	0.8	0.3	0
	Saturday	0	0.4	0.4	0	0
	Sunday	0	0.05	0.05	0	0
Community service – health/medical specialist *plug load*	Monday to Friday	0.1	0.9	0.9	0.3	0.1
	Saturday	0.1	0.4	0.4	0.1	0.1
	Sunday	0.05	0.1	0.1	0.05	0.05

CN

Table 2.5.3.1C: Default schedules for internal gains from occupancy and plug loads – Modification factors for communal non-residential – assembly care

Paragraph 2.5.3.1

Load	Day of the week	12 am to 8 am	8 am to 11 am	11 am to 6 pm	6 pm to 10 pm	10 pm to 12 am
School occupancy	Monday to Friday	0	0.95	0.95	0.1	0
	Saturday	0	0.1	0.1	0	0
	Sunday	0	0	0	0	0
School *plug load*	Monday to Friday	0.05	0.95	0.95	0.3	0.05
	Saturday	0.05	0.15	0.15	0.05	0.05
	Sunday	0.05	0.05	0.05	0.05	0.05

Com **Table 2.5.3.1D: Default schedules for internal gains from occupancy and plug loads – Modification factors for commercial buildings**

Paragraphs 2.5.3.1

Load	Day of the week	12 am to 8 am	8 am to 11 am	11 am to 6 pm	6 pm to 10 pm	10 pm to 12 am
Office occupancy	Monday to Friday	0	0.95	0.95	0.05	0
	Saturday	0	0.1	0.05	0	0
	Sunday	0	0.05	0.05	0	0
Office *plug load*	Monday to Friday	0.05	0.9	0.9	0.3	0.05
	Saturday	0.05	0.3	0.15	0.05	0.05
	Sunday	0.05	0.05	0.05	0.05	0.05
Restaurant occupancy	Monday to Friday	0	0.05	0.5	0.8	0.35
	Saturday	0	0	0.45	0.7	0.55
	Sunday	0	0	0.2	0.55	0.2
Restaurant *plug load*	Monday to Friday	0.15	0.4	0.9	0.9	0.5
	Saturday	0.15	0.3	0.8	0.9	0.5
	Sunday	0.15	0.3	0.7	0.6	0.5
Retail shop occupancy	Monday to Friday	0	0.6	0.7	0.4	0
	Saturday	0	0.6	0.8	0.2	0
	Sunday	0	0.1	0.4	0	0
Retail shop *plug load*	Monday to Friday	0.05	0.9	0.9	0.5	0.05
	Saturday	0.05	0.9	0.9	0.3	0.05
	Sunday	0.05	0.4	0.4	0.05	0.05

2.6 Documentation

2.6.1 Documentation of analysis

2.6.1.1 Documentation of the computer modelling analysis shall contain:

a) the name of the modeller; and
b) the thermal modelling program name, version number, and supplier; and
c) technical detail on the proposed *building* and reference *building* designs and the differences between the designs; and
d) the sum of the *heating load* and *cooling load* for the proposed *building* and reference *building*; and
e) where possible, the *heating load* and *cooling load* for the proposed *building* and the reference *building*; and
f) a list of any deviations from *default values* and schedules used in the modelling, including justification.

Appendix A. References

For the purposes of Building Code compliance, the standards and documents referenced in this verification method must be the editions, along with their specific amendments, listed below.

Standards New Zealand		**Where quoted**
NZS 4214:2006	Methods of determining the total thermal resistance of parts of buildings	2.1.2.1, 2.1.2.2
NZS 4299:2024	Earth buildings not requiring specific engineering design	2.1.2.1a)ii)
NZS 4303:1990	Ventilation for acceptable indoor air quality	2.4.2.1b)

These standards can be accessed from www.standards.govt.nz.

British Standards Institute		**Where quoted**
BS EN 673:2011	Glass in building – Determination of thermal transmittance (U value) – Calculation method	D.1.2.2(a), D.1.2.4(a), D.2.1.2(a), Equation D.5

This standard can be accessed from www.standards.govt.nz.

International Organization for Standardization		**Where quoted**
ISO 10077-1:2017	Thermal performance of windows, doors and shutters – Calculation of thermal transmittance – Part 1: General	D.1.2.2, D.1.2.4, D.2.1.2, Equation D.3
ISO 10077-2:2017	Thermal performance of windows, doors and shutters – Calculation of thermal transmittance – Part 2: Numerical method for frames	D.1.2.2(b), D.1.2.4(b), D.2.1.2(b)
ISO 10211:2017	Thermal bridges in building construction – Heat flows and surface temperatures – Detailed calculations	E.1.2.3
ISO 10456:2007	Building materials and products – Hygrothermal properties – Tabulated design values and procedures for determining declared and design thermal values	E.1.2.6
ISO 12631:2017	Thermal performance of curtain walling – Calculation of thermal transmittance	Equation D.5
ISO 13370:2017	Thermal performance of buildings – Heat transfer via the ground – Calculation methods	E.1.2.2, E.1.2.3, E.1.2.4, E.1.2.6

These standards can be accessed from www.standards.govt.nz.

Other standards and publications		**Where quoted**
ANSI/ASHRAE 140:2017	American National Standards Institute, Standard method of test for the evaluation of building energy analysis computer programs. Available from webstore.ansi.org.	2.2.3.1
BRANZ House Insulation Guide (6th Edition), August 2025	Available from www.branz.co.nz.	2.1.2.1 Comment, E.1.1.1 Comment
Building Energy Simulation Test (BESTEST) and Diagnostic Method (1995)	International Energy Agency. Available from www.nrel.gov.	2.2.3.1

References

Appendix B. Definitions

These definitions are specific to this verification method. Other defined terms italicised within the definitions are provided in clause A2 of the Building Code.

Term	Definition
Adequate	Adequate to achieve the objectives of the Building Code.
Building	Has the meaning given to it by sections 8 and 9 of the Building Act 2004.
Building element	Any structural and non-structural component or assembly incorporated into or associated with a *building*. Included are *fixtures*, services, *drains*, permanent mechanical installations for access, glazing, partitions, ceilings and temporary supports.
Building envelope	A *building's thermal envelope* plus the exterior surface of any spaces not requiring conditioning, e.g. garage, floor space (below insulating layer), *roof* space (above any outer surface defining an attic or when there is no attic above the insulating layer).
Conditioned space	That part of a *building* within the *thermal envelope* that may be directly or indirectly heated or cooled. It is separated from *unconditioned space* by *building elements* (walls, windows, *skylights*, doors, *roof*, and floor) to limit uncontrolled airflow and heat transfer.
Construct	In relation to a *building*, includes to design, build, erect, prefabricate, and relocate the *building*; and construction has a corresponding meaning.
Construction R-value	The *total thermal resistance* (*R-value*) of a typical area of a *building element*.
Cooling load	The amount of heat energy removed from the *building* to maintain it below the required maximum temperature (the amount of heat removed by the chosen appliances, not the amount of fuel required to run them).
Curtain walling	Part of the *building envelope* made of a framework usually spanning multiple floors and consisting of horizontal and vertical profiles, connected together and anchored to the supporting structure of the *building*, and containing fixed and/or openable infills, which provides all the required functions of an internal or *external wall* or part thereof, but does not contribute to the load bearing or the stability of the structure of the *building*.
Default value	Value(s) to be used for modelling purposes unless it can be demonstrated that a different assumption better characterises the *building*'s use over its expected life.
Door area (A_{door})	The total area of doors in the *thermal envelope*, including frames and opening tolerances, and including any opaque panels, glazing, decorative glazing, and louvres
External wall	Any exterior face of a *building* within 30° of vertical, consisting of primary and/or secondary elements intended to provide protection against the outdoor environment.
Floor area	In relation to a *building*, means the *floor area* (expressed in square metres) of all interior spaces used for activities normally associated with domestic living.
Foil insulation	Material that includes a thin layer of heat-reflecting metallic foil (usually aluminium).
Gross roof area	The *net roof area* (A_{roof}) plus the *skylight area* ($A_{skylight}$).

Definitions

Term	Definition
Gross wall area	The sum of the following: a) the *net wall area* of the *building*; and b) the *wall glazing area* of the *building*; and c) the *opaque door area* of the *building*.
Heated ceiling, heated wall, heated floor	Any ceiling, wall, or floor incorporating, within the *building element* or its finishes, pipes, electrical cables, or similar means of raising its temperature. Common examples are floors with underfloor heating or undertile heating.
Heating load	The amount of heat energy supplied to the *building* to maintain it above the required minimum temperature (the amount of heat delivered by the chosen appliances, not the amount of fuel required to run them).
Household unit	a) means a *building* or group of *buildings*, or part of a *building* or group of *buildings*, that is— i) used, or intended to be used, only or mainly for residential purposes; and ii) occupied, or intended to be occupied, exclusively as the home or residence of not more than 1 household; but b) does not include a hostel, boarding house, or other specialised accommodation.
HVAC system	For the purposes of Building Code performance clause H1.3.6 and in relation to a *building*, means a mechanical, electrical, or other system for modifying air temperature, modifying air humidity, providing ventilation, or doing all or any of those things, in a space within the *building*.
Intended use	In relation to a *building* – a) includes any or all of the following: i) any reasonably foreseeable occasional use that is not incompatible with the intended use; ii) normal maintenance; ii) activities undertaken in response to *fire* or any other reasonably foreseeable emergency; but b) does not include any other maintenance and repairs or rebuilding.
Net roof area (A_{roof})	The area of the *roof* that is part of the *thermal envelope*, excluding the *skylight area,* measured using overall internal dimensions.
Net wall area	The area of walls that are part of the *thermal envelope*, excluding the *opaque door area* and the *wall glazing area,* measured using overall internal dimensions.
Occupied space	Any space within a *building* in which a *person* will be present from time to time during the *intended use* of the *building*.
Opaque door area ($A_{door,opaque}$)	The total area of opaque doors and opaque panels of doors in the *thermal envelope*, including frames and opening tolerances.
Plug load	The electrical load drawn by electrical appliances connected to the *building* electrical reticulation system by way of general-purpose socket outlets.
R-value	The common abbreviation for describing the values of both *thermal resistance* and *total thermal resistance*.

Definitions

Term	Definition
Roof	Any roof/ceiling combination where the exterior surface of the *building* is at an angle of 60° or less to the horizontal and has its upper surface exposed to the outside.
Skylight	Translucent or transparent parts of the *roof*, including frames and glazing.
Skylight area ($A_{skylight}$)	The area of *skylights* that are part of the *thermal envelope*, including frames and opening tolerances.
Slab-on-ground floor	Floor *construction* consisting of a concrete slab or concrete raft foundation in contact with the ground over its whole area.
Solar heat gain coefficient (SHGC)	The total solar energy transmittance through a glazed element, that is the sum of the solar direct transmittance plus the secondary heat transfer factor of the glazing towards the inside, the latter resulting from inwards re-radiation of heat from solar radiation that is absorbed by the glass. The SHGC is also known as the solar factor (SF) or g-value.
Thermal envelope	The *roof*, wall, window, *skylight*, door, and floor *construction* between *conditioned spaces* and *unconditioned spaces,* the ground or the outdoor environment.
Thermal envelope floor area (A_{floor})	The area of the floor that forms part of the *thermal envelope* measured using overall internal dimensions.
Thermal mass	The heat capacity of the materials of the *building* affecting the *building's heating load* and *cooling load* by storing and releasing heat as the interior and/or exterior temperature and radiant conditions fluctuate.
Thermal resistance	The resistance to heat flow of a given component of a *building element*. It is equal to the air temperature difference (K) needed to produce unit heat flux (W) through unit area (m^2) under steady conditions. The units are $m^2 \cdot K/W$.
Total thermal resistance	The overall air-to-air *thermal resistance* across all components of a *building element* such as a wall, *roof*, or floor, including the surface resistances.
Unconditioned space	Space within the *building envelope* that is not *conditioned space.* For example, this may include a garage, conservatory, atrium, attic, subfloor, and so on. However, where a garage, conservatory or atrium is expected to be heated or cooled, these spaces shall be included in the *conditioned space*.
Wall framing fraction	The percentage of the *net wall area* taken up by framing, such as timber or steel framing, considering all framing members that are in the same plane as thermal insulation. Walls with multiple framing layers may have a different wall framing fraction for each layer.
Wall glazing area ($A_{wallglazing}$)	The total area of windows, and doors that include glazing, in walls of the *thermal envelope*, including transparent or translucent glazing, frames and opening tolerances, decorative glazing, and louvres. This excludes opaque panels, opaque doors, and *skylights*.
Wharenui	A communal meeting house having a large open floor area used for both assembly and sleeping in the traditional Māori manner.

Appendix C. New Zealand climate zones and weather files

C.1 Climate zones

C.1.1 Climate zone boundaries

C.1.1.1 There are six climate zones. The climate zone boundaries are based on climatic data taking into consideration territorial authority boundaries.

C.1.1.2 A list of the climate zones for each territorial authority is provided in Table C.1.1.2 and illustrated in Figure C.1.1.2. The list in the table takes precedence over the figure.

C.2 Weather files

C.2.1 Selecting weather files for building sites

C.2.1.1 A list of the approved weather files for each territorial authority is provided in Table C.2.1.1. These weather files are available for download from www.building.govt.nz.

> COMMENT: The approved weather files were created by the National Institute of Water and Atmospheric Research (NIWA) in 2024 and are representative of typical climate conditions in 2024.

Table C.1.1.2: Climate zones by territorial authority

Paragraph C.1.1.2

North Island/Te Ika-a-Māui Territorial authority	Climate zone	South Island/Te Waipounamu Territorial authority	Climate zone
Far North District	1	Tasman District	3
Whangarei District	1	Nelson City	3
Kaipara District	1	Marlborough District	3
Auckland	1	Kaikoura District	3
Thames-Coromandel district	1	Buller District	4
Hauraki District	2	Grey District	4
Waikato District	2	Westland District	4
Matamata-Piako District	2	Hurunui District	5
Hamilton City	2	Waimakariri District	5
Waipa District	2	Christchurch City	5
Ōtorohanga District	2	Selwyn District	5
South Waikato District	2	Ashburton District	5
Waitomo District	2	Timaru District	5
Taupo District	4	Mackenzie District	6
Western Bay of Plenty District	1	Waimate District	5
Tauranga City	1	Chatham Islands	3
Rotorua District	4	Waitaki District (true left of the Otekaieke river)	6
Whakatane District	1	Waitaki District (true right of the Otekaieke river)	5
Kawerau District	1	Central Otago District	6
Ōpōtiki District	1	Queenstown-Lakes District	6
Gisborne District	2	Dunedin City	5
Wairoa District	2	Clutha District	5
Hastings District	2	Southland District	6
Napier City	2	Gore District	6
Central Hawke's Bay District	2	Invercargill City	6
New Plymouth District	2		
Stratford District	2		
South Taranaki District	2		
Ruapehu District	4		
Whanganui District	2		
Rangitikei District (north of 39°50'S (-39.83))	4		
Rangitikei District (south of 39°50'S (-39.83))	3		
Manawatu District	3		
Palmerston North City	3		
Tararua District	4		
Horowhenua District	3		
Kapiti Coast District	3		
Porirua City	3		
Upper Hutt City	4		
Lower Hutt City	3		
Wellington City	3		
Masterton District	4		
Carterton District	4		
South Wairarapa District	4		

New Zealand climate zones and weather files

Figure C.1.1.2: Map of New Zealand climate zones

Paragraph C.1.1.2

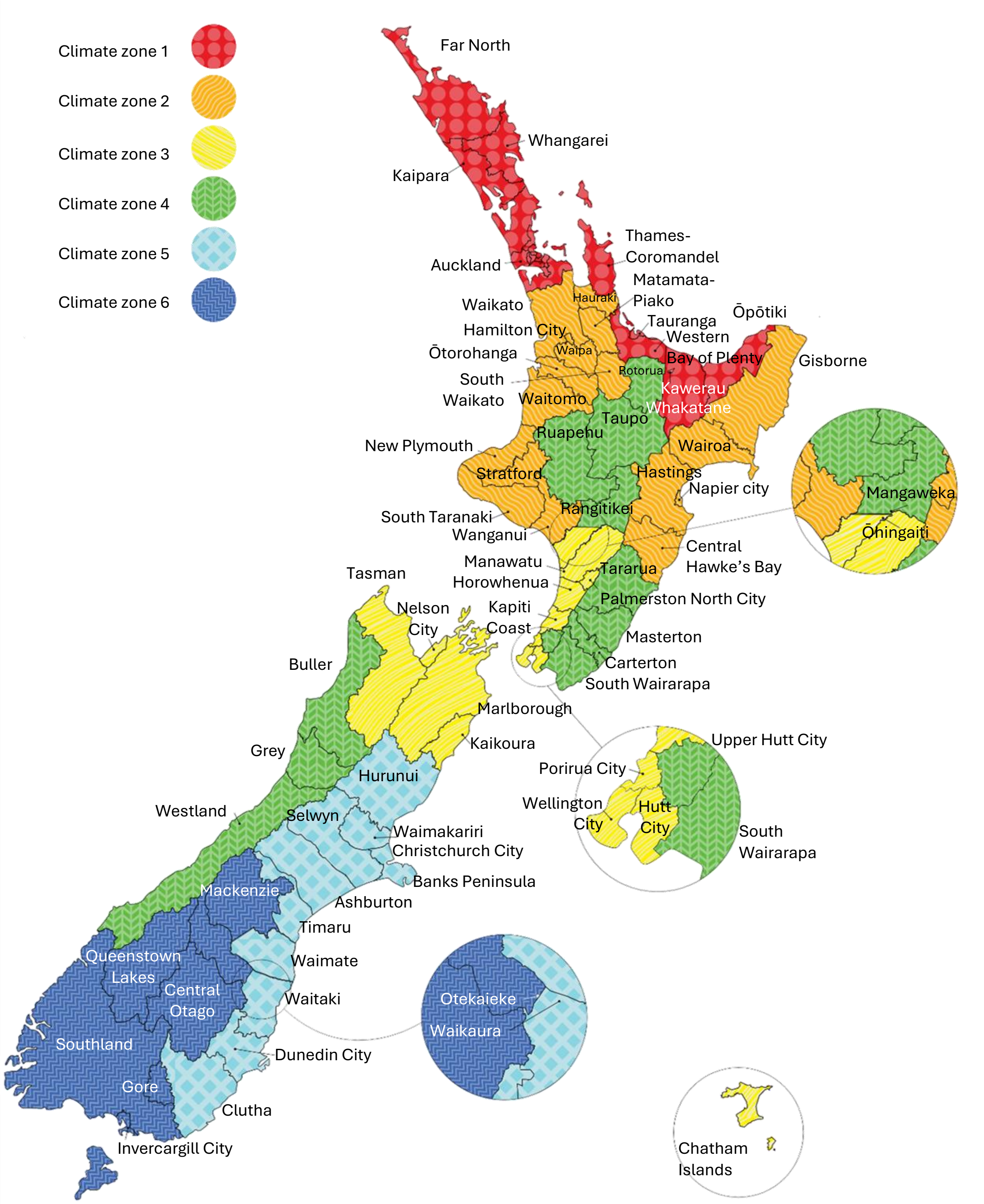

Table C.2.1.1: Approved weather files by territorial authority

Paragraph C.2.1.1

North Island/Te Ika-a-Māui Territorial authority	Weather file	South Island/Te Waipounamu Territorial authority	Weather file
Far North District	TMY3_NZ_NL.epw	Tasman District	TMY3_NZ_NM.epw
Whangarei District	TMY3_NZ_NL.epw	Nelson City	TMY3_NZ_NM.epw
Kaipara District	TMY3_NZ_NL.epw	Marlborough District	TMY3_NZ_NM.epw
Auckland	TMY3_NZ_AK.epw	Kaikoura District	TMY3_NZ_NM.epw
Thames-Coromandel district	TMY3_NZ_AK.epw	Buller District	TMY3_NZ_WC.epw
Hauraki District	TMY3_NZ_HN.epw	Grey District	TMY3_NZ_WC.epw
Waikato District	TMY3_NZ_HN.epw	Westland District	TMY3_NZ_WC.epw
Matamata-Piako District	TMY3_NZ_HN.epw	Hurunui District	TMY3_NZ_CC.epw
Hamilton City	TMY3_NZ_HN.epw	Waimakariri District	TMY3_NZ_CC.epw
Waipa District	TMY3_NZ_HN.epw	Christchurch City	TMY3_NZ_CC.epw
Ōtorohanga District	TMY3_NZ_HN.epw	Selwyn District	TMY3_NZ_CC.epw
South Waikato District	TMY3_NZ_HN.epw	Ashburton District	TMY3_NZ_CC.epw
Waitomo District	TMY3_NZ_HN.epw	Timaru District	TMY3_NZ_CC.epw
Taupo District	TMY3_NZ_TP.epw	Mackenzie District	TMY3_NZ_OC.epw
Western Bay of Plenty District	TMY3_NZ_BP.epw	Waimate District	TMY3_NZ_CC.epw
Tauranga City	TMY3_NZ_BP.epw	Chatham Islands	N/A
Rotorua District	TMY3_NZ_RR.epw	Waitaki District (true left of the Otekaieke river)	TMY3_NZ_OC.epw
Whakatane District	TMY3_NZ_BP.epw	Waitaki District (true right of the Otekaieke river)	TMY3_NZ_DN.epw
Kawerau District	TMY3_NZ_BP.epw	Central Otago District	TMY3_NZ_OC.epw
Ōpōtiki District	TMY3_NZ_BP.epw	Queenstown-Lakes District	TMY3_NZ_QL.epw
Gisborne District	TMY3_NZ_EC.epw	Dunedin City	TMY3_NZ_DN.epw
Wairoa District	TMY3_NZ_EC.epw	Clutha District	TMY3_NZ_DN.epw
Hastings District	TMY3_NZ_EC.epw	Southland District	TMY3_NZ_IN.epw
Napier City	TMY3_NZ_EC.epw	Gore District	TMY3_NZ_IN.epw
Central Hawke's Bay District	TMY3_NZ_EC.epw	Invercargill City	TMY3_NZ_IN.epw
New Plymouth District	TMY3_NZ_NP.epw		
Stratford District	TMY3_NZ_NP.epw		
South Taranaki District	TMY3_NZ_NP.epw		
Ruapehu District	TMY3_NZ_TP.epw		
Whanganui District	TMY3_NZ_NP.epw		
Rangitikei District (north of 39°50'S (-39.83))	TMY3_NZ_TP.epw		
Rangitikei District (south of 39°50'S (-39.83))	TMY3_NZ_MW.epw		
Manawatu District	TMY3_NZ_MW.epw		
Palmerston North City	TMY3_NZ_MW.epw		
Tararua District	TMY3_NZ_WI.epw		
Horowhenua District	TMY3_NZ_MW.epw		
Kapiti Coast District	TMY3_NZ_MW.epw		
Porirua City	TMY3_NZ_WN.epw		
Upper Hutt City	TMY3_NZ_WI.epw		
Lower Hutt City	TMY3_NZ_WN.epw		
Wellington City	TMY3_NZ_WN.epw		
Masterton District	TMY3_NZ_WI.epw		
Carterton District	TMY3_NZ_WI.epw		
South Wairarapa District	TMY3_NZ_WI.epw		

Appendix D. Windows, doors, skylights and curtain walling

D.1 Vertical windows and doors

D.1.1 Methods for determining construction R-values

D.1.1.1 The *construction R-values* for vertical windows and doors shall be determined using one of the following methods:

a) calculation of the *construction R-value* of each individual window and door that is part of the *thermal envelope*, in accordance with Subsection D.1.2; or

b) calculation of the representative *construction R-value* of all windows and doors that are part of the *thermal envelope* of the proposed *building*, which is then deemed to apply to all windows and doors of the proposed *building*, in accordance with Subsection D.1.3; or

H

c) for **housing** only, based on the performance table in Acceptable Solution H1/AS1 Appendix D.

> COMMENT: The window size and frame material have a major impact on the *construction R-value* of a window as a *building element*. Often the *thermal resistances* of the glazing and the frames are dissimilar. For large windows, the *thermal resistance* of the glazing will have more impact on the overall window *construction R-value* than in a small window, which is dominated by the frame performance. This means that the *construction R-values* of two differently sized windows consisting of identical frame and glazing materials will usually be dissimilar.

D.1.2 Calculation of the construction R-value of each individual window and door that is part of the thermal envelope

D.1.2.1 For each window that is part of the *thermal envelope* of the proposed *building*, the window *construction R-value* (R_w) shall be calculated in accordance with Equation D.1. The *construction R-value* shall be rounded down to no less than two significant figures.

Equation D.1: $R_w = \dfrac{1}{U_w}$

where:

R_w is the *construction R-value* of the window ($m^2 \cdot K/W$); and
U_w is the thermal transmittance of the window ($W/(m^2 \cdot K)$), determined in accordance with Paragraph D.1.2.2.

D.1.2.2 The thermal transmittance (U_w) of each vertical window that is part of the *thermal envelope* of the proposed *building* shall be determined in accordance with ISO 10077-1, with:

a) the thermal transmittance of the glazing (U_g) determined using BS EN 673; and

b) the thermal transmittance of the frame (U_f) determined using ISO 10077-2. For frames with special extensions overlapping the wall or other *building elements*, such as frames with flanges to the cladding, the following deviations from ISO 10077-2 Section 6.3.1 are permitted:

   i) special extensions may either be disregarded or included in the calculation model, but shall be disregarded when determining the projected width of the frame section (b_f) as per ISO 10077-2 Appendix F, and

   ii) window reveal liners that are integral with the window unit may either be disregarded or included in the calculation model.

D.1.2.3 For each door that is part of the *thermal envelope* of the proposed *building*, the door *construction R-value* (R_D) shall be calculated in accordance with Equation D.2. The *construction R-value* shall be rounded down to no less than two significant figures.

Equation D.2: $R_D = \frac{1}{U_D}$

where:

R_D is the *construction R-value* of the door ($m^2 \cdot K/W$); and
U_D is the thermal transmittance of the door ($W/(m^2 \cdot K)$), determined in accordance with Paragraph D.1.2.4.

> COMMENT: The door *construction R-value* (R_D) includes the effects of the frame, any glazing and any opaque panels.

D.1.2.4 The thermal transmittance (U_D) of each door that is part of the *thermal envelope* of the proposed *building* shall be determined in accordance with ISO 10077-1, with:

a) the thermal transmittance of the glazing (U_g) determined using BS EN 673; and
b) the thermal transmittance of the frame (U_f) determined using ISO 10077-2. For frames with special extensions overlapping the wall or other *building elements*, such as frames with flanges to the cladding, the following deviations from ISO 10077-2 Section 6.3.1 are permitted:
   i) special extensions may either be disregarded or included in the calculation model, but shall be disregarded when determining the projected width of the frame section (b_f) as per ISO 10077-2 Appendix F, and
   ii) door reveal liners that are integral with the door unit may either be disregarded or included in the calculation model.

D.1.3 Calculation of the representative construction R-value of all windows and doors that are part of the thermal envelope

D.1.3.1 The representative window and door *construction R-value* (R_{WD}) shall be calculated in accordance with Equation D.3. The *construction R-value* shall be rounded down to no less than two significant figures.

Equation D.3: $R_{WD} = \frac{\sum A_W + \sum A_D}{\sum \frac{A_W}{R_W} + \sum \frac{A_D}{R_D}}$

where:

R_w is the *construction R-value* of each vertical window that is part of the *thermal envelope* of the proposed *building* ($m^2 \cdot K/W$) calculated in accordance with Paragraph D.1.2.1; and

A_w is the window area of each vertical window that is part of the *thermal envelope* of the proposed *building* (m^2) calculated in accordance with ISO 10077-1 Section 6.3.1; and

R_D is the *construction R-value* of each door that is part of the *thermal envelope* of the proposed building ($m^2 \cdot K/W$) calculated in accordance with Paragraph D.1.2.3; and

A_D is the *door area* of each door that is part of the *thermal envelope* of the proposed *building* (m^2) calculated in accordance with ISO 10077-1 Section 6.3.1.

D.2 Skylights

D.2.1 Construction R-values

D.2.1.1 The *construction R-values* for *skylights* ($R_{skylight}$) shall include the effects of both the glazing materials and the frame materials and shall be calculated in accordance with Equation D.4. The *construction R-value* shall be rounded down to no less than two significant figures.

Equation D.4: $R_{skylight} = \frac{1}{U_W}$

where:

$R_{skylight}$ is the *construction R-value* of the *skylight* ($m^2 \cdot K/W$); and
U_W is the thermal transmittance of the *skylight* ($W/(m^2 \cdot K)$) determined in accordance with Paragraph D.2.1.2.

D.2.1.2 The thermal transmittance (U_W) of a *skylight* shall be determined in accordance with ISO 10077-1, with:

a) the thermal transmittance of the glazing (U_g) determined using BS EN 673, considering the effects of horizontal or angled (sloping) glazing on the heat transfer; and
b) the thermal transmittance of the frame (U_f) determined using ISO 10077-2.

D.3 Curtain walling

D.3.1 Construction R-values

D.3.1.1 The *construction R-values* for *curtain walling* (R_{cw}) shall be calculated in accordance with Equation D.5. The *construction R-value* shall be rounded down to no less than two significant figures.

Equation D.5: $R_{CW} = \frac{1}{U_{cw}}$

where:

R_{CW} is the *construction R-value* of the *curtain walling* ($m^2 \cdot K/W$); and
U_{CW} is the thermal transmittance of the *curtain walling* ($W/(m^2 \cdot K)$), determined in accordance with ISO 12631, with the thermal transmittance of the glazing (U_g) determined using BS EN 673.

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

E.1 Construction R-values

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

E.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 either:

a) calculation in accordance with Section E.1.2; or

b) the performance tables in Acceptable Solution H1/AS1 Appendix E.

> 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.

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

E.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.

E.1.2.2 The calculation shall be based on a three-dimensional numerical calculation in accordance with ISO 13370 Section 5.2a), or a two-dimensional numerical calculation in accordance with ISO 13370 Section 5.2b). The formulae provided in ISO 13370 Section 7 and Annex D shall not be used for determining the *construction R-value* of *slab-on-ground floors*.

E.1.2.3 When using a two-dimensional numerical calculation in accordance with ISO 13370 Section 5.2b), a geometrical model in accordance with ISO 10211 Sections 7.3, 12.4.1 and 12.4.2 shall be used. The model shall have a floor width equal to half the characteristic dimension of the floor. The characteristic dimension of the floor shall be determined using overall internal dimensions, measured between the interior surfaces of the walls that form the *thermal envelope,* including the thickness of any internal partitions.

> COMMENT:
>
> 1. The characteristic dimension of the floor (B as defined in ISO 13370) equals the area of the floor divided by half the perimeter of the floor.
> 2. Paragraph E.1.2.3 requires a two-dimensional geometrical model with a floor width equal to half the characteristic dimension of the floor. This represents a floor that is infinitely long and has a width equal to the characteristic dimension of the floor.

E.1.2.4 For *slab-on-ground floors* of inhomogeneous *construction*, such as concrete raft foundation floors, the results of any two-dimensional numerical calculation in accordance with ISO 13370 Section 5.2b) shall be validated by three-dimensional numerical calculations in accordance with ISO 13370 Section 5.2a).

Thermal resistance of slab-on-ground floors

> COMMENT: ISO 13370 Sections 5.2 a) and b) specify that the result of a three-dimensional numerical calculation is applicable only for the actual floor dimensions modelled, whereas the result of a two-dimensional numerical calculation is applicable to floors having the characteristic dimension that was modelled. Therefore, the result of a two-dimensional numerical calculation can have wider application, but, depending on the floor *construction*, may need to be validated by comparing the result against the result of a three-dimensional numerical calculation. This should be done for a sample across a range of floor dimensions that the resulting *construction R-value* is to be applied to.

E.1.2.5 The *external wall* shall be included in the model and extend 500 mm above the internal floor surface. For framed walls, the only framing member to be included in the model shall be the bottom plate.

E.1.2.6 The calculation shall use the *default values* for the thermal properties of the ground from ISO 13370 Table 7 category 2 (thermal conductivity $\lambda = 2.0$ W/(m·K), heat capacity per volume $\rho c = 2.0 \times 10^6$ J/(m^{3}K)). For other materials, thermal conductivity values from ISO 10456 shall be used and, for materials used below ground level, reflect the moisture and temperature conditions of the application. Values of surface resistance shall conform to ISO 13370 Section 6.4.3.

E.1.2.7 The *construction R-value* of the *slab-on-ground floor* shall be calculated according to Equation E.1. The *construction R-value* shall be rounded down to no less than two significant figures.

Equation E.1: $R_{floor} = \frac{1}{U}$

where:

R_{floor} is the *construction R-value* of the *slab-on-ground floor* (m^2·K/W); and
U is the temperature-specific heat flux through the internal floor surface of the two- or three-dimensional geometrical model, with the internal floor surface extending from the internal surface of the *external wall* to the cut-off plane of the floor (W/(m^2·K)), determined by a numerical calculation as per Paragraphs E.1.2.1, E.1.2.2, E.1.2.3, E.1.2.4, E.1.2.5, and E.1.2.6.

> COMMENT: A commonly used two-dimensional heat-transfer analysis software tool is THERM, developed at the Lawrence Berkeley National Laboratory (LBNL). When using THERM, the temperature specific heat flux U (required by Equation E.1) is the ‘U-factor’ of the internal floor surface of the two-dimensional geometrical model.

BUILDING PERFORMANCE

CONTACT DETAILS PO Box 1473, Wellington 6140 | T 0800 242 243 | E info@building.govt.nz
For more information, visit building.govt.nz
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