



**National
Construction
Code**

Housing energy efficiency Handbook



**Australian
Building
Codes Board**

The Australian Building Codes Board

The Australian Building Codes Board (ABCB) is a standards writing body responsible for the National Construction Code (NCC), WaterMark and CodeMark Certification Schemes.

The ABCB is a joint initiative of all levels of government in Australia, together with the building and plumbing industry. Its mission is to oversee issues relating to health, safety, amenity, accessibility and sustainability in building.

For more information visit the [ABCB website](#).

Copyright

© Commonwealth of Australia and the States and Territories of Australia 2023, published by the Australian Building Codes Board.

This work is licensed under the Creative Commons Attribution 4.0 International License. More information on this licence is set out at the [Creative Commons website](#).

Unless otherwise noted, copyright (and any other intellectual property rights, if any) in this publication is jointly owned by the Commonwealth, States and Territories of Australia.



Attribution

Use of all or part of this publication must include the following attribution:

The Housing energy efficiency handbook was provided by the [Australian Building Codes Board](#) under the [CC BY 4.0](#) licence.

Disclaimer

By accessing or using this publication, you agree to the following:

While care has been taken in the preparation of this publication, it may not be complete or up-to-date. You can ensure that you are using a complete and up-to-date version by checking the [ABCB website](#).

The ABCB, the Commonwealth of Australia and States and Territories of Australia do not accept any liability, including liability for negligence, for any loss (howsoever caused), damage, injury, expense or cost incurred by any person as a result of accessing, using or relying upon this publication, to the maximum extent permitted by law. No representation or warranty is made or given as to the currency, accuracy, reliability, merchantability, fitness for any purpose or completeness of this publication or any information which may appear on any linked websites, or in other linked information sources, and all such representations and warranties are excluded to the extent permitted by law.

This publication is not legal or professional advice. Persons rely upon this publication entirely at their own risk and must take responsibility for assessing the relevance and accuracy of the information in relation to their particular circumstances.

Version history

Original

Publish date: Mar 2023

Print version: 1.0

Preface

This handbook is one of a series by the ABCB. Handbooks expand on areas of existing regulation or relate to topics that are not regulated by the NCC. They provide advice and guidance.

The Housing energy efficiency handbook assists in understanding the energy efficiency provisions in NCC Volume Two that apply to houses.

It addresses issues in generic terms and is not a document that sets out specific compliance advice for developing solutions to comply with the requirements in the NCC. This handbook is intended to guide readers in developing solutions relevant to specific situations in accordance with the generic principles and criteria contained herein.

Contents

1 Introduction	1
1.1 Background	1
1.2 Scope.....	2
1.3 Using this document.....	3
2 Performance Requirements and compliance options	5
2.1 Introduction.....	5
2.2 Objective and Functional Statement.....	5
2.3 Performance Requirements	6
2.4 Compliance options.....	9
3 Compliance option 1 - NatHERS	12
3.1 Introduction.....	12
3.2 Method.....	13
3.3 Useful tips.....	35
3.4 Demonstrating compliance	37
3.5 Examples.....	38
4 Compliance option 2 - Elemental	39
4.1 Introduction.....	39
4.2 Method.....	40
4.3 Useful tips.....	77
4.4 Demonstrating compliance	86
4.5 Examples.....	87
5 Compliance option 3 - Verification using a reference building	88
5.1 Introduction.....	88
5.2 Method.....	88
5.3 Useful tips.....	99
5.4 Demonstrating compliance	100
5.5 Example.....	101
6 Compliance option 4 - Verification of building envelope sealing	102
6.1 Introduction.....	102

6.2 Method.....	102
6.3 Useful tips.....	104
6.4 Demonstrating compliance	104
6.5 Example.....	106
7 Compliance option 5 - Other Performance Solutions	107
7.1 Introduction.....	107
7.2 Assessment Methods.....	107
7.3 Performance Solution Process	110
7.4 Professional practice and ethics.....	111
Appendix A Abbreviations	117
Appendix B Glossary	119
Appendix C Compliance with the NCC.....	136
C.1 Responsibilities for regulation of building and plumbing in Australia.....	136
C.2 Demonstrating compliance with the NCC	136
Appendix D Examples	139
D.1 Heating and cooling load limits	140
D.2 Building fabric	143
D.3 Glazing.....	165
D.4 Ceiling fans	171
D.5 WOH energy usage.....	173
D.6 Artificial lighting.....	185
D.7 Verification using a reference building.....	188
D.8 Verification of building envelope sealing.....	191
Appendix E Relevant reports and standards	194

Reminder

This handbook is not mandatory or regulatory in nature. Compliance with it will not necessarily discharge a user's legal obligations. The handbook should only be read and used subject to, and in conjunction with, the general disclaimer at page i.

The handbook also needs to be read in conjunction with the NCC and the relevant legislation of the appropriate state or territory. It is written in generic terms and it is not intended that the content of the handbook counteract or conflict with the legislative requirements, any references in legal documents, any handbooks issued by the administration or any directives by the appropriate authority.

1 Introduction

1.1 Background

1.1.1 The NCC

The NCC is a performance-based code containing all Performance Requirements for the construction of buildings. To comply with the NCC, a solution must achieve compliance with the Governing Requirements and the Performance Requirements.

The Governing Requirements contain requirements about how the Performance Requirements must be met. A building, plumbing or drainage solution will comply with the NCC if it satisfies the Performance Requirements, which are the mandatory requirements of the NCC.

1.1.2 Housing energy efficiency requirements

Housing energy efficiency requirements were first introduced into the Building Code of Australia (BCA) in 2003. As a result of government policy initiatives¹, major changes to these requirements occurred in 2010 and more recently, 2022.

When compared to NCC 2019 there are 3 main changes to the housing energy efficiency requirements in NCC 2022. These are:

- (1) Changes to the clause numbering due to the introduction of a consistent volume structure (CVS) across all 3 volumes of the NCC.
- (2) Quantified Performance Requirements, which means they now primarily include numerical targets that clarify the level of performance required, rather than qualitative (non-numerical) statements.
- (3) An increase in thermal performance (building fabric) stringency coupled with an expansion of the requirements to regulate the 'energy value'² of a house with typical fixed appliance use.

For NCC 2022, the overall intent of the housing energy efficiency requirements is to improve the:

- efficient use of energy in housing design and construction, and
- energy usage by key equipment installed in a building.

¹ Policy initiatives include the [National Energy Productivity Plan](#), the [Trajectory for Low Energy Buildings](#) and the [National Strategy on Energy Efficiency](#).

² See the Glossary at Appendix B for the definition of 'energy value'.

1.1.3 Energy efficiency handbooks

Alongside other guidance and support materials available from the [ABCBC website](#), there will be a new series of energy efficiency handbooks. These new handbooks are intended to assist NCC users to understand and comply with the latest requirements.

The new handbooks:

- focus on available compliance options
- are easier-to-digest documents than previous handbooks on energy efficiency
- provide links to other guidance and support materials
- consider the needs of various types of practitioners.

The Housing Energy Efficiency Handbook is the first handbook in the new series of energy efficiency handbooks.

1.2 Scope

To specify particular requirements, the NCC uses a building classification system. Building classifications are labelled 'Class 1' through to 'Class 10'. Some classifications also have sub-classifications, referred to by a letter after the number (e.g., Class 1a).

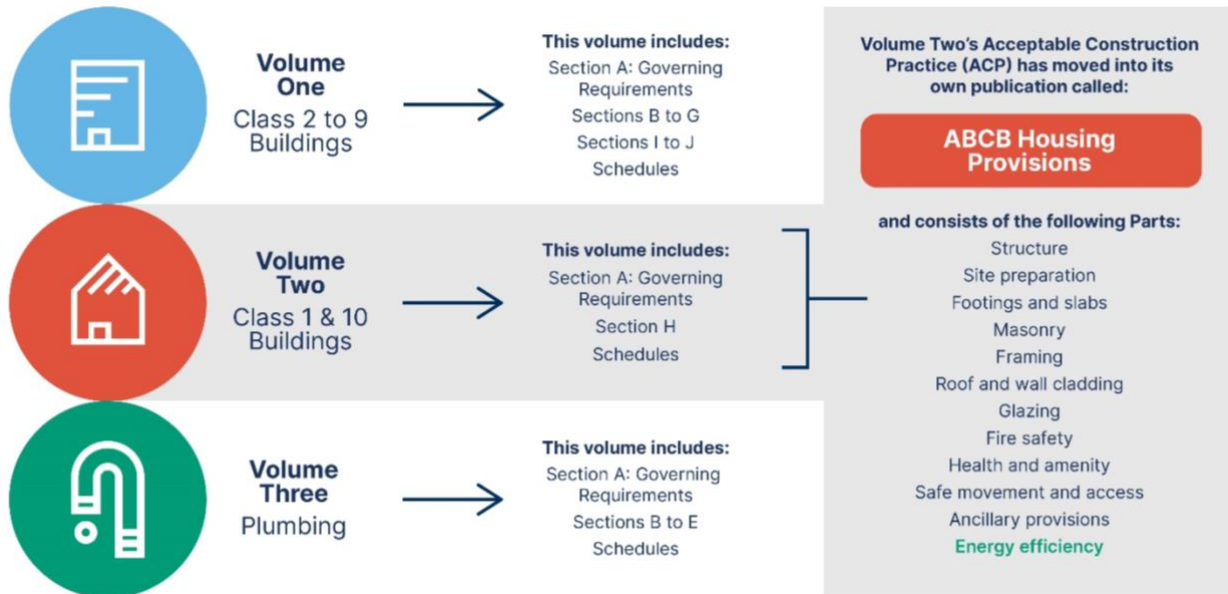
The scope of this document is limited to Class 1 and Class 10a buildings. Class 1 buildings are dwellings. A Class 10a building is a non-habitable building such as a garage, shed or carport.

For simplicity, this handbook uses the term 'house' for all Class 1 buildings.

The NCC housing energy efficiency requirements are in NCC Volume Two and the associated ABCBC Housing Provisions Standard (Housing Provisions).

More information on building classifications and access to the NCC is available from the [ABCBC website](#). See Figure 1.1 for how the NCC is structured.

Figure 1.1 How the NCC is structured



1.3 Using this document

1.3.1 Structure

Chapter 2 provides an overview of the mandatory Performance Requirements for housing energy efficiency and the compliance options that can be used.

Chapters 3 to 7 each describe an individual compliance option, with the intention to enable an NCC user to focus on the compliance option(s) they will likely use to meet the Performance Requirements.

For each compliance option there is an introduction, a method (that includes the key requirements), useful tips, information on demonstrating compliance and one or more examples.

1.3.2 Appendices

This document contains 5 appendices, which are as follows:

- Appendix A contains a list of abbreviations used in this document
- Appendix B is a glossary of key terms used in this document
- Appendix C provides general information about complying with the NCC and responsibilities for building and plumbing regulations
- Appendix D contains examples
- Appendix E provides a list of relevant reports and standards.

1.3.3 Document styles

Different styles are used in this document. Examples of these styles are below.

NCC extracts³

Examples

Alerts or Reminders

³ NCC extracts italicise defined terms as per the NCC. See Schedule 1 of the NCC for further information.

2 Performance Requirements and compliance options

2.1 Introduction

A building solution will comply with the NCC if it satisfies the Performance Requirements and the Governing Requirements, which are the mandatory requirements of the NCC.

The NCC 2022 Performance Requirements for housing energy efficiency are in NCC Volume Two, Part H6 Energy Efficiency. They are listed in Figure 2.1.

Figure 2.1 Housing energy efficiency Performance Requirements

H6P1	<ul style="list-style-type: none">• Thermal performance (house fabric)
H6P2	<ul style="list-style-type: none">• Energy usage

These Performance Requirements are discussed further in this chapter.

As a result of the changes to housing energy efficiency in NCC 2022, the non-mandatory Objective and Functional Statement, when compared to NCC 2019, have also been updated. This is discussed further in this chapter, see section 2.2.

2.2 Objective and Functional Statement

An Objective and Functional Statement is used in the NCC to provide guidance on the intent and interpretation of the Performance Requirements, in this case, for housing energy efficiency. They are provided as explanatory information with the Performance Requirements in Part 2 of NCC Volume Two.

Compared to NCC 2019, the Objective and Functional Statement for housing energy efficiency have been expanded to align with policy set by governments in the [Trajectory for Low Energy Buildings](#).

Objective H6O1 was previously known as O2.6 in NCC 2019. This Objective is in NCC Volume Two Part H6 Energy efficiency.

The Objective for housing energy efficiency is as follows:

H6O1 Objective

The Objective of this Part is to –

- (a) reduce energy consumption and energy peak demand; and
- (b) reduce greenhouse gas emissions; and
- (c) improve occupant health and *amenity*.

Functional Statement H6F1 was previously known as F2.6 in NCC 2019. This Functional Statement is in NCC Volume Two Part H6 Energy Efficiency.

The Functional Statement for housing energy efficiency is as follows:

H6F1 Energy efficiency

A building must –

- (a) reduce the energy consumption and energy peak demand of key energy using equipment; and
- (b) reduce greenhouse gas emissions that occur as a result of a building's energy consumption and energy source; and
- (c) improve occupant health and *amenity* by mitigating the impact of extreme hot and cold weather events, and energy blackouts.

2.3 Performance Requirements

2.3.1 Thermal Performance Requirement

H6P1 Thermal performance covers the thermal performance of a house's fabric⁴. H6P1 was previously referred to as P2.6.1 and contained qualitative statements.

For NCC 2022, this Performance Requirement has been quantified. An extract of H6P1 is shown below.

H6P1 Thermal performance

- (1) The total *heating load* of the *habitable rooms* and *conditioned spaces* in a building must not exceed the *heating load* limit in Specification 44.
- (2) The total *cooling load* of the *habitable rooms* and *conditioned spaces* in a building must not exceed the *cooling load* limit in Specification 44.

⁴ See the terms 'thermal performance' and 'fabric' in the Glossary at Appendix B for more information.

- (3) The total *thermal energy load* of the *habitable rooms* and *conditioned spaces* must not exceed the *thermal energy load* limit in Specification 44.

H6P1 Thermal performance regulates the maximum (or upper limit) of permitted heating loads, cooling loads and total thermal energy loads of homes⁵.

Many factors contribute to heating and cooling loads including insulation levels, solar gain, airtightness and local climate.

Alert

The heating load, cooling load and total thermal energy load limits specified by H6P1 is not the same as the actual amount of energy used for heating and cooling.

The amount of energy used for heating and cooling depends on the source of the energy used (i.e. fuel type) and the efficiency of the heating and cooling equipment.

The amount of energy used for heating and cooling is addressed by H6P2 Energy usage.

Performance Requirement H6P1 references Specification 44 (new for NCC 2022) to specify the heating load limit, cooling load limit and thermal energy load limit. Specification 44 is in NCC Volume Two, Section H.

Using the calculation method in Specification 44 is not required in most cases, except where a Performance Solution that references the limits is developed using a first principles approach (i.e. direct assessment against the Performance Requirements). Compliance options that can be used to meet this Performance Requirement are discussed in section 2.4.

2.3.2 Energy usage Performance Requirement

H6P2 Energy usage covers the energy use of a house's domestic services⁶. It was previously referred to as P2.6.2 in NCC 2019 and contained qualitative statements.

For NCC 2022, this Performance Requirement has been

- (1) expanded to better regulate the energy usage of a house's domestic services, and
- (2) partially quantified by including benchmark levels of performance for some components of a house's domestic services.

The benchmark levels of performance for domestic services are predominantly stated in terms of [Greenhouse and Energy Minimum Standards](#) (GEMS).

An extract of H6P2 is shown below.

⁵ See the NCC defined terms 'heating load', 'cooling load' and 'thermal energy load' in the Glossary at Appendix B for more information.

⁶ See the NCC defined term 'domestic services' in the Glossary at Appendix B for more information.

H6P2 Energy usage

- (1) The *energy value* of a building's *domestic services* must not exceed 70% of the *energy value* with—
 - (a) a 3-star ducted heat pump, rated under the 2019 GEMS determination, heating all spaces that are provided with heating; and
 - (b) a 3-star ducted heat pump, rated under the 2019 GEMS determination, cooling all spaces that are provided with cooling; and
 - (c) a 5-star instantaneous gas water heater, rated under the 2017 GEMS determination, providing all domestic hot water; and
 - (d) a lighting power density of 4 W/m² serving all internal spaces that are provided with artificial lighting.
- (2) *Domestic services*, including any associated distribution system and components must, to the degree necessary, have features that facilitate the efficient use of energy appropriate to—
 - (a) the *domestic service* and its usage; and
 - (b) the geographic location of the building; and
 - (c) the location of the *domestic service*; and
 - (d) the energy sources.

Simply put, a house will comply with H6P2 if it has an overall 'energy value'⁷ of less than or equal to what is specified in H6P2(1), and also complies with the qualitative requirements of H6P2(2).

Calculating the 'energy value' to comply with H6P2 is not required in most cases, except where a Performance Solution that uses an energy value is developed using a first principles approach. Compliance options that can be used to meet this Performance Requirement are discussed in the next section.

⁷ See the NCC defined term 'energy value' in the Glossary at Appendix B for more information.

Alert

A2G1 of all NCC Volumes specifies that all relevant NCC Performance Requirements need to be met to achieve compliance with the NCC. This means both H6P1 Thermal performance and H6P2 Energy usage need to be met in full for a house, with no reduction or trading of performance between Performance Requirements permitted.

2.4 Compliance options

Compliance with the NCC is achieved by complying with the NCC Governing Requirements and relevant Performance Requirements. There are 3 options available to demonstrate compliance with the Performance Requirements:

- a Performance Solution
- a Deemed-to-Satisfy (DTS) Solution, or
- a combination of a Performance Solution and a DTS Solution.

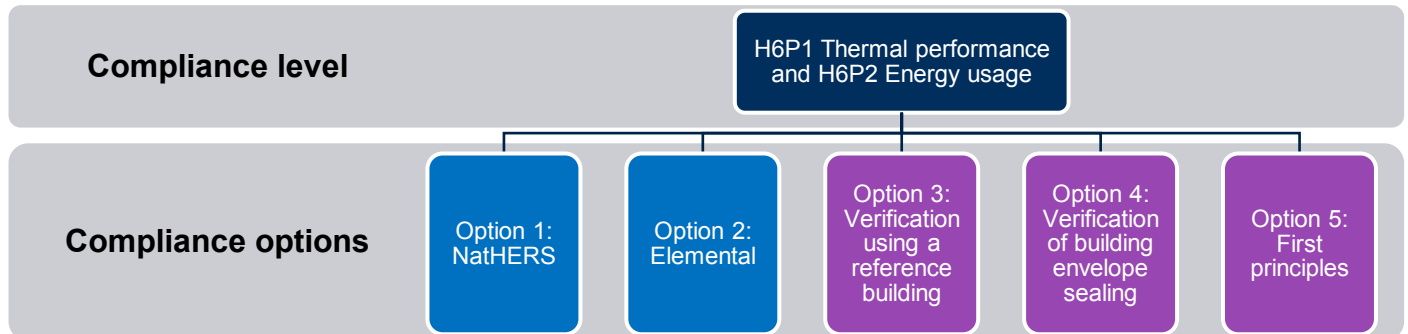
General information on compliance with the NCC is contained in Appendix C.

Specifically for housing energy efficiency, the mandatory Performance Requirements are H6P1 Thermal performance and H6P2 Energy usage.

There are several compliance options available to meet one, both or part of these Performance Requirements. A simplified overview⁸ of the available options is in Figure 2.2.

⁸ This figure provides a simplified overview of compliance options and does not include where a NatHERS software tool has been used to comply with H6P1 Thermal performance and the elemental provisions used to comply with H6P2 Energy usage. See NCC Volume Two for more information.

Figure 2.2 Simplified overview of compliance options



Notes to Figure 2.2

Blue shading indicates a DTS Solution, purple shading indicates a Performance Solution.

Option 3 and Option 4 only provide partial compliance with one of the Performance Requirements H6P1 Thermal performance.

Additional guidance on available compliance options and where further information can be obtained in this document is in Table 2.1.

Table 2.1 Compliance options

Options	Type of solution	H6P1 Thermal performance	H6P2 Energy usage	Chapter reference
Nationwide House Energy Rating Scheme (NatHERS)	DTS Solution	Y	Y	Chapter 3
Elemental	DTS Solution	Y	Y	Chapter 4
Verification using a reference building	Performance Solution	Y	N ⁹	Chapter 5
Verification of building envelope sealing	Performance Solution	Y ¹⁰	N ¹¹	Chapter 6
Other Performance Solutions	Performance Solution	Y	Y	Chapter 7

⁹ 'N' means another compliance option must be used to meet this Performance Requirement.

¹⁰ Part compliance only.

¹¹ 'N' means another compliance option must be used to meet this Performance Requirement.

Alert

A key principle underpinning the NCC 2022 housing energy efficiency requirements is that all compliance options aim to offer an equivalent level of performance. This principle helps ensure the policy objectives set out in Objective H6O1 (see section 2.2) are achieved.

Figure 2.2 and Table 2.1 above provide a simplified overview of compliance options, noting a combination of DTS Solutions is permitted. For example, NatHERS could be used to meet H6P1 and the Elemental provisions used to meet H6P2.

3 Compliance option 1 - NatHERS

3.1 Introduction

The NatHERS compliance option is a set of DTS Provisions that can be used to meet both housing energy efficiency Performance Requirements i.e. H6P1 Thermal performance and H6P2 Energy usage.

Alert

NatHERS is a scheme administered by the Australian Government on behalf of all states and territories that facilitates consistent energy ratings from NatHERS accredited software tools for new¹² Australian homes.

More information is available from [NatHERS](#).

The DTS Provisions that form the NatHERS compliance option are used to demonstrate NCC compliance using a DTS Solution. See Appendix C for more information on how to comply with the NCC.

This compliance option is in the DTS Provisions of NCC Volume Two clauses H6D2(1)(a) and H6D2(2)(a).

Compared to NCC 2019, there are 6 main changes to this compliance option for NCC 2022. These are:

- (1) Changes to the clause numbering due to the CVS.
- (2) An increase in stringency to the minimum star rating required, from 6 to 7 stars, which includes changes to the heating and cooling load limits.
- (3) Introduction of a Whole of Home¹³ (WOH) rating requirement to meet the expanded Performance Requirement H6P2 Energy usage.
- (4) Relocation of some requirements to Specification 42 (S42) House Energy Rating Software.
- (5) Relocation of the additional fabric DTS Provisions from NCC Volume Two to the Housing Provisions.

¹² 'New' includes proposed new homes and apartments and proposed 'new building work' to existing homes and apartments. What constitutes 'new building work' is the responsibility of individual jurisdictions.

¹³ Note NatHERS uses 'Whole of Home' (no hyphens, upper case 'H' for home) for its WOH software tools, whereas the NCC uses 'Whole-of-home' (hyphens, lower case 'h' for home). Both NatHERS and the NCC use the same abbreviation which is 'WOH'.

- (6) Introduction of Clause A5G9 in the NCC Governing Requirements that requires evidence of a NatHERS software tool output be in the form of a NatHERS certificate issued in accordance with the NatHERS scheme.

Alert

Figure 2.2 and Table 2.1 in Chapter 2 provides a simplified overview of compliance options, noting a combination of DTS Solutions is permitted. For example NatHERS could be used to meet H6P1 and the Elemental provisions used to meet H6P2.

3.2 Method

The NatHERS compliance option is the most used method to meet the housing energy efficiency Performance Requirements. The intent of this method is to provide a compliance pathway that utilises computer simulation, since this aids in the development of unique and optimised solutions.

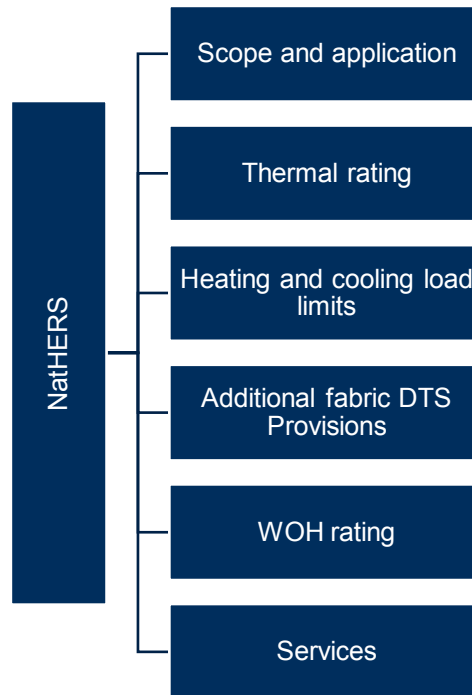
The NatHERS compliance option references the following:

- S42 of NCC Volume Two
- software accredited under NatHERS
- the ABCB Standard for NatHERS heating and cooling load limits (2022)
- DTS Provisions contained in the Housing Provisions.

These references are discussed in further detail throughout this chapter.

Figure 3.1 outlines the relevant requirements that form the NatHERS compliance option. Each of these requirements is discussed in further detail in this chapter.

Figure 3.1 NatHERS compliance option



Alert

The NatHERS compliance option now includes 2 ratings: a thermal rating and a WOH rating. A thermal rating assesses the potential thermal performance of a new¹⁴ home. The results are converted to a score between 0 and 10 stars.

A WOH rating is more holistic and assesses equipment efficiencies and any offsets from on-site renewable energy of a proposed home. A WOH builds on the thermal performance assessment (i.e. star rating) of the proposed house. The results are converted to a score between 1 and 100.

3.2.1 Scope and application

H6D2 and S42C1 of NCC Volume Two together specify the scope and application of the NatHERS compliance option. The scope of the requirements is outlined in Figure 3.1.

¹⁴ 'New' includes proposed new homes and apartments and proposed 'new building work' to existing homes and apartments. What constitutes 'new building work' is the responsibility of individual jurisdictions.

3.2.2 Thermal rating

From NCC 2022, houses are required to achieve a minimum thermal rating greater than or equal to 7 stars using a software tool accredited under NatHERS. This requirement is specified in NCC Volume Two S42C2(1)(a).

Further information and resources on NatHERS are available from the [NatHERS website](#).

Like previous editions of the NCC, lower thermal ratings (i.e. lower stringency) are specified for houses in climate zones 1 and 2 that contain a compliant outdoor living area (OLA).

This is because there is some evidence that suggests that most homeowners turn off their air-conditioners when using an OLA. When an air-conditioner is not being used, the total energy use is significantly reduced, hence the lower thermal rating required.

Table 3.1 outlines the key requirements for houses with OLAs and what thermal ratings need to be achieved.

Table 3.1 Key requirements for houses with OLAs

S42C2(1) reference	Key requirements
(a)	<ul style="list-style-type: none"> • Applies to climate zones 1 and 2 only • Minimum thermal rating greater than or equal to 6.5 stars if the following are met: <ul style="list-style-type: none"> - OLA complies with S42C2(3) - OLA with roof with Total R-Value greater than or equal to R1.5
(b)	<ul style="list-style-type: none"> • Applies to climate zones 1 and 2 only • Minimum thermal rating greater than or equal to 6.0 stars if the following are met: <ul style="list-style-type: none"> - OLA complies with S42C2(3) - OLA with roof with Total R-Value greater than or equal to R1.5 - At least one permanently installed ceiling fan that meets S42C2(5).

An extract of S42C2(3) and (4) for OLAs is shown below.

S42C2 Heating and cooling loads

(3) An outdoor living area in (1)(b) and (1)(c) is a space that—

S42C2 Heating and cooling loads

- (a) is directly adjoining, and directly accessible from, a general purpose living area of Class 1 building such as a lounge, kitchen, dining or family room, which is not a room for sleeping or specialist tasks such as a study or home theatre; and
 - (b) has a *floor area* greater than or equal to 12.0 m²; and
 - (c) has length and width dimensions greater than or equal to 2.5 m each; and
 - (d) has an opening height above floor level greater than or equal to 2.1 m; and
 - (e) has one side permanently open with a second side either—
 - (i) permanently open; or
 - (ii) readily openable.
- (4) The sides referred to in (3)(e) must be greater than or equal to 900 mm from an allotment boundary or 900 mm from an obstruction to the breeze path such as a building, fence or other structure.

3.2.3 Heating and cooling load limits

Heating and cooling load limits were first introduced in NCC 2019 for thermal ratings. These limits were introduced because the thermal ratings determined by NatHERS software tools are based on a house's total thermal energy load (i.e. the combined heating and cooling loads). Consequently, a house may perform poorly in either winter or summer despite meeting the total thermal energy load that equates to the required thermal rating. The heating and cooling load limits in the NCC address this issue.

For NCC 2022, the heating and cooling load limits have been made slightly more stringent than they were in NCC 2019. Like NCC 2019, heating load and cooling load limits for NCC 2022 do not apply in NSW, NT, Tas and parts of Qld and WA.

S42C2(1) specifies that heating load and cooling load limits must be met. The limits are specified in the ABCB Standard for NatHERS heating and cooling load limits (2022) which is available from the [ABCB website](#).

3.2.4 Additional fabric DTS Provisions

Software tools alone cannot be used to meet certain fabric requirements that are needed for compliance with the housing energy efficiency Performance Requirements. This means certain fabric requirements need to be met in addition to determining a thermal rating using a NatHERS software tool. These additional fabric requirements are listed in S42C4(1) and reference specific DTS Provisions contained in the Housing Provisions.

Table 3.2 outlines these additional fabric DTS Provisions. Each of these requirements is discussed in the following sections.

Table 3.2 Additional fabric DTS Provisions

DTS Provision(s)	Housing Provisions reference(s)
Building fabric thermal insulation	13.2.2
Thermal breaks	13.2.3(7) and 13.2.5(5)
Compensation for loss of ceiling insulation, other than where NatHERS software does this automatically	13.2.3(5)
Floor edge insulation	13.2.6(4), 13.2.6(5) and 13.2.6(6)
Building sealing	13.4

Building fabric thermal insulation

Clause 13.2.2 aims to ensure that when insulation, either bulk or reflective, is installed it –

- thermally performs as intended, and
- does not interfere with the safety or performance of plumbing or electrical components.

The building fabric thermal insulation requirements consists of 3 main subclauses. A summary of the key requirements of these subclauses is in Table 3.3.

Table 3.3 Key requirements for building fabric thermal insulation

Clause 13.2.2 reference	Key requirements
(1) Integrity of the insulation	<ul style="list-style-type: none"> Meets AS/NZS 4859.1 Materials for the thermal insulation of buildings Adjoins or overlaps to form a consistent and continuous thermal barrier, except at supporting members¹⁵ 'Consistent and continuous' insulation means filling any voids in the framing unless a gap is otherwise required. Voids may include between window and door jambs, surrounding lintels, and voids in intersecting walls Does not affect the safe or effective operation of any plumbing or electrical component¹⁶
(2) Installation of reflective insulation	<ul style="list-style-type: none"> Necessary airspace¹⁷ between the reflective side of insulation and lining/cladding Closely fits against any penetration and adequately supported by framing Adjoining sheets must overlap or be taped
(3) Installation of bulk insulation	<ul style="list-style-type: none"> Maintains its position and thickness, except where it crosses roof battens, water pipes etc. Ceiling insulation must overlap the external wall by greater than or equal to 50 mm. This only applies when there is no insulation in the external wall below.

AS/NZS 4859.1 specifies the testing criteria for insulation, including both reflective and bulk insulation. In broad terms, this standard requires the manufacturer test its products using a specified method and then provide a data sheet. A data sheet typically explains the thermal performance and the installation requirements for the product that should be followed.

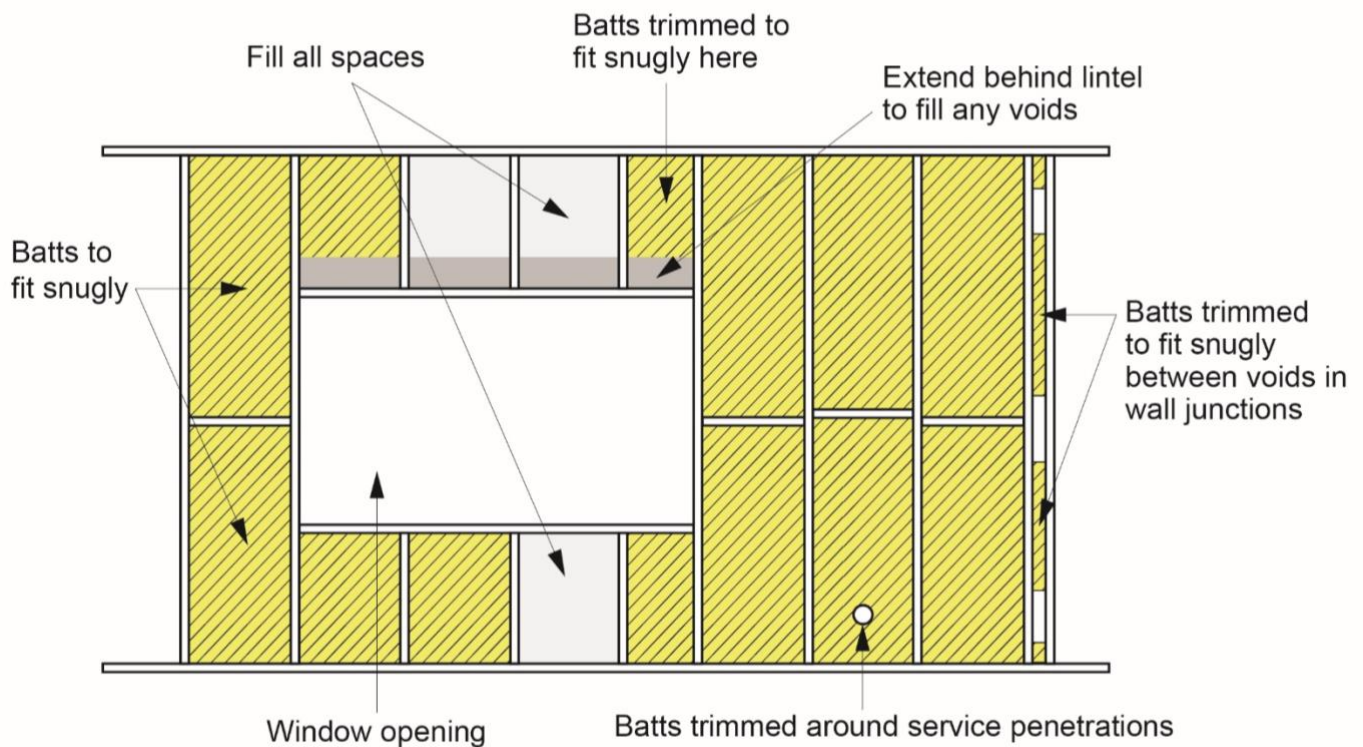
See Figure 3.2 for an illustration of installing bulk insulation in walls.

¹⁵ 'Supporting members' include columns, studs, noggings etc.

¹⁶ This includes providing appropriate clearance as detailed in relevant legislation and referenced standards such as for electrical, gas and fuel oil installations.

¹⁷ The width of the airspace will vary depending on the type of reflective insulation and the R-Value to be achieved.

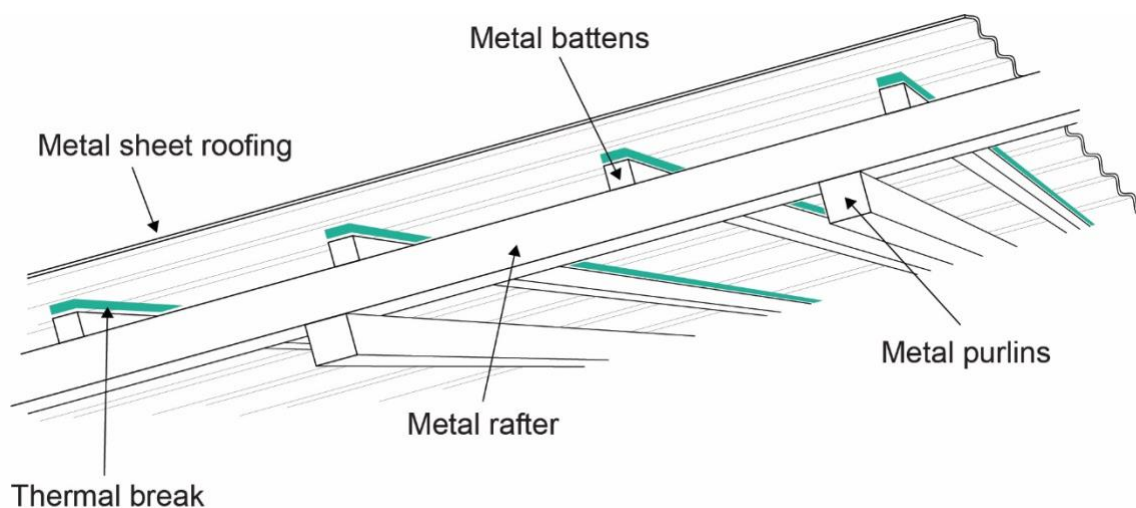
Figure 3.2 Installing bulk insulation in framed walls



Thermal breaks

Subclause 13.2.3(7) applies to some metal roof combinations and requires a thermal break greater than or equal to R0.2 to minimise conductive heat flow. Figure 3.3 provides an example of the thermal break requirements for roofs.

Figure 3.3 Example of roof thermal break construction

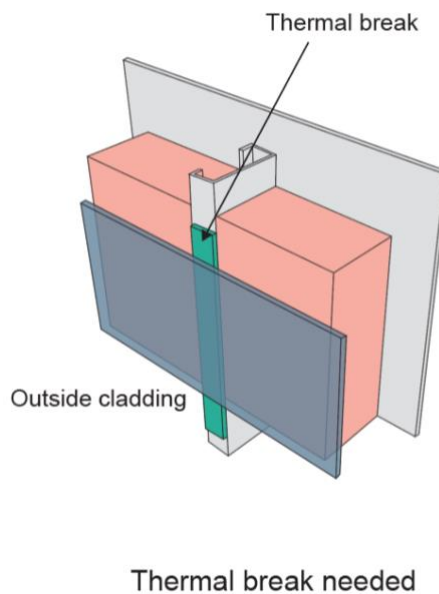


Alert

An important issue for roof design, especially in cooler climates where insulation with higher R-Values is required, will be to ensure that the roof structure has sufficient space to accommodate the insulation without the insulation being compressed. Any compression of the insulation will reduce its R-Value and consequently the effectiveness of the insulation.

Similarly, subclauses 13.2.5(5) and (6) applies to some metal-framed wall combinations that are part of the envelope. A thermal break of at least R0.2 is required to minimise conductive heat flow. Figure 3.4 provides an example of the thermal break requirements for walls.

Figure 3.4 Example of thermal break requirement for walls



Compensation for loss of ceiling insulation

Subclause 13.2.3(5) aims to account for loss of performance when insulation is reduced due to penetrations. To compensate, the insulation R-Value must be increased by complying with Table 13.2.3w of the Housing Provisions¹⁸.

This requirement does not apply when using a NatHERS accredited software tool, as it automatically compensates for a loss of ceiling insulation.

¹⁸ This requirement does not apply to skylights.

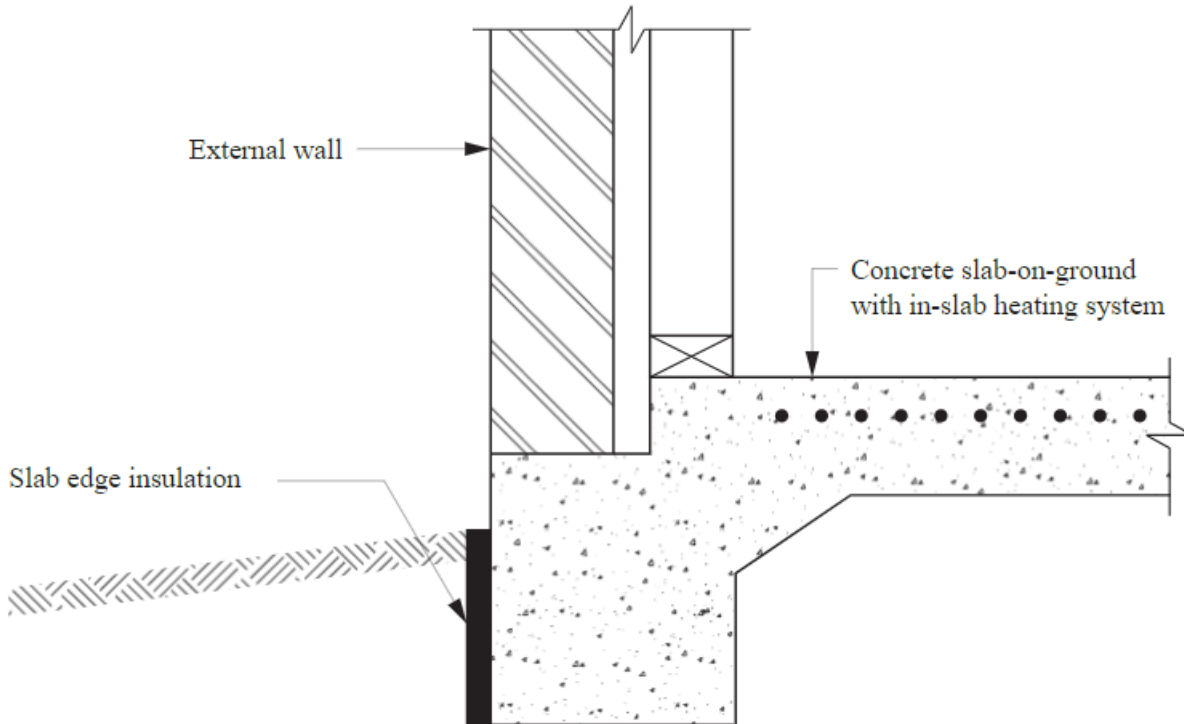
Floor edge insulation

The floor edge insulation requirements are in Clause 13.2.6 of the Housing Provisions and consist of 3 main subclauses for the NatHERS compliance option. A summary of the key requirements of these subclauses is in Table 3.4.

Table 3.4 Key requirements for floor edge insulation

Clause 13.2.6 reference	Key requirements
(4) CSOG insulation	<ul style="list-style-type: none"> • Applies to CSOG floors that have an in-slab or in-screed heating or cooling system • Requires insulation with additional R-Value greater than or equal to R1.0 installed around the vertical edge of its perimeter.
(5) Slab insulation	<ul style="list-style-type: none"> • Applies to floors in climate zone 6 and 7: <ul style="list-style-type: none"> - insulation R-Value greater than or equal to 0.64 installed around the vertical edge of its perimeter - insulation R-Value greater than or equal to R0.64 installed underneath the slab • Applies to floors in climate zone 8: <ul style="list-style-type: none"> - Insulation R-Value greater than or equal to R1.0 installed around the vertical edge of its perimeter - Insulation R-Value greater than or equal to R2.0 installed underneath the slab.
(6) Insulation installation and properties	<ul style="list-style-type: none"> • Applies to insulation required by (4) • Insulation must be installed and have the following properties: <ul style="list-style-type: none"> - water resistant - continuous from the ground level to a depth greater than or equal to 300 mm - continuous from the ground level for at least the full depth of the vertical edge of the CSOG • Figure 3.5 illustrates the requirements of Clause 13.2.6(6).

Figure 3.5 Insulation of slab edge (Figure 13.2.6 of the Housing Provisions)



3.2.5 Building sealing

Part 13.4 Building sealing in the Housing Provisions contains the relevant DTS Provisions to adequately seal parts of a house. The intent is to restrict air infiltration and air exfiltration¹⁹. Unintended leakage can lead to greater heat losses or gain and therefore reduced thermal comfort of occupants and consequently, increase the use of artificial heating and/or cooling.

Within Part 13.4 Building sealing, there are several clauses that need to be met, arranged by building element. These are outlined in Table 3.5 and discussed in the following sections.

Table 3.5 Building sealing clauses

Building element	Clause reference
Application	13.4.1
Chimneys and flues	13.4.2
Roof lights	13.4.3

¹⁹ See the terms 'air infiltration and 'air exfiltration' in the Glossary at Appendix B for more information.

Building element	Clause reference
External windows and doors	13.4.4
Exhaust fans	13.4.5
Construction of ceilings, walls and floors	13.4.6
Evaporative coolers	13.4.7

Application

Clause 13.4.1 specifies the DTS Provisions for building sealing apply to the following:

- all houses, and
- a garage, shed or carport where it has a conditioned space.

There are 2 exemptions:

- (1) A house or garage (shed or carport) located in climate zones 1, 2, 3 and 5 that only uses evaporative cooling.
- (2) A permanent ventilation opening that is needed to ensure the safe operation of a gas appliance.

Alert

Appropriate ventilation requirements for gas appliances can be obtained from relevant state and territory legislation, referenced standards and product installation manuals.

Chimneys and flues

Clause 13.4.2 requires a solid-fuel burning appliance (e.g. wood fireplace) to have a damper or flap on its chimney or flue so that it can be closed.

The intent of this requirement is to prevent conditioned air being drawn up the chimney or flue when the appliance is not in use.

Roof lights

Clause 13.4.3 provides the minimum sealing requirements for roof lights (skylights). The skylight sealing requirements consist of 2 subclauses.

A summary of the key requirements of these subclauses is in Table 3.6.

Table 3.6 Key requirements to seal skylights

Clause 13.4.3 reference	Key requirements
(1) Application	<ul style="list-style-type: none"> • Skylights must be sealed, or capable of being sealed in the following locations: <ul style="list-style-type: none"> - a conditioned space - a habitable room in climate zones 4, 5, 6, 7 and 8.
(2) Sealing requirements	<ul style="list-style-type: none"> • Sealing can be achieved by any of the following: <ul style="list-style-type: none"> - a ceiling diffuser (no holes) - a weatherproof seal - a manual, mechanical or electronic shutter system.

External windows and doors

Clause 13.4.4 provides the minimum sealing requirements for external windows and doors. The requirements consist of 2 subclauses.

A summary of the key requirements of these subclauses is in Table 3.7.

Table 3.7 Key requirements to seal external windows and doors

Clause 13.4.4 reference	Key requirements
(1) Application	<ul style="list-style-type: none"> • Applies to the following external openings: <ul style="list-style-type: none"> - external doors - internal doors between a house and an unconditioned garage or carport - openable windows - similar openings to those listed above. • Seals are needed for the following locations: <ul style="list-style-type: none"> - a conditioned space - a habitable room in climate zones 4, 5, 6, 7 and 8.
(2) Sealing requirements	<ul style="list-style-type: none"> • A draft protection device must be used to seal the bottom edge of a door • A foam or rubber compressible strip, or fibrous seal, must be used to seal the edge of doors and openable windows.
(3) Exemption	<ul style="list-style-type: none"> • (2)(b) does not apply to a window that complies with the maximum air infiltration rates in AS 2047.

Exhaust fans

Clause 13.4.5 provides the minimum requirements to seal exhaust fans.

Exhaust fans must be sealed with a self-closing damper or filter when located in one of the following:

- (1) A conditioned space
- (2) A habitable room in climate zones 4, 5, 6, 7 and 8.

Construction of ceilings, walls and floors

Clause 13.4.6 provides the minimum requirements to seal ceilings, walls and floors at junctions and around window and door penetrations.

The requirements consist of 2 subclauses. A summary of the key requirements is in Table 3.8.

Table 3.8 Key construction requirements to seal ceilings, walls and floors

Clause 13.4.6 reference	Key requirements
(1) Application	<ul style="list-style-type: none"> • Applies to the following components of the external fabric: <ul style="list-style-type: none"> - ceilings - floors - window frames - door frames - roof light frames • Seals are needed for the following locations: <ul style="list-style-type: none"> - a conditioned space - a habitable room in climate zones 4, 5, 6, 7 and 8.
(2) Construction requirements	<ul style="list-style-type: none"> • Option 1: Construction in (1) must be enclosed by internal lining systems that are close-fitting for the following construction elements: <ul style="list-style-type: none"> - ceilings - walls - wall and floor junctions • Option 2: Construction in (1) must be sealed at junctions and penetrations by either of the following: <ul style="list-style-type: none"> - close-fitting architrave, skirting or cornice - expanding foam, rubber compressive strip or caulking.

Evaporative coolers

Clause 13.4.7 provides the minimum requirements to seal evaporative coolers.

Evaporative coolers must be sealed with a self-closing damper when supplying one of the following:

- (1) A heated space
- (2) A habitable room in climate zones 4, 5, 6, 7 and 8.

3.2.6 WOH rating

S42C3 in NCC Volume Two requires a WOH rating not less than 60 (out of 100) is achieved using NatHERS software. A WOH rating includes the fuel type and efficiency of heating and heated water systems, the efficiency of cooling systems, an allowance for lighting and the efficiency and energy use of pools and spas. This reflects the scope and level of stringency specified in Performance Requirement H6P2.

More information on WOH ratings, including NatHERS certificates, is available from [NatHERS](#) and section 3.3 of this document which contains useful tips.

Alert

The WOH rating in S42C3 and the DTS Provisions for Services in Part 13.7 both contain requirements for a house's domestic services and both requirements need to be met. This requirement is specified in S42C4(2). This should be considered during the selection of the domestic services, including the size of any on-site renewable energy such as rooftop solar and the heated water system.

3.2.7 Services

Part 13.7 Services in the Housing Provisions contains the relevant DTS Provisions for the minimum performance of fixed services, such as artificial lighting and swimming pool heating and pumping.

Minor changes to the DTS Provisions occurred for NCC 2022 when compared to NCC 2019. These are outlined in the following sections.

Within Part 13.7 Services, there are several clauses that need to be met, arranged by building type of service. These are discussed in the following sections.

Table 3.9 Services clauses

Service	Clause reference
Application	13.7.1
Insulation of services	13.7.2
Central heating water piping	13.7.3
Heating and cooling ductwork	13.7.4
Electric resistance space heating	13.7.5
Artificial lighting	13.7.6
Water heater in a heated water supply system	13.7.7
Swimming pool heating and pumping	13.7.8
Spa pool heating and pumping	13.7.9

Application

Clause 13.7.1 specifies the DTS Provisions for services apply to the following:

- all houses
- all garages, sheds and carports, and
- a swimming pool that is associated with a house, garage shed or carport.

In addition, the DTS Provisions for services can only be used for buildings that have a total floor area less than or equal to 500 m². For houses with a floor area greater than 500 m², another compliance option must be used. See section 2.4 for other options.

The application of the services requirements is specified in NCC Volume Two H6D2(2)(b) and Clause 13.7.1 of the Housing Provisions.

Insulation of services

Clause 13.7.2 aims to ensure that when central heating water piping or heating and cooling ductwork is insulated, the insulation can perform as intended. The insulation should:

- be protected from the weather
- can withstand the temperatures within the pipe or ductwork, and
- meet AS/NZS 4859.1.

Central heating water piping

Clause 13.7.3 aims to limit heat loss from central heating water piping when they are in an unconditioned space.

Insulation is required to achieve minimum R-Values based on the climate zone and location of the pipes. Generally, the more exposed the pipework to the external environment, the higher the insulation requirement.

A summary of the key requirements for central heating water piping is outlined in Table 3.10.

Table 3.10 Key requirements for central heating water piping

Clause 13.7.3 reference	Key requirements
(2)	<ul style="list-style-type: none"> • Applies to flow and return piping located: <ul style="list-style-type: none"> - within an unventilated wall space - within an internal floor between storeys - between ceiling insulation and a ceiling • Applies to heated water piping encased in a concrete floor (except if part of a floor heating system) • R-Value greater than or equal to 0.4 for all climate zones
(3) and (5)	<ul style="list-style-type: none"> • Applies to the following: <ul style="list-style-type: none"> - flow and return piping - cold water supply piping* - relief valve piping* • Applies to piping located within: <ul style="list-style-type: none"> - a ventilated wall space - an enclosed building subfloor - an enclosed roof space • R-Value greater than or equal to 0.6 for climate zones 1, 2, 3 and 5 • R-Value greater than or equal to 0.9 for climate zones 4, 6 and 7 • R-Value greater than or equal to 1.3 for climate zone 8

Clause 13.7.3 reference	Key requirements
(4) and (6)	<ul style="list-style-type: none"> • Applies to the following: <ul style="list-style-type: none"> - flow and return piping - cold water supply piping* - relief valve piping* • Applies to piping located: <ul style="list-style-type: none"> - outside the house - an unenclosed building subfloor - an unenclosed roof space • R-Value greater than or equal to 0.6 for climate zones 1, 2, 3 and 5 • R-Value greater than or equal to 0.9 for climate zones 4, 6 and 7 • R-Value greater than or equal to 1.3 for climate zone 8

* Insulation only applies to piping within 500 mm of the connection to the central heating system.

Heating and cooling ductwork

Clause 13.7.4 aims to ensure heating and cooling ductwork and associated fittings are protected, sealed and insulated to minimise heat loss or gain. The amount of insulation required is determined by the location of the ductwork within the house and the climate zone.

A summary of the key requirements for heating and cooling ductwork is in Table 3.11.

Table 3.11 Key requirements for heating and cooling ductwork

Clause 13.7.4 reference	Key requirements
(1), (4)(a) and (4)(b)	<ul style="list-style-type: none"> • For heating and cooling ductwork and fittings in a heating-only or cooling-only system: <ul style="list-style-type: none"> - insulation R-Value greater than or equal to 1.0 for climate zones 1 to 7 - insulation R-Value greater than or equal to 1.5 for climate zone 8 • For heating and cooling ductwork and fittings in a combined heating and refrigerated cooling system: <ul style="list-style-type: none"> - insulation R-Value greater than or equal to 1.5 for climate zones 1, 3, 4, 6, 7 and 8

Clause 13.7.4 reference	Key requirements
	<ul style="list-style-type: none"> - insulation R-Value greater than or equal to 1.0 for climate zones 2 and 5 • Insulation should be sealed against air loss using adhesives, mastics, sealants or gaskets in accordance with AS 4254.1 and AS 4254.2 for a Class C seal.
(2)	<ul style="list-style-type: none"> • Insulation should: <ul style="list-style-type: none"> - abut adjoining duct insulation to form a continuous barrier - be installed so that it maintains its position and thickness • Insulation should be protected from the effects of weather when located: <ul style="list-style-type: none"> - outside the house - in an attached garage, or - in a roof space. • The protection of the ductwork insulation should: <ul style="list-style-type: none"> - be an outer sleeve of protective sheeting to prevent the insulation becoming damp, and - have the outer protective sleeve sealed with adhesive tape that is at least 48 mm wide to create an airtight and waterproof seal.

Alert

In some climate zones condensation may create problems with uninsulated ductwork, in which case insulation should still be considered.

Insulation for refrigerated cooling ductwork should have a vapour barrier to prevent possible damage by condensation.

Some flexible ductwork is used to transfer products that have initiated from a flame-based heat source. For these applications, there are additional fire safety requirements for flexible ductwork in H3D2(2) of NCC Volume Two.

Electric resistance space heating

Clause 13.7.5 applies to electric resistance heating systems that can be used to heat more than one room. The requirements aim to limit the size of permanent electric heating systems and limit unnecessary wastage of energy when they are not been used. This clause only applies when a heating system serves more than one room.

The requirements include separate isolating switches for each room and temperature controllers and time switches for groups of rooms with common heating needs. There are also maximum power loads for living areas of 110 W/m² and 150 W/m² for bathrooms.

Artificial lighting

Clause 13.7.6 aims to limit unreasonable energy use from artificial lighting. The requirements only apply to artificial lights that are permanently installed.

To produce the same light output, different lighting systems use different amounts of energy. The NCC requirements recognise lighting systems that use technology such as timers or dimmers to reduce energy consumption.

Apart from clause numbering, the DTS Provisions for artificial lighting are unchanged for NCC 2022 when compared to NCC 2019.

The artificial lighting requirements consist of 6 main subclauses. A summary of the key requirements of these subclauses is in Table 3.12.

To assist determining compliance, a Lighting Calculator is available that automates the calculations required. The Lighting Calculator is available from Resource Library on the [ABCB website](#).

Table 3.12 Key requirements for artificial lighting

13.7.6 subclause reference	Key requirements
(1) Allowances	<ul style="list-style-type: none"> • Lamp power density or illumination power density allowances: <ul style="list-style-type: none"> - less than or equal to 5 W/m² in a house - less than or equal to 4 W/m² on a verandah or balcony - less than or equal to 3 W/m² in a garage, shed or carport that is associated with a house.
(2) Options to increase the allowance	<ul style="list-style-type: none"> • The illumination power density allowance in (1) can be increased by using a control device in (6) • Recognises energy saving technologies/devices.
(3) Power of proposed installation	<ul style="list-style-type: none"> • The power of the proposed installation must be used rather than nominal allowances of complete light fittings. • The intent is to ensure the installed system is the same as the proposed compliant installation.
(4) Halogen lamps	<ul style="list-style-type: none"> • Halogen lights must be separately switched from fluorescent lights, as halogen lights consume more energy.
(5) Perimeter lighting	<ul style="list-style-type: none"> • Artificial perimeter lighting must be controlled by a daylight sensor and have an average light source efficacy greater than or equal to 40 Lumens/W.
(6) Illumination power density adjustment factors	<ul style="list-style-type: none"> • Illumination power density adjustment factors are provided for a range of control devices including: <ul style="list-style-type: none"> - lighting timers - motion detectors - manual, programmable, dynamic and fixed dimming systems - daylight sensors. • The adjustment factors above can increase the illumination power density allowance in (1).

Subclauses (7) to (11) of 13.7.6 contain additional requirements when certain control devices are used in subclause (6). See the Housing Provisions for more information.

Water heater in a heated water supply system

Clause 13.7.7 of the Housing Provisions provides a cross-reference to the requirements for a water heater in a heated water supply system. Prior to the Housing Provisions being introduced this cross-reference was in NCC Volume Two. These requirements are now located in Part B2 of NCC Volume Three – the Plumbing Code of Australia (PCA).

The following figure illustrates where the requirements for a water heater in a heated water supply system are now located in the NCC and the relevant cross-references.

Figure 3.6 Water heater in a heated water supply system



There were minor changes to the requirements for a water heater in a heated water supply system in Part B2 of NCC Volume Three for NCC 2022. The main change is the amount of Small-scale Technology Certificates (STCs) required has been updated.

This is a result of changes to the relevant standard AS/NZS 4234 Heated water systems – calculation of energy consumption and the expanded Performance Requirement H6P2 Energy usage.

Alert

State and territory plumbing legislation may already require compliance with certain plumbing and drainage standards irrespective of the NCC requirements.

Swimming pool heating and pumping

Clause 13.7.8 aims to limit energy consumption associated with swimming pools.

To achieve this, when a swimming pool is intended to be heated, one or more of the following need to be used:

- a solar heater not boosted by electric resistance heating
- a heater using reclaimed energy
- a gas heater
- a heat pump.

When a heat pump or gas heater is used, there are 2 additional requirements:

- (1) The swimming pool must have a pool cover with a minimum R-Value of 0.05, unless in a conditioned space.
- (2) A time switch to control the operation of the heater.

In addition, a time switch is required for all swimming pools to control the operation of the circulation pump.

Spa pool heating and pumping

Clause 13.7.9 aims to limit energy consumption associated with spas.

When a spa is intended to be heated and shares water reticulation with a swimming pool, one or more of the following need to be used:

- a solar heater not boosted by electric resistance heating
- a heater using reclaimed energy
- a gas heater
- a heat pump.

When a heat pump or gas heater is used there are 3 additional requirements:

- (1) The spa must have a spa cover.
- (2) A push button and a time switch are required to operate the heater.
- (3) A time switch must be provided to control the operation of a circulation pump. This applies when a spa has a capacity of more than 680 L.

3.3 Useful tips

3.3.1 Thermal ratings and WOH ratings

Reminder

The NatHERS compliance option now includes 2 ratings: a thermal rating and a WOH rating.

A thermal rating assesses the thermal performance (heating and cooling loads) of a proposed house. The results are converted to a score between 0 and 10 stars.

A WOH rating is more holistic and assesses equipment efficiencies and any offsets from on-site renewable energy of a proposed house. A WOH rating also includes the thermal performance assessment (i.e. star rating) of the proposed house. The results are converted to a score between 1 and 100.

- Thermal ratings and WOH ratings are conducted by a NatHERS assessor. Note some jurisdictions only permit accredited assessors to undertake ratings.
- To assist compliance with the thermal rating and WOH rating requirements, NatHERS have developed a range of education and support materials. These are available from the [NatHERS website](#) and include the following:
 - Top tips for building for 7 stars
 - Using NatHERS to pass the energy efficiency requirements of the NCC
 - NatHERS FAQs
 - NatHERS Technical Notes (for assessors)
 - NatHERS Assessor Handbook (for assessors)
 - NatHERS Whole of Home Guidance Note (for assessors).
- Further information and resources will continue to be developed and released by the NatHERS Administrator, software tool providers and Assessor Accrediting Organisations (AAOs).
- The calculations used in NatHERS software tools are based on scientific research by the CSIRO.

3.3.2 Heating and cooling load limits

- The heating and cooling load limits are specified in the ABCB Standard for NatHERS Heating and Cooling Load Limits (2022), which is available from the [ABCB website](#).

3.3.3 Additional fabric DTS Provisions

- In addition to a thermal rating, the selection and installation of reflective and bulk insulation must meet other NCC requirements such as Part 10.8 Condensation management in the Housing Provisions.
- Guidance on installing bulk insulation in houses is in the Australian Standard AS 3999: Bulk thermal insulation – Installation.
- The effects of thermal bridging are accounted for in NatHERS software. This means there are no additional thermal bridging requirements when using this compliance option.
- Despite NatHERS software accounting for thermal bridging, the thermal break requirements of subclauses 13.2.3(7) and 13.2.5(5) of the Housing Provisions still need to be met, where applicable.
- Reflective insulation alone is not suitable for use as a thermal break since it requires an adjoining airspace to achieve its specified R-Value.

3.3.4 Building sealing

- Air leakage most commonly occurs at the:
 - roof/ceiling to wall junction
 - floor to wall junction
 - wall to door frame junction
 - wall to window frame junction
 - all services penetrations.
- In addition to the sealing requirements for chimneys and flues, Clause H7D5 of NCC Volume Two contains fire safety requirements that also need to be met.
- For exhaust fans, a simple flap damper system can fulfil the minimum requirements. These are readily available for most fan types.
- In subclause 13.4.6(2) that covers the construction of ceilings, walls and floors, the term ‘close-fitting’ is used, but what does this term mean? Since doors and windows require a compressible seal, it would not be acceptable to have visible gaps surrounding the window or door unit. Therefore, a reasonable interpretation of ‘close fitting’ could be a gap less than that between the compressible seal of a closed window or door and the associated frame.

3.3.5 Services

- For central heating water piping, Clause 13.7.3 requires more insulation for pipework in locations which are more exposed to external environmental conditions. Pipework location

- is described as located outside the building (4), within a part of the structure that is ventilated (3) or internal (2).
- Ductwork insulation needs to be protected from the effects of weather as required by subclause 13.7.4(2). This can be achieved with an outer protective sleeve to prevent the insulation becoming damp and sealing the outer protective sleeve with an adhesive tape (minimum width 48 mm).
 - For water heaters in a heated water supply system, there are two compliance pathways for solar and heat pump water heaters. These are as follows:
 - Obtain the required number of STCs.
 - Comply with the specified energy saving in accordance with AS/NZS 4234.
 - See NCC Volume Three for more information on the requirements for water heaters in a heated water supply system.

3.4 Demonstrating compliance

3.4.1 Assessment Methods for DTS Solutions

An overview of how to comply with the NCC is in Appendix C of this document. Further guidance is available from the [ABCB website](#).

The DTS Provisions that form the NatHERS compliance option are used to demonstrate NCC compliance using a DTS Solution. A2G3(2) sets out the following Assessment Methods as being suitable for demonstrating compliance for DTS Solutions:

- Evidence of suitability (NCC Clauses A2G2, A2G3, A5G1 to A5G4).
- Expert Judgement (NCC Clauses A2G2 and A2G3 of the NCC).

Due to the nature of NatHERS software, evidence of suitability is the appropriate Assessment Method for demonstrating compliance of a DTS Solution using NatHERS. This is outlined in section 3.4.2 and 3.4.3.

3.4.2 Evidence of suitability

Evidence of suitability, also known as 'documentary evidence', can generally be used to support that a material, product, form of construction or design satisfies a DTS Provision. Subject to certain NCC provisions, the form of evidence that may be used consists of one, or a combination, of the following:

- A report from an Accredited Testing Laboratory.
- A Certificate of Conformity or a Certificate of Accreditation.

- A certificate from a professional engineer or appropriately qualified person.
- A current certificate issued by a product certification body that has been accredited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).
- Any other form of documentary evidence that adequately demonstrates suitability such as a Product Technical Statement.

More information on this Assessment Method is available in the ABCB Evidence of Suitability Handbook which is available from the [ABCB website](#).

In relation to housing energy efficiency, individual jurisdictions may have issued directions or notices specifying what documentary evidence is considered acceptable to demonstrate compliance.

The NCC contains limitations on the application and use of evidence of suitability in certain circumstances. One of those circumstances is where compliance with the NCC housing energy efficiency Performance Requirements is demonstrated using NatHERS. See 3.4.3 below.

3.4.3 NatHERS certificate

Compared to NCC 2019, NCC 2022 requires specific documentary evidence when the NatHERS DTS compliance option is used. See NCC Clause A5G9.

The evidence of suitability must be in the form of a NatHERS certificate issued in accordance with NatHERS. NatHERS has developed further guidance on NatHERS Certificates which is available from the [NatHERS website](#).

3.5 Examples

- To assist with complying with the thermal rating requirement, the NatHERS Administrator has developed worked examples, available from the [NatHERS website](#).
- To assist complying with the heating and cooling load limit requirements of S42C2(1), an example is in Appendix D.1.
- To assist complying with the artificial lighting requirements of Clause 13.7.6, an example is in Appendix D.6

4 Compliance option 2 - Elemental

4.1 Introduction

The Elemental compliance option is a set of DTS Provisions that can be used to meet both housing energy efficiency Performance Requirements i.e. H6P1 Thermal performance and H6P2 Energy usage.

The DTS Provisions that form the Elemental compliance option are used to demonstrate NCC compliance using a DTS Solution. See Appendix C for more information on how to comply with the NCC.

This compliance option is in the DTS Provisions of NCC Volume Two clauses H6D2(1)(b) and H6D2(2)(b) and references the Housing Provisions.

Compared to NCC 2019, there are 5 main changes to this compliance option for NCC 2022. These are:

- (1) Changes to the clause numbering due to the CVS.
- (2) An increase in stringency to the minimum level of thermal performance for each part of a proposed house²⁰.
- (3) Introduction of Part 13.6 Whole-of-home²¹ (WOH) energy usage to meet the expanded Performance Requirement H6P2 Energy usage.
- (4) Changes to better address thermal bridging.
- (5) Relocation of the DTS Provisions from NCC Volume Two to the new Housing Provisions.

Alert

Figure 2.2 and Table 2.1 in Chapter 2 provides a simplified overview of compliance options, noting a combination of DTS Solutions is permitted. For example NatHERS could be used to meet H6P1 and the Elemental provisions used to meet H6P2.

²⁰ The increase in stringency aligned with 7 stars thermal performance using NatHERS software. To achieve more alignment of the DTS Elemental compliance option to the DTS NatHERS compliance option, changes to some of the calculation methodologies were needed. These are outlined in section 4.3 Useful tips.

²¹ Note NatHERS uses 'Whole of Home' (no hyphens, upper case 'H' for home) for its WOH software tools, whereas the NCC uses 'Whole-of-home' (hyphens, lower case 'h' for home). Both NatHERS and the NCC use the same abbreviation which is 'WOH'.

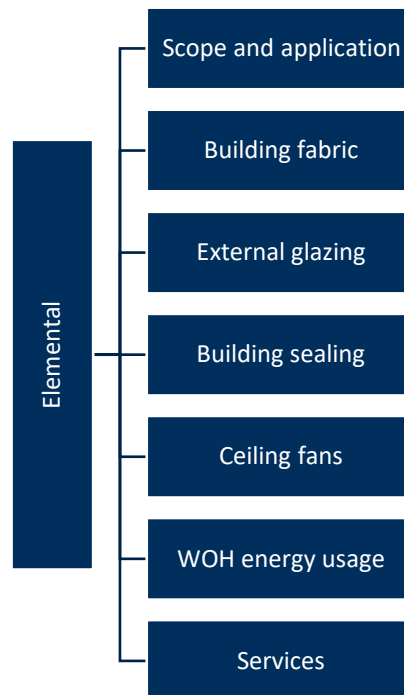
4.2 Method

The intent of this method is to provide a step-by-step approach to comply with the housing energy efficiency Performance Requirements. To do this, the method requires each element or part of a proposed house to meet a minimum level of thermal performance or efficiency. For example, the floors, walls, glazing, roof and ceiling.

These requirements are specified in the DTS Provisions and when followed in their entirety form a DTS Solution i.e. deemed-to-meet the housing energy efficiency Performance Requirements.

Figure 4.1 outlines the relevant DTS Provisions that form the Elemental compliance option. The DTS Provisions are in Section 13 of the Housing Provisions.

Figure 4.1 Elemental compliance option



Each section of this Chapter provides further guidance on the DTS Provisions outlined in Figure 4.1.

4.2.1 Scope and application

Part 13.1 specifies the scope and application of the DTS Provisions. The scope or extent of the DTS Provisions is outlined in Figure 4.1.

To achieve the intended outcome, the DTS Provisions must be applied in accordance with:

- (1) The Governing Requirements.
- (2) Any state and territory variations, additions and deletions.

4.2.2 Building fabric

Part 13.2 Building fabric contains the relevant DTS Provisions for the minimum thermal performance of the opaque parts of the envelope of a house (i.e. walls, floor and roof), and any skylights (roof lights).

Within Part 13.2 Building fabric, there are several clauses that need to be met, arranged by building element. These are outlined in Table 4.1 and discussed in the following sections.

Table 4.1 Building fabric clauses

Building element	Clause reference
Application	13.2.1
Building fabric thermal insulation	13.2.2
Roofs and ceilings	13.2.3
Roof lights	13.2.4
External walls	13.2.5
Floors and subfloor walls	13.2.6
Attached garages/sheds/carports	13.2.7

Application

Clause 13.2.1 specifies the DTS Provisions for the building fabric apply to:

- all houses, and
- a garage, shed or carport where it has a conditioned space.

The only exception is the DTS Provisions in Clause 13.2.7. These DTS Provisions apply to a garage, shed or carport attached to a house, regardless of whether it has a conditioned space.

Building fabric thermal insulation

Clause 13.2.2 aims to ensure that when insulation, either bulk or reflective, is installed it –

- thermally performs as intended, and
- does not interfere with the safety or performance of plumbing or electrical components.

The building fabric thermal insulation requirements consists of 3 main subclauses. A summary of the key requirements of these subclauses is in Table 4.2.

Table 4.2 Key requirements for building fabric thermal insulation

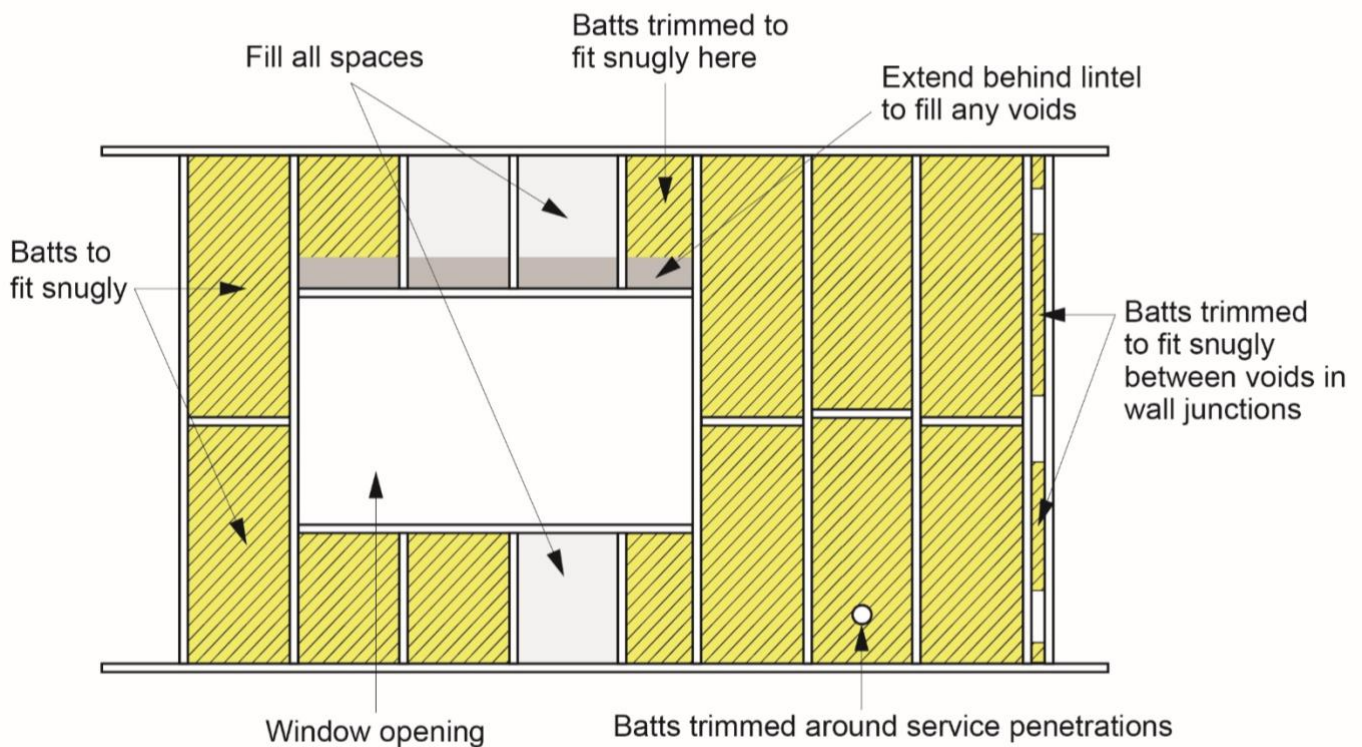
Clause 13.2.2 reference	Key requirements
(1) Integrity of the insulation	<ul style="list-style-type: none"> • Meets AS/NZS 4859.1 Materials for the thermal insulation of buildings • Adjoins or overlaps to form a consistent and continuous thermal barrier, except at supporting studs and noggins etc. • ‘Consistent and continuous’ insulation means filling any voids in the framing unless a gap is otherwise required. Voids may include between window and door jambs, surrounding lintels, and voids in intersecting walls • Does not affect the safe or effective operation of any plumbing or electrical component
(2) Installation of reflective insulation	<ul style="list-style-type: none"> • Necessary airspace²² between the reflective side of insulation and lining/cladding • Closely fits against any penetration and adequately supported by framing • Installed so there is no air leakage across the reflective insulation • Adjoining sheets must overlap or be taped
(3) Installation of bulk insulation	<ul style="list-style-type: none"> • Maintains its position and thickness, except where it crosses roof battens, water pipes etc. • Ceiling insulation must overlap the external wall by greater than or equal to 50 mm. This only applies when there is no insulation in the external wall below.

AS/NZS 4859.1 specifies the testing criteria for insulation, including both reflective and bulk insulation. In broad terms, this standard requires the manufacturer test its products using a specified method and then provide a data sheet. A data sheet typically explains the thermal performance and the installation requirements for the product that should be followed.

See Figure 4.2 for an illustration of installing bulk insulation in walls.

²² The width of the airspace will vary depending on the type of reflective insulation and the R-Value to be achieved.

Figure 4.2 Installing bulk insulation in framed walls



Alert

When determining the location of the bulk and reflective insulation, careful consideration should be given to avoid possible condensation forming inside the layers of the building envelope particularly in certain climates and where there are high concentrations of water vapour.

The NCC contains mandatory requirements for condensation and water vapour management for houses. See NCC Volume Two and the Housing Provisions for more information.

The ABCB has also produced a handbook, *Condensation in Buildings*, to assist in understanding condensation risk and the requirements contained in the NCC. The handbook can be accessed from the [ABCB website](http://www.abcb.gov.au).

Roofs and ceilings

Clause 13.2.3 provides the minimum thermal performance requirements for roofs and ceilings.

For NCC 2022, the method to determine the thermal performance of roofs and ceilings has changed. The main change is the Total R-Value of a roof and ceiling does not need to be calculated to demonstrate compliance in most instances.

Instead, the requirements primarily specify a minimum R-Value for ceiling insulation based on a range of factors such as roof construction (flat, cathedral etc.) and whether the roof is ventilated.

These changes were made to recognise roof and ceiling construction elements and combinations that are better suited to the climate they are to be constructed in. i.e. these elements and combinations are rewarded with lower specifications, and still achieve a thermal rating equivalence to NatHERS of 7 stars.

In addition, there are new requirements to mitigate thermal bridging. The requirements for roofs and ceilings are summarised in Table 4.3 and discussed in more detail in the useful tips section of this chapter, see 4.3.1.

Alert: What is thermal bridging?

Thermal bridging, in practical terms for the NCC, is an unintended path of heat flow between the outside and inside of the building envelope. Thermal bridges may occur where there is an interruption in the insulation or where highly conductive materials (e.g. metal) are used. See the Glossary in Appendix B for more information.

The roof and ceiling requirements consist of 10 main subclauses. A summary of the key requirements of these subclauses is in Table 4.3.

Table 4.3 Key requirements for roof and ceilings

Clause 13.2.3 reference	Key requirements
(1) Roof and ceiling insulation	<ul style="list-style-type: none"> • Minimum R-Values for insulation are specified in a range of look-up tables (Tables 13.2.3a to 13.2.3r) • The look-up tables provide several variables including the following: <ul style="list-style-type: none"> - roof ventilation (vented or standard) - location and performance of reflection insulation - solar absorptance - roof construction - climate zone.

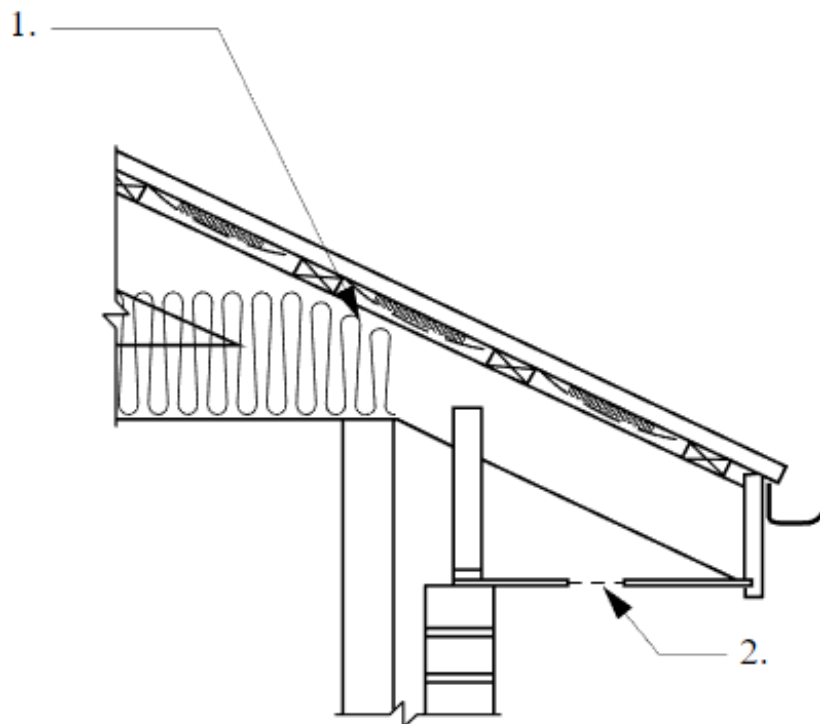
Clause 13.2.3 reference	Key requirements
(2) Reflective insulation	<ul style="list-style-type: none"> • Must have surface emittance of less than or equal to 0.05 • Must face downwards in climate zones 3 to 8 • Must face an airspace of at least 20 mm. An example is shown in Figure 4.3.
(3) Thermal bridging	<ul style="list-style-type: none"> • Options for pitched roof with a horizontal ceiling: <ul style="list-style-type: none"> - achieve Total R-Value in Table 13.2.3s using a method that can account for thermal bridging - increase R-Value required by (1) by R0.5 - adding a continuous ceiling insulation layer of at least R0.13 - stacking 2 layers of insulation on top of each other²³ • Options for a flat, skillion or cathedral roof: <ul style="list-style-type: none"> - achieve Total R-Value in Table 13.2.3t using a method that can account for thermal bridging - comply with Table 13.2.3u.
(4) Condensation consideration due to thermal bridging	<ul style="list-style-type: none"> • Continuous insulation placed above the innermost insulation layer must have a vapour permeance greater than or equal to the innermost insulation layer • Only applies when Clause 10.8.3(1) applies
(5) Compensation for loss of ceiling insulation	<ul style="list-style-type: none"> • When the area of the ceiling insulation is reduced due to penetrations, the insulation must be increased by complying with Table 13.2.3w
(6) Edge insulation options	<ul style="list-style-type: none"> • Applies to attic roofs to maintain sufficient clearance of edge insulation within 450 mm of wall²⁴ • When ceiling insulation required by (1) – (5) is greater than R3.0 and less than R4.5, edge insulation can be reduced to R3.0 • When ceiling insulation required by (1) – (5) is greater than R4.5, edge insulation can be reduced to R3.0 provided the ceiling insulation is increased by R0.5.

²³ The second layer of insulation will cover the ceiling framing members.

²⁴ If there is sufficient clearance for the insulation within 450 mm of the wall, then this clause does not apply.

Clause 13.2.3 reference	Key requirements
(7) Thermal break	<ul style="list-style-type: none"> Applies to some metal roof combinations. Figure 4.4 provides an example. Requires a thermal break greater than or equal to R0.2
(8) Exclusion for insulated sandwich panels	<ul style="list-style-type: none"> Requirements of 13.2.3(1) – 13.2.3(7) do not apply
(9) Insulated sandwich panels	<ul style="list-style-type: none"> Total R-Value in Table 13.2.3x must be achieved
(10) Roof solar absorptance limit	<ul style="list-style-type: none"> Applies in climate zones 1 to 5 Requires the solar absorptance of upper surface of roof less than or equal to R0.64

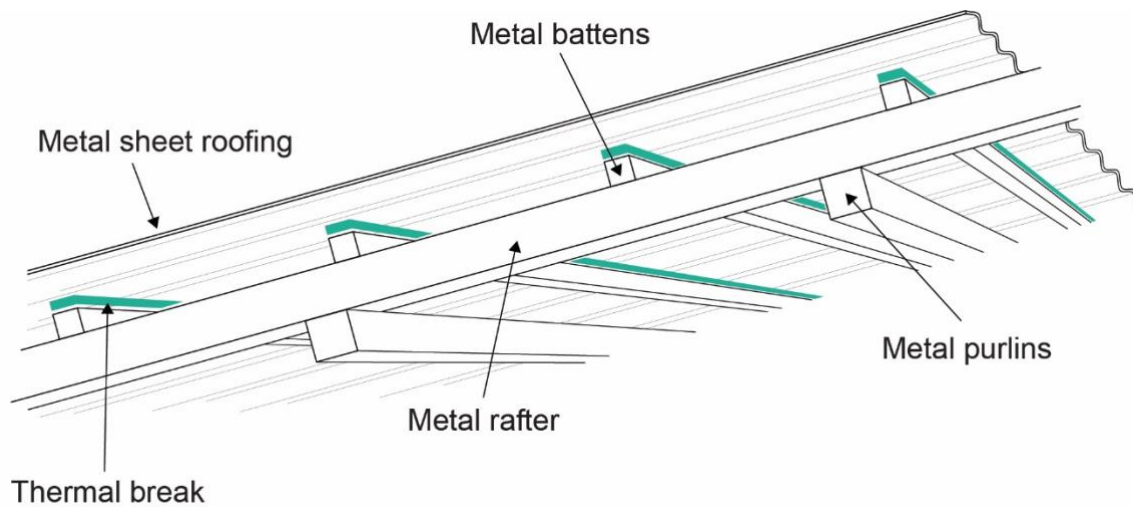
Figure 4.3 Example of required airspace for reflective insulation (Explanatory Figure 10.8.3 of the Housing Provisions)



Notes to Figure 4.3:

- (1) Minimum 20 mm airspace maintained for the reflective insulation as required by subclause 13.2.3(2).
- (2) Eave ventilation opening in accordance with Table 10.8.3 of the Housing Provisions (for condensation management where required).

Figure 4.4 Example of roof thermal break construction



Alert

An important issue for roof design, especially in cooler climates where insulation with higher R-Values is required, will be to ensure that the roof structure has sufficient space to accommodate the insulation without the insulation being compressed. Any compression of the insulation will reduce its R-Value and consequently the effectiveness of the insulation.

Roof lights

Clause 13.2.4 provides the minimum thermal performance requirements for roof lights (skylights).

For NCC 2022 the provisions are based on a maximum area of roof lights as a percentage of the floor area of the room or space the roof lights serve. This aligns with the approach used in NCC Volume One for commercial buildings.

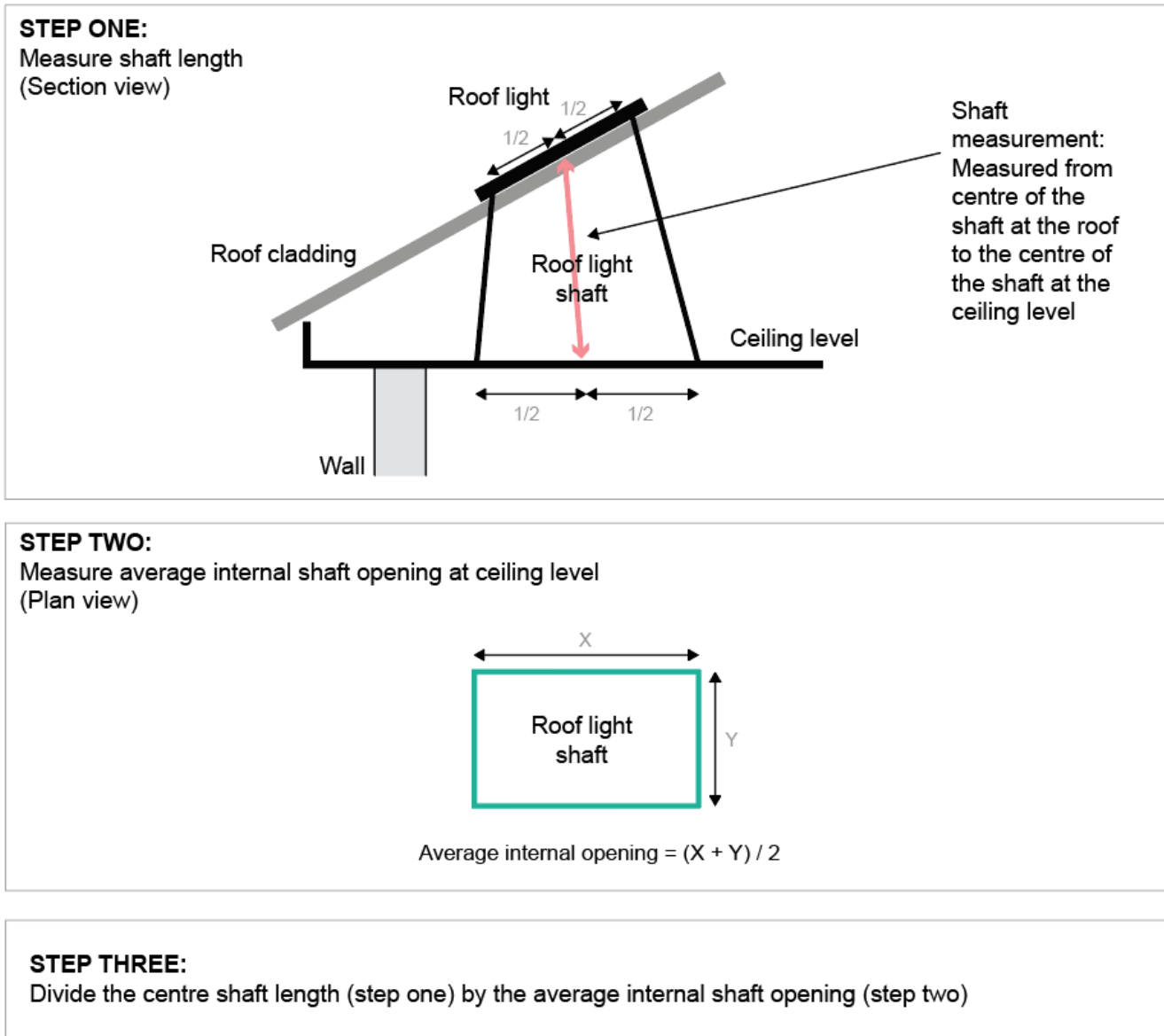
The roof light requirements consist of 2 subclauses. A summary of the key requirements of these subclauses is in Table 4.4.

Table 4.4 Key requirements for roof lights

13.2.4 subclause reference	Key requirements
(a) Maximum area	<ul style="list-style-type: none"> Less than or equal to 5% of the floor area of the room or space the roof light serves
(b) Thermal performance	<ul style="list-style-type: none"> Transparent and translucent elements of roof lights: <ul style="list-style-type: none"> - achieve Total System SHGC in Table 13.2.4 - maximum Total System U-Value of U3.9

13.2.4 subclause reference	Key requirements
	<ul style="list-style-type: none"> - requires calculation of roof light shaft index (See Figure 4.5)

Figure 4.5 Determining the roof light shaft index



External walls

Clause 13.2.5 provides the minimum thermal performance requirements for external walls.

For NCC 2022, the method to determine the thermal performance of walls has changed. The main change is the total R-Value of an external wall does not need to be calculated to demonstrate compliance in most instances.

Instead, the requirements primarily specify a minimum R-Value for wall insulation based on a range of factors such as wall height, shading and wall construction (concrete block, lightweight, masonry cavity etc.).

Like roofs and ceilings, these changes were made to recognise wall construction elements and combinations that are better suited to the climate they are to be constructed in. i.e. these elements and combinations are rewarded with lower specifications, and still achieve a thermal rating equivalence to NatHERS of 7 stars.

In addition, there are new requirements to mitigate thermal bridging²⁵. The requirements for external walls are summarised in Table 4.5 and discussed in more detail in the useful tips section of this chapter, see 4.3.1.

The external wall requirements consist of 6 main subclauses. A summary of the key requirements of these subclauses is in Table 4.5.

Table 4.5 Key requirements for external walls

13.2.5 subclause reference	Key requirements
(1) and (2) Wall insulation	<ul style="list-style-type: none"> • Minimum R-Values for insulation are specified in a range of look-up tables (Tables 13.2.5a to 13.2.5o) • The look-up tables provide several variables, including the following: <ul style="list-style-type: none"> - wall height - wall construction - solar absorptance - location, and performance of reflective insulation - shading by overhangs - number of storeys - climate zone. • (1) does not apply to the external wall of a sub-floor space that is below a suspended floor.
(3) Solar absorptance	<ul style="list-style-type: none"> • Applies in climate zones 1 to 5 • Solar absorptance of outer surface of a wall in (1) or (2) less than or equal to 0.7

²⁵ See the definition of 'thermal bridging' in the Glossary in Appendix B for more information.

13.2.5 subclause reference	Key requirements
(4) Thermal bridging	<ul style="list-style-type: none"> • Available compliance options are based on the following: <ul style="list-style-type: none"> - type of wall construction - R-Value of insulation required by (1) or (2) - adding additional bulk and/or reflective insulation • <u>Option 1</u>: Achieve Total R-Value in Tables 13.2.5p to 13.2.5r using the methods in AS/NZS 4859.2 • <u>Option 2</u>: Comply with 1 of the options in Tables 13.2.5s to 13.2.5u.
(5) Thermal break	<ul style="list-style-type: none"> • Applies to some metal framed wall combinations, • Figure 4.6 provides an example. • Requires a thermal break greater than or equal to R0.2
(6) Exclusion for insulated sandwich panels	<ul style="list-style-type: none"> • The requirements of (5) do not apply

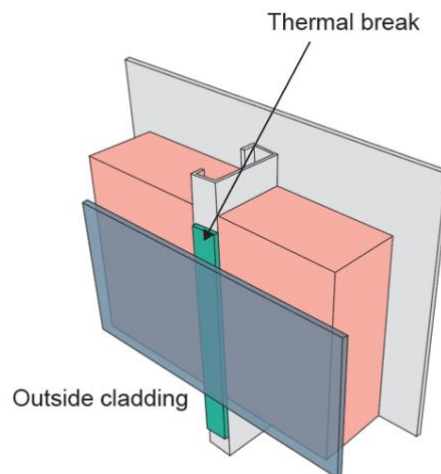
Alerts

The Table Notes under the tables for external walls that are referenced in Clause 13.2.5 need to read and applied in conjunction with the information contained in the tables. For example, Table Note (5) under Table 13.2.5a (referenced in subclause 13.2.5(1)) states the following:

“This table shows wall heights for single storey dwellings. For two storey (or more) dwellings with a wall height up to 2.4 m, add R0.5 to the R-Values given in this Table. For two storey (or more) dwellings with a wall height greater than 2.4 m, add R1.0.”

The requirement for a thermal break has not changed for NCC 2022. The new thermal bridging requirements in 13.2.5(4) need to be met in addition to the existing thermal break requirements, where required.

Figure 4.6 Example of wall thermal break construction



Alert

Care should be taken to ensure the selection and installation of bulk and reflective insulation products to meet the requirements of 13.2.5 in the ABCB Housing Provisions, also meet other necessary requirements of the ABCB Housing Provisions. For example, the Condensation management requirements of Part 10.8.

Floors and subfloor walls

Clause 13.2.6 provides the minimum thermal performance required for floors and subfloor walls.

For NCC 2022, the method to determine the thermal performance of floors has changed. The main change is the total R-Value of a floor does not need to be calculated to demonstrate compliance in most instances.

Instead, the requirements primarily specify a minimum R-Value for floor insulation based on factors such as the inclusion of reflective insulation and whether the subfloor space is enclosed.

These changes were made to recognise floor and subfloor wall insulation combinations that are better suited to the climate they are to be constructed in. i.e. these elements and combinations are rewarded with lower specifications, and still achieve a thermal rating equivalence to NatHERS of 7 stars.

In addition, there are new requirements to mitigate thermal bridging²⁶. The requirements for floors and subfloor walls are summarised in Table 4.6 and discussed in more detail in the Useful tips section of this chapter, see 4.3.1.

The floor and subfloor wall requirements consist of 7 main subclauses. A summary of the key requirements of these subclauses is in Table 4.6.

Table 4.6 Key requirements for floors and subfloor walls

13.2.6 subclause reference	Key requirements
(1) Floor insulation	<ul style="list-style-type: none"> Applies to floors over an <u>unenclosed</u> space. Minimum R-Values of floor insulation is specified in Table 13.2.6a.

²⁶ See the definition of 'thermal bridging' in the Glossary in Appendix B for more information.

13.2.6 subclause reference	Key requirements
(2) Floor and subfloor insulation	<ul style="list-style-type: none"> • Applies to floors over an <u>enclosed</u> space • Specifies insulation requirement for floors and subfloor walls • Minimum R-Values for insulation are specified in a range of look-up tables (Tables 13.2.3b to 13.2.3h)²⁷ • The look-up tables provide several variables including the following: <ul style="list-style-type: none"> - insulation R-Value of subfloor wall or suspended floor - height of subfloor wall²⁸ - location and performance of reflection insulation - direction of heat flow²⁹ - climate zone.
(3) Thermal bridging	<ul style="list-style-type: none"> • Option 1: Achieve Total R-Value in Table 13.2.6i using a method that can account for thermal bridging • Option 2: Achieve Total R-Value in Table 13.2.6i using AS/NZS 4859.2 • Option 3: Comply with Table 13.2.6j.
(4) CSOG insulation	<ul style="list-style-type: none"> • Applies to CSOG floors that have an in-slab or in-screed heating or cooling system • Requires insulation with additional R-Value greater than or equal to R1.0 installed around the vertical edge of its perimeter.

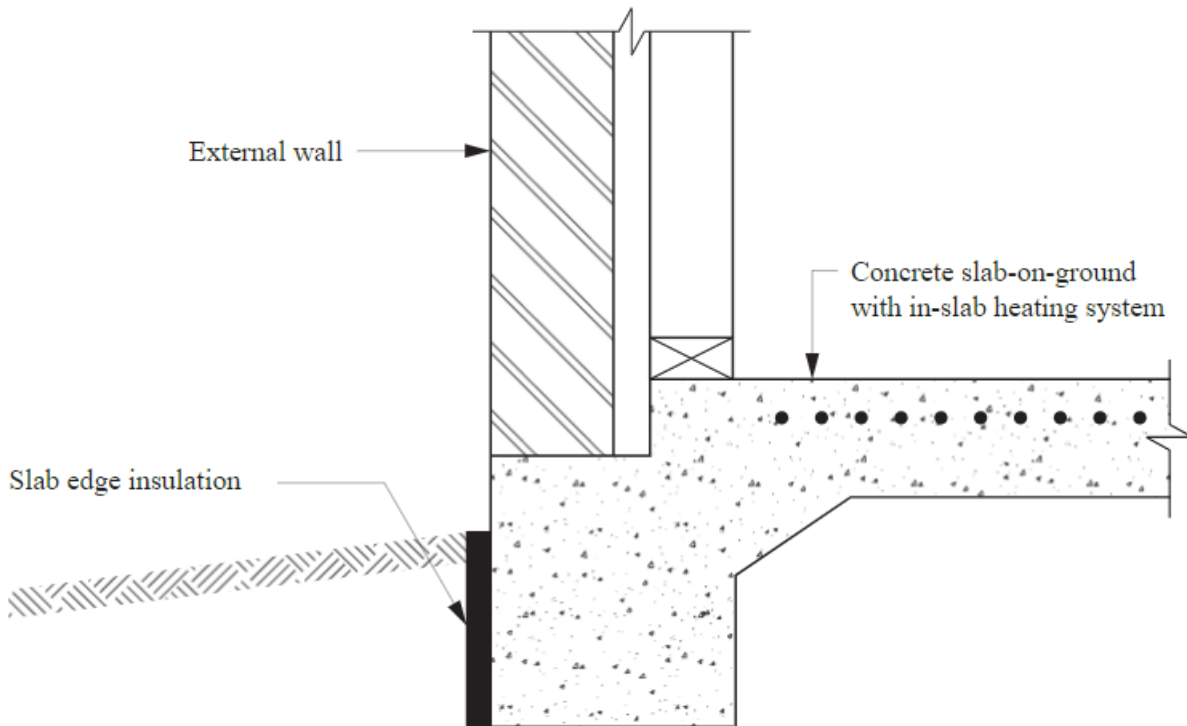
²⁷ Except for climate zone 1, where subfloor insulation with an R-Value = 1.5 is required.

²⁸ The DTS Provisions cover scenarios with a subfloor height up to 1800 mm. For subfloors with a height greater than 1800mm another compliance option must be used. See section 2.4 for other options.

²⁹ The direction of heat flow is relevant when (3) is being met for a floor with steel framing.

13.2.6 subclause reference	Key requirements
(5) Edge and under slab insulation	<ul style="list-style-type: none"> • Waffle-pod slabs are exempt from the requirements of (5) in climate zones 1 to 5 • Applies to floors in climate zone 6 and 7: <ul style="list-style-type: none"> - insulation R-Value greater than or equal to 0.64 installed around the vertical edge of its perimeter - insulation R-Value greater than or equal to R0.64 installed underneath the slab • Applies to floors in climate zone 8: <ul style="list-style-type: none"> - Insulation R-Value greater than or equal to R1.0 installed around the vertical edge of its perimeter - Insulation R-Value greater than or equal to R2.0 installed underneath the slab.
(6) Insulation installation and properties	<ul style="list-style-type: none"> • Applies to insulation required by (4) and vertical edge insulation in (5) • Insulation must be installed and have the following properties: <ul style="list-style-type: none"> - Water resistant - Continuous from the ground level to a depth greater than or equal to 300mm - Continuous from the ground level for at least the full depth of the vertical edge of the CSOG • Figure 4.7 illustrates the requirements of 13.2.6(6).
(7) Exemption	<ul style="list-style-type: none"> • Requirements of (4) do not apply to an in-screed heating or cooling system used solely in a bathroom or amenity area.

Figure 4.7 Insulation of slab edge (Figure 13.2.6 of the Housing Provisions)



Attached garages

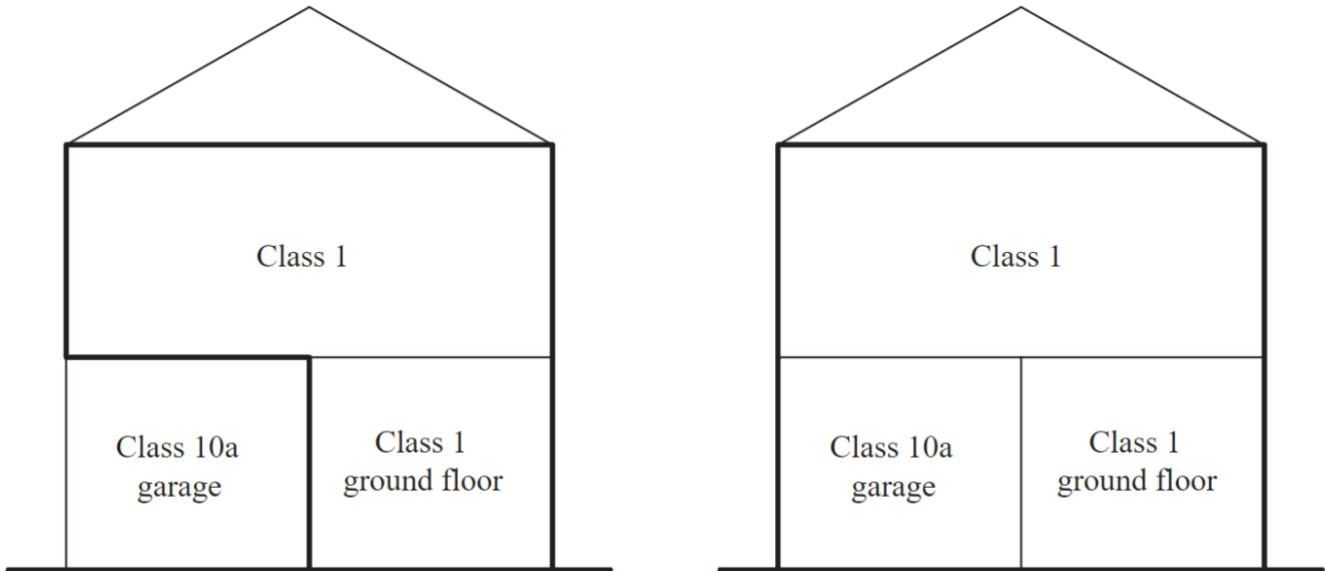
Clause 13.2.7 provides the minimum thermal performance for garages, sheds or carports that are attached to a house. The intent is an attached garage, shed or carport should not reduce the thermal performance of the house.

There are 2 options:

- (1) The external fabric of a garage, shed or carport must have a thermal performance level equal to the house
- (2) A garage, shed or carport must be separated from a house by construction equal to the thermal performance of the house.

These 2 options are shown in Figure 4.8.

Figure 4.8 Options for attached garages³⁰



Notes to Figure 4.8

The diagram to the left shows a garage that is thermally separated from the house, see 13.2.7(a). The bold line is the building envelope.

The diagram to the right shows a garage that has the same thermal performance as the house, see 13.2.7(b). The bold line is the building envelope.

4.2.3 External glazing

Part 13.3 External glazing contains the thermal performance requirements for glazing. The intent is to control unwanted heat gain and/or loss through external glazing.

For NCC 2022, the method to determine the thermal performance of external glazing has changed. In addition to the thermal performance of the glazing itself (conductance, solar heat gain and amount of shading), the requirements are now based on a larger range of factors. These include the following:

- the type of room the glazing is located
- the number of levels in the house
- floor coverings
- greater window open-ability to account for cross-ventilation

³⁰ Source: Explanatory Figure 13.2.7 of the Housing Provisions.

- solar absorptance of window frames
- greater benefits from ceiling fans, which are now required by Part 13.5 of the Housing Provisions (see section 4.2.5).

Improvements to how the requirements consider summer and winter performance have also been made.

These changes were made to better recognise designs that more effectively consider glazing. The outcomes more closely align with NatHERS software and can provide more cost-effective solutions than those available in NCC 2019.

Within Part 13.3 External glazing, there are several clauses that need to be met. These are outlined in Table 4.7 and discussed in the following sections.

To assist determining compliance, a Glazing Calculator is available that automates the calculations required. The Glazing Calculator is available from the Resource Library on the [ABCB website](#).

Table 4.7 External glazing clauses

External glazing	Clause reference
Application	13.3.1
Glazing winter performance	13.3.2
Glazing summer performance	13.3.3
Shading	13.3.4

Application

Clause 13.3.1 specifies the DTS Provisions for external glazing apply to:

- all houses, and
- a garage, shed or carport with a conditioned space.

Glazing winter performance

Clause 13.3.2 provides the minimum thermal performance for external glazing in winter and consists of 3 subclauses.

A summary of the key requirements of these subclauses is in Table 4.8.

Table 4.8 Key requirements for glazing winter performance

13.3.2 subclause reference	Key requirements
(1) Allowance and method	<ul style="list-style-type: none"> • Applies to climate zones 2 to 8³¹ • Allowance = C_U/C_{SHGC} ratios in Table 13.2.2a • For each piece of glazing in a house the C_U/C_{SHGC} ratio less than or equal to allowance • For each piece of glazing in a house³² the C_U/C_{SHGC} ratio must be determined using the method in (1)(b)³³
(2) Method inputs and their location	<ul style="list-style-type: none"> • Method inputs for each piece of glazing: <ul style="list-style-type: none"> - A = area - U = Total System U-Value - $SHGC$ = Total System $SHGC$³⁴ - E_w = winter exposure factor³⁵ - L_w = level factor (applies to floors other than ground floor) - F_w = frame factor - H_w = floor factor • Method inputs: <ul style="list-style-type: none"> - BC = bedroom conductance factor - OC = orientation sector conductance factor - R_w = room type factor - BS_w = bedroom solar heat gain factor • Location of inputs in the Housing Provisions: <ul style="list-style-type: none"> - E_w – Tables 13.3.2b to 13.3.2q - BC – Tables Table 13.3.2r - OC - Tables 13.3.2s to 13.3.2y

³¹ The requirements do not apply to climate zone 1 as there is no need for artificial or passive heating.

³² Except glazing in an attached Class 10a building.

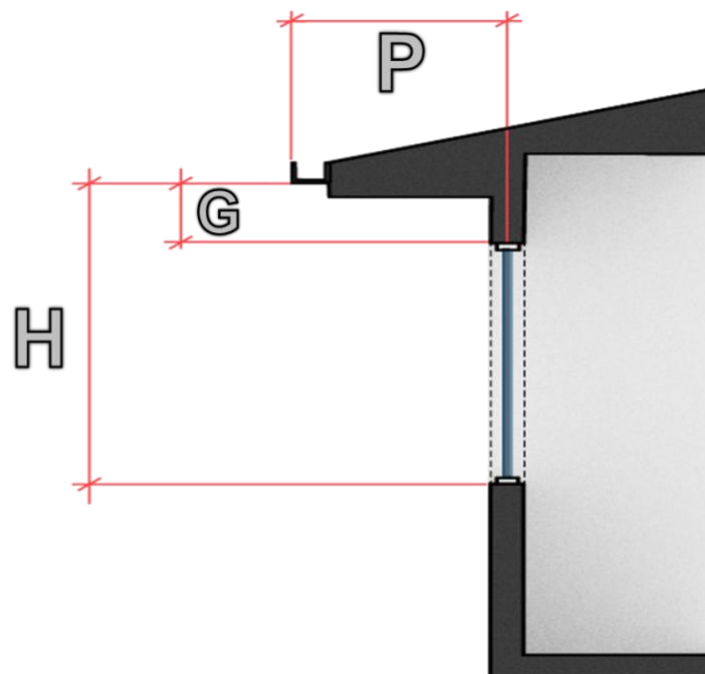
³³ See the Housing Provisions for a copy of the full method. An excerpt is shown in Appendix D.3.

³⁴ The $SHGC$ must not exceed 0.7 for any piece of glazing.

³⁵ A different E_w applies to windows adjacent to floors in direct contact with ground and other floors. The selection of E_w is for upper floors determined by the construction of the ground floor.

13.3.2 subclause reference	Key requirements
	<ul style="list-style-type: none"> - R_w, BS_w, L_w, F_w and H_w - Tables 13.3.2z to 13.3.2ag
(3) Shading	<ul style="list-style-type: none"> • Orientation sectors must use Figure 13.3.2a • The projection (P)/height (H) ratio of shading must be determined in accordance with Figure 13.3.2b. • See Figure 4.9 for an illustration.

Figure 4.9 Method of calculating P and H



Glazing summer performance

Clause 13.3.3 provides the minimum thermal performance for external glazing in summer and consists of 3 subclauses.

A summary of the key requirements of these subclauses is in Table 4.9.

Table 4.9 Key requirements for glazing summer performance

13.3.3 subclause reference	Key requirements
(1) Allowance and method	<ul style="list-style-type: none"> • Applies to climate zones 1 to 7³⁶ • Allowance = floor area of storey x C_{SHGC} from Table 13.3.3a • The combined solar heat gain from glazing in a house less than or equal to allowance • The combined solar heat gain from glazing in a house must be determined using the method in (1)(b)³⁷
(2) Method inputs and their location	<ul style="list-style-type: none"> • Method inputs for each piece of glazing: <ul style="list-style-type: none"> - A = area - SHGC = Total System SHGC³⁸ - E_S = summer exposure factor - R_S = room type factor³⁹ - L_S = level factor⁴⁰ - F_S = frame factor - H_S = floor factor • Location of inputs in the Housing Provisions: <ul style="list-style-type: none"> - E_S – Tables 13.3.3b to 13.3.3q - R_S, L_S, F_S and H_S -Tables 13.3.3r to 13.3.3y
(3) Shading	<ul style="list-style-type: none"> • Orientation sectors must use Figure 13.3.2a • The projection (P)/height (H) ratio of shading must be determined in accordance with Figure 13.3.2b. See Figure 4.9 for further information.

Shading

Clause 13.3.4 provides the shading requirements for external glazing. The requirements apply to any shading that was needed to comply with the external glazing requirements for winter or summer performance (i.e. clauses 13.3.2 and 13.3.3 that are discussed above).

³⁶ The requirements do not apply to climate zone 8 as there is no need for artificial or passive cooling.

³⁷ See the Housing Provisions for a copy of the method. An excerpt is shown in Appendix D.3.

³⁸ The SHGC must not exceed 0.7 for any piece of glazing.

³⁹ Applies to bedrooms or rooms that are not a conditioned space.

⁴⁰ Applies to floors other than ground floor.

A summary of the key requirements for shading of external glazing is in Table 4.10.

Table 4.10 Key requirements for shading external glazing

13.3.4 subclause reference	Key requirements
Option 1: Permanent shading	<ul style="list-style-type: none"> • Shading can be provided by an external permanent projection that may include any of the following: <ul style="list-style-type: none"> - verandah - balcony - fixed canopy - eaves - shading hood - carport. • Permanent shading must extend horizontally on both sides of the glazing for a distance that is greater than or equal to the projection distance P (see Figure 4.9) or provide equivalent shading with a reveal.
Option 2: Shading device	<ul style="list-style-type: none"> • Shading can be provided by an external shading device that may include any of the following: <ul style="list-style-type: none"> - shutter - blind - vertical or horizontal external screen with blades, battens or slats. • Shading devices must be able to restrict greater than or equal to 80% of summer solar radiation • An occupant of a house should be able to easily operate an adjustable shading device either manually, mechanically or electronically.

4.2.4 Building sealing

Part 13.4 Building sealing contains the relevant DTS Provisions to adequately seal parts of a house. The intent is to restrict unintended leakage of outdoor air into the house and the loss of heated and/or cooled air from the house. Unintended leakage can lead to greater heat losses or gain and therefore reduced thermal comfort of occupants and consequently, increase the use of artificial heating and/or cooling.

Within Part 13.4 Building sealing, there are several clauses that need to be met, arranged by building element. These are outlined in Table 4.11 and discussed in the following sections.

Table 4.11 Building sealing clauses

Building element	Clause reference
Application	13.4.1
Chimneys and flues	13.4.2
Roof lights	13.4.3
External windows and doors	13.4.4
Exhaust fans	13.4.5
Construction of ceilings, walls and floors	13.4.6
Evaporative coolers	13.4.7

Application

Clause 13.4.1 specifies the DTS Provisions for building sealing apply to the following:

- all houses, and
- a garage, shed or carport where it has a conditioned space.

There are 2 exemptions:

- (1) A house or garage (shed or carport) located in climate zones 1, 2, 3 and 5 that only uses evaporative cooling.
- (2) A permanent ventilation opening that is needed to ensure the safe operation of a gas appliance.

Alert:

Appropriate ventilation requirements for gas appliances can be obtained from relevant state and territory legislation, referenced standards and product installation manuals.

Chimneys and flues

Clause 13.4.2 requires a solid-fuel burning appliance (e.g. wood fireplace) to have a damper or flap on its chimney or flue so that it can be closed.

The intent of this requirement is to prevent conditioned air being drawn up the chimney or flue when the appliance is not in use.

Roof lights

Clause 13.4.3 provides the minimum sealing requirements for roof lights (skylights). The skylight sealing requirements consist of 2 subclauses.

A summary of the key requirements of these subclauses is in Table 4.12.

Table 4.12 Key requirements to seal skylights

13.4.3 subclause reference	Key requirements
(1) Application	<ul style="list-style-type: none"> • Skylights must be sealed, or capable of being sealed in the following locations: <ul style="list-style-type: none"> - A conditioned space - A habitable room in climate zones 4, 5, 6, 7 and 8.
(2) Sealing requirements	<ul style="list-style-type: none"> • Sealing can be achieved by any of the following: <ul style="list-style-type: none"> - a ceiling diffuser (no holes) - a weatherproof seal - a manual, mechanical or electronic shutter system.

External windows and doors

Clause 13.4.4 provides the minimum sealing requirements for external windows and doors. The requirements consist of 2 subclauses.

A summary of the key requirements of these subclauses is in Table 4.13.

Table 4.13 Key requirements to seal external windows and doors

13.4.4 subclause reference	Key requirements
(1) Application	<ul style="list-style-type: none"> • Applies to the following external openings: <ul style="list-style-type: none"> - external doors⁴¹ - internal doors between a house and an unconditioned garage, shed or carport - openable windows⁴² - similar openings to those listed above.

⁴¹ This only applies to an attached garage that is heated or cooled.

⁴² This only applies to an attached garage that is heated or cooled.

13.4.4 subclause reference	Key requirements
	<ul style="list-style-type: none"> Seals are needed for the following locations: <ul style="list-style-type: none"> a conditioned space a habitable room in climate zones 4, 5, 6, 7 and 8.
(2) Sealing requirements	<ul style="list-style-type: none"> A draft protection device must be used to seal the bottom edge of a door A foam or rubber compressible strip, or fibrous seal, must be used to seal the edge of doors and openable windows.
(3) Exemption	<ul style="list-style-type: none"> (2)(b) does not apply to a window that complies with the maximum air infiltration rates in AS 2047.

Exhaust fans

Clause 13.4.5 provides the minimum requirements to seal exhaust fans.

Exhaust fans must be sealed with a self-closing damper or filter when located in one of the following:

- (1) a conditioned space
- (2) a habitable room in climate zones 4, 5, 6, 7 and 8.

Construction of ceilings, walls and floors

Clause 13.4.6 provides the minimum requirements to seal ceilings, walls and floors.

The requirements consist of 2 subclauses. A summary of the key requirements of these subclauses is in Table 4.14.

Table 4.14 Key construction requirements to seal ceilings, walls and floors

13.4.6 subclause reference	Key requirements
(1) Application	<ul style="list-style-type: none"> Applies to the following components of the external fabric: <ul style="list-style-type: none"> ceilings floors window frames door frames roof light frames Seals are needed for the following locations:

13.4.6 subclause reference	Key requirements
	<ul style="list-style-type: none"> - a conditioned space - a habitable room in climate zones 4, 5, 6, 7 and 8.
(2) Construction requirements	<ul style="list-style-type: none"> • Option 1: Construction in (1) must be enclosed by internal lining systems that are close fitting for the following construction elements: <ul style="list-style-type: none"> - ceilings - walls - wall and floor junctions • Option 2: Construction in (1) must be sealed at junctions and penetrations by either of the following: <ul style="list-style-type: none"> - close-fitting architrave, skirting or cornice - expanding foam, rubber compressive strip or caulking.

Evaporative coolers

Clause 13.4.7 provides the minimum requirements to seal evaporative coolers.

Evaporative coolers must be sealed with a self-closing damper when supplying one of the following:

- (1) a heated space
- (2) a habitable room in climate zones 4, 5, 6, 7 and 8.

4.2.5 Ceiling fans

Part 13.5 Ceiling fans contains the minimum requirements for air movement using ceiling fans. Air movement assists passive cooling.

For NCC 2022, the method to specify minimum air movement has changed, by no longer considering air movement in isolation. Instead, there are minimum ceiling fan requirements and changes to the method used to calculate glazing performance (see section 4.2.3 of this document).

These changes were made to better recognise the following:

- The role that ceiling fans have in reducing the use of artificial cooling.
- Air movement benefits provided by windows with large openable areas. This is also considered in the external glazing requirements.

The changes also better align with the benefits of ceiling fans recognised through the NatHERS software tools.

The ceiling fan requirements consist of 2 main clauses. A summary of the key requirements of these subclauses is in Table 4.15.

Table 4.15 Key requirements for ceiling fans

Part 13.5 reference	Key requirements
Clause 13.5.1 Application	<ul style="list-style-type: none"> Applies to the habitable rooms of a house.
Clause 13.5.2 Ceiling fans	<ul style="list-style-type: none"> Required in climate zones 1, 2, 3 and 5 (Qld and NSW only) Installed in accordance with Table 13.5.2.

4.2.6 WOH energy usage

Part 13.6 WOH energy usage is new for NCC 2022. The intent is to reduce the energy use of a new house. The requirements holistically consider:

- (1) the efficiency of fixed⁴³ energy-using equipment, such as heating and cooling equipment, heated water, lighting, and pool and spa pumps and
- (2) on-site renewable energy generating systems, such as rooftop solar photovoltaics (PV).

By using an ‘annual energy use allowance’, the WOH energy usage requirements allow trading between the efficiency of energy-using equipment, as well as off-setting through energy generated onsite. Together, this approach allows flexibility and enables cost-effective solutions to reduce overall energy consumption.

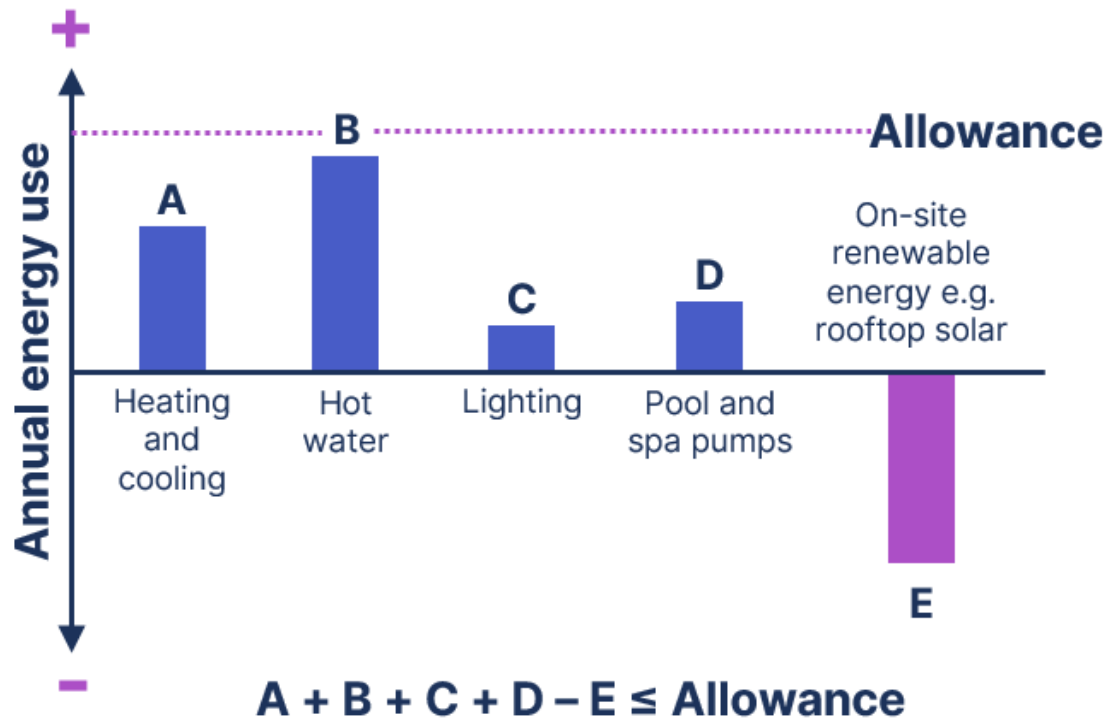
Alert

The DTS Provisions for WOH energy usage in Part 13.6 and the DTS Provisions for Services in Part 13.7 both contain requirements for a house’s domestic services and both parts need to be met. This should be considered during the selection of the domestic services, including the size of any on-site renewable energy such as rooftop solar PV and heated water service.

Figure 4.10 shows an illustration of the annual energy use allowance approach used in the WOH energy usage requirements.

⁴³ Portable appliances and equipment are excluded.

Figure 4.10 Annual energy use allowance approach



Within Part 13.6 WOH energy usage, there are 2 clauses that need to be met. These are discussed in the following sections.

To assist determining compliance, a calculator is available that automates the calculations required. The Whole-of-home calculator is available from the [ABCBC website](#).

Application

The DTS Provisions for WOH energy usage apply to the following:

- all houses
- garages, sheds and carports with a conditioned space.

In addition, the DTS Provisions for WOH energy usage can only be used for buildings that have a total floor area less than or equal to 500 m². For houses with a floor area greater than 500 m², another compliance option must be used. See section 2.4 for other options.

The application of the WOH energy usage requirements is specified in NCC Volume Two H6D2(2)(b) and Clause 13.6.1 of the Housing Provisions.

Net equivalent energy use (annual energy use)

Clause 13.6.2 provides the method to determine the annual energy use of a home and the annual energy use allowance.

The requirements consist of 3 subclauses. A summary of the key requirements of these subclauses is in Table 4.16.

Table 4.16 Key requirements for annual energy use

13.6.2 subclause reference	Key requirements
Method (1)(a) and allowance (1)(b)	<ul style="list-style-type: none"> • Method is provided in a calculation and requires the following inputs: <ul style="list-style-type: none"> - A = floor area factor - E_E = main space conditioning and main water heater efficiency factors - E_P = swimming pool pump usage - E_S = spa pump energy usage - E_R = capacity of installed on-site photovoltaics (kW) • Allowance is provided in a calculation and requires the following inputs: <ul style="list-style-type: none"> - A = floor area factor - E_F = energy factor (based on location) • Location of inputs in the Housing Provisions: <ul style="list-style-type: none"> - A – total floor area of house and Table 13.6.2a - E_E – ABCB Standard for Whole-of-Home Efficiency Factors (2022) available from the ABCBC website - E_P – see (2) - E_S = see (3) - E_F = Table 13.6.2b
Swimming pool pump energy method	<ul style="list-style-type: none"> • To determine E_P, the method requires the following inputs: <ul style="list-style-type: none"> - V = volume of swimming pool⁴⁴ - F_P = swimming pool pump factor (see Table 13.6.2c)

⁴⁴ To nearest 1000 litres

13.6.2 subclause reference	Key requirements
Spa pool pump energy method	<ul style="list-style-type: none"> To determine E_s, the method requires the following inputs: <ul style="list-style-type: none"> - V = volume of spa pool⁴⁵ - F_s = spa pool pump factor (see Table 13.6.2d)

4.2.7 Services

Part 13.7 Services contains the relevant DTS Provisions for the minimum performance of fixed services, such as artificial lighting and swimming pool heating and pumping.

Minor changes to the DTS Provisions occurred for NCC 2022 when compared to NCC 2019. These are outlined in the following in the following sections.

Within Part 13.7 Services, there are several clauses that need to be met, arranged by building type of service. These are outlined in Table 4.17 and discussed in the following sections.

Table 4.17 Services clauses

Service	Clause reference
Application	13.7.1
Insulation of services	13.7.2
Central heating water piping	13.7.3
Heating and cooling ductwork	13.7.4
Electric resistance space heating	13.7.5
Artificial lighting	13.7.6
Water heater in a heated water supply system	13.7.7
Swimming pool heating and pumping	13.7.8
Spa pool heating and pumping	13.7.9

⁴⁵ To nearest 100 litres.

Alert

The DTS Provisions for WOH energy usage in Part 13.6 and the DTS Provisions for Services in Part 13.7 both contain requirements for a house's domestic services and both parts need to be met. This should be considered during the selection of the domestic services, including the size of any on-site renewable energy such as rooftop solar PV and heated water system.

Application

Clause 13.7.1 specifies the DTS Provisions for services apply to the following:

- all houses
- all garages, sheds and carports, and
- a swimming pool that is associated with a house, garage shed or carport.

In addition, the DTS Provisions for services can only be used for buildings that have a total floor area less than or equal to 500 m². For houses with a floor area greater than 500 m², another compliance option must be used. See section 2.4 for other options.

The application of the services requirements is specified in NCC Volume Two H6D2(2)(b) and Clause 13.7.1 of the Housing Provisions.

Insulation of services

Clause 13.7.2 aims to ensure that when central heating water piping or heating and cooling ductwork is insulated, the insulation can perform as intended. The insulation should:

- be protected from the weather
- withstand the temperatures within the pipe or ductwork
- meet AS/NZS 4859.1.

Central heating water piping

Clause 13.7.3 aims to limit heat loss from central heating water piping in an unconditioned space.

Insulation is required to achieve minimum R-Values based on the climate zone and location of the pipes. Generally, the more exposed the pipework to the external environment, the higher the insulation requirement.

A summary of the key requirements for central heating water piping is outlined in Table 4.18.

Table 4.18 Key requirements for central heating water piping

13.7.3 subclause reference	Key requirements
(2)	<ul style="list-style-type: none"> • Applies to flow and return piping located: <ul style="list-style-type: none"> - within an unventilated wall space - within an internal floor between storeys - between ceiling insulation and a ceiling • Applies to heated water piping encased in a concrete floor (except if part of a floor heating system) • R-Value greater than or equal to 0.4 for all climate zones
(3) and (5)	<ul style="list-style-type: none"> • Applies to the following: <ul style="list-style-type: none"> - flow and return piping - cold water supply piping* - relief valve piping* • Applies to piping located within: <ul style="list-style-type: none"> - a ventilated wall space - an enclosed building subfloor - an enclosed roof space • R-Value greater than or equal to 0.6 for climate zones 1, 2, 3 and 5 • R-Value greater than or equal to 0.9 for climate zones 4, 6 and 7 • R-Value greater than or equal to 1.3 for climate zone 8
(4) and (6)	<ul style="list-style-type: none"> • Applies to the following: <ul style="list-style-type: none"> - flow and return piping - cold water supply piping* - relief valve piping* • Applies to piping located: <ul style="list-style-type: none"> - outside the house - an unenclosed building subfloor - an unenclosed roof space • R-Value greater than or equal to 0.6 for climate zones 1, 2, 3 and 5

13.7.3 subclause reference	Key requirements
	<ul style="list-style-type: none"> R-Value greater than or equal to 0.9 for climate zones 4, 6 and 7 R-Value greater than or equal to 1.3 for climate zone 8

* Insulation only applies to piping within 500 mm of the connection to the central heating system.

Heating and cooling ductwork

Clause 13.7.4 aims to ensure heating and cooling ductwork and associated fittings are protected, sealed and insulated to minimise heat loss or gain. The amount of insulation required is determined by the ductwork location within the house and the climate zone.

A summary of the key requirements for heating and cooling ductwork is outlined in Table 4.19.

Table 4.19 Key requirements for heating and cooling ductwork

13.7.4 subclause reference	Key requirements
(1), (4)(a) and (4)(b)	<ul style="list-style-type: none"> For heating and cooling ductwork and fittings in a heating-only or cooling-only system: <ul style="list-style-type: none"> insulation R-Value greater than or equal to 1.0 for climate zones 1 to 7 insulation R-Value greater than or equal to 1.5 for climate zone 8 For heating and cooling ductwork and fittings in a combined heating and refrigerated cooling system: <ul style="list-style-type: none"> insulation R-Value greater than or equal to 1.5 for climate zones 1, 3, 4, 6, 7 and 8 Insulation R-Value greater than or equal to 1.0 for climate zones 2 and 5 Insulation should be sealed against air loss using adhesives, mastics, sealants or gaskets in accordance with AS 4254.1 and AS 4254.2 for a Class C seal

13.7.4 subclause reference	Key requirements
(2)	<ul style="list-style-type: none"> • Insulation should: <ul style="list-style-type: none"> - form a continuous barrier without gaps between the sections of insulation - be installed so that it maintains its position and thickness • Insulation should be protected from the effects of weather when located: <ul style="list-style-type: none"> - outside the house, - in an attached garage, shed or carport, or - in a roof space. • The protection of the ductwork insulation should: <ul style="list-style-type: none"> - be an outer sleeve of protective sheeting to prevent the insulation becoming damp, and - have the outer protective sleeve sealed with adhesive tape that is at least 48 mm wide to create an airtight and waterproof seal.

Alert

In some climate zones condensation may create problems with uninsulated ductwork, in which case insulation should still be considered.

Insulation for refrigerated cooling ductwork should have a vapour barrier to prevent possible damage by condensation.

Some flexible ductwork is used to transfer products that have initiated from a flame-based heat source. For these applications, there are additional fire safety requirements for flexible ductwork located in H3D2(2) of NCC Volume Two.

Electric resistance space heating

Clause 13.7.5 aims to limit the size of permanent electric heating systems and limit unnecessary wastage of energy when they are not been used. This clause only applies when a heating system serves more than one room.

The requirements include separate isolating switches for each room and temperature controllers and time switches for groups of rooms with common heating needs. There are also maximum power loads for living areas of 110 W/m² and 150 W/m² for bathrooms.

Artificial lighting

Clause 13.7.6 aims to limit unreasonable energy use from artificial lighting. The requirements only apply to artificial lights that are permanently installed.

Different types of lights use different levels of energy. In recognition, the NCC requirements promote using more efficient lights through different lighting technology and/or control devices such as timers or dimmers.

Apart from clause numbering, the DTS Provisions for artificial lighting are unchanged for NCC 2022 when compared to NCC 2019.

The artificial lighting requirements consist of 6 main subclauses. A summary of the key requirements of these subclauses is in Table 4.20.

To assist determining compliance, a calculator is available that automates the calculations required. The Lighting Calculator is available from the Resource Library on the [ABCB website](#).

Table 4.20 Key requirements for artificial lighting

13.7.6 subclause reference	Key requirements
(1) Allowances	<ul style="list-style-type: none"> Lamp power density or illumination power density allowances: <ul style="list-style-type: none"> less than or equal to 5 W/m² in a house less than or equal to 4 W/m² on a verandah or balcony less than or equal to 3 W/m² in a garage attached to a house.
(2) Options to increase the allowance	<ul style="list-style-type: none"> The illumination power density allowance in (1) can be increased by using a control device in (6) Recognises energy saving technologies/devices.
(3) Power of proposed installation	<ul style="list-style-type: none"> The power of the proposed installation must be used rather than nominal allowances of complete light fittings. The intent is to ensure the installed system is the same as the proposed compliant installation.
(4) Halogen lamps	<ul style="list-style-type: none"> Halogen lights must be separately switched from fluorescent lights, as halogen lights consume more energy.

13.7.6 subclause reference	Key requirements
(5) Perimeter lighting	<ul style="list-style-type: none"> Artificial perimeter lighting must be controlled by a daylight sensor and have an average light source efficacy greater than or equal to 40 Lumens/W.
(6) Illumination power density adjustment factors	<ul style="list-style-type: none"> Illumination power density adjustment factors are provided for a range of control devices including: <ul style="list-style-type: none"> lighting timers motion detectors manual, programmable, dynamic and fixed dimming systems daylight sensors. The adjustment factors above can increase the illumination power density allowance in (1).

Subclauses (7) to (11) of 13.7.6 contain additional requirements when certain control devices are used in subclause (6). See the Housing Provisions for more information.

Water heater in a heated water supply system

Clause 13.7.7 of the Housing Provisions provides a cross-reference to the heated water requirements. Prior to the Housing Provisions being introduced, this cross-reference was in NCC Volume Two. These requirements are in Part B2 of the NCC Volume Three.

The following figure illustrates where the requirements for water heater in a heated water supply system are in the NCC and the relevant cross-references.

Figure 4.11 Water heater in a heated water supply system



There were minor changes to the requirements for heated water in a heated water supply system in Part B2 of NCC Volume Three for NCC 2022. The main change is the amount of STCs required has been updated. This is a result of changes to the relevant standard AS/NZS 4234 Heated water systems – calculation of energy consumption and the expanded Performance Requirement H6P2 Energy usage.

Alert

State and territory plumbing legislation may already require compliance with certain plumbing and drainage standards irrespective of the NCC requirements.

Swimming pool heating and pumping

Clause 13.7.8 aims to limit energy consumption associated with swimming pools.

To achieve this, when a swimming pool is intended to be heated, one or more of the following need to be used:

- a solar heater not boosted by electric resistance heating
- a heater using reclaimed energy
- a gas heater
- a heat pump.

When a heat pump or gas heater is used there are 2 additional requirements:

- (1) The swimming pool must have a pool cover with a minimum R-Value of 0.05, unless in a conditioned space.
- (2) A time switch to control the operation of the heater.

In addition, a time switch is required for all swimming pools to control the operation of the circulation pump.

Spa pool heating and pumping

Clause 13.7.9 aims to limit energy consumption associated with spas.

When a spa is intended to be heated and shares water reticulation with a swimming pool, one or more of the following need to be used:

- a solar heater not boosted by electric resistance heating
- a heater using reclaimed energy
- a gas heater
- a heat pump.

When a gas heater or heat pump is used there are 3 additional requirements:

- (1) The spa must have a spa cover.
- (2) A push button and a time switch are required to operate the heater.
- (3) A time switch must be provided to control the operation of a circulation pump. This applies when a spa has a capacity of more than 680 L.

4.3 Useful tips

4.3.1 Building fabric

Building fabric thermal insulation

- Guidance on installing bulk insulation in houses is in AS 3999: Bulk thermal insulation – Installation.
- In addition to meeting the DTS Provisions for energy efficiency, the selection and installation of reflective and bulk insulation must meet other NCC requirements such as Part 10.8 Condensation management of the Housing Provisions.

Roofs and ceilings

- The definition of a ‘vented’ roof has changed for NCC 2022. A roof with an attic space (sloping roof and flat ceiling) is considered ‘vented’ if it—
 - has one wind-driven roof ventilator per 50 m² of ceiling area, with gable, eave or ridge vents or
 - has one powered roof ventilator per 200 m² of ceiling area, with gable, eave or ridge vents or
 - is a tiled roof without sarking-type material at roof level.
- If a roof is not ‘vented’, it is considered a ‘standard’ roof since it does not meet the additional ventilation requirements described above.
- Roof ventilation allowances:
 - Only apply to pitched roofs with a horizontal ceiling.
 - Do not apply to a flat, skillion or a cathedral roof.
 - Refers to the ventilation of the attic space between the roof and ceiling.
- Minimum R-Values are not available for every combination of variables (e.g. roof ventilation, solar absorptance, etc.) using DTS elemental provisions. In this case, alternative options include:
 - identifying a different combination of variables which comply
 - another compliance option, see section 2.4.
- The effect of reflective insulation in a roof changes depending on the internal and external conditions at a point in time. This means they cannot be accurately represented by a single R-Value for the dominant heat flow direction. Similarly, roof ventilation has a highly variable impact.

- For these reasons, separate R-Values are provided for roofs with and without reflective insulation as well as roofs with and without roof ventilation. This replaces the approach of providing a single R-Value as was the case in previous editions of the NCC.
- The benefit for roof solar absorptance is calibrated to the climate zone (e.g. light roofs allow lower R-Values in cooling dominated climates and darker roofs allow lower R-Values in heat-dominated climates).

Roof lights

- Compared to previous editions of the NCC, the roof light requirements have been simplified by:
 - reducing the roof light index options for SHGC and
 - specifying the Total System U-Value is not more than U3.9 for all roof lights.

External walls

- Wall height is a new factor added to NCC 2022. It affects thermal performance in 2 ways:
 - Surface area - taller walls with larger surface areas will experience greater heat flow.
 - Shading - the shade from an overhang will cover less area of a taller wall than a shorter wall.
- Minimum R-Values are not available for every combination of variables (e.g. wall height, overhang, etc.) using DTS elemental provisions. In this case, alternative options include:
 - identifying a different combination of variables which do comply
 - another compliance option, see section 2.4.
- Note that wall types not described in the NCC 2022 tables will still have to use Total R-Value calculations. The Total R-Value should be calculated in accordance with AS/NZS 4859.2.

Floors and subfloor walls:

- Reflective insulation in the tables refers to a reflective insulation layer facing the (enclosed) subfloor.
- If a reflective air space does not face the subfloor, it should be considered as part of the floor insulation and contribute to the required insulation R-Value of the floor.

Thermal bridging (roofs and ceilings, external walls and floors and subfloor walls)

- As outlined above in Table 4.3, Table 4.5, Table 4.6, there are several options to mitigate thermal bridging, such as:
 - calculating the Total R-Value for the ceiling, or floor element to demonstrate that your design achieves the specified value

- installing more insulation between the frame members to offset the higher heat flow through the frame
- installing continuous insulation inside or outside the frame, or
- installing foil to create a reflective cavity in walls.
- Not all options are available for all construction types. For example, there is no option to add extra insulation in metal-framed brick veneer walls in houses because typical frames aren't deep enough to house the insulation required without encroaching upon the cavity.
- You can also reduce the level of thermal bridging mitigation needed by optimising other features, like the roof or wall colour. If you choose characteristics that work best in your climate to minimise the overall insulation requirement, you won't need to do as much to mitigate the thermal bridging.
- In most cases, you won't need to calculate the Total R-Value of a construction element. However, you will need to if you choose to meet a specified Total R-Value within the elemental provisions.
- For walls, the Total R-Value is calculated in accordance with AS/NZS 4859.2. This standard refers to NZS 4214 for the treatment of thermal bridging through framing members.
- For metal-framed suspended floors above an unenclosed subfloor space, the Total R-Value is also calculated using AS/NZS 4859.2.
- For metal-framed roofs and suspended floors above an enclosed subfloor space, the NCC doesn't specify the method of calculating the Total R-Value.
- This is because research by the University of Wollongong shows that AS/NZS 4859.2 and other simplistic one-dimensional arithmetic calculation methods do not accurately account for the effect of the enclosed airspace adjacent to the thermal bridge, such as a roof space or an enclosed subfloor. The University of Wollongong research includes an empirically based calculation method to use in these situations. A copy of the research report is available from the [ABCB website](#).

Thermal bridging vs. thermal break requirements

- The NCC requires a thermal break with an R-Value of at least R0.2 at all points of contact between:
 - metal roof sheeting and purlins, battens or rafters where there is no ceiling, or where the ceiling lining is attached directly to those purlins, battens or rafters
 - the metal frame and fibre-cement, weatherboard and metal-sheet cladding or the like, if the building does not have a wall lining or has a wall lining directly fixed to the frame.

- This requirement is distinct from the thermal bridging mitigation requirements and addresses localised cold/hot patches due to heat transfer from the cladding through the frame.
- Some products or construction systems can meet the thermal bridging and thermal break requirements simultaneously. For example, if a designer specifies continuous insulation between the lining and the frame, the lining is no longer fixed directly to the frame, so there is no need for an additional thermal break.
- If thermal bridging is instead addressed with extra insulation in the frames, a thermal break is still needed as the extra insulation does not prevent local cold/hot patches.
- Equally, no thermal break is needed with metal-framed brick veneer walls, as the cavity separates the frame from the cladding. However, in most climate zones thermal bridging mitigation would still be needed for metal-framed brick veneer walls, to reduce the overall heat transfer.

4.3.2 External glazing

- The external glazing requirements are now based on a larger range of factors. These include the following:
 - **The type of room where the glazing is located:** Glazing in bedroom and utility areas have a lesser effect on the energy demands of the house than windows in living and daytime occupied habitable rooms.⁴⁶
 - **The number of levels in the house:** Upper floors aren't directly linked to the more benign ground temperatures under a slab or in an enclosed subfloor space. This means the solar gains and heat losses from windows on upper floors have a different impact than windows on a ground floor. This new feature also allows dwellings with multiple storeys to be assessed with the one set of calculations, rather than having to provide separate calculations for each level as was the case in NCC 2019.
 - **Floor coverings** since on slab floors affect the amount of solar gain stored in the slab floor, and the extent of heat flow to the ground under the slab.
 - **Window open-ability** to account for cross-ventilation. This replaces the change to the summer performance target used in NCC 2019 for dwellings with highly openable windows. A variable allowance for window open-ability now is provided, rather than a fixed allowance for highly openable windows. This change has led to greater benefits

⁴⁶ Note there are window screening options available that can provide high window open-ability whilst still meeting the requirements of Part 11.3 Barriers and handrails in the Housing Provisions. Refer to the [Australian Glass and Window Association \(AGWA\)](#) for more information.

for highly openable windows in NCC 2022 than in NCC 2019 and better considers the impacts of window open-ability in general.

- **Solar absorptance of window frames:** Darker frames conduct more heat from solar radiation and effectively increase the impact of solar gains through glazing. Darker frames improve performance in winter and decrease it in summer.
- In NCC 2019 the impact of ceiling fans was accounted for by allowing higher heat gains through windows in the summer glazing performance target. In NCC 2022, ceiling fans are now required by Part 13.5 of the Housing Provisions in warmer climates (see section 4.2.5).
- For external shading devices (e.g. external blinds), the material used needs to stop at least 80% of the incident radiation from striking the glazing.
- Meeting the requirements of 13.3.3 External glazing may not occur on the first attempt. Here are some tips that may help to develop a compliant solution:
 - **Correct room use:** As outlined above, there are several new data inputs. It is particularly important to make sure you select the factors appropriate to the occupancy of the room for each window. In the Glazing Calculator it differentiates between bedroom and utility areas and all other types of rooms. Windows in bedrooms and utility areas have much less impact on the glazing calculations than windows in daytime occupied areas like living rooms. If you have selected a living room factor for a bedroom the performance calculated will be much worse than it should be.
 - **Focus on the season:** Figure out which season you fail in and focus the improvement on that season. For example, if you pass in winter, but fail in summer you will need to reduce the effective solar heat gain. Adding double glazed windows will slightly improve summer performance but will likely add significant cost. The best approach in summer may be to use a hard floor surface on a slab floor like ceramic tiles (floating timber does not help). Using glazing with a lower SHGC, a deeper overhang or lighter coloured window frames will also help in summer but may cause problems in winter. Lighter frame colours often reduce heat gain in summer by more than they reduce it in winter. In milder climates e.g. climate zones 2, 4 and 5, single low-e (low-emittance) glazing can reduce solar heat gain in summer and provide just enough improvement to limit heat loss to ensure winter performance still passes.
 - **Increase window open-ability:** Increasing window open-ability will help in summer without any winter penalty, particularly on upper floor windows in two storey dwellings. Window open-ability is limited below 1700 mm on upper floors, so a good strategy for these windows is to concentrate the openable windows above this height.
 - **Winter performance:** If you fail in winter, the strategies which increase the effective solar gain (higher SHGC or less shade) and reduce heat loss (lower U- Value) will be

needed. Other factors such as selecting a hard floor surface on a concrete slab floor and darker window frames will also help. Note for most variables, any change which increases solar heat gain in winter will also increase gains in summer, so monitor the summer score when improving heat gain in winter.

- **Window percentages:** Look at the windows with the highest scores. In the glazing calculator, the percentage of the total score for each window is shown to help you identify this. Focus your improvement strategies on the windows with the highest scores to get the best value for money improvements.
 - **Window orientation:** The cheapest and easiest way to improve glazing performance is to improve window orientation. North windows in cool and mild climates and south windows in hot climates (NCC zones 1 and 3) will allow you to achieve the easiest compliance. Not all sites allow ideal glazing orientation. However, even on a poorly oriented site better design can at least minimise the glazing exposed to the worst orientations. Mirroring the plan on a particular site or choosing an alternative plan that is better suited to the site can be easy and cheap ways to achieve compliance more cheaply.
 - **Window size:** When all these options have been exhausted some minor reduction of window size, particularly for those windows with the highest scores (i.e. lowest performing), may allow compliance cost savings. However, reducing window size will not always produce a better result as this will depend on orientation and NCC climate zone. Typically, the benefits of smaller windows are more pronounced in cooler climates and particularly for poorly oriented or shaded windows, but loss of passive solar gain on North, East and West elevations can lead to adverse impacts. In warmer climates, larger windows with improved ventilation (window open-ability) produce better outcomes, particularly when orientated South or are shaded. Note the ventilation and natural light requirements contained in Parts 10.5 and 10.6 of the Housing Provisions still need to be met.
 - **Other compliance options:** If the design has a high area of windows, compliance will likely be more expensive using the elemental DTS Provisions for external glazing. The use of another compliance option such as NatHERS (Chapter 3) or Verification using a reference building (Chapter 5) should be considered. These options permit trading of lower performing windows against improving the performance of other parts of the building fabric. This means these options are more likely to provide cheaper compliance solutions for houses with high window areas.
- Window products and their thermal performance (Total U-Value and Total System SHGC) are available from the [Window Energy Rating Scheme \(WERS\)](#)
 - The NCC 2022 Volume Two Glazing Calculator also contains a 'New features NCC 2022' tab which provides further practical advice when using the glazing calculator.

4.3.3 Building sealing

- Air leakage most commonly occurs at the:
 - roof/ceiling to wall junction
 - floor to wall junction
 - wall to door frame junction
 - wall to window frame junction
 - all services penetrations.
- In addition to the sealing requirements for chimneys and flues, Part H7D5 of NCC Volume Two contains fire safety requirements that also need to be met.
- For exhaust fans, a simple flap damper system can fulfil the minimum requirements. These are readily available for most fan types. Alternatively, a mesh filter system, like those used in kitchen range hoods, is acceptable. This is because these systems significantly restrict the flow of air when the fan is not operating.
- In 13.4.6(2) that covers the construction of ceilings, walls and floors, the term 'close-fitting' is used, but what does this term mean? Since doors and windows require a compressible seal, it would not be acceptable to have visible gaps surrounding the window or door unit. Therefore, a reasonable interpretation of 'close fitting' could be a gap less than that between the compressible seal of a closed window or door and the associated frame.

4.3.4 Ceiling fans

- The new ceiling fan requirements were implemented because NatHERS software tools show they can significantly reduce the use of artificial cooling.
- Climate zones 1, 2, and 3 benefit from ceiling fans being installed in habitable rooms, including bedrooms.
- In climate zone 5 areas of NSW (e.g. Sydney) and Qld, ceiling fans were found to similarly minimise the use of artificial cooling in habitable rooms, other than bedrooms.
- Bedrooms need fewer ceiling fans because they are typically occupied at cooler times of the day.
- Non-habitable spaces and circulation spaces are not required to have ceiling fans.

4.3.5 WOH energy usage

- The WOH energy usage calculations:
 - allow for variable energy load conditions throughout each day

- are based on the total energy costs of the dwelling (net sum of hourly costs for regulated energy uses for a year)
- consider the cost savings afforded by rooftop solar PV by accounting for the reduction in operating costs of non-regulated appliances, such as the plug loads of fridges, microwaves, computers and TVs.
- If the WOH energy use calculations did not account for non-regulated energy appliances, then the calculations would not correctly value the contribution of rooftop solar PV. This is because a greater proportion of solar generation would appear to be fed back into the grid than used in the house.
- The ABCB Standard for Whole-of-Home Efficiency Factors (2022) should be read in conjunction with the NCC and when using the ABCB Whole-of-home Calculator so the requirements are applied correctly.
- Part 1 of the standard covers introductory matters such as the scope and application of the standard, how it is referenced by the NCC and forms part of the DTS Provisions.
- Part 2 of the standard contains limitations and further guidance on using the standard. A limitation of the standard is that it only covers the range from 1 to 10 kW or equivalent rooftop solar PV capacity beyond this another compliance option must be used, see section 2.4 of this document.
- When using the standard, for gas heating and heat pump appliances, the factors must be obtained from the closest rating that can be chosen from the tables. For example, if the heating equipment is a 2-star gas ducted system, 'Gas – ducted < 3 stars' should be used, not 'Gas – ducted < 4.5 stars'.
- Other than climate zone 1, if no heating and/or cooling is specified for a dwelling, 'Other or none specified' must be selected to determine the applicable WOH efficiency factors.
- The ratings in brackets for heat pumps are values based on ratings to the GEMS pre-2019 determination for air-conditioners.
- The star rating selected for heat pumps registered under the GEMS 2019 (or later) determination should correspond to the appropriate zone on the energy rating label (hot, cold or average) for the house location. For more detail, see the [energy rating website](#).
- There are some clear trends to the WOH energy usage calculations, which may assist with meeting the requirements of Part 13.6 WOH energy usage. These are as follows:
 - If a house design does not include rooftop solar PV, then the efficiency of the heated water system becomes important to meet Part 13.6. For example, a solar or heat pump heated water system are likely to be required if rooftop solar PV is not used.
 - Similarly, high efficiency reverse cycle heating and cooling is also likely to be required if there is no rooftop solar PV, although this depends on the state or territory the

house will be built. In some state or territories with low prices for gas or wood, reverse cycle heating may not be needed.

- If rooftop solar PV of at least 3 kW is included in a house design, there is considerably more flexibility in the type, fuel and efficiency of heating, cooling and heated water appliances.
- Larger homes need more efficient appliances and it is harder to develop a compliant solution without rooftop solar PV. Larger PV sizes are needed in larger homes.
- If a dwelling has a swimming pool, it is far more likely that rooftop solar PV is required to meet Part 13.6.
- Careful handling on-site of rooftop solar PV is recommended due to the associated electrical risks. Users should observe the relevant instructions provided in AS/NZS 5033: Installation and safety requirements for photovoltaic arrays.
- To reflect the stringency set by the Performance Requirement H6P2 Energy usage, the WOH energy usage requirements in the DTS Provisions that form part of the Elemental compliance option, are set to a level where the annual net cost of energy use is equal to (or less than) 70% of the cost for the house:
 - that meets the minimum thermal performance for the building fabric (equivalent to a thermal rating of 7-star using NatHERS) and
 - benchmark heating, cooling and heated water appliances installed.
- WOH energy usage calculations using the DTS Provisions that form part of the Elemental compliance option are consistent with but provide slightly different outcomes to WOH ratings using NatHERS software tools. This is because NatHERS WOH ratings use hourly calculations for a full year using the thermal rating of the house being modelled, whereas the WOH energy usage calculations in the DTS Provisions approximate this calculation.

4.3.6 Services

- For central heating water piping, the requirements of clause 13.7.3(6) are more onerous for pipework in locations which are more exposed to external environmental conditions than described in clause 13.7.3(5). This is why higher levels of insulation are required.
- Ductwork insulation needs to be protected from the effects of weather as required by subclause 13.7.4(2). This can be achieved with an outer protective sleeve to prevent the insulation becoming damp and sealing the outer protective sleeve with an adhesive tape (minimum width 48 mm).
- For water heaters in a heated water supply system, there are 2 compliance pathways for solar and heat pump water heaters. These are:
 1. Obtain the required number of STCs.

2. Comply with the specified energy saving in accordance with AS/NZS 4234.
- See NCC Volume Three for more information on the requirements for water heaters in a heated water supply system.

4.4 Demonstrating compliance

4.4.1 Assessment Methods for DTS Solutions

An overview of how to comply and demonstrate compliance with the NCC is in Appendix C of this document, with further guidance available from the [ABCB website](#).

The DTS Provisions that form the Elemental compliance option are used to demonstrate NCC compliance using a DTS Solution. A2G3(2) sets out the following Assessment Methods as being suitable for demonstrating compliance for DTS Solutions:

- Evidence of suitability (NCC clauses A2G2, A2G3, A5G1 to A5G4).
- Expert Judgement (NCC clauses A2G2 and A2G3 of the NCC).

The following provides further information on these Assessment Methods.

4.4.2 Evidence of suitability

Evidence of suitability, also known as 'documentary evidence', can generally be used to support that a material, product, form of construction or design satisfies a DTS Provision. Subject to certain NCC provisions, the form of evidence that may be used consists of one, or a combination, of the following:

- A report from an Accredited Testing Laboratory.
- A Certificate of Conformity or a Certificate of Accreditation.
- A certificate from a professional engineer or appropriately qualified person.
- A current certificate issued by a product certification body that has been accredited by JAS-ANZ.
- Any other form of documentary evidence that adequately demonstrates suitability such as a Product Technical Statement.

More information on this Assessment Method is available in the ABCB Evidence of Suitability Handbook (2021).

In relation to housing energy efficiency, individual jurisdictions may have issued directions or notices specifying what documentary evidence is considered acceptable to demonstrate compliance.

4.4.3 Expert Judgement

Where physical criteria is unable to be tested, or modelled by calculation, the opinion of an expert may be accepted. Expert Judgment is the judgement of a person who has the qualifications and experience necessary to determine whether a Performance Solution or DTS Solution complies with the Performance Requirements.

It is the role of the appropriate authority to determine whether a person providing an Expert Judgement is considered an expert.

More information on the use of Expert Judgement including guidance on who may be considered an expert is in the resource Understanding the NCC – Assessment Methods, which is available from the [ABCB website](#).

The energy efficiency of a proposed house design is readily determined by impartial methods such as evidenced-based calculations; therefore, Expert Judgement is inappropriate as a sole Assessment Method for assessing a DTS Solution for housing energy efficiency.

4.5 Examples

To assist complying with the DTS Provisions that form the Elemental compliance option, several examples are in Appendix D. A list of these examples that are relevant and their location is as follows:

- Building fabric - Appendix D.2
- External glazing – Appendix D.3
- Ceiling fans – Appendix D.4
- WOH energy usage – Appendix D.5
- Artificial lighting (part of services) – Appendix D.6

5 Compliance option 3 - Verification using a reference building

5.1 Introduction

H6V2 Verification using a reference building (VURB) is a Verification Method that can be used as part of a Performance Solution to meet the housing energy efficiency thermal Performance Requirement H6P1. See Appendix C for more information on how to comply with the NCC.

Alert

- (1) 'Verification Method' is an NCC defined term and means a test, inspection, calculation or other method that determines whether a Performance Solution complies with the relevant Performance Requirements.
- (2) H6V2 VURB is limited to Performance Requirement H6P1 and cannot be used to meet Performance Requirement H6P2 Energy usage. Another method must be used, see section 2.4 for more options.

The use of Verification Method H6V2 is limited to houses and houses that incorporate attached and enclosed Class 10a parts such as garages. It is not applicable to detached garages or sheds, or to open carports.

Compared to NCC 2019, there are 2 main changes to this Verification Method for NCC 2022. These are:

- (1) Changes to reflect the increase in stringency of the housing energy efficiency requirements from 6 to 7 stars equivalent.
- (2) Inclusion of operating schedules for heating and cooling, thermostat settings, and maximum occupancy to provide more clarity for modelling.

5.2 Method

The intent of this method is to provide a method that utilises computer simulation using non-NatHERS tools⁴⁷. Compliance option 1 NatHERS (Chapter 3) requires the use of software tools accredited under NatHERS.

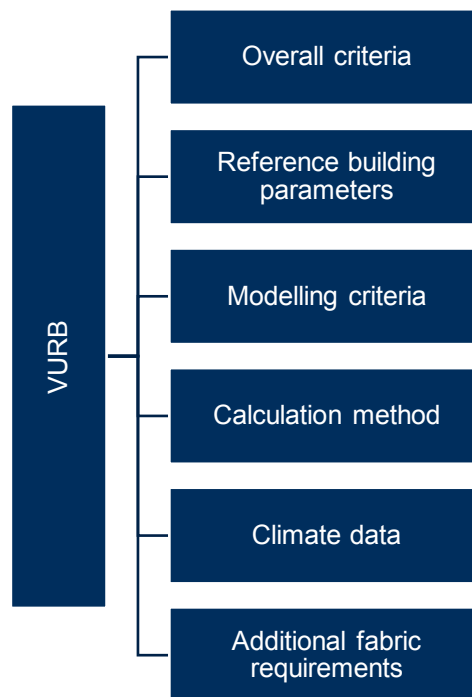
⁴⁷ For more information, see the definition of 'house energy rating software' in the Glossary at Appendix B.

H6V2 VURB is a comparative method because it assesses the heating load and/or cooling load of a theoretical reference house and compares it to the heating load and/or cooling load of the proposed house.

The theoretical reference house characteristics are those of a house modelled using certain elemental DTS Provisions contained in the Housing Provisions.

Figure 5.1 outlines the relevant requirements that form the VURB. Each of these requirements is discussed in further detail in this chapter.

Figure 5.1 VURB



5.2.1 Overall criteria

H6V2(1)(a) contains the overarching requirements for this Verification Method. These are summarised in Figure 5.1.

Table 5.1 Overall VURB criteria

Climate zone(s)	Criteria
1	<ul style="list-style-type: none"> Cooling load of proposed house less than or equal to cooling load of reference house
8	<ul style="list-style-type: none"> Heating load of proposed house less than or equal to heating load of reference house

Climate zone(s)	Criteria
2, 3, 4, 5, 6 and 7	<ul style="list-style-type: none"> Cooling load and heating load of proposed house is less than or equal to the cooling load and heating load of reference house
8	<ul style="list-style-type: none"> Heating load of proposed house less than or equal to heating load of reference house

5.2.2 Reference building parameters

Prior to NCC 2022, the VURB included a table with input values that had to be used in the model for the theoretical reference house. This is no longer the case. This change was made to improve alignment across NCC compliance pathways, recognising the importance of achieving consistent outcomes.

H6V2(2) in NCC 2022 states the theoretical reference house must be modelled to comply with certain requirements contained in the Housing Provisions. Figure 5.2 outlines the Housing Provisions that must be used.

Figure 5.2 Reference building requirements for H6V2 VURB

Part 13.2	<ul style="list-style-type: none"> Building fabric
Part 13.3	<ul style="list-style-type: none"> External glazing
Part 13.5	<ul style="list-style-type: none"> Ceiling fans

More information on these requirements is in Chapter 4 of this document, which outlines the DTS Provisions that form the Elemental compliance option.

5.2.3 Modelling criteria

There are several parameters that must be the same in both models for the theoretical reference house and the proposed house. This is to ensure that only the thermal performance of the building fabric for the reference and proposed house affects the simulated energy demand, rather than any differences in underlying simulation assumptions.

Essentially, a fair and equal comparison of parameters between the 2 building models is required.

The key requirements that must be the same in both modelling runs and the associated clause reference is in Table 5.2.

Table 5.2 Key requirements for both models using H6V2 VURB

Requirements that must be the same for both models	NCC reference(s)
Calculation method	H6V2(3)(a)
Location specific data	H6V2(3)(b)
Adjoining structures and features	H6V2(3)(c)
Soil conditions	H6V2(3)(d)
Orientation	H6V2(3)(e)
The floor plan, including the location and size of glazing	H6V2(3)(f)
Number of storeys	H6V2(3)(g)
Roof cladding and roof lights	H6V2(3)(h)
Separating walls	H6V2(3)(i)
The external non-glazed doors	H6V2(3)(j)
The intermediate floors	H6V2(3)(k)
Floor coverings	H6V2(3)(l)
Ventilation	H6V2(3)(m)
Function and use of the building including zoning and hours of occupation	H6V2(3)(n)
Operating schedules for heating and cooling	H6V2(3)(o) Table H6V2a
Cooling thermostat settings	H6V2(3)(p)
Heating thermostat setting	H6V2(3)(q)
Occupancy	H6V2(3)(r) Table H6V2b Table H6V2c
Internal heat gains	H6V2(3)(s)

Requirements that must be the same for both models	NCC reference(s)
	Table H6V2b Table H6V2d
Air-infiltration rate	H6V2(3)(t)

5.2.4 Calculation method

The calculation method is the energy rating software used to undertake the modelling runs. H6V2(4) outlines the requirements for the calculation method and states it must comply with ANSI/ASHRAE Standard 140. This standard provides a consistent test method for the evaluation of building analysis computer programs.

The intent of H6V2(4) is to ensure sufficient parameters (i.e. those identified in Table 5.2 above) can be taken into account when undertaking the calculation of heating loads and cooling loads.

5.2.5 Climate data

H6V2(5) specifies that climate data from a reliable source should be used and be based on hourly recorded values and representative of a typical year for the proposed location. This is because climate data heavily influences the heating loads and cooling loads calculated for the house design.

Suitable climate data may be obtained from the [Bureau of Meteorology website](#).

5.2.6 Additional fabric requirements

Software tools alone cannot be used to meet certain fabric requirements needed for compliance with the housing energy efficiency Performance Requirements. This means certain fabric requirements need to be met in addition to using a software tool. These additional fabric requirements are listed in H6V2(b) and mainly reference specific DTS Provisions contained in the Housing Provisions.

Table 5.3 outlines these additional fabric DTS Provisions. Each of these requirements is discussed in the following sections.

Table 5.3 Additional fabric DTS Provisions

DTS Provision(s)	Housing Provisions clause reference(s)
Building fabric thermal insulation	13.2.2
Thermal breaks	13.2.3(7) and 13.2.5(5)

DTS Provision(s)	Housing Provisions clause reference(s)
Floor edge insulation	13.2.6(4), 13.2.6(6) and 13.2.6(7)
Building sealing	13.7.6 or H6V3 (NCC Volume Two)

Building fabric thermal insulation

Clause 13.2.2 aims to ensure that when insulation, either bulk or reflective, is installed it –

- thermally performs as intended, and
- does not interfere with the safety or performance of plumbing or electrical components.

The building fabric thermal insulation requirements consists of 3 main subclauses. A summary of the key requirements of these subclauses is in Table 5.4.

Table 5.4 Key requirements for building fabric thermal insulation

13.2.2 subclause reference	Key requirements
(1) Integrity of the insulation	<ul style="list-style-type: none"> • Meets AS/NZS 4859.1 Materials for the thermal insulation of buildings • Adjoins or overlaps to form a consistent and continuous thermal barrier, except at supporting members⁴⁸ • ‘Consistent and continuous’ insulation means filling any voids in the framing unless a gap is otherwise required. Voids may include between window and door jambs, surrounding lintels, and voids in intersecting walls • Does not affect the safe or effective operation of any plumbing or electrical component⁴⁹
(2) Installation of reflective insulation	<ul style="list-style-type: none"> • Necessary airspace between the reflective side of insulation and lining/cladding • Closely fits against any penetration and adequately supported by framing • Adjoining sheets must overlap or be taped
(3) Installation of bulk insulation	<ul style="list-style-type: none"> • Maintains its position and thickness, except where it crosses roof battens, water pipes etc.

⁴⁸ ‘Supporting members’ include columns, studs, noggings etc.

⁴⁹ This includes providing appropriate clearance as detailed in relevant legislation and referenced standards such as for electrical, gas and fuel oil installations.

13.2.2 subclause reference	Key requirements
	<ul style="list-style-type: none"> Ceiling insulation must overlap the external wall by greater than or equal to 50 mm. This only applies when there is no insulation in the external wall below.

Thermal breaks

Clause 13.2.3(7) applies to some metal roof combinations and requires a thermal break greater than or equal to R0.2 to minimise conductive heat flow.

Alert

An important issue for roof design, especially in cooler climates where insulation with higher R-Values is required, will be to ensure that the roof structure has sufficient space to accommodate the insulation without the insulation being compressed. Any compression of the insulation will reduce its R-Value and consequently the effectiveness of the insulation.

Similarly, clause 13.2.3(5) applies to some metal-framed wall combinations that are part of the envelope. A thermal break greater than or equal to R0.2 is required to minimise conductive heat flow.

Floor edge insulation

The floor edge insulation requirements are in the Housing Provisions and consist of 3 main subclauses. A summary of the key requirements of these subclauses is in Table 5.5.

Table 5.5 Key requirements for floor edge insulation

13.2.6 subclause reference	Key requirements
(4) CSOG insulation	<ul style="list-style-type: none"> Applies to CSOG floors that have an in-slab or in-screed heating or cooling system Requires insulation with additional R-Value greater than or equal to 1 installed around the vertical edge of its perimeter.
(6) Insulation installation and properties	<ul style="list-style-type: none"> Applies to insulation required by (4) and vertical edge insulation in (5) Insulation must be installed and have the following properties: <ul style="list-style-type: none"> - water resistant

13.2.6 subclause reference	Key requirements
	<ul style="list-style-type: none"> - continuous from the ground level to a depth greater than or equal to 300 mm - continuous from the ground level for greater than or equal to the full depth of vertical edge of CSOG
(7) Thermal break	<ul style="list-style-type: none"> • Applies to some metal roof combinations • Requires a thermal break greater than or equal to R0.2

Building sealing

The intent of the building sealing requirements is to restrict unintended leakage of outdoor air into the house and the loss of heated and/or cooled air from the house. Unintended leakage can lead to reduced thermal comfort of occupants and consequently, increase the use of artificial heating and/or cooling.

To comply with the building sealing requirements using the VURB, there are 2 options:

- (1) The DTS Provisions of Part 13.4 Building sealing in the Housing Provisions.
- (2) Using H6V3 Verification of building envelope sealing.

For Option 1 there are several clauses in Part 13.4 that need to be met. See Table 5.6. These are outlined in Table 5.6 and discussed in the following sections.

For Option 2, see Chapter 6 of this document.

Table 5.6 Building sealing clauses

Building element	Clause reference
Application	13.4.1
Chimneys and flues	13.4.2
Roof lights	13.4.3
External windows and doors	13.4.4
Exhaust fans	13.4.5
Construction of ceilings, walls and floors	13.4.6
Evaporative coolers	13.4.7

Application

Clause 13.4.1 specifies the DTS Provisions for building sealing apply to the following:

- all houses, and
- a garage, shed or carport where it has a conditioned space.

There are 2 exemptions:

- (1) A house or garage (shed or carport) located in climate zones 1, 2, 3 and 5 that only uses evaporative cooling.
- (2) A permanent ventilation opening that is needed to ensure the safe operation of a gas appliance.

Alert

Appropriate ventilation requirements for gas appliances can be obtained from relevant state and territory legislation, referenced standards and product installation manuals.

Roof lights

Clause 13.4.3 provides the minimum sealing requirements for roof lights (skylights). The skylight sealing requirements consist of 2 subclauses.

A summary of the key requirements of these subclauses is in Table 5.7.

Table 5.7 Key requirements to seal skylights

13.4.3 subclause reference	Key requirements
(1) Application	<ul style="list-style-type: none"> • Skylights must be sealed, or capable of being sealed in the following locations: <ul style="list-style-type: none"> - a conditioned space - a habitable room in climate zones 4, 5, 6, 7 and 8.
(2) Sealing requirements	<ul style="list-style-type: none"> • Sealing can be achieved by any of the following: <ul style="list-style-type: none"> - a ceiling diffuser (no holes) - a weatherproof seal - a manual, mechanical or electronic shutter system.

Chimneys and flues

Clause 13.4.2 requires a solid-fuel burning appliance (e.g. wood fireplace) to have a damper or flap on its chimney or flue so that it can be closed.

The intent of this requirement is to prevent conditioned air being drawn up the chimney or flue when the appliance is not in use.

External windows and doors

Clause 13.4.4 provides the minimum sealing requirements for external windows and doors. The requirements consist of 2 subclauses.

A summary of the key requirements of these subclauses is in Table 5.8.

Table 5.8 Key requirements to seal external windows and doors

13.4.4 subclause reference	Key requirements
(1) Application	<ul style="list-style-type: none"> • Applies to the following external openings: <ul style="list-style-type: none"> - external doors - internal doors between a house and an unconditioned garage or carport - openable windows - similar openings to those listed above. • Seals are needed for the following locations: <ul style="list-style-type: none"> - a conditioned space - a habitable room in climate zones 4, 5, 6, 7 and 8.
(2) Sealing requirements	<ul style="list-style-type: none"> • A draft protection device must be used to seal the bottom edge of a door • A foam or rubber compressible seal, or fibrous seal must be used to seal the edge of doors and openable windows.
(3) Exemption	<ul style="list-style-type: none"> • The requirements of (2)(b) do not apply for a window that complies with the maximum air infiltration rates in AS 2047.

Exhaust fans

Clause 13.4.5 provides the minimum requirements to seal exhaust fans.

Exhaust fans must be sealed with a self-closing damper or filter when located in one of the following:

- (1) A conditioned space.
- (2) A habitable room in climate zones 4, 5, 6, 7 and 8.

Construction of ceilings, walls and floors

Clause 13.4.6 provides the minimum requirements to seal ceilings, walls and floors. The requirements consist of 2 subclauses.

A summary of the key requirements of these subclauses is in Table 5.9.

Table 5.9 Key construction requirements to seal ceilings, walls and floors

13.4.6 subclause reference	Key requirements
(1) Application	<ul style="list-style-type: none"> • Applies to the following parts of the external fabric: <ul style="list-style-type: none"> - ceilings - floors - window frames - door frames - roof light frames • Seals are needed for the following locations: <ul style="list-style-type: none"> - a conditioned space - a habitable room in climate zones 4, 5, 6, 7 and 8.
(2) Construction requirements	<ul style="list-style-type: none"> • Option 1: Construction in (1) must be enclosed by internal lining systems that are close fitting for the following construction elements: <ul style="list-style-type: none"> - ceilings - walls - wall and floor junctions • Option 2: Construction in (1) must be sealed at junctions and penetrations by either of the following: <ul style="list-style-type: none"> - close-fitting architrave, skirting or cornice - expanding foam, rubber compressive strip or caulking.

Evaporative coolers

Clause 13.4.7 provides the minimum requirements to seal evaporative coolers.

Evaporative coolers must be sealed with a self-closing damper when supplying one of the following:

- (1) A heated space.
- (2) A habitable room in climate zones 4, 5, 6, 7 and 8.

5.3 Useful tips

- H6V2 can facilitate certain “trade-offs” between different elements of the building fabric, such as a reduction of insulation in the walls whilst increasing the insulation in the roof or improving the thermal performance of the glazing.
- The key requirements that must be the same for both models is in Table 5.2. However, parameters that can be changed include the following:
 - type of glazing - this includes the thermal performance of the glazing (Total System U-Value and Total System SHGC), ability to open, degree of shading, and the size and location of the glazing
 - amount of insulation
 - types of construction materials (may affect glazing calculations)
 - timber floor to slab (may affect glazing calculations)
 - colours of external cladding.
- ANSI/ASHRAE Standard 140 can be used to identify and diagnose differences from building energy simulation software that may be caused by modelling limitations, input errors, algorithmic differences, faulty coding, or inadequate documentation.
- The number of hours per day which heating and cooling is available (as identified in H6V2(4)(d)), is likely to lie between 8 and 17 hours. Hours outside of this duration are considered unlikely, other than in exceptional circumstances.
- Climate data should be based on hourly data for a typical year of the following factors:
 - dry-bulb temperature
 - direct and diffuse solar radiation
 - wind speed and direction
 - cloud cover.
- Part 13.2 Building fabric of the Housing Provisions contains new requirements for mitigating thermal bridging in certain metal framed roofs, walls and floors and these must be included in the reference house. It follows that those undertaking software models also need to account for thermal bridging in the proposed house. If either the heating or cooling load of the proposed house exceeds the maximum allowance, then changes should be made to address thermal bridging directly or make other design changes to reduce the loads of the proposed house.

5.4 Demonstrating compliance

5.4.1 Background

A Performance Solution can be used in an individual situation where the desired solution meets the Performance Requirements of the NCC, but not the relevant DTS Provisions. These solutions are often flexible in achieving the outcomes required and encourage innovative design and technology use.

An overview of how to demonstrate compliance with the NCC is in Appendix C of this document, with further guidance available from the [ABCB website](#).

VURB is a Verification Method; therefore, where a Performance Solution utilises VURB, Verification Method is the relevant Assessment Method. More information on Assessment Methods is in the resource Understanding the NCC – Assessment Methods, which is available from the [ABCB website](#).

Reminder

‘Verification Method’ is an NCC defined term and means a test, inspection, calculation or other method that determines whether a Performance Solution complies with the relevant Performance Requirements.

5.4.2 Performance Solution process

To help ensure a Performance Solution provides the level of intended performance, clause A2G2(4) of the NCC mandates a process for developing Performance Solutions. This process must be followed regardless of whether the Performance Solution is simple or complex in nature.

In simple terms, the 4 steps of the Performance Solution process are:

- (1) prepare a brief
- (2) carry out analysis
- (3) evaluate results
- (4) prepare a final report.

More information on this process is in the Performance Solution Process Guidance Document and the ABCB Performance Solution Process Handbook, which are available from the [ABCB website](#).

5.4.3 Professional practice and ethics

Some state and territory legislation empowers certain practitioners to develop and/or approve Performance Solutions. Irrespective of controls about who can undertake this work, the practitioners involved have a professional responsibility for ensuring that appropriately skilled and experienced persons are engaged to develop and approve Performance Solutions.

When preparing a Performance Solution, practitioners should exercise their duties in an appropriate manner. Key principles include:

(1) Acting in the public interest

In undertaking their duties, a practitioner should exercise their discretionary powers in ways that safeguard the public interest. A practitioner's consideration of the interests of their clients and employers must not be contrary to the public interest.

(2) Independence

In performing their professional duties, a building surveyor/certifier should be objective, impartial and conduct themselves in accordance with the relevant requirements of state and territory legislation. Other practitioners should ensure any conflicts of interest are disclosed to all relevant parties.

(3) Competence

A practitioner should not undertake professional work that they are not competent to perform.

5.5 Example

To assist with use of H6V2 Verification using a reference building, an example is in Appendix D.7.

6 Compliance option 4 - Verification of building envelope sealing

6.1 Introduction

H6V3 Verification of building envelope sealing is a Verification Method that can be used as part of a Performance Solution to assess if a proposed solution complies with the Performance Requirement H6P1 for building envelope sealing.

The use of Verification Method H6V3 is limited to houses and houses that incorporate attached and enclosed Class 10a parts such as garages. It is not applicable to detached garages or open carports.

Compared to NCC 2019, the main change to this compliance option for NCC 2022 is the inclusion of mechanical ventilation requirements. This is because tightly sealed homes require mechanical ventilation to manage indoor moisture and air quality.

Reminder

The Performance Requirement H6P1 relates to thermal performance, whilst the Performance Requirement H6P2 relates to the energy usage of the house.

To fully satisfy the energy efficiency Performance Requirements, other requirements under H6P1 and the Performance Requirement H6P2 must also be met.

6.2 Method

The intent of this method is to provide a means of verifying the thermal Performance Requirement H6P1 for building envelope⁵⁰ sealing through practical testing.

The key requirements of this Verification Method are summarised in Table 6.1.

⁵⁰ See the Glossary at Appendix B for the definition of 'envelope'.

Table 6.1 Key requirements of Verification of building envelope sealing

Clause reference	Key requirements
H6V3(1) Overall criteria	<ul style="list-style-type: none"> House must be sealed to an air permeability less than or equal to 10 m³/hr.m² at 50 Pa reference air pressure Tested using Method 1 of AS/NZS ISO 9972
H6V3(2) Additional ventilation requirements	<ul style="list-style-type: none"> When a house is sealed to an air permeability less than or equal to 5 m³/hr.m² at 50 Pa reference air pressure, additional ventilation is required A mechanical ventilation system must be provided that meets the following: <ul style="list-style-type: none"> be able to be overridden supplies either continuous outdoor air or outdoor air intermittently for at least 25% of a 4 hour period supplies a minimum flow rate greater than or equal to the flow rate calculated using equation in H6V3(2)(a)(iii). Solid-fuelled appliances must be ventilated directly outside Gas-fuelled appliances must be ventilated in accordance with clauses 6.4 and 6.4.5 of AS/NZS 5601.1
H6V3(3) Note	<ul style="list-style-type: none"> The volume of space for determining ventilation requirements for gas-fuelled appliances is 1 m³.

Alert

AS/NZS ISO 9972 is the Australian/New Zealand standard, “Thermal performance of buildings – Determination of air permeability of buildings – Fan pressurization method”.

This standard contains requirements for testing the air permeability of buildings using the fan pressurisation method, including the apparatus, measurement procedures, expression of results and the standardised format of testing reports.

There are 3 different methods contained within the standard; however Method 1 must be used for the purposes of Verification Method H6V3.

6.3 Useful tips

- Verification Method H6V3 is limited to Performance Requirement H6P1 for building envelope sealing and cannot verify compliance with H6P2 or any other components of H6P1.
- The DTS Provisions for building sealing in Part 13.4 can be used as guidance prior to testing commencing.
- $10\text{m}^3/\text{hr.m}^2$ at 50 Pa is broadly equivalent to 10 air changes per hour at 50 Pa when applied to homes. The requirement in $\text{m}^3/\text{hr.m}^2$ is used because it is more practical to test and confirm the performance of the building envelope.
- Temporary envelope sealing (except for that within the testing procedure) is not appropriate, as the tested scenario must represent the final building.
- This verification testing should be planned in the program of a build, to ensure that the requirement can be demonstrated, and improvements made after testing if required.
- Air infiltration rates are determined for all windows tested to AS 2047 and are published on the [WERS](#) website. It may be worth selecting windows with a low air infiltration rate to assist complying with the criteria in Verification Method H6V3.
- Method 1 within AS/NZS ISO 9972 precisely defines the testing requirements, so refer to the standard to confirm the requirements for your specific project.
- When designing a building, both Performance Solutions and DTS Solutions can be used to achieve compliance with the Performance Requirements. A combination of solutions may be used to satisfy a single Performance Requirement. This may include occasions where a specific Performance Requirement covers several elements of a building. This is the case for Performance Requirement H6P1 for building envelope sealing. Therefore, it is possible to use the H6V3 Verification Method that covers building sealing in a combination with the DTS Provisions that form part of the Elemental compliance option for the remainder of the building elements of the house. See Part A2 of NCC Volume Two for more information.

6.4 Demonstrating compliance

6.4.1 Background

A Performance Solution can be used in an individual situation where the desired solution meets the Performance Requirements of the NCC, but not the relevant DTS Provisions. These solutions are often flexible in achieving the outcomes required and encourage innovative design and technology use.

An overview of how to demonstrate compliance with the NCC is in Appendix C of this document, with further guidance available from the [ABCB website](#).

Verification of building envelope sealing is a Verification Method; therefore, where a Performance Solution utilises Verification of building envelope sealing, Verification Method is the relevant Assessment Method. More information on Assessment Methods is in the resource Understanding the NCC – Assessment Methods, which is available from the [ABCB website](#).

Reminder

‘Verification Method’ is an NCC defined term and means a test, inspection, calculation or other method that determines whether a Performance Solution complies with the relevant Performance Requirements.

6.4.2 Performance Solution process

To help ensure a Performance Solution provides the level of intended performance, Clause A2G2(4) of the NCC mandates a process for developing Performance Solutions. This process must be followed regardless of whether the Performance Solution is simple or complex in nature.

In simple terms, the 4 steps of the Performance Solution process are:

- (1) prepare a brief
- (2) carry out analysis
- (3) evaluate results
- (4) prepare a final report.

More information on this process is in the Performance Solution Process Guidance Document and the ABCB Performance Solution Process Handbook, which are available from the [ABCB website](#).

6.4.3 Professional practice and ethics

Some state and territory legislation empowers certain practitioners to develop and/or approve Performance Solutions. Irrespective of controls about who can undertake this process, the practitioners involved have a professional responsibility for ensuring that appropriately skilled and experienced persons are engaged and participate as stakeholders in the process.

When preparing a Performance Solution, practitioners should exercise their duties in an appropriate manner. Key principles include:

- (1) Acting in the public interest

In undertaking their duties, a practitioner should exercise their discretionary powers in ways that safeguard the public interest. A practitioner's consideration of the interests of their clients and employers must not be contrary to the public interest.

(2) Independence

In performing their professional duties, a building surveyor/certifier should be objective, impartial and conduct themselves in accordance with the relevant requirements of state and territory legislation. Other practitioners should ensure any conflicts of interest are disclosed to all relevant parties.

(3) Competence

A practitioner should not undertake professional work that they are not competent to perform.

6.5 Example

To assist with use of H6V3 Verification of building envelope sealing, an example is in Appendix 0.

7 Compliance option 5 - Other Performance Solutions

7.1 Introduction

As outlined in Chapter 1, there are 3 options available to demonstrate compliance with the Performance Requirements:

- a Performance Solution
- a DTS Solution, or
- a combination of a Performance Solution and a DTS Solution.

An overview of how to comply with the NCC is in Appendix C of this document, with further guidance available from the [ABCB website](#).

A Performance Solution can be used in an individual situation where the desired solution meets the Performance Requirements of the NCC, but not the relevant DTS Provisions. These solutions are often flexible in achieving the outcomes required and encourage innovative design and technology use.

To comply with the housing energy efficiency Performance Requirements both H6P1 Thermal Performance and H6P2 Energy usage need to be met. Any proposed Performance Solution needs to demonstrate this has been achieved.

This chapter outlines some potential options for Performance Solutions that do not use an NCC Verification Method as the Assessment Method.

Reminder

A key principle underpinning the NCC 2022 housing energy efficiency requirements is that all compliance options aim to offer an equivalent level of performance. This principle helps ensure the policy objectives set out in Objective H6O1 (see section 2.2) are achieved.

7.2 Assessment Methods

Assessment Methods are used when determining if a Performance Solution complies with the relevant Performance Requirements.

The following Assessment Methods are listed in the NCC (see A2G2 and A2G3) and each, or any combination, can be used to demonstrate compliance for a Performance Solution where appropriate:

- Evidence of suitability
- Expert Judgement
- Comparison with the DTS Provisions
- Verification Methods.

Each of these Assessment Methods is discussed in the following sections.

7.2.1 Evidence of suitability

Evidence of suitability, also known as ‘documentary evidence’, can generally be used to support that a material, product, form of construction or design satisfies a Performance Requirement. Subject to certain NCC provisions, the form of evidence that may be used consists of one, or a combination, of the following:

- A report from an Accredited Testing Laboratory.
- A Certificate of Conformity or a Certificate of Accreditation.
- A certificate from a professional engineer or appropriately qualified person.
- A current certificate issued by a product certification body that has been accredited by the JAS-ANZ.
- Any other form of documentary evidence that adequately demonstrates suitability such as a Product Technical Statement.

More information on this Assessment Method is available in the ABCB Evidence of Suitability Handbook (2021).

In relation to housing energy efficiency, individual jurisdictions may have issued specific directions or notices specifying what documentary evidence is considered acceptable to demonstrate compliance.

7.2.2 Expert Judgement

Where physical criteria is unable to be tested, or modelled by calculation, the opinion of an expert may be accepted. Expert Judgment is the judgement of a person who has the qualifications and experience necessary to determine whether a Performance Solution complies with the Performance Requirements.

It is the role of the appropriate authority to determine whether a person providing an Expert Judgement is considered an expert.

More information on the use of Expert Judgement, including guidance on who may be considered an expert, is in the resource Understanding the NCC – Assessment Methods, which is available from the [ABCB website](#).

The energy efficiency of a house design is readily determined by verifiable means; therefore, Expert Judgement is inappropriate as a sole Assessment Method for assessing a Performance Solution for housing energy efficiency.

7.2.3 Comparison with the DTS Provisions

This Assessment Method involves a comparative analysis demonstrating that a Performance Solution is better than, or at least equivalent to, a solution that complies with the relevant DTS Provision(s).

To carry out this comparison, the applicable DTS Solution and Performance Solution both need to be subject to the same level of analysis using the same methodology. This provides the building designer and appropriate authority with a defined benchmark or level for the DTS Solution and the Performance Solution.

The intent of VURB is to provide a pathway that utilises the principle underpinning the Comparison with the DTS Provisions Assessment Method, in that the outcome must be better than, or at least equivalent to, a DTS Solution (see Chapter 4). This is achieved using a reference house and a proposed house. VURB provides a set of reasonable assumptions, parameters and exclusions to help ensure a Performance Solution produced using this Verification Method provides the intended level of performance.

Therefore, it is expected that a Performance Solution that uses a Comparison with the DTS Provisions Assessment Method would use a similar set of reasonable assumptions, parameters and exclusions (such as not permitting use of NatHERS software tools) to those specified in VURB. The parameters, assumptions, exclusions, calculation methodology and acceptance criteria would also need to be agreed by relevant stakeholders as required by the Performance Solution Process (discussed in section 7.3).

7.2.4 Verification Methods

Verification Methods are tests or calculations that prescribe a way to assess compliance with relevant NCC Performance Requirements. They include a test, inspection, calculation, or a combination of these.

Verification Methods not contained in the NCC may be used if deemed suitable by the appropriate authority.

7.3 Performance Solution Process

To help ensure a Performance Solution provides the level of intended performance, clause A2G2(4) of the NCC mandates a process for developing Performance Solutions. This process must be followed regardless of whether the Performance Solution is simple or complex in nature.

In simple terms, the 4 steps of the Performance Solution process are:

- (1) prepare a brief
- (2) carry out analysis
- (3) evaluate results
- (4) prepare a final report.

More information on this process is in the Performance Solution Process Guidance Document and the ABCB Performance Solution Process Handbook, which are available from the [ABCB website](#).

7.3.1 Quantified Performance Requirements

For step 1 of the Performance Solution process, a performance-based design brief (PBDB) needs to be developed. The purpose of the brief is to record the fundamental activities and outcomes of the Performance Solution development, as agreed by stakeholders. The PBDB must include the acceptance criteria for the proposed Performance Solution, which often requires accounting for the location and characteristics of the building.

For NCC 2022, H6P1 is quantified and H6P2 is partially quantified. This means both Performance Requirements contain measurable benchmarks that should be used in the acceptance criteria for a PBDB for housing energy efficiency.

H6P1 specifies load limits in Specification 44 of NCC Volume Two. These limits vary based on climate factors and floor type. By defining the load limits based on climate factors, load limits can be determined for any home in any climate (and associated energy modelling climate file).

The quantified heating load limits and cooling load limits in H6P1 were developed with reference to the heating and cooling load limits that were introduced in 2019 as part of the DTS Provisions that form the NatHERS compliance option. The limits have been generalised for broader use in the H6P1 Performance Requirement and adjusted to reflect the stringency increase from NCC 2019 to NCC 2022.

H6P1 allows for higher heating loads in cold locations, and higher cooling loads in hot, humid locations. The limits include an area adjustment to avoid unfairly disadvantaging small houses, which are naturally more exposed to outside conditions than large houses because of their higher ratio of surface area to internal space.

7.4 Professional practice and ethics

Some state and territory legislation empowers certain practitioners to develop and/or approve Performance Solutions. Irrespective of controls about who can undertake this work, the practitioners involved have a professional responsibility for ensuring that appropriately skilled and experienced persons are engaged to develop and approve Performance Solutions.

When preparing a Performance Solution, practitioners should exercise their duties in an appropriate manner. Key principles include:

(1) Acting in the public interest

In undertaking their duties, a practitioner should exercise their discretionary powers in ways that safeguard the public interest. A practitioner's consideration of the interests of their clients and employers must not be contrary to the public interest.

(2) Independence

In performing their professional duties, a building surveyor/certifier should be objective, impartial and conduct themselves in accordance with the relevant requirements of state and territory legislation. Other practitioners should ensure any conflicts of interest are disclosed to all relevant parties.

(3) Competence

A practitioner should not undertake professional work that they are not competent to perform.



Appendices

Appendix A Abbreviations

The following table, Table A.1 contains abbreviations used in this document.

Table A.1 Abbreviations

Abbreviations	Meaning
ABCB	Australian Building Codes Board
AAOs	Assessor Accrediting Organisations
AC	Air conditioning
ANSI	American National Standards Institute
AS	Australian Standard
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BASIX	Building Sustainability Index
BCA	Building Code of Australia
COP	Coefficient of Performance
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSOG	Concrete slab-on-ground
CVS	Consistent volume structure ⁵¹
DTS	Deemed-to-Satisfy
EER	Energy Efficiency Rating
GEMS	Greenhouse and Energy Minimum Standards
GHG	Greenhouse gas
ISO	International Organisation for Standardisation
JAS-ANZ	Joint Accreditation System of Australia and New Zealand
MEPS	Minimum Energy Performance Standards
NatHERS	Nationwide House Energy Rating Scheme
NCC	National Construction Code
NZS	New Zealand Standard
OLA	Outdoor living area

⁵¹ More information is available from the [ABCB website](http://www.abcb.gov.au).

Abbreviations	Meaning
PBDB	Performance-based design brief
PCA	Plumbing Code of Australia
PV	Photovoltaic
SA	Solar absorptance
SF	Suspended floor
SHGC	Solar heat gain coefficient
SRI	Star rating index
STC	Small-scale Technology Certificate
VURB	Verification using a reference building
WERS	Window Energy Rating Scheme
WOH	Whole-of-home (NCC) Whole of Home (NatHERS) ⁵²
ZERL	Zoned energy rating label

⁵² Note NatHERS uses 'Whole of Home' (no hyphens, upper case 'H' for home) for its WOH software tools, whereas the NCC uses 'Whole-of-home' (hyphens, lower case 'h' for home). Both NatHERS and the NCC use the same abbreviation which is 'WOH'.

Appendix B Glossary

This appendix contains a glossary of key terms used in this document with links to further information where relevant.

The glossary includes NCC extracts of defined terms. These are identified by the following document style below.

NCC extracts⁵³

Air barrier: A layer used to restrict the movement of air under the normal pressure differences found across building elements⁵⁴.

More information is available from the ABCB Condensation in buildings Handbook which is available from the [ABCBC website](#).

Air infiltration: The unintended movement of outside air into a house through gaps, cracks and penetrations in the building structure.

The DTS Provisions for building sealing in Part 13.4 of the Housing Provisions aim to minimise air infiltration. See section 3.2.5 (NatHERS compliance option) or section 4.2.4 (Elemental compliance option) for more information.

Air exfiltration: The unintended movement of indoor air out of a house building through gaps, cracks and penetrations in the building structure.

The DTS Provisions for building sealing in Part 13.4 of the Housing Provisions aim to minimise air exfiltration. See section 3.2.5 (NatHERS compliance option) or section 4.2.4 (Elemental compliance option) for more information.

Air movement: The movement of air for the purpose of cooling that is created either through natural forces (i.e. openings, vents) or mechanical power (i.e. fans).

Performance Requirement H6P1 considers the benefits of air movement for cooling through:

- (1) the openability of windows in the calculation of acceptable summer heat gain through windows (glazing), and
- (2) by requiring ceiling fans in hot and warm climate zones.

Air permeability: The tested rate of air infiltration and air exfiltration in $\text{m}^3/\text{hr.m}^2$ for a house measured using a blower door test at a 50 Pa reference pressure.

See H6V3 Verification building envelope sealing (Chapter 6) and [YourHome](#) for more information.

⁵³ NCC extracts italicise defined terms as per the NCC. See Schedule 1 of the NCC for further information.

⁵⁴ ABCB (2023) Condensation in buildings handbook, ABCB, accessed Jan 2023.

Amenity: An attribute which contributes to the health, physical independence, comfort and well-being of people.

Artificial cooling: The cooling of an indoor air space using air-conditioning, not including passive cooling⁵⁵.

More information is available from [YourHome](#).

Artificial heating: The heating of an indoor air space using air-conditioning, not including passive heating⁵⁶.

Assessment Method: A method that can be used for determining that a *Performance Solution* or *Deemed-to-Satisfy Solution* complies with the *Performance Requirements*.

More information on Assessment Methods is in the resource Understanding the NCC – Assessment Methods, which is available from the [ABCB website](#).

Building element: The major functional parts of the building envelope such as roof, walls and floors.

Building sealing: To seal a building is to limit air infiltration and exfiltration through the building envelope by caulking, sealing, weather-stripping, or using dampers. The tighter the building is sealed; the less air infiltration and exfiltration occurs. This can help with lowering the heating and cooling load of a house and reduce the use of artificial heating or cooling.

The DTS Provisions for building sealing are in Part 13.4 of the Housing Provisions and are referenced by all compliance options outlined in section 2.4 that can be used to meet the housing energy efficiency Performance Requirements.

Bulk insulation: Bulk insulation includes glass fibre, wool, cellulose fibre, polyester, wood fibre and polystyrene foam. These materials have a high percentage of air voids that provide thermal resistance to heat flow⁵⁷, i.e. limits conduction. In some cases, the material itself may provide significant thermal resistance, e.g. cellulose.

More information is available from [YourHome](#).

Cavity: A void between 2 leaves of masonry, or in masonry veneer construction, a void between a leaf of masonry and the supporting frame.

Typically, a cavity is a minimum void of 35 mm between 2 leaves of masonry, or in masonry veneer construction, the void between a leaf of masonry and the supporting frame.

⁵⁵ YourHome, [Passive cooling](#) (2020), YourHome, accessed Oct 2022.

⁵⁶ YourHome, [Passive heating](#) (2020), YourHome, accessed Nov 2022.

⁵⁷ YourHome, [Insulation](#) (2020), YourHome, accessed Oct 2022.

Climate zone: Climate zone means an area defined in Figure 2 and in Table 3 of the NCC for specific locations, having energy efficiency provisions based on a range of similar climatic characteristics.

The NCC specifies 8 climate zones for thermal design. There are also 69 regional subzones that are defined and used by NatHERS.

Condensation: The formation of moisture on the surface of a building element or material as a result of moist air coming into contact with a surface which is at a lower temperature.

More information on condensation management in the NCC is available in the ABCB's handbook, *Condensation in Buildings (2023)*, which is available from the [ABCB website](#).

Conditioned space: For the purposes of—

- (a) ...
- (b) Volume Two, a space within a building that is heated or cooled by the building's *domestic services*, excluding a non-*habitable room* in which a heater with a capacity of not more than 1.2 kW or 4.3 MJ/hour is installed.

Examples of a conditioned space in a house include a bedroom and a living area.

Conduction: The process of heat transfer from one material to another by direct contact of the materials. A simple example of conduction is the transfer of heat from a stovetop to a metal pot.

Cooling load: The calculated amount of energy removed from the cooled spaces of the building annually by artificial means to maintain the desired temperatures in those spaces.

Cooling loads can be controlled by limiting the amount of heat that enters a building or air circulating into or out of the house through air infiltration and exfiltration.

Cooling loads are regulated by Performance Requirement H6P1 and the associated compliance options outlined in section 2.4. These compliance options are:

- (1) NatHERS (see Chapter 3),
- (2) Elemental (see Chapter 4),
- (3) VURB (see Chapter 5),
- (4) First principles (see Chapter 7).

Reminder

The heating load, cooling load and total thermal energy load limits specified by H6P1 and associated compliance options, are not the same as the actual amount of energy used for heating and cooling.

The amount of energy used for heating and cooling depends on the source of the energy used (i.e. fuel type) and the efficiency of the heating and cooling equipment.

The amount of energy used for heating and cooling is regulated by H6P2 Energy usage.

Cross-ventilation: A natural method of cooling a house by allowing cool air in and hot air out through openings such as windows⁵⁸. Cross-ventilation is a technique used in passive cooling. Window open-ability can be varied to account for the benefits of cross-ventilation.

Cross-ventilation is considered in the external glazing requirements in section 4.2.3 of this document.

Deemed-to-Satisfy Provisions: Provisions which are deemed to satisfy the *Performance Requirements*.

The DTS Provisions are prescriptive (i.e. like a recipe book, they tell you how, what and in which location things must be done). They include materials, components, design factors, and construction methods that, if used, are deemed to meet the Performance Requirements, hence the term 'Deemed-to-Satisfy'.

Deemed-to-Satisfy Solution: A method of satisfying the *Deemed-to-Satisfy Provisions*.

A DTS Solution is achieved by following all appropriate DTS Provisions in the NCC.

⁵⁸ YourHome, [Glossary](#) (2020), YourHome, accessed Oct 2022.

Domestic services: The basic engineering systems that use energy or control the use of energy; and—

- (a) includes—
 - (i) heating, *air-conditioning*, mechanical ventilation and artificial lighting; and
 - (ii) pumps and heaters for *swimming pools* and spa pools; and
 - (iii) heated water systems; and
 - (iv) on-site *renewable energy* equipment; but
- (b) excludes cooking facilities and portable appliances.

The definition of domestic services excludes portable appliances. This means the definition of domestic services excludes plug-in appliances such as like fridges, dishwashers, clothes washers and microwaves.

Elemental provisions: DTS Provisions that require each element or part of a proposed house to meet a minimum level of thermal performance or efficiency. For example, the floors, walls, glazing and roof.

Energy value: The net cost to society including, but not limited to, costs to the building user, the environment and energy networks.

Energy value is the economic or societal cost (or cost savings) associated with on-site energy usage or generation. It is primarily based on:

- energy prices,
- impacts of pollution and GHG emissions,⁵⁹ and
- impacts on energy networks.⁶⁰

This term is used in the Performance Requirement H6P2 to set the level of stringency for the energy use from a house's domestic services.

Energy efficiency: To minimise the use of energy for heating, cooling, heated water, lighting, pool pumps and heating services by improving the efficiency of appliances or minimising heat flow through building fabric.

Energy source: The type of energy used for domestic services, such as electricity, gas, wood or solar power⁶¹.

More information is available from [YourHome](#).

⁵⁹ The costs to the environment were determined per tonne of GHG emissions.

⁶⁰ The costs to the energy network were determined using a time of use tariff.

⁶¹ YourHome, [Energy](#) (2020), YourHome, accessed 2022.

Envelope: For the purposes of—

- (a) ...
- (b) Part H6 in NCC Volume Two and Section 13 of the ABCB Housing Provisions, the parts of a building's *fabric* that separate artificially heated or cooled spaces from—
 - (i) the exterior of the building; or
 - (ii) other spaces that are not artificially heated or cooled.

Expert Judgement: The judgement of an expert who has the qualifications and experience to determine whether a *Performance Solution* or *Deemed-to-Satisfy Solution* complies with the *Performance Requirements*.

Contemporary and relevant qualifications and/or experience are necessary to determine whether a Performance Solution complies with the Performance Requirements. The level of qualification and/or experience may differ depending on the complexity of the proposal and the requirements of the regulatory authority.

Practitioners should seek advice from the authority having jurisdiction or appropriate authority for clarification as to what will be accepted.

External wall: For the purposes of—

- (a) ...
- (b) Volume Two, an outer wall of a building which is not a *separating wall*.

Evaporative cooling: Evaporative cooling is a type of passive cooling that uses evaporated water to cool hot air.

Fabric: The basic building structural elements and components of a building including the roof, ceilings, walls, glazing and floors.

Floor area: For the purposes of—

- (1) ...
- (2) Volume Two and the ABCB Housing Provisions, in relation to a room, the area of the room measured within the finished surfaces of the walls, and includes the area occupied by any cupboard or other built-in furniture, fixture or fitting (see Figure 4 of the NCC).

Functional statement: A non-mandatory statement providing guidance on how buildings and building elements achieve the Objectives. The Functional Statement for housing energy efficiency is in the introduction of NCC Volume Two Part H6 and discussed in Chapter 2.

Glazing: For the purposes of—

- (a) ...
- (b) ...
- (c) Part H6 of NCC Volume Two and Section 13 of the ABCB Housing Provisions—
 - (i) a transparent or translucent element and its supporting frame located in the external *fabric* of the building; and
 - (ii) includes a *window* other than a *roof light*.

Greenhouse gas: The atmospheric gases responsible for causing climate change⁶².

More information is available from [YourHome](#).

Governing Requirements: These are the mandatory rules and instructions for using and complying with the NCC. They are in Section A of NCC Volumes One, Two and Three.

The Governing Requirements explain important concepts on how the NCC must be interpreted and applied. There are certain conventions and approaches that need to be taken into account when using the NCC, such as interpreting specific language and terms. This is critical to understanding the intended technical and legal meaning of the NCC.

The Governing Requirements also explain the difference between the mandatory parts of the NCC and the parts that are only explanatory or guidance in nature.

Habitable room: A room used for normal domestic activities, and—

- (a) includes a bedroom, living room, lounge room, music room, television room, kitchen, dining room, sewing room, study, playroom, family room, home theatre and sunroom; but
- (d) excludes a bathroom, laundry, water closet, pantry, walk-in wardrobe, corridor, hallway, lobby, photographic darkroom, clothes-drying room, and other spaces of a specialised nature occupied neither frequently nor for extended periods.

Heated water: Water that has been intentionally heated; normally referred to as hot water or warm water.

Heat flow: The movement of heat (energy). Heat flows from hot objects to cool objects through the processes of conduction, convection and radiation.

For example, in cold climates heat flows from indoors to outdoors.

⁶² YourHome, [Glossary](#) (2020), YourHome, accessed Oct 2022.

Heating load: The calculated amount of energy delivered to the heated spaces of the building annually by artificial means to maintain the desired temperatures in those spaces.

Heating loads can be controlled by limiting the amount of heat that leaves a building, and/or optimising the amount of solar gain that enters a house.

Heating loads are regulated by Performance Requirement H6P1 and the associated compliance options outlined in section 2.4. These compliance options are:

- (1) NatHERS (see Chapter 3),
- (2) Elemental (see Chapter 4),
- (3) VURB (see Chapter 5),
- (4) First principles (see Chapter 7).

Reminder

The heating load, cooling load and total thermal energy load limits specified by H6P1 and associated compliance options, are not the same as the actual amount of energy used for heating and cooling.

The amount of energy used for heating and cooling depends on the source of the energy used (i.e. fuel type) and the efficiency of the heating and cooling equipment.

The amount of energy used for heating and cooling is regulated by H6P2 Energy usage.

House energy rating software: For the purposes of—

- (c) ...
- (b) Volume Two—
 - (i) applied to H6V2—software accredited or previously accredited under the Nationwide House Energy Rating Scheme (NatHERS) and the additional functionality provided in non-regulatory mode; and
 - (ii) applied to Specification 42—software accredited under the Nationwide House Energy Rating Scheme (NatHERS).

Illumination power density: The total of the power that will be consumed by the lights in a space, including any lamps, ballasts, current regulators and control devices other than those that are plugged into socket outlets for intermittent use such as floor standing lamps, desk lamps or work station lamps, divided by the area of the space, and expressed in W/m^2 .

The DTS Provisions for artificial lighting in 13.7.6 of the Housing Provisions specify the lighting allowances permitted and these depend on the space the lights serve. The allowances can be

increased by using an illumination power density adjustment factor. See section 4.2.7 of this document for more information.

Indoor air quality: A measure of the condition of air in a room with respect to the health and comfort of its occupants. It includes the physical, chemical and microbiological makeup of the air. Note the term means different things to different people and there is no single accepted definition.

More information is available in the ABCB Indoor Air Quality Verification Methods Handbook (2023) that is available from the [ABCB website](#).

Insulation: A material, assembly of materials, or building product which provides resistance to conductive or radiative heat flow. Examples include bulk insulation and reflective insulation.

Lamp power density: The total of the maximum power rating of the lamps in a space, other than those that are plugged into socket outlets for intermittent use such as floor standing lamps, desk lamps or work station lamps, divided by the area of the space, and expressed in W/m^2 .

The DTS Provisions for artificial lighting in 13.7.6 of the Housing Provisions specify the lighting allowances permitted (i.e. lamp power density) and these depend on the space the lights serve. See section 4.2.7 of this document for more information.

Main space conditioning: Either—

- (a) the heating or cooling equipment that serves at least 70% of the *conditioned space* of a dwelling, or
- (b) if no one heating or cooling equipment serves at least 70% of the *conditioned space* of the dwelling, the equipment that results in the highest net equivalent energy usage when calculated in accordance with J3D14(1)(a) of NCC Volume One or 13.6.2(1)(a) of the ABCB Housing Provisions.

Notes

- (1) If a multi-split *air-conditioning* unit is installed, it is considered to be a single heating or cooling *service*.
- (2) A series of separate heaters or coolers of the one type can be considered a single heater or cooler type with a performance level of that of the unit with the lowest efficiency.

Main water heater: The domestic hot water unit in a dwelling that is connected to at least one shower and the largest number of hot water outlets.

Mechanical ventilation: The use of outside air which has been distributed within the building, most commonly through the use of one or more fans⁶³. More information is available from [YourHome](#).

Membrane: A barrier impervious to moisture.

Nationwide House Energy Rating Scheme (NatHERS): A scheme administered by the Commonwealth on behalf of all states and territories that facilitates consistent energy ratings from NatHERS accredited tools for new⁶⁴ Australian homes.

More information is available from [NatHERS](#).

Net equivalent energy usage (annual allowance): The net equivalent energy usage, or allowance, is assessed by taking to account of the floor area, space conditioning, water heating, swimming pool and spa pump energy use. It is determined in accordance with 13.6.2 of the ABCB Housing Provisions.

The ABCB Whole-of-home calculator can be used to determine the net equivalent energy usage. See section 4.2.6 of this document for more information.

⁶³ YourHome, [Ventilation and airtightness](#) (2020), YourHome, accessed 2022.

⁶⁴ 'New' includes proposed new homes and apartments and proposed 'new building work' to existing homes and apartments. What constitutes 'new building work' is the responsibility of individual jurisdictions.

Objective: A statement providing guidance on the public's expectation of requirements in the NCC. The objective for housing energy efficiency is located under the introduction of NCC Volume Two Part H6. See Chapter 2 of this document for more information.

Orientation: The position of a home based on climate, solar exposure and wind direction⁶⁵. More information is available from [YourHome](#).

Outdoor air: Air outside the building.

On-site energy production: Energy produced on-site through sources such as solar panels. On-site energy production is accounted for in Performance Requirement H6P2 Energy usage and the associated DTS compliance options: NatHERS (see Chapter 3) and Elemental (see Chapter 4).

Passive cooling: Using the design of the building and selection of materials to manage the temperature during hot weather⁶⁶. More information is available from [YourHome](#).

Passive heating: Using the design of the building and selection of materials to utilise the sun to increase and trap that warmth⁶⁷. The glazing calculations allow for the heating of a home from solar gains through glazing. More information is available from [YourHome](#).

Performance Requirement: A requirement which states the level of performance which a *Performance Solution* or *Deemed-to-Satisfy Solution* must meet.

Performance Solution: A method of complying with the *Performance Requirements* other than by a *Deemed-to-Satisfy Solution*.

Piping: For the purposes of Section J in Volume One or Part H6 in Volume Two, and Section 13 of the Housing Provisions, means an assembly of pipes, with or without valves or other fittings, connected together for the conveyance of liquids and gases.

Pliable building membrane: A water barrier as classified by AS/NZS 4200.1.

Primary insulation layer: The most interior insulation layer of a wall or roof construction.

Projection: The depth of a horizontal overhang as defined by NCC 2022 Figure 13.2.3b. Provides shading which extends horizontally on both sides of the glazing, generally located externally.

⁶⁵ YourHome, [Orientation](#) (2020), YourHome, accessed 2022.

⁶⁶ YourHome, [Passive cooling](#) (2020), YourHome, accessed 2022.

⁶⁷ YourHome, [Passive heating](#) (2020), YourHome, accessed 2022.

This could be in a form of a verandah, balcony, fixed canopy, eaves, shading hood or a carport⁶⁸. More information is available from [YourHome](#).

R-Value: The thermal resistance of a component calculated by dividing its thickness by its thermal conductivity, expressed in $\text{m}^2\cdot\text{K}/\text{W}$.

For bulk insulation products, this is simply the R-Value shown on the packaging. For reflective products, the R-Value they add to a building component is more complicated. Reflective insulation only works when installed in conjunction with an air space. The R-Value that a reflective product adds to a component is the R-Value of the reflective air space(s), less the R-Value of any non-reflective air spaces that the reflective air space(s) replace.

Reference building: For the purposes of—

- (a) ...
- (b) Volume Two, a hypothetical building that is used to determine the maximum allowable *heating load* and *cooling load* for the proposed building.

Reflective insulation: A building membrane with a reflective surface such as a reflective foil laminate, reflective barrier, foil batt or the like capable of reducing radiant heat flow.

Renewable energy: Energy that is not depleted when used. Renewable energy includes solar, wind and geothermal power⁶⁹.

More information is available from [YourHome](#).

Required: Required to satisfy a *Performance Requirement* or a *Deemed-to-Satisfy Provision* of the NCC as appropriate.

Roof light: For the purposes of Section J and Part F6 in NCC Volume One, Part H6 in NCC Volume Two, and Part 10.5 and Section 13 of the ABCB Housing Provisions, a skylight, window or the like installed in a roof—

- (a) to permit natural light to enter the room below; and
- (b) at an angle between 0 and 70 degrees measured from the horizontal plane.

Roof light shaft index: is determined by measuring the distance from the centre of the shaft at the roof to the centre of the shaft at the ceiling level and dividing it by the average internal dimension of the shaft opening at the ceiling level. See Table 13.2.4 of the Housing Provisions, note 1.

⁶⁸ YourHome, [Shading](#) (2020), YourHome, accessed 2022.

⁶⁹ YourHome, [Renewable energy](#) (2020), YourHome, accessed 2022.

Sarking-type material: A material such as a *reflective insulation* or other flexible membrane of a type normally used for a purpose such as waterproofing, vapour management or thermal reflectance.

Separating wall: A wall that is common to adjoining Class 1 buildings.

Shading device: A device used to block direct rays from the sun, generally these devices are fixed or operable. Some examples of these are awnings, blinds and eaves⁷⁰.

More information is available from [YourHome](#).

Skylight: A type of window located on a roof to permit light to enter a room below. The NCC defines this as a roof light.

Solar absorptance: A measure of the solar radiation which an object can absorb. The higher the solar absorptance, the more heat it can absorb. Lighter coloured materials are commonly more reflective and absorb less heat. More information is available from [BASIX](#)⁷¹.

Solar gain: Heat gained through solar radiation entering a home through windows or skylights.⁷² More information on solar gain and how to use solar gain for passive heating can be found at [YourHome](#).

Specification: A specification provides technical data in the NCC which is relied upon as a component of one or more DTS Provisions. A specification may be referenced by multiple DTS Provisions, wherever the same data needs to be referred to by different parts of the NCC. Including this common information in a single specification avoids the need to repeat the same information across multiple parts of the NCC.

⁷⁰ YourHome, [Shading](#) (2020), YourHome, accessed 2022.

⁷¹ BASIX, [Roof colour and solar absorptance](#), BASIX, accessed 2022.

⁷² [YourHome](#), (2020), YourHome, accessed 2022.

Storey: A space within a building which is situated between one floor level and the floor level next above, or if there is no floor above, the ceiling or roof above, but not—

- (a) a space that contains only—
 - (i) a lift *shaft*, stairway or meter room; or
 - (ii) a bathroom, shower room, laundry, water closet, or other *sanitary compartment*; or
 - (iii) accommodation intended for not more than 3 vehicles; or
 - (iv) a combination of the above; or
- (b) a *mezzanine*.

Swimming pool: Any excavation or structure containing water and principally used, or that is designed, manufactured or adapted to be principally used for swimming, wading, paddling, or the like, including a bathing or wading pool, or spa.

Thermal break: A material of low conductivity which is used between materials with high conductivity to reduce its heat transfer.

Thermal bridging: Thermal bridging, in practical terms for the NCC, is an unintended path of heat flow between the outside and inside of the building envelope. Thermal bridges may occur where there is an interruption in the insulation or where highly conductive materials (e.g. metal) are used.

As an example, if a steel truss roof directly supports an insulated corrugated iron roof, the heat flows through the truss more readily than the surrounding insulation, negating the effect of the insulation (i.e. the truss acts as a thermal bridge).

Thermal bridges can significantly reduce the effectiveness of the insulation (thermal resistance) of the building envelope (i.e. walls, floors and roof) by essentially bypassing the insulation in favour of a more conductive material (e.g. metal). This results in either losing heat from inside the building to the outside on a cold day or adding warmth to the inside the building on a hot day.

This may cause unwanted comfort issues in a building, and a likely increase in energy use by a building's heating and cooling systems. Additionally, unaddressed thermal bridges may lead to condensation where warm, moist air contacts a colder surface and condenses into water droplets. Condensation can result in mould growth, causing indoor air quality issues, negative health impacts for occupants, and potentially affects the durability of the structure.

Thermal conductivity: Thermal conductivity is defined as the rate of thermal conduction through a material per unit area per unit thickness per unit temperature differential.

Thermal energy load: The sum of the *heating load* and the *cooling load*.

Thermal energy loads are regulated by Performance Requirement H6P1 and the associated compliance options outlined in section 2.4. These compliance options are:

- (1) NatHERS (see Chapter 3),
- (2) Elemental (see Chapter 5),
- (3) VURB (see Chapter 5),
- (4) First principles (see Chapter 7).

Reminder

The heating load, cooling load and total thermal energy load limits specified by H6P1 and associated compliance options, are not the same as the actual amount of energy used for heating and cooling.

The amount of energy used for heating and cooling depends on the source of the energy used (i.e. fuel type) and the efficiency of the heating and cooling equipment.

The amount of energy used for heating and cooling is regulated by H6P2 Energy usage.

Thermal performance: The effectiveness of a building envelope to maintain acceptable levels of human comfort inside a building relative to the outside weather conditions, while minimising the need for artificial heating or cooling⁷³.

More information is available from [YourHome](#).

Thermal rating: A thermal rating is a computer simulation using accredited NatHERS software that assesses the potential thermal performance of a new⁷⁴ home. The results are converted to a star rating between 1 and 10.

⁷³ YourHome, [Glossary](#) (2020), YourHome, accessed 2022.

⁷⁴ 'New' includes proposed new homes and apartments and proposed 'new building work' to existing homes and apartments. What constitutes 'new building work' is the responsibility of individual jurisdictions.

Total R-Value: The sum of the *R-Values* of the individual component layers in a composite element including any building material, insulating material, airspace, thermal bridging and associated surface resistances, expressed in $\text{m}^2.\text{K}/\text{W}$.

Total System Solar Heat Gain Coefficient: For the purposes of—

- (a) ...
- (b) Volume Two, the fraction of incident irradiance on *glazing* or a *roof light* that adds heat to a building's space.

Total System U-Value: The sum of the *R-Values* of the individual component layers in a composite element including any building material, insulating material, airspace, thermal bridging and associated surface resistances, expressed in $\text{m}^2.\text{K}/\text{W}$.

Unconditioned space: A space that is not usually heated or cooled by the building's domestic services. Examples include laundries and bathrooms.

Ventilation opening: An opening in the *external wall*, floor or roof of a building designed to allow air movement into or out of the building by natural means including a permanent opening, an openable part of a *window*, a door or other device which can be held open.

Vapour barrier: A layer or material used to restrict the transmission of vapour, generally water vapour into a building or from inside into the cavity of the building fabric⁷⁵.

More information is available in the [ABCB Condensation in Buildings Handbook \(2023\)](#) which is available from the [ABCB website](#).

Vapour permeance: The degree that water vapour is able to diffuse through a material, measured in $\mu\text{g}/\text{N}.\text{s}$ and tested in accordance with the ASTM-E96 Procedure B – Water Method at 23°C 50% relative humidity.

Verification Method: A test, inspection, calculation or other method that determines whether a *Performance Solution* complies with the relevant *Performance Requirements*.

Water control layer: A *pliable building membrane* or the exterior cladding when no *pliable building membrane* is present.

WOH energy use: The total amount of energy used by a home and includes:

- (1) the efficiency of fixed⁷⁶ energy-using equipment, such as heating and cooling equipment, heated water, lighting, and pool and spa pumps; and

⁷⁵ ABCB (Australian Building Codes Board) (2021) Condensation in buildings handbook, ABCB, accessed Oct 2022.

⁷⁶ Portable appliances and equipment are excluded.

(2) on-site renewable energy generating systems, such as rooftop solar PV.

WOH rating: A WOH rating is a computer simulation using NatHERS accredited software that assesses equipment efficiencies and any offsets from on-site renewable energy of a proposed house. A WOH rating builds on the thermal performance assessment (i.e. star rating) of the proposed house. The results are converted to a score between 1 and 100.

Water control layer: Includes a *roof light*, glass panel, glass block or brick, glass louvre, glazed sash, glazed door, or other device which transmits natural light directly from outside a building to the room concerned when in the closed position.

Appendix C Compliance with the NCC

C.1 Responsibilities for regulation of building and plumbing in Australia

State and territory governments are responsible for regulation of building, plumbing and development/planning in their respective state or territory.

The NCC is a joint initiative of the Commonwealth and State and Territory Governments in Australia and is produced and maintained by the ABCB on behalf of the Australian Government and each state and territory government. The NCC provides a uniform set of technical provisions for the design and construction of buildings and other structures, and plumbing and drainage systems throughout Australia. It allows for variations in climate and geological or geographic conditions.

The NCC is given legal effect by building and plumbing regulatory legislation in each state and territory. This legislation consists of an Act of Parliament and subordinate legislation (e.g. Building Regulations) which empowers the regulation of certain aspects of buildings and structures, and contains the administrative provisions necessary to give effect to the legislation.

Each state's and territory's legislation adopts the NCC subject to the variation or deletion of some of its provisions, or the addition of extra provisions. These variations, deletions and additions are generally signposted within the relevant section of the NCC, and located within appendices to the NCC. Notwithstanding this, any provision of the NCC may be overridden by, or subject to, state or territory legislation. The NCC must therefore be read in conjunction with that legislation.

C.2 Demonstrating compliance with the NCC

Compliance with the NCC is achieved by complying with the NCC Governing Requirements and relevant Performance Requirements.

The Governing Requirements are a set of governing rules outlining how the NCC must be used and the process that must be followed.

The Performance Requirements prescribe the minimum necessary requirements for buildings, building elements, and plumbing and drainage systems. They must be met to demonstrate compliance with the NCC.

There are 3 options available to demonstrate compliance with the Performance Requirements. These are:

- a Performance Solution

- a DTS Solution, or
- a combination of a Performance Solution and a DTS Solution.

Wherever a Performance Solution is used, it must be assessed using one or a combination of Assessment Methods, as appropriate. These include:

- Evidence of suitability
- Expert Judgement
- Verification Methods
- Comparison with DTS Provisions.

Evidence of suitability and Expert Judgement may be used to demonstrate compliance for a DTS Solution.

A figure showing hierarchy of the NCC and its compliance options is in Figure C.1. It should be read in conjunction with the NCC.

To access the NCC or for further general information regarding demonstrating compliance with the NCC visit the [ABCB website](https://www.abcb.gov.au).

Figure C. 1 Demonstrating compliance with the NCC



Appendix D Examples

This appendix contains 10 examples to assist with understanding and applying the DTS Provisions and Verifications Methods in the NCC relevant to housing energy efficiency.

The examples and their location in this appendix are listed and hyperlinked in Table D.1.

They should be read in conjunction with a copy of the NCC and Housing Provisions.

Table D.1 Examples and their location

Appendix reference	Page reference
D.1 Heating and cooling load limits	140 - 142
D.2 Building fabric	143 - 165
D.3 Glazing	166 - 171
D.4 Ceiling fans	172 - 173
D.5 WOH energy usage	174 - 185
D.6 Artificial lighting	186 - 188
D.7 Verification using a reference building	189 - 192
D.8 Verification of building envelope sealing	193 - 195

D.1 Heating and cooling load limits

D.1.1 Example 1: A house with a suspended floor in Brisbane

Introduction

A DTS Solution using the DTS Provisions of the NatHERS compliance option is proposed for a single storey house in Brisbane. The house has an undercover outdoor area.

This example provides guidance on the heating and cooling load limit requirements that are part of the NatHERS compliance option. See Chapter 3 for more information on this compliance option.

The relevant NCC references are Volume Two H6D2(1)(a), which refers to S42C2 and S42C4(1).

Step 1: Identify the requirements that need to be met

To comply with S42C2(1), the modelled energy loads of a house must not exceed 3 separate load limits:

- (1) The total load limit corresponding to the required thermal rating.
- (2) The heating load limit.
- (3) The cooling load limit.

The modelled energy loads and the 3 load limits are determined in the following steps.

Step 2: Identify the required thermal rating

The city of Brisbane is in NCC climate zone 2 (NatHERS climate zone 10).

Under S42C2(1) the required thermal rating for houses located in NCC climate zone 2 depends on whether the design includes an OLA.

The OLA must meet certain design criteria (see S42C2(3) and (4) or section 3.2.2 of this document).

The required thermal rating is either:

- 7 stars (i.e. no OLA) (see S42C2(1)(a))
- 6.5 stars, if there is an OLA with an impervious roof with a Total R-Value equal to or greater than R1.5 (see S42C2(1)(b))
- 6.0 stars, if there is an OLA that has an impervious roof with a Total R-Value equal to or greater than R1.5 AND at least one permanently installed ceiling fan that complies with certain requirements (see S42C2(1)(b)) and S42C2(5)).

For this example, the house design includes a 21 m² outdoor area that meets the OLA design criteria and has an impervious roof with a Total R-Value equal to R2.0.

The OLA also has a permanently installed ceiling fan that complies with S42C2(5).

This means the proposed house design needs to achieve a thermal rating greater than or equal to 6.0 stars.

Step 3: Identify heating and cooling load limits

S42C2(1) also requires the house does not exceed the heating load limits and cooling load limits stated in the ABCB Standard for NatHERS Heating and Cooling Load Limits (2022) (the Standard).

Clause 2.3(a) of the Standard sets the heating and cooling load limits based on the floor type of the lowest living area.

The house design in this example has a suspended timber floor 600 mm above the ground.

Referring to Table 6 in the Standard for a Class 1 Suspended Floor (SF) building and a thermal rating of 6.0 stars in NatHERS climate zone 10, it shows the house design must not exceed a heating load limit of 29 MJ/m².annum and a cooling load limit of 42 MJ/m².annum.

The heating and cooling load limits are summarised in Table D.2.

Table D.2 Heating and cooling load limits

NatHERS climate zone	Heating load limit (MJ/m ² .annum)	Cooling load limit (MJ/m ² .annum)
10	29	42

Step 4: Calculate the 3 loads of the proposed house design

The house design is modelled using software accredited under NatHERS.

The design achieves a 6.1 star rating.

The software also shows that the heating load for the house's design is 16.6 MJ/m².annum while the cooling load is 24.3 MJ/m².annum.

This information can be sourced from the NatHERS Universal Certificate for the proposed house. An example of a NatHERS Universal Certificate that includes where the heating and cooling loads are listed in the certificate is available from the [NatHERs website](#).

The load limits for the total load, heating load and cooling load for NatHERS climate zone 10 along with the calculated loads of the proposed house design, are summarised in Table D.3.

Table D.3 Heating and cooling load limits

Scenario and outcome	Thermal rating (stars)	Heating load limit (MJ/m ² .annum)	Cooling load limit (MJ/m ² .annum)
Load limits for NatHERS climate zone 10	6	29	42
Calculated loads of proposed house	6.1	16.6	24.3
S42C2(1) met?	Yes	Yes	Yes

Outcome

The individual heating, cooling and total loads do not exceed the respective load limits defined for NatHERS climate zone 10.

This means the house's design complies with S42C2(1).

Note the other requirements listed in S42C4(1)(a)-(e) must also be complied with.

D.2 Building fabric

D.2.1 Example 2: A slab-on-ground house in Adelaide

Introduction

A DTS Solution using the DTS Provisions of the Elemental compliance option is proposed for a house in Adelaide. See Chapter 4 for more information on this compliance option.

The calculations provided are limited to those required for the building fabric i.e. Part 13.2 of the Housing Provisions.

The relevant NCC references are Volume Two H6D2(1)(b), which refers to Part 13.2 of the Housing Provisions.

The site and construction details are summarised in Table D.4.

Table D.4 Example 2 - Site and construction details

House detail	Description
House location	South Australia
NCC climate zone	5
NCC building classification	Class 1 house with an attached Class 10a garage Class 1 floor area = 142 m ²
Roof and ceiling	<ul style="list-style-type: none"> • Standard pitched roof with flat ceiling • Reflective insulation under roof • Eaves with 750 mm overhang • Steel framed • Tiled roof with tile SA = 0.579 • Downlights to 1% of floor area • 600 mm x 1200 mm skylight in kitchen with 2 m drop from ceiling to roof
External wall	<ul style="list-style-type: none"> • Steel framed brick veneer • Brick SA = 0.5 • Wall height = 2400 mm
Floor	Concrete slab on ground with in-screed underfloor heating

Step 1: Application requirements (clause 13.2.1)

Since this example is a house with an attached Class 10a garage, clauses 13.2.2 to 13.2.7 of the Housing Provisions apply.

Step 2: Building fabric thermal insulation requirements (clause 13.2.2)

Clause 13.2.2 relates to insulation selection and installation, where insulation is required. Since this example focusses on calculations, the requirements of clause 13.2.2 are not discussed further. More information on complying with clause 13.2.2 is available in section 4.2.2 of this document.

Step 3: Roof and ceiling requirements (clause 13.2.3)

Since the house is in climate zone 5, clause 13.2.3(1)(e) applies.

This means the roof and ceiling insulation must have a minimum R-Value in accordance with the relevant table, from Tables 13.2.3f to 13.2.3o.

The example house has a pitched roof and flat ceiling, so the relevant table is Table 13.2.3f.

The site and construction details in Table D.4 do not include wind driven or mechanical ventilators. This means the roof ventilation is 'standard'.

The site and construction details in Table D.4 specify the SA of the tiles is 0.579 and that reflective insulation under the roof will be installed.

Figure D.1 is an excerpt of Table 13.2.3f. It shows the required minimum R-Value for ceiling insulation is R2.5.

Figure D.1 Pitched roof with horizontal ceiling - minimum R-Value for ceiling insulation, climate zone 5 (Table 13.2.3f of the Housing Provisions)

Roof ventilation	Reflective insulation under-roof	Under-roof insulation R-Value	SA ≤ 0.42	0.42 < SA ≤ 0.64
Vented	Yes	< 0.5	3.0	2.5
		≥ 0.5	2.5	
	No	< 2.0	3.0	
		≥ 2.0	2.5	
Standard	Yes	Any	2.5	
	No	≤ 0.5	3.0	
		> 0.5 to < 2.0	2.5	
		≥ 2.0	3.0	

13.2.3(2) applies since reflective insulation is installed to comply with (1). These additional requirements are stated in Table 4.3 of this document.

Since the house has a metal-framed (steel) roof, clause 13.2.3(3) applies to address thermal bridging.

There are 4 options available in clause 13.2.3(3) to address thermal bridging in a pitched roof with a flat ceiling. They are:

- (1) Achieve Total R-Value in Table 13.2.3s using a method that can account for thermal bridging.
- (2) Increase R-Value required by (1) by R0.5.
- (3) Adding a continuous ceiling insulation layer of at least R0.13.
- (4) Stacking 2 layers of insulation on top of each other.

Option 2 was chosen, which means the required minimum R-Value for ceiling insulation is R3.0 (i.e. R2.5 from (1) + R0.5).

Clause 13.2.3(5) applies when clause 10.8.3(1) of the Housing Provisions applies. Clause 10.8.3(1), which relates to condensation management, only applies in climate zones 6 to 8.

Since the example house is in climate zones 5, this means clause 10.8.3(1) and consequently clause 13.2.3(5) do not apply.

The site and construction details in Table D.4 specify the house has downlights to 1% of the floor area. This means that clause 13.2.3(5) to compensate for the loss of ceiling insulation applies.

Clause 13.2.3(5) requires the compensation for the loss of ceiling insulation to be determined in accordance with Table 13.2.3w.

The minimum R-Value determined was R3.0.

Figure D.2 is an excerpt of Table 13.2.3w. It shows the required minimum R-Value for ceiling insulation is R3.6 for 1% of ceiling area uninsulated.

Figure D.2 Adjusted minimum R-Value of ceiling insulation required to compensate for the loss of ceiling insulation area (Table 13.2.3w of the Housing Provisions)

Percentage of ceiling area uninsulated	Minimum R-Value of ceiling insulation required to satisfy 13.2.3(1) and (3)									
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
0.5 to less than 1.0%	1.0	1.6	2.2	2.8	3.4	4.0	4.7	5.4	6.2	6.9
1.0% to less than 1.5%	1.1	1.7	2.3	2.9	3.6	4.4	5.2	6.1	7.0	x
1.5% to less than 2.0%	1.1	1.7	2.4	3.1	3.9	4.8	5.8	6.8	x	x
2.0% to less than 2.5%	1.1	1.8	2.5	3.3	4.2	5.3	6.5	x	x	x
2.5% to less than 3.0%	1.2	1.9	2.6	3.6	4.6	5.9	x	x	x	x
3.0% to less than 4.0%	1.2	2.0	3.0	4.2	5.7	x	x	x	x	x
4.0% to less than 5.0%	1.3	2.2	3.4	5.0	x	x	x	x	x	x

Clauses 13.2.3(6) to 13.2.3(9) do not apply for this example.

The SA of the roof tiles is 0.579. Clause 13.2.3(10) requires the SA to be less than 0.64, which it is and therefore complies.

A summary of roof and ceiling requirements is in Table D.5.

Table D.5 Example 2 - Summary of roof and ceiling requirements

13.2.3 subclause reference	Description	R-Value
(1)	Initial minimum R-Value	R2.5
(3)	Thermal bridging	R3.0 (increased from R2.5 by R0.5)
(5)	Compensation for loss of ceiling insulation	R3.6 (increased from R3.0 using Table 13.2.3w)
	Outcome:	Minimum required R-Value of ceiling insulation = R3.6

Step 4: Skylight (roof light) requirements (clause 13.2.4)

Since the house has a skylight, clause 13.2.4 applies.

Clause 13.2.4(a) requires the total area of the skylight to be less than or equal to 5% of the floor area the skylight serves.

For the example house, the skylight is 600 mm x 1200 mm in size, which equals 0.72 m².

From the house plans in **Error! Reference source not found.**, the kitchen is 3 m x 6 m, which equals 18 m².

The total area of the skylight as a percentage of the floor area the skylight serves is equal to 0.72 m² / 18 m², i.e. 4%.

Since the total area of the skylight as a percentage of the floor area is less than 5%, the skylight complies with clause 13.2.4(a).

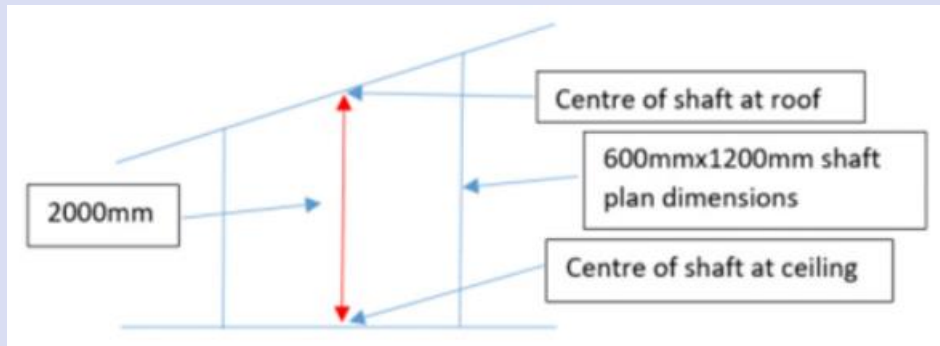
Clause 13.2.4(b)(i) requires the Total System SHGC⁷⁷ to meet Table 13.2.4.

Table 13.2.4 requires the skylight (roof light) shaft index to be calculated first to determine the required Total System SHGC.

A vertical cross section of the skylight shaft is shown in Figure D.3.

⁷⁷ Combined performance of transparent and translucent elements, including any imperforate ceiling diffuser.

Figure D.3 Example 2: Skylight shaft dimensions



The skylight shaft index is equal to $2000 / ((600 + 1200) / 2) = 2.22$

Figure D.4 is an excerpt of Table 13.2.4. For a skylight with a shaft index of 2.22, that has a total skylight area as a percentage of the floor area the skylight serves equal to 4%, the Total System SHGC required must be less than or equal to 0.33.

Figure D.4 Skylights - Total System SHGC (Table 13.2.4 of the Housing Provisions)

Roof light shaft index Note 1	Total area of roof lights up to 3.5% of the floor area of the room or space	Total area of roof lights more than 3.5% and up to 5% of the floor area of the room or space
< 1.0	≤ 0.45	≤ 0.29
≥ 1.0 to < 2.5	≤ 0.51	≤ 0.33
≥ 2.5	≤ 0.76	≤ 0.49

Clause 13.2.4(b)(ii) requires the Total System U-Value⁷⁸ be less than or equal to U3.9.

In summary, the skylight must have a Total System SHGC less than or equal to 0.33 and a Total System U-Value less than or equal to 3.9.

Step 5: External wall requirements (clause 13.2.5)

Since the external wall of the example house is brick veneer, which is not a lightweight wall construction, clause 13.2.5(1) applies.

For climate zone 5 clause 13.2.5(1)(e) applies, which requires wall insulation to have a minimum R-Value in accordance with Tables 13.2.5i and 13.2.5j as applicable.

Since the external wall in this example is brick veneer, Table 13.2.5i applies.

The site and construction details in Table D.4 specify the brick SA is less than or equal to 0.5, the eaves have a 750 mm overhang and the wall height is 2400 mm.

⁷⁸ Combined performance of transparent and translucent elements, including any imperforate ceiling diffuser.

Figure D.5 is an excerpt of Table 13.2.5i. It shows the required minimum R-Value for wall insulation for a wall with a SA of 0.5, overhang of 750 mm and wall height of 2400 mm is R2.0.

Figure D.5 Masonry veneer wall - minimum insulation R-Value, climate zone 5 (Table 13.2.5i of the Housing Provisions)

SA	Overhang (mm)	Wall height (m)			
		≤ 2.4	> 2.4 to ≤ 2.7	2.7 to ≤ 3.0	> 3.0 to ≤ 3.6
≤ 0.35	0	1.5	2.0	2.0	2.5
	> 0 to ≤ 300	1.5	2.0	2.0	2.5
	> 300 to ≤ 450	1.5	1.5	2.0	2.5
	> 450 to ≤ 600	1.5	2.0	2.0	2.5
	> 600 to ≤ 900	2.0	2.0	2.0	2.5
	> 900 to ≤ 1200	3.0	2.0	2.0	2.5
	> 1200 to ≤ 1500	X	3.0	2.5	2.5
> 0.35 to ≤ 0.5	0	1.5	2.0	2.0	2.5
	> 0 to ≤ 300	1.5	1.5	2.0	2.5
	> 300 to ≤ 450	1.5	1.5	2.0	2.5
	> 450 to ≤ 600	1.5	1.5	2.0	2.5
	> 600 to ≤ 900	2.0	2.0	2.0	2.5
	> 900 to ≤ 1200	2.5	2.0	2.0	2.5
	> 1200 to ≤ 1500	3.0	2.5	2.5	2.5
> 0.5 to ≤ 0.7	0	1.5	2.0	2.0	3.0
	> 0 to ≤ 300	1.5	2.0	2.0	3.0
	> 300 to ≤ 450	1.5	1.5	2.0	2.5
	> 450 to ≤ 600	1.5	2.0	2.0	2.5
	> 600 to ≤ 900	2.0	2.0	2.0	2.5
	> 900 to ≤ 1200	2.5	2.0	2.0	2.5
	> 1200 to ≤ 1500	X	3.0	2.5	2.5

The SA of the bricks is 0.5. Clause 13.2.5(3) requires the SA of the outer surface of a wall to be less than or equal to 0.7, which it is and therefore complies.

Since the house has a metal-framed (steel) wall, clause 13.2.5(4) applies to address thermal bridging.

There are 2 options available in clause 13.2.5(4) to address thermal bridging in a metal framed wall. They are:

- (1) Achieve Total R-Value in Tables 13.2.5p to 13.2.5r using the methods in AS/NZS 4859.2.
- (2) Comply with 1 of the options in Tables 13.2.5s to 13.2.5u as applicable.

Option 2 was chosen which means Table 13.2.5u applies since the wall is masonry veneer.

Within Table 13.2.5u there are 2 options: either install reflective insulation or add a layer of insulation with an R-Value of at least R0.3. The option to install insulation with an R-Value of R0.3 on the outside of the metal frame was chosen.

Step 6: Floor and subfloor wall requirements (clause 13.2.6)

The site and construction details in Table D.4 specify the floor is CSOG with an in-screed heating system.

Clauses 13.2.6(1) and (2) do not apply to this example house since the floor is a CSOG, rather than a floor over an enclosed space.

Clause 13.2.6(3) also doesn't apply to this example since the floor doesn't contain a metal frame.

Clause 13.2.6(4) applies since the floor does contain an in-screed heating system. This means insulation with an R-Value greater than or equal to R1.0 must be installed around the vertical edge of the perimeter of the slab.

Since the house is in climate zone 5, clause 13.2.6(5)(a) and (b) do not apply.

Clause 13.2.6(6) requires the insulation in 13.2.6(4) to be water resistant and correctly installed. See section 4.2.2 of this document for further guidance.

Clause 13.2.6(7) is an exemption that does not apply for this example.

Step 7: Attached garage (clause 13.2.7)

The example house has an attached Class 10a garage, which means clause 13.2.7 applies.

To comply, Option 1 was chosen (clause 13.2.7(a)) which means the external fabric of the garage will have the same thermal performance as the house.

Step 7: Summary of building fabric requirements

Table D.6 shows a summary of the minimum requirements for the building fabric for Example 2, as determined from Steps 2 to 6 above.

Table D.6 Summary of building fabric requirements (Part 3.12) for Example 2

Building element	Clause	Minimum requirements
Building fabric thermal insulation	13.2.2	As per section 4.2.2 of this document
Roof and ceiling	13.2.3	Reflective insulation under the roof Ceiling insulation = R3.6
Skylight (roof light)	13.2.4	Skylight Total System SHGC less than or equal to 0.33 Skylight Total System U-Value not more than 3.9
External wall	13.2.5	Wall insulation = R2.0 Insulation strip to the outer face of all elements of the steel wall frame

Floor and subfloor walls	13.2.6	Edge perimeter slab insulation greater or than or equal to R1.0 Edge perimeter slab insulation properties and installation as per section 4.2.2 of this document
Attached garage	13.2.7	Insulation requirements to the external fabric of the garage as per the house (i.e. requirements above).

Notes to Example 2

Compliance with other NCC requirements (such as fire, waterproofing, condensation, etc.) is not considered. This should be considered separately when determining required construction arrangements and details.

These requirements are considered general in nature. Specific detailing requirements as required by NCC, relevant codes and standards and supplier product technical requirements are not included (such as fit-up and installation detailing, abutting and fixing of insulation etc.). This should be considered during design and construction.

D.2.2 Example 3: Suspended timber floor house in Melbourne

Introduction

A DTS Solution using the DTS Provisions of the Elemental compliance option is proposed for a house in Melbourne. See Chapter 4 for more information on this compliance option.

The calculations provided are limited to those required for the building fabric i.e. Part 13.2 of the Housing Provisions.

The relevant NCC references are Volume Two H6D2(1)(b), which refers to Part 13.2 of the Housing Provisions.

The plans are in Figure D.10 to Figure D.17⁷⁹.

The site and construction details are summarised in Table D.7.

Table D.7 Example 3 - Site and construction details

House detail	Description
House location	Melbourne
NCC climate zone	6
NCC building classification	Class 1 house with an attached Class 10a garage Class 1 floor area = 160 m ²
Roof and ceiling	<ul style="list-style-type: none"> Standard pitched roof with flat ceiling Reflective insulation under roof Eaves with 500 mm overhang Timber framed Tiled roof with tile SA equal to or less than 0.7 Downlights to 0.5% of floor area
External wall and subfloor walls	<ul style="list-style-type: none"> Timber framed brick veneer with double brick subfloor walls Brick SA equal to or less than 0.7 Wall height = 2400 mm
Floor	<ul style="list-style-type: none"> Timber framed subfloor Subfloor wall height = 540 mm

⁷⁹ The plans and specifications for Example 3 were kindly provided by the Housing Industry Association (HIA).

- No reflective insulation

Step 1: Application requirements (clause 13.2.1)

Since this example is a house with an attached Class 10a garage, clauses 13.2.2 to clause 13.2.7 of the Housing Provisions apply.

Step 2: Building fabric thermal insulation requirements (clause 13.2.2)

Clause 13.2.2 relates to insulation selection and installation, where insulation is required. Since this example focusses on calculations, the requirements of clause 13.2.2 are not discussed further. More information on complying with clause 13.2.2 is available in section 4.2.2 of this document.

Step 3: Roof and ceiling requirements (clause 13.2.3)

Since the house is in climate zone 6, clause 13.2.3(1)(f) applies.

This means the roof and ceiling insulation must have a minimum R-Value in accordance with the relevant table, from Tables 13.2.3g to 13.2.3p.

The example house has a pitched roof and flat ceiling, so the relevant table is Table 13.2.3g.

The site and construction details in Table D.7 do not include wind driven or mechanical ventilators. This means the roof ventilation is 'standard'.

The site and construction details in Table D.7 specify the SA of the tiles is less than or equal to 1 and no reflective insulation will be installed.

Figure D.6 is an excerpt of Table 13.2.3g. It shows the required minimum R-Value for:

- under-roof insulation must be at least R1.0, and
- ceiling insulation is R3.5.

Figure D.6 Pitched roof with horizontal ceiling – minimum R-Value for ceiling insulation, climate zone 6 (Table 13.2.3g of the Housing Provisions)

Table 13.2.3g Pitched roof with horizontal ceiling – minimum R-Value for ceiling insulation: climate zone 6

Roof ventilation	Reflective insulation under-roof	Under-roof insulation R-Value	0.23 ≤ SA ≤ 0.64	0.64 < SA ≤ 0.96
Vented	Yes	< 1.0	4.0	3.5
		≥ 1.0	3.5	
	No	< 1.0	4.0	
		≥ 1.0	3.5	
Standard	Yes	< 1.0	3.5	
		≥ 1.0	3.0	
	No	< 1.0	4.0	
		≥ 1.0	3.5	

The notes to Table 13.2.3g must also be met.

Note 4 to Table 13.2.3g states that in climate zones 6 to 8 roof ventilation must comply with clause 10.8.3.

Clause 10.8.3 Ventilation of roof spaces states that a roof in climate zones 6 to 8 must have a roof space located immediately above any ceiling insulation that is needed to meet the requirements of clause 13.2.3(3).

As outlined above for this example, under-roof insulation with an R-Value of at least R1.0 is needed to comply with clause 13.2.3(3). This means a roof space with a height of not less than 20 mm and roof space ventilation is required. See clause 10.8.3 for more information.

Since the house doesn't have a metal-framed roof, clause 13.2.3(3) to address thermal bridging, does not apply.

Clause 13.2.3(4) applies when thermal bridging mitigation is required and when clause 10.8.3(1) of the Housing Provisions applies. Since thermal bridging mitigation is not required, clause 13.2.3(4) does not apply.

The site and construction details in Table D.7 specify the house has downlights to 0.5% of the floor area. This means that clause 13.2.3(5) to compensate for the loss of ceiling insulation applies.

Clause 13.2.3(5) requires the compensation for the loss of ceiling insulation to be determined in accordance with Table 13.2.3w.

The minimum R-Value of the ceiling insulation determined using Figure D.6 above was R3.5.

Figure D.7 is an excerpt of Table 13.2.3w. It shows the required minimum R-Value for ceiling insulation is R4.0 for 1% of uninsulated ceiling area.

Figure D.7 Adjusted minimum R-Value of ceiling insulation required to compensate for loss of ceiling insulation area (Table 13.2.3w of the Housing Provisions)

Percentage of ceiling area uninsulated	Minimum R-Value of ceiling insulation required to satisfy 13.2.3(1) and (3)									
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
0.5 to less than 1.0%	1.0	1.6	2.2	2.8	3.4	4.0	4.7	5.4	6.2	6.9
1.0% to less than 1.5%	1.1	1.7	2.3	2.9	3.6	4.4	5.2	6.1	7.0	x
1.5% to less than 2.0%	1.1	1.7	2.4	3.1	3.9	4.8	5.8	6.8	x	x
2.0% to less than 2.5%	1.1	1.8	2.5	3.3	4.2	5.3	6.5	x	x	x
2.5% to less than 3.0%	1.2	1.9	2.6	3.6	4.6	5.9	x	x	x	x
3.0% to less than 4.0%	1.2	2.0	3.0	4.2	5.7	x	x	x	x	x
4.0% to less than 5.0%	1.3	2.2	3.4	5.0	x	x	x	x	x	x

Since the ceiling insulation required by Clauses 13.2.3(1) to (5) is greater than R3.0 and less than R4.5, it can be reduced to R3.0 within 450 mm of the external wall using 13.2.3(6).

Although the roof in this example is a metal sheet roof, clause 13.2.3(7) does not apply. This is because the roof has a flat ceiling lining which is not attached directly to the purlins, rafters or battens, regardless of whether any of the purlins, rafters or battens are metal.

Clauses 13.2.3(8) to 13.2.3(10) do not apply for this example.

A summary of roof and ceiling requirements is in Table D.8.

Table D.8 Example 3 - Summary of roof and ceiling requirements

13.2.3 subclause reference	Description	R-Value
(1)	Initial minimum R-Value	Under-roof insulation = R1.0 Ceiling insulation = R3.5
(5)	Compensation for loss of ceiling insulation	Ceiling insulation = R4.0 (increased from R3.5 using Table 13.2.3w)
(6)	Edge of ceiling insulation	Ceiling insulation = R3.0 within 450 mm of wall
	Outcome	Minimum required R-Value of ceiling insulation = R4.0, reduced to R3.0 within 450 mm of wall Under-roof insulation = R1.0

Step 4: Skylight (roof light) requirements (clause 13.2.4)

Clause 13.2.4 does not apply as there are no roof lights in this house.

Step 5: External wall requirements (clause 13.2.5)

Since the external wall of the example house is brick veneer, which is not a lightweight wall construction, clause 13.2.5(1) applies (except for the external walls of the subfloor space below the suspended floor, which is addressed separately).

For climate zone 6 clause 13.2.5(1)(f) applies, which requires wall insulation to have a minimum R-Value in accordance with Tables 13.2.5k and 13.2.5l as applicable.

Since the external wall in this example is brick veneer, Table 13.2.5k applies.

The site and construction details in Table D.7 specify the brick SA is less than or equal to 0.7 (adopt 0.7 as the design value), the eaves have a 500 mm overhang and the wall height is 2400 mm.

Figure D.8 is an excerpt of Table 13.2.5k. It shows the required minimum R-Value for wall insulation for a wall with an SA of 0.7, overhang of 500 mm and wall height of 2400 mm is R2.5.

Figure D.8 Masonry veneer wall - minimum insulation R-Value, climate zone 6 (Table 13.2.5k of the Housing Provisions)

SA	Overhang (mm)	Wall height (m)			
		≤ 2.4	> 2.4 to ≤ 2.7	> 2.7 to ≤ 3.0	> 3.0 to ≤ 3.6
≤ 0.35	0	2.0	2.4	X	X
	> 0 to ≤ 300	2.4	2.4	X	X
	> 300 to ≤ 450	2.5	X	X	X
	> 450 to ≤ 600	X	X	X	X
	> 600 to ≤ 900	X	X	X	X
> 0.35 to ≤ 0.5	0	2.0	2.4	2.5	X
	> 0 to ≤ 300	2.4	2.5	X	X
	> 300 to ≤ 450	2.4	X	X	X
	> 450 to ≤ 600	X	X	X	X
	> 600 to ≤ 900	X	X	X	X
> 0.5 to ≤ 0.7	0	2.0	2.0	2.4	X
	> 0 to ≤ 300	2.0	2.4	2.5	X
	> 300 to ≤ 450	2.4	2.4	2.5	X
	> 450 to ≤ 600	2.5	2.5	X	X
	> 600 to ≤ 900	X	X	X	X
> 0.7 to ≤ 0.85	0	1.5	2.0	2.4	X
	> 0 to ≤ 300	2.0	2.0	2.4	X
	> 300 to ≤ 450	2.4	2.4	2.4	X
	> 450 to ≤ 600	2.4	2.4	2.4	X
	> 600 to ≤ 900	X	X	X	X

The SA of the bricks is 0.7. Clause 13.2.5(3) requires the SA of the outer surface of a wall to be less than or equal to 0.7, which it is and therefore complies.

The house does not have a metal-framed wall, so clauses 13.2.5(4) to (5) do not apply.

Step 7: Floor and subfloor wall requirements (clause 13.2.6)

The site and construction details in Table D.7 specify the floor is timber framed over an enclosed space with double brick subfloor walls. The subfloor wall height = 540 mm.

The floor is not over an unenclosed space, therefore clause 13.2.6(1) does not apply.

Since the floor is over an enclosed subfloor space, clause 13.2.6(2) applies.

For climate zone 6, clause 13.2.6(2)(f) applies, which means the floor and subfloor insulation must be in accordance with Table 13.2.6f.

The subfloor wall is 540 mm and Table D.7 specifies there is no reflective insulation.

Figure D.9 is an excerpt of Table 13.2.6f. It shows the required minimum R-Value for the suspended floor is R2.0 and no insulation is required for the subfloor wall.

Figure D.9 Minimum R-Value of floor and subfloor wall insulation where the floor is over an enclosed subfloor space, climate zone 6 (Table 13.2.6f)

Subfloor wall height (mm)	Reflective insulation facing down over the subfloor area	Minimum subfloor wall insulation R-Value	Minimum suspended floor insulation R-Value
≤600	No	0.0	2.0
≤600	Yes	0.0	1.5
>600 to ≤900	No	0.0	2.0
>600 to ≤900	Yes	0.0	1.5
>900 to ≤1200	No	0.0	2.0
>900 to ≤1200	Yes	0.0	1.5
>1200 to ≤1500	No	0.0	2.5
>1200 to ≤1500	No	0.5	2.0
>1200 to ≤1500	Yes	0.0	1.5
>1500 to ≤1800	No	0.0	2.5
>1500 to ≤1800	Yes	0.0	2.0
>1500 to ≤1800	Yes	0.5	1.5

Clause 13.2.6(3) doesn't apply to this example since the floor doesn't contain a metal frame.

Clause 13.2.6(4) also doesn't apply to this example since the floor is not a CSOG.

Since the example house is in climate zone 6, 13.2.6(5)(a) applies. This means insulation with an R-Value greater than or equal to R1.0 must be installed around the vertical edge of the perimeter of the floor.

Clause 13.2.6(6) requires the insulation in Clause 13.2.6(4) to be water resistant and correctly installed. See section 4.2.2 of this document for further guidance.

Clause 13.2.6(7) is an exemption that does not apply for this example.

Step 7: Attached garage (clause 13.2.7)

The example house has an attached Class 10a garage, which means clause 13.2.7 applies.

The roof of the garage does not share a common roof with the house. This means clause 13.2.7(b) is more practical since it requires insulation to separate the thermal performance of the house from the garage.

Step 7: Summary of building fabric requirements

Table D.9 shows a summary of the minimum requirements for the building fabric for Example 3, as determined from Steps 2 to 6 above.

Table D.9 Summary of building fabric requirements (Part 3.12) for Example 3

Building element	Clause	Minimum requirements
Building fabric thermal insulation	13.2.2	As per section 4.2.2 of this document

Roof and ceiling	13.2.3	Under-roof insulation = R1.0 Ceiling insulation = R4.0, reduced to R3.0 within 450 mm of wall
Skylight (roof light)	13.2.4	Not applicable
External wall	13.2.5	Wall insulation = R2.5
Floor and subfloor walls	13.2.6	Suspended floor insulation = R2.0 Edge perimeter subfloor wall insulation = R1.0 Edge perimeter slab insulation properties and installation as per section 4.2.2 of this document
Attached garage	13.2.7	Insulation requirements to the separating wall between the garage and house to be as per the house (i.e. requirements above).

Notes to Example 3

Compliance with other NCC requirements (such as fire, waterproofing, condensation, etc.) is not considered. This should be considered separately when determining required construction arrangements and details.

These requirements are considered general in nature. Specific detailing requirements as required by NCC, relevant codes and standards and supplier product technical requirements are not included (such as fit-up and installation detailing, abutting and fixing of insulation etc.). This should be considered during design and construction.

Figure D.10 Climate zone 6 house – Floor plan

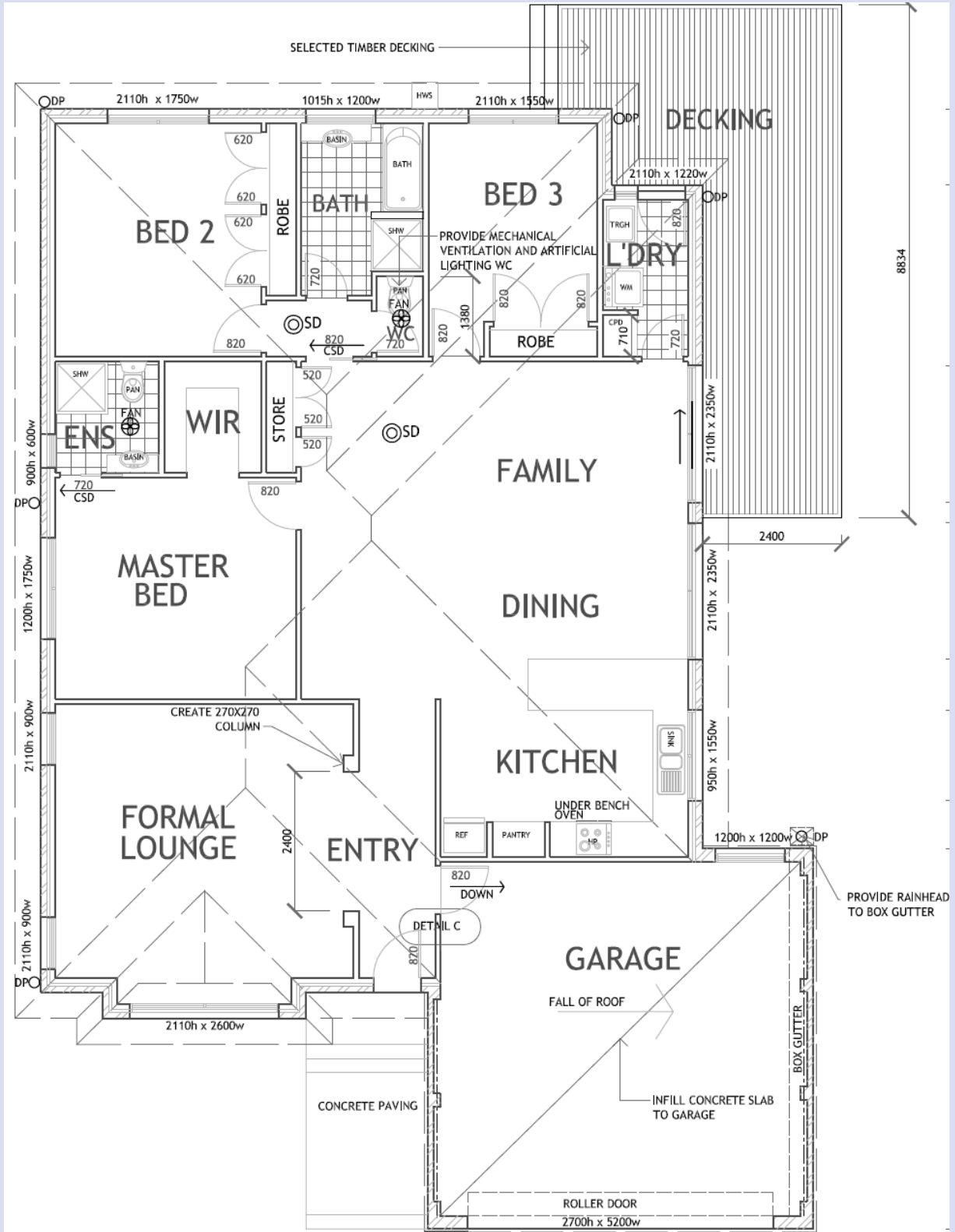


Figure D.11 Climate zone 6 house – North elevation

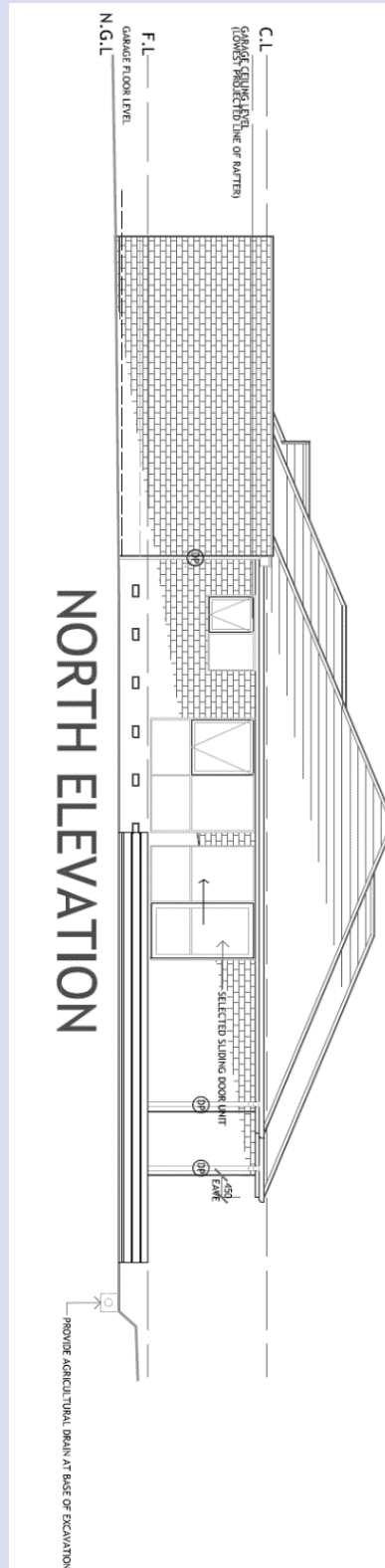


Figure D.12 Climate zone 6 house – South elevation

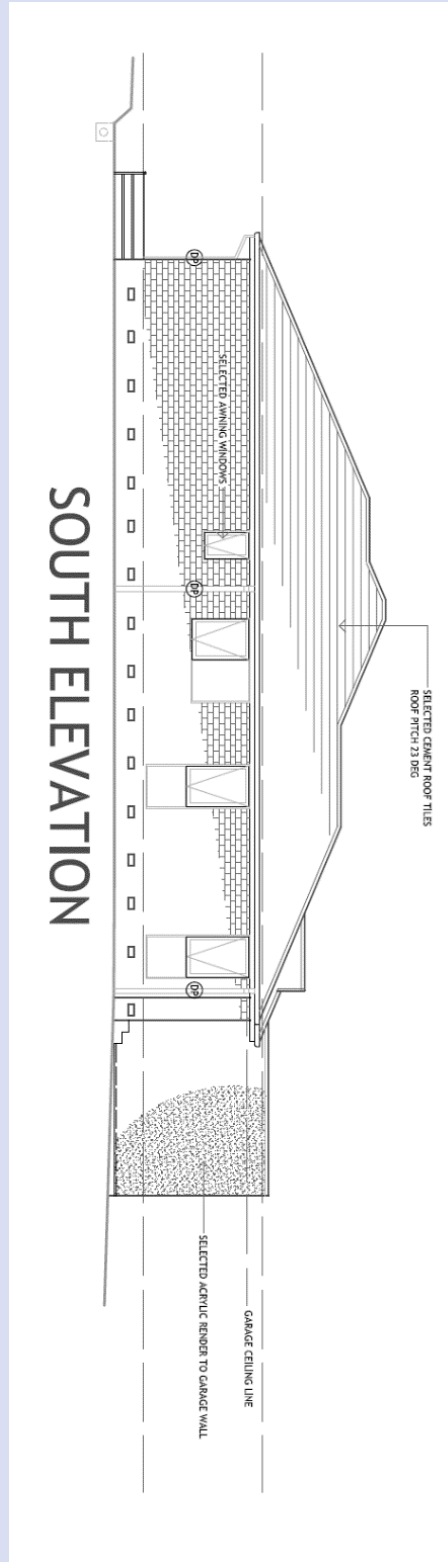


Figure D.13 Climate zone 6 house – East elevation

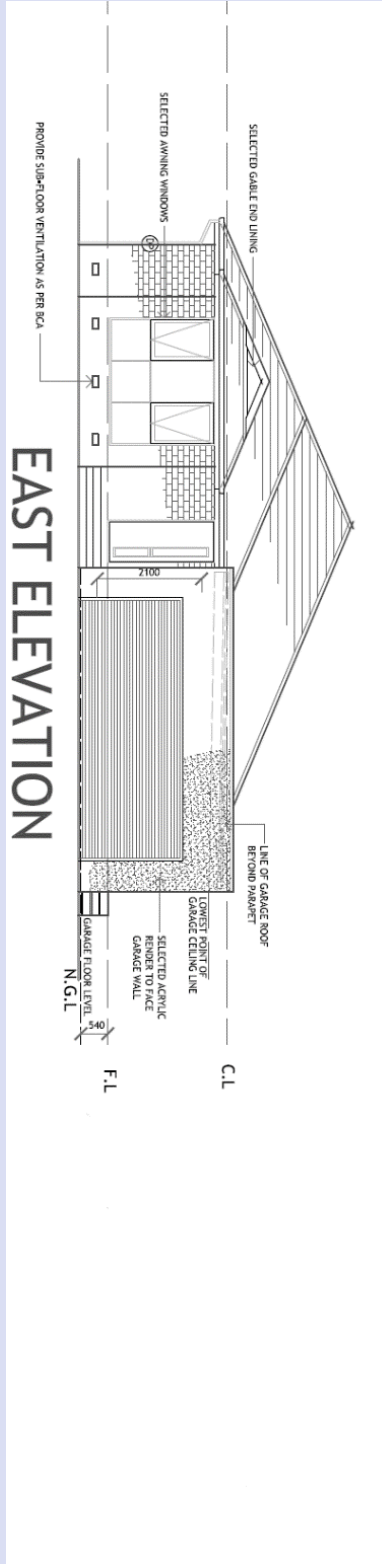


Figure D.14 Climate zone 6 house - West elevation

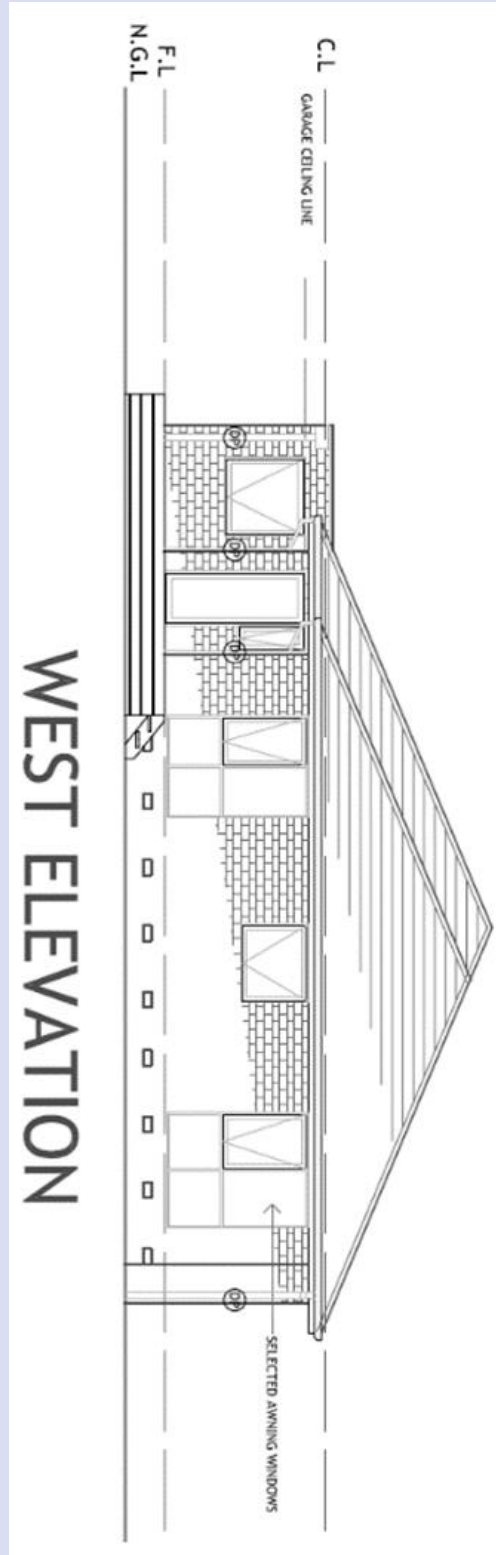


Figure D.15 Climate zone 6 house - section A details

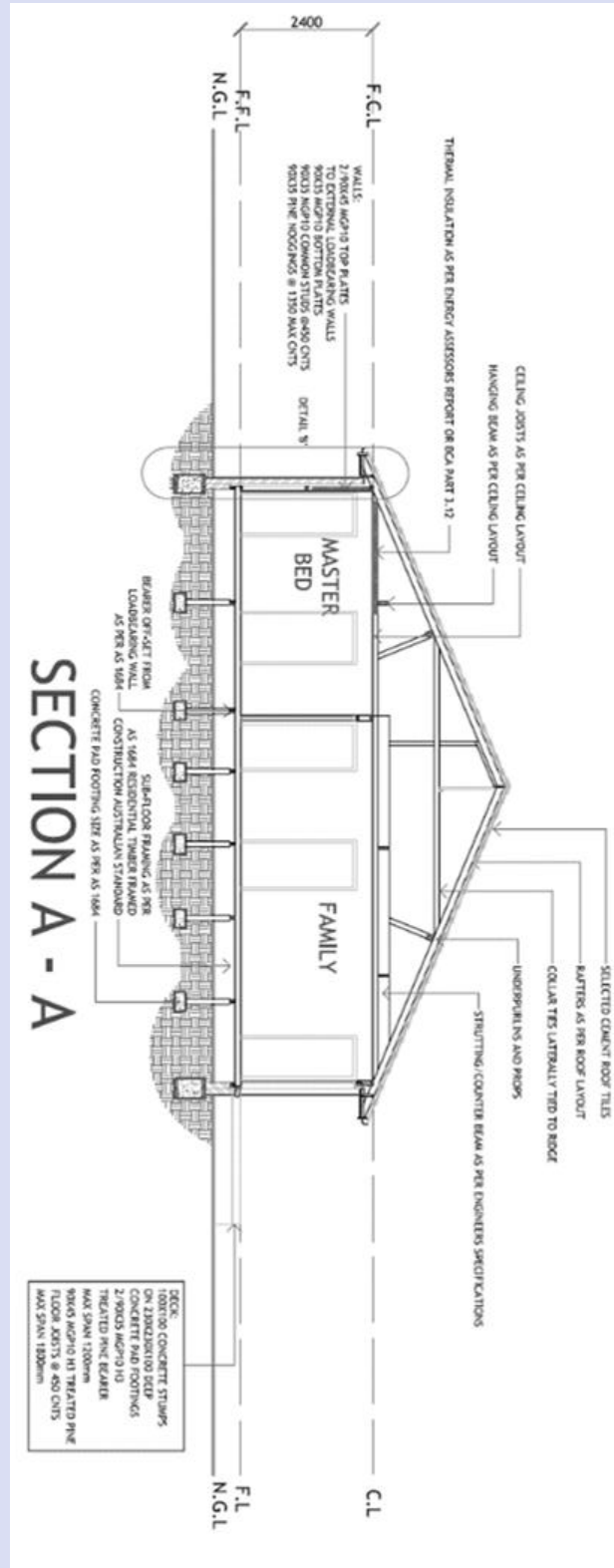


Figure D.16 Climate zone 6 house - section B details

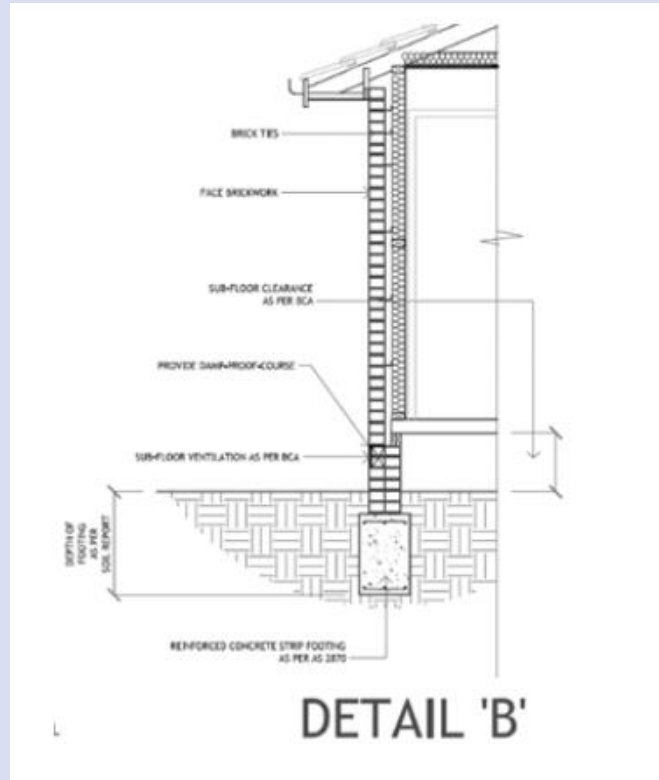
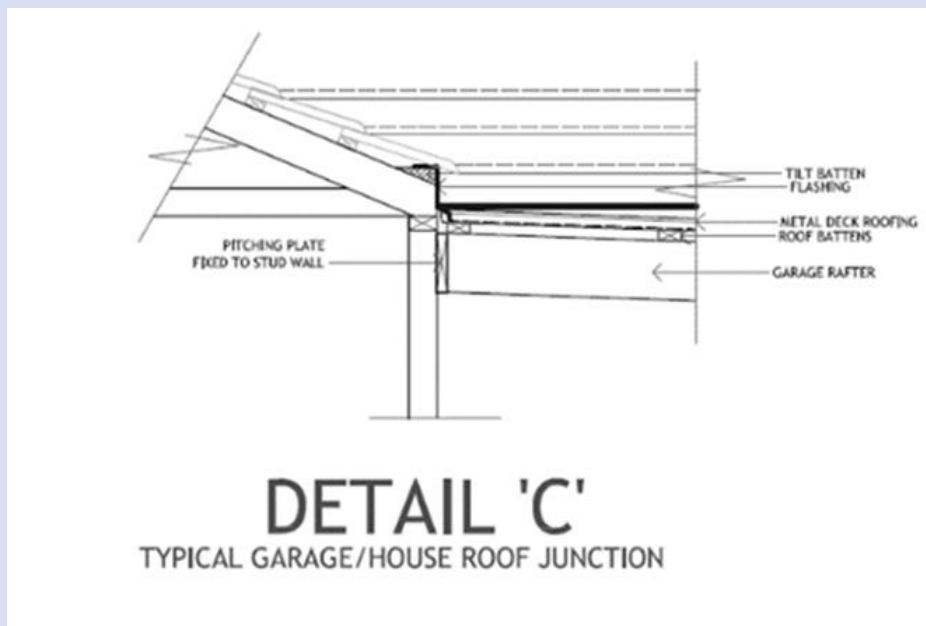


Figure D.17 Climate zone 6 house - section C details



D.3 Glazing

D.3.1 Example 4: Suspended timber floor house in Melbourne

Introduction

A DTS Solution using the DTS Provisions that form the Elemental compliance option is proposed for a house in Melbourne. See Chapter 4 for more information on this compliance option.

The calculations provided are limited to those required for the external glazing i.e. Part 13.3 of the Housing Provisions.

The relevant NCC references are Volume Two H6D2(1)(b), which refers to Part 13.3 of the Housing provisions.

The plans are in Figure D.10 to Figure D.17

The windows specified for this house were aluminium framed with a black powder coating with an SA = 0.96, double glazed glass with a low emittance (low-e) coating.

Window products and their thermal performance (Total System U-Value and Total System SHGC) were determined using [WERS](#).

Step 1: Determine winter glazing allowance

In accordance with clause 13.3.2(1), the allowable ratio of glazing conduction (C_u) and solar heat gain (C_{SHGC}) of the glazing in the storey is given in Table 13.3.2a.

Figure D.18 shows that for a suspended floor in climate zone 6, the $C_u/C_{SHGC} = 6.06$.

Figure D.18 Maximum conductance to solar heat gain (Table 13.3.2a of Housing Provisions)

Table 13.3.2a Maximum conductance to solar heat gain ratio (C_U/C_{SHGC})

Climate zone	Floor in direct contact with the ground	Suspended floor
2	9.60	9.37
3	19.10	14.75
4	10.25	8.04
5 (lightweight wall)	8.89	8.32
5 (concrete or masonry wall)	8.79	10.12
6	8.45	6.06
7	7.02	7.96
8	4.93	9.41

Step 2 Calculate design C_u/C_{SHGC} vales

The design value of the ratio of glazing conduction (C_u) and solar gain (C_{SHGC}) (C_u/C_{SHGC}) is calculated in accordance with clause 13.3.2(1)(b).

An excerpt of the calculation is shown in Figure D.19

Figure D.19 Excerpt of external glazing (winter) calculation (13.3.2 (1)(b) of Housing Provisions)

$$\frac{[(A_1 \times U_1 \times BC_1 \times OC_1 \times R_{W1}) + (A_2 \times U_2 \times BC_2 \times OC_2 \times R_{W2}) + \dots]}{[(A_1 \times SHGC_1 \times E_{W1} \times R_{W1} \times BS_{W1} \times L_{W1} \times F_{W1} \times H_{W1}) + (A_2 \times SHGC_2 \times E_{W2} \times R_{W2} \times BS_{W2} \times L_{W2} \times F_{W2} \times H_{W2}) + \dots]}$$

See Table 4.8 for a description of the required inputs for this calculation.

All the relevant values for this example have been entered into the ABCB Glazing Calculator to assist in this calculation, this is shown in Figure D.20

Figure D.20 Table of window design inputs in the ABCBC Glazing calculator

ID	Glazing element Description (optional)	Orient- ation Facing sector	Size			Factors affecting impact of glazing performance				Performance		Shading		Calculation data		Area used (m ²)	
			Height (m)	Width (m)	Area (m ²)	Bedroom / Utility?	Level/ Floor type	Adjacent floor covering	Frame colour	Openability	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H		E _s
1	Formal Lounge	E	2.11	2.60		Other	Ground: Suspended	Carpet	Dark	Double Hung	2.70	0.52	0.50	2.11	0.24	0.76	5.49
2	Formal Lounge	S	2.11	0.90		Other	Ground: Suspended	Carpet	Dark	Double Hung	2.80	0.53	0.50	2.11	0.24	0.17	1.90
3	Formal Lounge	S	2.11	0.90		Other	Ground: Suspended	Carpet	Dark	Highly Openable	2.80	0.53	0.50	2.11	0.24	0.17	1.90
4	Kitchen	N	0.95	1.55		Utility	Ground: Suspended	Floating Timber	Dark	40%	2.80	0.53	0.50	0.95	0.53	0.27	1.47
5	Dining	N	2.11	2.35		Other	Ground: Suspended	Floating Timber	Dark	Sliding Door	2.60	0.52	0.50	2.11	0.24	0.51	4.96
6	Family	N	2.11	2.35		Other	Ground: Suspended	Floating Timber	Dark	10%	2.70	0.51	0.50	2.11	0.24	0.51	4.96
7	Master Bed	S	1.20	1.75		Bedroom	Ground: Suspended	Carpet	Dark	Highly Openable	2.90	0.53	0.50	1.20	0.42	0.11	2.10
8	Ensuite	S	0.90	0.60		Utility	Ground: Suspended	Ceramic Tile	Dark	20%	3.30	0.54	0.50	0.90	0.56	0.10	0.54
9	Bed 2	W	2.11	1.75		Bedroom	Ground: Suspended	Carpet	Dark	Highly Openable	2.60	0.52	0.50	2.11	0.24	1.23	3.69
10	Bathroom	W	1.00	1.20		Utility	Ground: Suspended	Ceramic Tile	Dark	70%	3.30	0.54	0.50	1.02	0.49	0.96	1.20
11	Bed 3	W	2.11	1.55		Bedroom	Ground: Suspended	Carpet	Dark	10%	2.60	0.52	0.50	2.11	0.24	1.23	3.27
12	Laundry	W	2.11	1.22		Utility	Ground: Suspended	Ceramic Tile	Dark	Highly Openable	3.30	0.54	3.02	2.11	1.43	0.47	2.57

Step 3 Check compliance

The ABCB Glazing calculator shows the design C_u/C_{SHGC} accounts for 81.4%, of the allowance of 6.06 (determined in step 1) and therefore complies. See Figure D.23 and Figure D.24 which show the results from the ABCB Glazing Calculator.

Step 4 Determine summer glazing solar heat gain allowance

In accordance clause 13.3.3(1), the allowable aggregate solar heat gain of the glazing must not exceed the multiplication of the floor area of each storey (one storey since there is a framed subfloor) by the constant C_{SHGC} .

The floor area of storey $\times C_{SHGC} = 160 \times 0.0989 = 15.824$, noting $C_{SHGC} = 0.0989$ (ventilation opening of 10%) for suspended floor in climate zone 6. This is shown in

Figure D.21 below.

Figure D.21 Constant for solar heat gain coefficient (C_{SHGC}): climate zones 1 to 7 (Table 13.3.3a of Housing Provisions)

Floor type	Ventilation opening area	Climate zone							
		1	2	3	4	5 (lightweight wall)	5 (concrete or brick wall)	6	7
Floor in direct contact with the ground	5%	0.0672	0.0595	0.0945	0.0604	0.0484	0.0657	0.0786	0.0762
	10%	0.0718	0.0640	0.0985	0.0626	0.0538	0.0695	0.0817	0.0821
	15%	0.0770	0.0682	0.1001	0.0641	0.0569	0.0714	0.0832	0.0871
	20%	0.0827	0.0719	0.1007	0.0650	0.0587	0.0723	0.0840	0.0912
Suspended floor	5%	0.0431	0.0324	0.0768	0.0651	0.0334	0.0630	0.0963	0.0750
	10%	0.0497	0.0404	0.0783	0.0697	0.0426	0.0683	0.0989	0.0778
	15%	0.0541	0.0458	0.0792	0.0721	0.0477	0.0710	0.1001	0.0789
	20%	0.0570	0.0494	0.0796	0.0734	0.0505	0.0723	0.1007	0.0793

Step 5 Determine design aggregate solar heat gain

The design value of aggregate solar heat gain of the glazing is calculated in accordance with the calculation at 13.3.3(1)(b). An excerpt of this calculation is shown in Figure D.22.

Figure D.22 Excerpt of external glazing (summer) calculation (13.3.3 (1)(b) of Housing Provisions)

$$(A_1 \times SHGC_1 \times E_{S1} \times R_{S1} \times L_{S1} \times F_{S1} \times H_{S1}) + (A_2 \times SHGC_2 \times E_{S2} \times R_{S2} \times L_{S2} \times F_{S2} \times H_{S2}) + \dots$$

See Table 4.9 for a description of the required inputs for this calculation.

All the relevant values for this example have been entered into the ABCB NCC Volume Two Glazing Calculator to assist in this example, as shown in Table D.10

Step 6: Check summer compliance

The ABCB Glazing calculator outputs show the glazing design complies with the summer glazing allowance. The glazing design solar heat gain uses 71.3% of the allowed solar heat gain, see Figure D.23 and Figure D.24.

Figure D.23 ABCB Glazing calculator outputs

Shading		Calculation data			Winter outcomes		Summer outcomes	
P&H or Device		Exposure		Size	Conduction / Solar gain - PASSED 81.4%		Solar heat gain - PASSED 71.3%	
P (m)	H (m)	P/H	E _s	Area used (m ²)	% of winter heat loss	% of winter heat gain	SHGC x E _s x Area	Element share % of allowance used
0.50	2.11	0.24	0.76	5.49	14%	15%	2.2	19% of 71%
0.50	2.11	0.24	0.17	1.90	5%	2%	0.2	2% of 71%
0.50	2.11	0.24	0.17	1.90	5%	2%	0.2	2% of 71%
0.50	0.95	0.53	0.27	1.47	5%	7%	0.2	2% of 71%
0.50	2.11	0.24	0.51	4.96	15%	20%	1.3	12% of 71%
0.50	2.11	0.24	0.51	4.96	16%	19%	1.3	12% of 71%
0.50	1.20	0.42	0.11	2.10	6%	3%	0.1	1% of 71%
0.50	0.90	0.56	0.10	0.54	2%	1%	0.0	0.3% of 71%
0.50	2.11	0.24	1.23	3.69	10%	13%	2.4	21% of 71%
0.50	1.02	0.49	0.96	1.20	4%	4%	0.6	5% of 71%
0.50	2.11	0.24	1.23	3.27	9%	11%	2.1	19% of 71%
3.02	2.11	1.43	0.47	2.57	9%	4%	0.7	6% of 71%

ing Codes Board website (abcb.gov.au). The Australian Building Codes Board, the Commonwealth of
ximum extent permitted by law. No representation or warranty is made or given as to the currency,
mitted by law. This calculator is not legal or professional advice. Persons rely upon this calculator

If inputs are valid



Figure D.24 Screenshot of ABCBC Glazing calculator

1. Enter building name and description below - identifying the particular part(s) covered by this assessment.

Example 2 story house

Floor construction: Area (21% of floor area)

Diect contact: Area of dwelling (21% of floor area)

Suspended upper floor(s): Area of glazing (as currently displayed)

Number of rows for table below:

Climate zone:

Constants: C_{g1} C_{g2}

Allowances: C_{g1} / C_{g2} $C_{g2} \times$ area

ID	Description (optional)	Orient-ation	Size			Bedroom / Utility?	Level/ Floor type	Factors affecting impact of glazing performance		Performance		Shading			Calculation data		Winter outcomes		Summer outcomes	
			Facing sector	Height (m)	Width (m)			Area (m²)	Adjacent floor covering	Frame colour	Operability	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P	H	PH	E _s	Area used (m²)	Conduction / Soak gain - PASSED 80.5%	Solar heat gain - 71.5%
1	Formal Lounge	E	2.11	2.60	Other	Ground Suspended	Carpet	Dark	Awning	2.70	0.52	0.50	2.11	0.24	0.78	5.49	14%	15%	2.2	19% of 72%
2	Formal Lounge	S	2.11	0.90	Other	Ground Suspended	Carpet	Dark	Awning	2.80	0.53	0.50	2.11	0.24	0.17	1.90	5%	2%	0.2	2% of 72%
3	Formal Lounge	S	2.11	0.90	Other	Ground Suspended	Carpet	Dark	Awning	2.80	0.53	0.50	2.11	0.24	0.17	1.90	5%	2%	0.2	2% of 72%
4	Kitchen	N	0.95	1.55	Utility	Ground Suspended	Floating Timber	Dark	Awning	2.60	0.52	0.50	0.95	0.53	0.27	1.47	5%	7%	0.2	5% of 72%
5	Dining	N	2.11	2.35	Other	Ground Suspended	Floating Timber	Dark	Sliding Door	2.60	0.51	0.50	2.11	0.24	0.51	4.96	15%	20%	1.3	12% of 72%
6	Family	N	2.11	2.35	Other	Ground Suspended	Floating Timber	Dark	Awning	2.70	0.51	0.50	2.11	0.24	0.51	4.96	15%	19%	1.3	12% of 72%
7	Master Bed	S	1.20	1.75	Bedroom	Ground Suspended	Ceramic Tile	Dark	Awning	3.00	0.54	0.50	1.20	0.42	0.11	2.10	6%	3%	0.1	1% of 72%
8	Ensuite	W	0.90	0.60	Utility	Ground Suspended	Ceramic Tile	Dark	Awning	3.00	0.54	0.50	0.90	0.56	0.10	0.54	2%	1%	0.0	0.3% of 72%
9	Bed 2	W	2.11	1.75	Bedroom	Ground Suspended	Ceramic Tile	Dark	Awning	3.00	0.54	0.50	2.11	0.24	1.23	3.69	10%	13%	2.4	21% of 72%
10	Bathroom	W	1.00	1.20	Bedroom	Ground Suspended	Ceramic Tile	Dark	Awning	3.00	0.54	0.50	1.00	0.50	0.95	1.20	4%	4%	0.6	8% of 72%
11	Bed 3	W	2.11	1.55	Bedroom	Ground Suspended	Ceramic Tile	Dark	Awning	3.00	0.54	0.50	2.11	0.24	1.23	3.27	4%	11%	2.1	19% of 72%
12	Laundry	W	2.11	1.22	Utility	Ground Suspended	Ceramic Tile	Dark	Awning	3.00	0.54	0.50	2.11	1.42	0.49	2.57	9%	4%	0.7	8% of 72%

IMPORTANT NOTICE AND DISCLAIMER IN RESPECT OF THE GLAZING CALCULATOR

By accessing or using this calculator, you agree that the following advice can be taken in the preparation of a building design, a rating and the construction of a building. This calculator is provided as a service to the Australian Building Codes Board and is not intended to be used as a substitute for professional advice. The user shall be responsible for the accuracy of the data entered and the results of the calculations. The user shall be responsible for the accuracy of the data entered and the results of the calculations. The user shall be responsible for the accuracy of the data entered and the results of the calculations.

Inputs are valid

Glazing Calculator

D.4 Ceiling fans

D.4.1 Example 5: A slab-on-ground house in Toowoomba

Introduction

A DTS Solution using the DTS Provisions that form the Elemental compliance option is proposed for a house in Toowoomba. See Chapter 4 for more information on this compliance option.

The calculations provided are limited to those required for ceiling fans i.e. Part 13.5 of the Housing Provisions.

The relevant NCC references are Volume Two H6D2(1)(b), which refers to Part 13.5 of the Housing provisions.

Step 1: Determine climate zone and room sizes

The building is in climate zone 5 in Queensland.

From the plans in **Error! Reference source not found.** and **Error! Reference source not found.**, the room sizes are:

- dining/family room = 32 m²
- theatre room = 14 m².

Step 2: Air movement using ceiling fans

Part 13.5 states that ceiling fans must be installed in accordance with Table 13.5.2.

An excerpt of Table 13.5.2 is shown in Figure D.25. It shows that a minimum number of ceiling fans are required in habitable rooms (other than bedrooms) in NCC climate zone 5.

Figure D.25 Minimum ceiling fan requirements in climate zones 1, 2, 3 and 5 (Table 13.5.2 of the Housing Provisions)

Size of room (m ²)	Minimum number and diameter (mm) of ceiling fans required in a bedroom in climate zones 1, 2 and 3	Minimum number and diameter (mm) of ceiling fans required in a habitable room other than a bedroom in climate zones 1, 2, 3 and 5 (NSW and Qld)
<15	1 x 900	1 x 900
≥15<20	1 x 1200	1 x 1200
≥20<25	1 x 1200	1 x 1400
≥25<30	1 x 1400	2 x 1200
≥30<45	1 x 1400	2 x 1400
≥45<50	2 x 1400	3 x 1200
≥50	2 x 1400	3 x 1400

The ceiling fan requirements are summarised in Table D.10.

Table D.10 Summary of required ceiling fans

Room	Required ceiling fan(s)
Family/dining room	2 x 1400 mm
Theatre room	1 x 900

D.5 WOH energy usage

D.5.1 Example 6: House in Canberra with 7 kW rooftop solar PV

Introduction

A DTS Solution using the DTS Provisions that form the Elemental compliance option is proposed for a house in Canberra. See Chapter 4 for more information on this compliance option.

The calculations provided are limited to those required for WOH energy usage i.e. Part 13.6 of the Housing Provisions.

The relevant NCC references are Volume Two H6D2(1)(b), which refers to Part 13.6 of the Housing Provisions.

The house is in NCC climate zone 7 and has a floor area of 256 m²

The house will have the following domestic services:

- Heater: single split ducted system - 2019 GEMS Determination is 2 stars
- Cooling: single split ducted system - 2019 GEMS Determination is 2.5 stars
- Water heater: heat pump heated water system
- Spa: No
- Pool: No
- Solar: 7 kW solar system to be installed

Note: As outlined above, this example uses a ducted split system rated under the 2019 Determination. This means the star ratings are based on the 'cold' zone of the air conditioner zoned energy rating label (ZERL). The star ratings will likely be different for the 'average' and 'hot' zones.

Step 1: Determine net equivalent energy allowance (annual energy allowance)

From 13.6.2(1)(b), the energy allowance = $A \times E_F$.

A = floor area multiplied by floor area adjustment factor obtained from Table 13.6.2a and E_F obtained from Table 13.6.2b.

Figure D.26 shows an excerpt of Table 13.6.2a of the Housing Provisions and shows the floor adjustment factor = 0.0089.

Figure D.26 Floor area adjustment factor (Table 13.6.2a of the Housing Provisions)

Total floor area m ²	Floor area factor	Total floor area m ²	Floor area factor	Total floor area m ²	Floor area factor	Total floor area m ²	Floor area factor
<50	0.0123	160–169	0.0097	280–289	0.0087	400–409	0.0080
50–59	0.0119	170–179	0.0096	290–299	0.0086	410–419	0.0079
60–69	0.0116	180–189	0.0095	300–309	0.0085	420–429	0.0079
70–79	0.0113	190–199	0.0094	310–319	0.0085	430–439	0.0078
80–89	0.0111	200–209	0.0093	320–329	0.0084	440–449	0.0078
90–99	0.0108	210–219	0.0092	330–339	0.0083	450–459	0.0077
100–109	0.0106	220–229	0.0091	340–349	0.0083	460–469	0.0077
110–119	0.0105	230–239	0.0090	350–359	0.0082	470–479	0.0077
120–129	0.0103	240–249	0.0090	360–369	0.0082	480–489	0.0076
130–139	0.0101	250–259	0.0089	370–379	0.0081	490–499	0.0076
140–149	0.0100	260–269	0.0088	380–389	0.0081	500	0.0075
150–159	0.0099	270–279	0.0087	390–399	0.0080	—	—

Figure D.27 shows an excerpt of Table 13.6.2b of the Housing Provisions and shows that $E_F = 2.56$.

Figure D.27 Energy factor (E_F) (Table 13.6.2b of the Housing Provisions)

Climate zone	ACT	NSW	NT	Qld	SA	Tas	Vic	WA
1	—	—	1.91	2.77	—	—	—	3.25
2	—	1.32	—	1.78	—	—	—	—
3	—	—	1.23	2.46	—	—	—	2.87
4	—	1.80	—	—	1.86	—	1.25	2.34
5	—	1.75	—	2.28	1.79	—	—	2.35
6	—	2.40	—	—	2.51	—	1.63	3.20
7	2.56	1.33	—	—	—	3.08	1.62	—
8	—	3.99	—	—	—	3.92	2.82	—

This means the energy allowance = $A \times E_F = 256 \times 0.0089 \times 2.56 = 5.83 \text{ kW}$

Step 2: Determine net equivalent energy usage (annual energy use)

From 13.6.2(1)(a) the net equivalent energy usage = $(A \times E_E) + E_P + E_S - E_R$

A = floor area multiplied by floor area adjustment factor obtained from Table 13.6.2a. From Step 1, $A = 2.278$.

E_E is obtained from the ABCB Standard for Whole-of-Home Efficiency Factors (2022) for the main space conditioning, and main water heater.

The heating and cooling system is a single split system ducted system with a 2 and 2.5 star rating respectively using GEMS.

The water heater is a heat pump heated water system.

The relevant table in the ABCB Standard for Whole-of-Home Efficiency Factors (2022) is Table 7.2.4 and an excerpt is shown in Figure D.28 with the services for this example selected. Therefore $E_E = 2.347$

Figure D.28 Whole-of-home efficiency factors E_E (kW/100 m²) – climate zone 7 – heat pump heating – Australian Capital Territory (Table 7.2.4 of the ABCB Standard for Whole-of-Home Efficiency Factors)

Main type of heater	Main type of cooler	Electric storage (standard)	Electric storage (off peak)	Heat pump (standard)	Heat pump (off-peak)	Solar electric (standard)	Gas storage	Gas instantaneous	Solar gas
Heat pump - Ducted < 2.25 Stars (< 3)	Heat pump - Non-ducted < 3.75 stars (< 6)	4.128	3.403	2.307	2.097	2.200	4.529	3.907	1.862
Heat pump - Ducted < 2.25 Stars (< 3)	Heat pump - Non-ducted ≥ 3.75 stars (≥ 6)	4.075	3.351	2.254	2.044	2.147	4.477	3.855	1.810
Heat pump - Ducted < 2.25 Stars (< 3)	Other or none specified	4.284	3.562	2.468	2.259	2.362	4.686	4.066	2.025
Heat pump - Ducted < 3.0 Stars (< 4.5)	Evaporative	3.829	3.099	1.992	1.785	1.893	4.224	3.601	1.540
Heat pump - Ducted < 3.0 Stars (< 4.5)	Heat pump - Ducted < 2.25 stars (< 3)	4.163	3.441	2.347	2.138	2.241	4.565	3.945	1.904
Heat pump - Ducted < 3.0 Stars (< 4.5)	Heat pump - Ducted < 3 stars (< 4.5)	4.120	3.398	2.304	2.096	2.198	4.522	3.902	1.861
Heat pump - Ducted < 3.0 Stars (< 4.5)	Heat pump - Ducted < 3.75 stars (< 6)	4.056	3.334	2.240	2.031	2.134	4.458	3.838	1.797
Heat pump - Ducted < 3.0 Stars (< 4.5)	Heat pump - Ducted ≥ 3.75 stars (≥ 6)	3.992	3.270	2.176	1.967	2.070	4.394	3.774	1.733

$E_P = 0$ (no pool)

$E_S = 0$ (no spa)

The net equivalent energy usage:

$$= (A \times E_E) + E_P + E_S - E_R$$

$$= (256 \times 0.0089 \times 2.347) + 0 + 0 - 7 \text{ (kW of rooftop solar PV as planned)}$$

$$= 5.35 - 7 = -1.65 \text{ kW}$$

Step 3: Compare with the energy allowance E_F calculated in Step 1

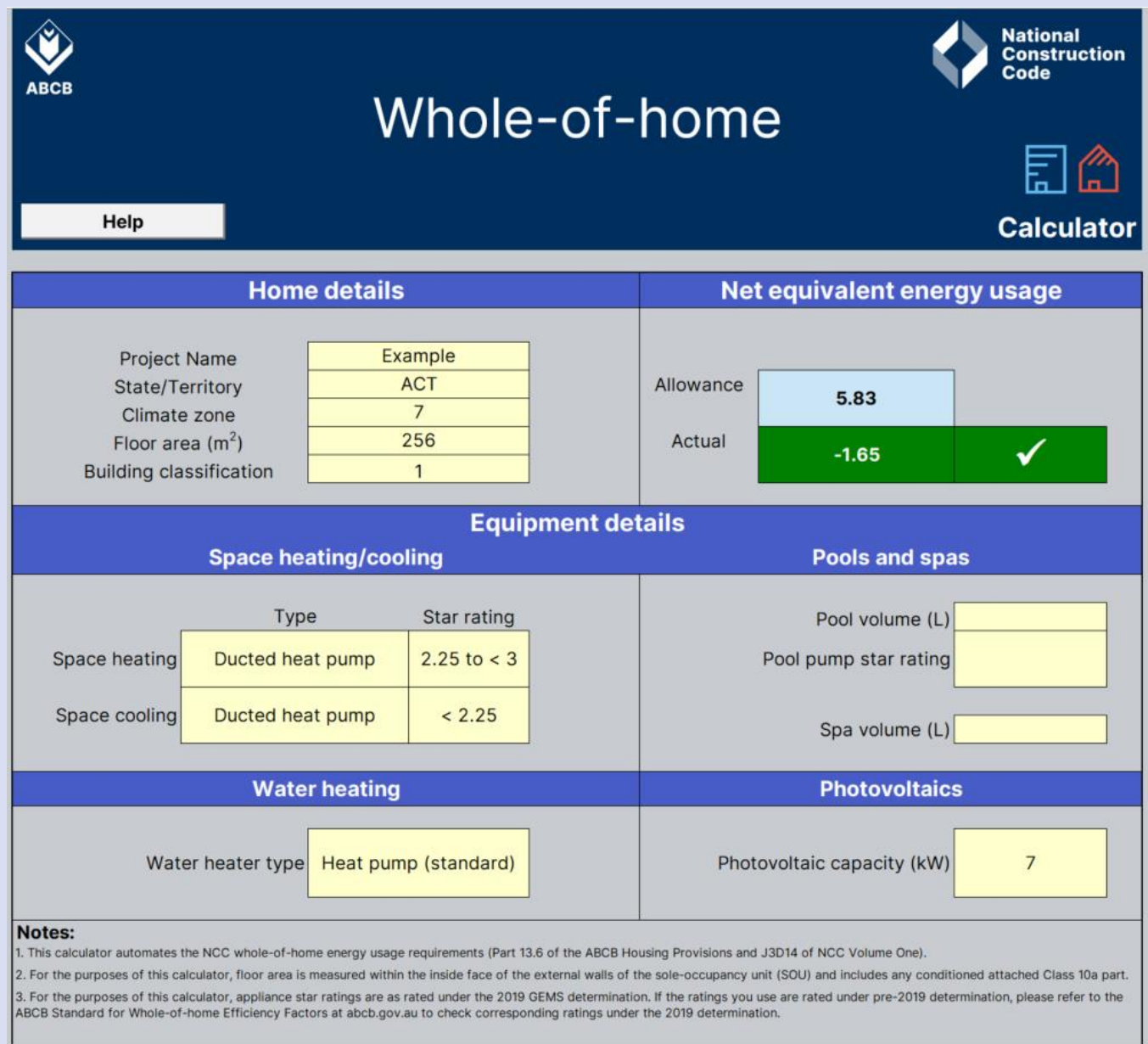
-1.65 kW from Step 2 is less than $E_F = 5.83$ kW from Step 1 and therefore complies.

In this example the WOH requirements can be satisfied even without rooftop solar PV. Without rooftop solar PV off-set, the net equivalent energy usage is 4.87 kW, which is still smaller than $E_F = 5.83$ kW.

Step 4: Check using the ABCB WOH Whole-of-home calculator

Figure D.29 shows the above input values in the ABCB Whole-of-home calculator with the same outcome achieved.

Figure D.29 Whole-of-home calculator screenshot – Canberra



The screenshot shows the ABCB Whole-of-home calculator interface. The title is "Whole-of-home" and it includes the ABCB logo and National Construction Code logo. A "Help" button is on the left and a "Calculator" button is on the right. The interface is divided into several sections:

- Home details:**

Project Name	Example
State/Territory	ACT
Climate zone	7
Floor area (m ²)	256
Building classification	1
- Net equivalent energy usage:**

Allowance	5.83	
Actual	-1.65	✓
- Equipment details:**
 - Space heating/cooling:**

	Type	Star rating
Space heating	Ducted heat pump	2.25 to < 3
Space cooling	Ducted heat pump	< 2.25
 - Pools and spas:**

Pool volume (L)	<input type="text"/>
Pool pump star rating	<input type="text"/>
Spa volume (L)	<input type="text"/>
- Water heating:**

Water heater type	Heat pump (standard)
-------------------	----------------------
- Photovoltaics:**

Photovoltaic capacity (kW)	7
----------------------------	---

Notes:

- This calculator automates the NCC whole-of-home energy usage requirements (Part 13.6 of the ABCB Housing Provisions and J3D14 of NCC Volume One).
- For the purposes of this calculator, floor area is measured within the inside face of the external walls of the sole-occupancy unit (SOU) and includes any conditioned attached Class 10a part.
- For the purposes of this calculator, appliance star ratings are as rated under the 2019 GEMS determination. If the ratings you use are rated under pre-2019 determination, please refer to the ABCB Standard for Whole-of-home Efficiency Factors at abcb.gov.au to check corresponding ratings under the 2019 determination.

Step 5 Results

The WOH energy requirements are met as the:

- Net equivalent energy allowance is 5.83 kW
- Net equivalent energy usage is -1.65 kW.

D.5.2 Example 7: House in Brisbane with 3 kW rooftop solar PV

Introduction

A DTS Solution using the DTS Provisions that form the Elemental compliance option is proposed for a house in Brisbane. See Chapter 4 for more information on this compliance option.

The calculations provided are limited to those required for WOH energy usage i.e. Part 13.6 of the Housing Provisions.

The relevant NCC references are Volume Two H6D2(1)(b), which refers to Part 13.6 of the Housing Provisions.

The house is in NCC climate zone 2 and has a floor area of 246 m².

The house will have the following domestic services:

- Heating and cooling: Reverse cycle air-conditioner (pre-2019 GEMS determination) with a 4.66 Coefficient of Performance (COP) for heating and a 4.66 Energy Efficiency Rating (EER) for cooling
- Water heater: electric storage water heater (off peak)
- Spa: 2,000 L spa
- Pool: 45,000 L pool with 4 stars GEMS water pump
- Solar: 3 kW solar system to be installed

Step 1: Determine net equivalent energy allowance

From 13.6.2(1)(b), the energy allowance = $A \times E_F$.

A = floor area multiplied by floor area adjustment factor obtained from Table 13.6.2a and E_F obtained from Table 13.6.2b.

Figure D.30 shows an excerpt of Table 13.6.2a of the Housing Provisions and shows the floor adjustment factor = 0.0090.

Figure D.30 Floor area adjustment factor (Table 13.6.2a of the Housing Provisions)

Total floor area m ²	Floor area factor	Total floor area m ²	Floor area factor	Total floor area m ²	Floor area factor	Total floor area m ²	Floor area factor
<50	0.0123	160–169	0.0097	280–289	0.0087	400–409	0.0080
50–59	0.0119	170–179	0.0096	290–299	0.0086	410–419	0.0079
60–69	0.0116	180–189	0.0095	300–309	0.0085	420–429	0.0079
70–79	0.0113	190–199	0.0094	310–319	0.0085	430–439	0.0078
80–89	0.0111	200–209	0.0093	320–329	0.0084	440–449	0.0078
90–99	0.0108	210–219	0.0092	330–339	0.0083	450–459	0.0077
100–109	0.0106	220–229	0.0091	340–349	0.0083	460–469	0.0077
110–119	0.0105	230–239	0.0090	350–359	0.0082	470–479	0.0077
120–129	0.0103	240–249	0.0090	360–369	0.0082	480–489	0.0076
130–139	0.0101	250–259	0.0089	370–379	0.0081	490–499	0.0076
140–149	0.0100	260–269	0.0088	380–389	0.0081	500	0.0075
150–159	0.0099	270–279	0.0087	390–399	0.0080	—	—

Figure D.31 shows an excerpt of Table 13.6.2b of the Housing Provisions and shows that $E_F = 1.78$

Figure D.31 Energy factor (E_F) (Table 13.6.2b of the Housing Provisions)

Climate zone	ACT	NSW	NT	Qld	SA	Tas	Vic	WA
1	—	—	1.91	2.77	—	—	—	3.25
2	—	1.32	—	1.78	—	—	—	—
3	—	—	1.23	2.40	—	—	—	2.87
4	—	1.80	—	—	1.86	—	1.25	2.34
5	—	1.75	—	2.28	1.79	—	—	2.35
6	—	2.40	—	—	2.51	—	1.63	3.20
7	2.56	2.33	—	—	—	3.08	1.62	—
8	—	3.99	—	—	—	3.92	2.82	—

This means the energy allowance = $A \times E_F = 246 \times 0.0090 \times 1.78 = 3.94$ kW.

Step 2: Determine net equivalent energy usage (annual energy use)

From 13.6.2(1)(a) Net equivalent energy usage = $(A \times E_E) + E_P + E_S - E_R$

A = floor area multiplied by floor area adjustment factor obtained from Table 13.6.2a, from Step 1, $A = 2.214$.

E_E is obtained from the ABCB Standard for Whole-of-Home Efficiency Factors (2022) for the main space conditioning, and main water heater.

Since the reverse cycle air-conditioner chosen does not have a GEMS 2019 rating, the COP and EER must be used and converted to a star rating using AS/NZS 3823.2 Performance of electrical appliances – Air conditioners and heat pumps – Part 2: Energy labelling and minimum energy performance standards (MEPS) requirements.

This standard contains a formula to calculate the star rating index (SRI):

- Cooling SRI = 2 x EER - 4.5 = 2 x 4.66 - 4.5 = 4.82
- Heating SRI = 2 x COP-4.5 = 2 x 4.66 - 4.5 = 4.82

In accordance with the standard, the final star ratings are rounded down to nearest half-star, so the ratings for the air-conditioner are 4.5 stars for heating and 4.5 stars for cooling.

Section 2.4 clause (1)(c) of the ABCB Standard for Whole-of-Home Efficiency Factors (2022) states that ‘ratings in brackets for heat pumps are values based on ratings to the GEMS pre-2019 determination for air-conditioners’ which is relevant for this example.

The main water heater is an electric storage water heater (off peak).

The relevant table in the ABCB Standard for Whole-of-Home Efficiency Factors (2022) is Table 2.2.2 and an excerpt is shown in Figure D.32 with the domestic services for this example selected.

Figure D.32 Whole-of-home efficiency factors E_E (kW/100 m²) - climate zone 2 - heat pump heating - Queensland (Table 2.2.2 of the ABCB Standard for Whole-of-Home Efficiency Factors)

Main type of heater	Main type of cooler	Electric storage (standard)	Electric storage (off peak)	Heat pump (standard)	Heat pump (off-peak)	Solar electric (standard)	Gas storage	Gas instantaneous	Solar gas
Heat pump - Ducted < 3.75 Stars (< 6)	Heat pump - Ducted < 3.75 stars (< 6)	2.168	1.769	0.950	0.824	0.786	3.091	2.540	0.642
Heat pump - Ducted < 3.75 Stars (< 6)	Heat pump - Ducted ≥ 3.75 stars (≥ 6)	2.121	1.722	0.903	0.777	0.739	3.044	2.494	0.595
Heat pump - Ducted < 3.75 Stars (< 6)	Heat pump - Non-ducted < 2.25 stars (< 3)	2.191	1.789	0.974	0.843	0.807	3.113	2.562	0.665
Heat pump - Ducted < 3.75 Stars (< 6)	Heat pump - Non-ducted < 3 stars (< 4.5)	2.165	1.763	0.948	0.817	0.781	3.087	2.536	0.639
Heat pump - Ducted < 3.75 Stars (< 6)	Heat pump - Non-ducted < 3.75 stars (< 6)	2.126	1.724	0.909	0.778	0.742	3.048	2.497	0.600
Heat pump - Ducted < 3.75 Stars (< 6)	Heat pump - Non-ducted ≥ 3.75 stars (≥ 6)	2.087	1.685	0.870	0.739	0.704	3.009	2.458	0.562
Heat pump - Ducted < 3.75 Stars (< 6)	Other or none specified	2.246	1.847	1.029	0.903	0.864	3.169	2.619	0.721
Heat pump - Ducted ≥ 3.75 Stars (≥ 6)	Evaporative	1.969	1.550	0.740	0.615	0.597	2.884	2.329	0.482

Therefore $E_E = 1.769$

The swimming pool pump factor (F_P) is determined from Table 13.6.2c.

For this example, the pool pump has a 4 stars GEMS rating.

Figure D.33 is an excerpt of Table 13.6.2c of the Housing Provisions and shows that $F_P = 0.021$.

Therefore, $E_P = V \times F_P / 1000 = 45,000 \times 0.021 / 1000 = 0.945 \text{ kW}$

Figure D.33 Swimming pool pump factor (F_P) (kW/1000 litres.annum) (Table 13.6.2c of the Housing Provisions)

Pool pump GEMS star rating	ACT	NSW	NT	Qld	SA	Tas	Vic	WA
1 or unrated	0.056	0.060	0.028	0.046	0.068	0.061	0.049	0.063
1.5	0.048	0.050	0.023	0.039	0.057	0.052	0.041	0.053
2	0.041	0.044	0.020	0.034	0.050	0.045	0.036	0.046
2.5	0.037	0.039	0.018	0.030	0.044	0.040	0.032	0.041
3	0.033	0.035	0.016	0.027	0.039	0.035	0.028	0.036
3.5	0.029	0.031	0.014	0.024	0.035	0.032	0.025	0.033
4	0.026	0.028	0.013	0.021	0.032	0.029	0.023	0.029
4.5	0.024	0.025	0.012	0.019	0.029	0.026	0.021	0.027
5	0.022	0.023	0.011	0.018	0.026	0.023	0.019	0.024
5.5	0.020	0.021	0.010	0.016	0.023	0.021	0.017	0.022
6	0.018	0.019	0.009	0.014	0.021	0.019	0.015	0.020
6.5	0.016	0.017	0.008	0.013	0.019	0.017	0.014	0.018
7	0.014	0.015	0.007	0.012	0.017	0.016	0.012	0.016
7.5	0.013	0.013	0.006	0.010	0.015	0.014	0.011	0.014
8	0.011	0.012	0.006	0.009	0.014	0.012	0.010	0.013
8.5	0.010	0.011	0.005	0.008	0.012	0.011	0.009	0.011
9	0.009	0.009	0.004	0.007	0.011	0.010	0.008	0.010
9.5	0.008	0.008	0.004	0.006	0.009	0.008	0.007	0.009
10	0.007	0.007	0.003	0.005	0.008	0.007	0.006	0.007

The spa holds 2000 litres, so $V = 2000$.

Figure D.34 shows $F_S = 0.055$ for a spa pump in Brisbane, Queensland.

Therefore $E_S = V \times F_S / 100 = 2000 \times 0.055 / 100 = 1.1 \text{ kW}$

Figure D.34 Spa pump factor (F_S)(kW/100 litres.annum)(Table 13.6.2d of the Housing Provisions)

Spa pump GEMS star rating	ACT	NSW	NT	Qld	SA	Tas	Vic	WA
All types	0.067	0.071	0.033	0.055	0.081	0.073	0.058	0.075

A summary of the inputs needed to calculate the net equivalent energy usage are as follows:

$A = 246 \text{ m}^2$

Area factor = 0.0090

$E_E = 1.769$

$E_P = 0.945$

$E_S = 1.1$

$$E_R = 3.0$$

The net equivalent energy usage:

$$= (A \times E_E) + E_P + E_S - E_R$$

$$= (246 \times 0.0090 \times 1.769) + 0.945 + 1.1 - 3$$

$$= 3.0 \text{ kW}$$

Step 3: Compare with the energy allowance E_F calculated in Step 1

The net equivalent energy usage (3.0 kW from Step 2) is less than the net equivalent energy allowance (3.94 kW in Step 1) and therefore complies.

Step 4: Check using the ABCB WOH Whole-of-home calculator


Figure D.35 shows the above input values in the ABCB Whole-of-home calculator with the same outcome achieved.

Step 5 Results


The WOH energy requirements are met as:

- Net equivalent energy allowance is 3.9 kW.
- Net equivalent energy usage is 3.0 kW.

Figure D.35 Whole-of-home calculator screenshot - Brisbane



Whole-of-home



Help
Calculator

Home details		Net equivalent energy usage	
Project Name	Example	Allowance	3.9
State/Territory	QLD	Actual	3.0 ✓
Climate zone	2		
Floor area (m ²)	246		
Building classification	1		
Equipment details			
Space heating/cooling		Pools and spas	
	Type Star rating	Pool volume (L)	45,000
Space heating	Ducted heat pump 3 to < 3.75	Pool pump star rating	4
Space cooling	Ducted heat pump 3 to < 3.75	Spa volume (L)	2,000
Water heating		Photovoltaics	
Water heater type	Electric storage (off peak)	Photovoltaic capacity (kW)	3
<p>Notes:</p> <p>1. This calculator automates the NCC whole-of-home energy usage requirements (Part 13.6 of the ABCB Housing Provisions and J3D14 of NCC Volume One).</p> <p>2. For the purposes of this calculator, floor area is measured within the inside face of the external walls of the sole-occupancy unit (SOU) and includes any conditioned attached Class 10a part.</p> <p>3. For the purposes of this calculator, appliance star ratings are as rated under the 2019 GEMS determination. If the ratings you use are rated under pre-2019 determination, please refer to the ABCB Standard for Whole-of-home Efficiency Factors at abcb.gov.au to check corresponding ratings under the 2019 determination.</p>			

Alternative to Example 7: No rooftop solar PV system installed

Consider a house with the same domestic services as Example 7 but with no rooftop solar PV system installed. The following outlines the calculations required to determine whether the WOH energy usage requirements would still be met.

The inputs needed to calculate the net equivalent energy usage are as follows:

$$A = 246 \text{ m}^2$$

$$\text{Area factor} = 0.0090$$

$$E_E = 1.769$$

$$E_P = 0.945$$

$$E_S = 1.1$$

$E_R = 0$ (this input was 3 in Example 7)

The net equivalent energy usage:

$$= (A \times E_E) + E_P + E_S - E_R$$

$$= (246 \times 0.009 \times 1.769) + 0.945 + 1.1 - 0$$

$$= 5.9 \text{ kW}$$

Compare with the energy allowance E_F calculated in Step 1

The net equivalent energy usage (5.9 kW from Alternative to Example 7 above) is greater than the net equivalent energy allowance (3.94 kW in Step 1 Example 7) and therefore doesn't comply.

This means Example 7 would not comply with the WOH energy usage requirements unless a rooftop solar PV system is installed.

D.6 Artificial lighting

D.6.1 Example 8: Artificial lighting

Introduction

A DTS Solution using the DTS Provisions that form the Elemental compliance option is proposed for an example house. See Chapter 4 for more information on this compliance option.

The calculations provided are limited to those required for artificial lighting i.e. clause 13.7.6 of the Housing Provisions.

The relevant NCC references are Volume Two H6D2(1)(b), which refers to Part 13.7 of the Housing Provisions.

This example uses a 110.5 m² house with an associated garage of 20 m².

There is a calculator available, the ABCB Lighting Calculator, that automates the calculations required for artificial lighting. See the Resource Library on the [ABCB website](#).

Step 1: Calculating the allowance

- For lamp power density, the following applies:
- The house does not have any control devices or regulators applied to the lighting. The lamp power density is calculated using 13.7.6(1).
- The house wattage allowance is $110.5 \text{ m}^2 \times 5 \text{ W/m}^2 = 553 \text{ Watts (W)}$.
- The garage wattage allowance is $20 \text{ m}^2 \times 3 \text{ W/m}^2 = 60 \text{ W}$.

For illumination power density, the following applies:

- Using the same house as above and providing a dimmer switch to control the lighting for 80% of the lounge, living and dining areas, the allowance can be adjusted using the illumination power density approach.
- The total area of the lounge, living and dining area that is controlled by the lighting dimmer switch is 50.4 m². The remaining part of the house without lighting control devices is 60.1 m².
- For the areas of the house and verandah that do not have any control devices or regulators applied to the lighting, the allowance is calculated using 13.7.6(1) and the area.

- For the lounge, living and dining areas controlled by the dimmer switch, the allowance is calculated using 13.7.6(1), 13.7.6(2) and the area. From 13.7.6(6), the illumination power density adjustment factor for a dimmer switch is 0.85.
- The house wattage allowance (excluding the lounge, living and dining areas) is: $60.1 \text{ m}^2 \times 5 \text{ W/m}^2 = 301 \text{ W}$.
- The garage wattage allowance is $12.1 \text{ m}^2 \times 3 \text{ W/m}^2 = 36 \text{ W}$.
- Lastly, the allowance for the lounge, living and dining area with the adjustment factor is calculated using 13.7.6 (6). From 13.7.6(6), there is a requisite to have 75% of the area of the space controlled by the manually operated dimmers to qualify for use of it. This is the case for this design. Next to note is that the adjustment factor given for use with manual dimming is 0.85.
- The house allowance for the lounge, living and dining areas is:
 $5 \text{ W/m}^2 \div 0.85 = 5.9 \text{ W/m}^2$.
This is the increased allowance based on applying 13.7.6(2).
- The house wattage allowance for the lounge, living and dining areas is:
 $5.9 \text{ W/m}^2 \times 50.4 \text{ m}^2 = 297 \text{ W}$.
- Therefore, using the illumination power density approach, the overall allowance for the house is higher than using the lamp power density approach due to the installation of the dimmer switch as a lighting control device.
- The overall house wattage allowance is 598 W ($301 \text{ W} + 297 \text{ W}$).
- The garage wattage allowance is 36 W .

Step 2: Calculate the lighting design wattage

The overall lamp power density and illumination power density is calculated by adding the maximum power ratings of all the permanently installed lights (lamps) in a space and dividing them by the area of the space.

This is where all the proposed hardwired light's maximum wattages are added up to achieve a total. Desk lamps, floor lamps and the like that are plugged into general power outlets are not included; it is only the permanent lighting in a space that is regulated.

Step 3: Compare the wattage of the proposed design to the allowance

If the proposed design is equal to or less than the allowance, then compliance is achieved. If it is over the allowance – reworking of the proposed design is needed to achieve compliance.

In the example above, using the—

- lamp power density, if the proposed design total wattage does not exceed 553 W , compliance is achieved.

- illumination power density and dimmer switches, if the proposed design total wattage does not exceed 598 W, compliance is achieved.

D.7 Verification using a reference building

D.7.1 Example 9: Verification using a reference building for a double brick house in Perth

Introduction

A Performance Solution to satisfy H6P1, assessed using Verification Method H6V2 is proposed for a single storey house located in Perth. Since Perth is in NCC climate zone 5, both the heating load and cooling load must be verified as being equal to or less than that of the reference house.

To apply the Verification Method H6V2 in this scenario, the following steps are needed.

Step 1: Determine the suitability of proposed calculation method

The calculation method used to assess the heating and cooling loads under H6V2 must be validated using the 2007 version of ANSI/ASHRAE Standard 140 (see H6V2(4)). The same calculation method must be used for determining heating load and cooling loads of both the reference house and the proposed house.

The proposed calculation method must also use hourly climate data that is representative of the house's proposed location (see H6V2(5) for further details). Suitable climate data should be made available by the developer of the calculation method or will need to be sourced from a third party.

Additionally, the proposed calculation method must not be the same method as used for house energy rating software – see H6V2(1)(a). House energy rating software cannot be used with this Verification Method. This means current and previously accredited software under NatHERS cannot be used for H6V2. Non-regulatory functions included in the NatHERS software cannot be applied under H6V2 either.

Step 2: Model the reference house

H6V2(2) and (3) outline the required settings that must be used when modelling the heating and cooling loads for the reference house.

H6V2(2) requires that the proposed house must comply with the DTS Provisions in Parts 13.2, 13.3 and 13.5 of the Housing Provisions. See Chapter 4 for further guidance.

Step 3: Model the proposed house

It is recommended that the reference house modelling and calculation results be recorded separately and tested one change at a time, for easy comparison with the proposed house.

Using the same calculation method for both the reference and proposed house satisfies the requirements outlined in H6V2(3)(a).

Other restrictions may also apply to the reference and proposed house - see H6V2(3) for detailed requirements.

Step 4: Calculate proposed house loads

The heating and cooling loads are then recalculated for the first iteration of the proposed house, resulting in a heating load of 7,677 kWh/year and a cooling load of 7,405 kWh/year.

Step 5: Compare the heating load and/or cooling load of the reference house and the proposed house and test further changes if required.

By comparing the heating and cooling loads of the reference and proposed house it is now possible to determine whether the design complies with Verification Method H6V2.

For a house located in NCC climate zone 5, H6V2(1)(a)(iii) states that the heating load and cooling load of the proposed house must be equal to or less than that of the reference house.

Table D.11 Comparison of load results

Model	Heating load (kWh/year)	Cooling load (kWh/year)
Reference house	7,365	8,027
Proposed house	7,677	7,405

Referring to Table D.11, while the cooling load of the proposed house is less than the reference house (622 kWh/year lower), the heating load of the proposed house is higher than the reference house (312 kWh/year higher).

This means the proposed house does not currently comply with Verification Method H6V2.

Further changes to the proposed house will need to be tested in comparison to the reference house. For example, selecting higher performance windows with a lower Total System U-Value may help to reduce the proposed house's heating load.

Table D.12 Adjustment to window Total System U-Value

Design parameter	Reference house	Proposed house
Window Total System U-Value (W/m ² .K)	6.0	5.6

The heating and cooling loads for the proposed house are now recalculated based on the lower Total System U-Value for the windows. This results in a heating load of 7,229 kWh/year and a cooling load of 7,265 kWh/year as shown in Table D.13.

Table D.13 Comparison of results after adjustment to Total System U-Value

Model	Heating load (kWh/year)	Cooling load (kWh/year)
Reference house	7,365	8,027
Proposed house	7,229	7,265
Satisfies V2.6.2.2(a)(i)	Yes	Yes

By improving the Total System U-Value of the windows, the proposed house heating load is now less than the reference house heating load (136 kWh/year lower).

The proposed house cooling load is also further reduced compared to the reference house (762 kWh/year lower).

Outcome

The design and specification changes tested in the various iterations of the proposed house design will comply with Performance Requirement H6P1 using Verification Method H6V2, provided requirements of H6V2(1)(b) are also met.

Design options

Instead of specifying higher performance windows, other changes could be investigated to help reduce the heating load for the proposed house, such as:

- increasing the ceiling and/or roof insulation
- adding external wall insulation.

Alternatively, a different Assessment Method could be used.

Notes

If the heating and cooling load of the proposed house continue to be equal to or less than the established limits of the reference house, the proposed house will comply with H6V2(1)(a).

The proposed house must also meet the additional DTS Provisions listed in H6V2(1)(b).

D.8 Verification of building envelope sealing

D.8.1 Example 10: Verification of building envelope sealing for a double brick house in Perth

Introduction

A Performance Solution to satisfy H6P1, assessed using Verification Method H6V3 is proposed to verify the air-tightness of a house.

Step 1: Plan ahead

Since Verification Method H6V3 requires verification through testing, the building and/or design professionals need to ensure that their program of work accounts for the associated risks.

Testing will be needed immediately after the building envelope is complete to ensure that if improvements are required, the staff are available to complete them. Several days may be needed for testing, to account for adverse weather conditions.

Allow a month between testing and handover of the building. This is because a second test during this period may be needed if the building fails to meet the 10 m³/hr.m² requirement. This allows enough time for sealing to be improved and retesting to occur.

The air barrier is continuous and needs to be clearly defined and marked on the building's drawings.

Step 2: Quality construction

Although using Verification Method H6V3 means that the DTS Provisions are not mandatory, they can still be used as guidelines. In some areas, departures from the DTS Provisions may be used as they suit an innovative method, so long as the Performance Requirement is satisfied.

Step 3: Prepare for the test

After the building envelope is complete, the building needs to be made suitable for testing. To follow the requirements of AS/NZS ISO 9972 Method 1, closing the house's windows, doors, trapdoors, ventilation openings and other openings in the building's envelope is needed. The air terminal devices in the house's ducted air conditioning system is also sealed so the whole building is treated as a whole system.

Openings in the building's envelope for the kitchen and toilet exhaust systems are closed, but not specifically sealed, as these systems are intermittent.

The blower door testing experts will then mount a blower door assembly at the house's front door and connect pressure measuring devices to the inside and outside of the building.

Step 4: Test

The blower door testing experts follow the procedures listed in AS/NZS ISO 9972. They check for large leaks and failures of temporarily sealed openings. They record the temperature inside and outside the building, as well as the wind speed.

They also measure the pressure difference between the inside and outside of the building without the blower door providing any airflow, to ensure that this can be accounted for.

The blower door testing experts then turn on the blower door. The test is carried out by taking measurements of blower door air flow rate and indoor/outdoor pressure difference over a range of applied pressure differences in 10 Pa increments.

They repeat this up to 60 Pa, as their attempt to test at 70 Pa proves beyond the capability of their equipment. When pressure differences above 50 Pa can be achieved like this, the accuracy of the test is enhanced, so they should be attempted to improve accuracy, but are not required by AS/NZS ISO 9972. They repeat this process for both positive and negative pressures.

Step 5: Calculation

The blower door testing experts still need to convert their recordings into an air flow rate at 50 Pa, to verify the results. As part of this process, they refer again to AS/NZS ISO 9972 which sets out the calculations required.

They account for the base pressure difference, convert airflow readings into airflow through the envelope and plot the results to determine the relationship between the airflow through the envelope and induced pressure difference.

By synthesising data from the series of tests as required by the standard, they reduce the error in measurement. The final result is calculated as the average result of both positive and negative test results.

Corrections for the environmental conditions universalise the results, so that they can be compared with the requirements of the Verification Method.

Step 6: Test reporting

The blower door testing experts then produce a test report with all the information specified by AS/NZS ISO 9972.

This includes that the test was undertaken using Method 1 of AS/NZS ISO 9972, the status of all building openings, testing apparatus, data, calculations, and results.

Step 7: Check

The building and/or design professionals check the results of the test against the 10 m³/hr.m² requirement. Due to the attention paid to construction and quality assurance, their

test results show that the building meets the requirement. If they fell short, then they would return to Step 2, rectify any defects and test again.

If the test results indicate that an air permeability of less than $5 \text{ m}^3/\text{hr.m}^2$ is achieved then additional requirements must be incorporated into the design, such as additional mechanical ventilation. These additional requirements can be found in H6V3(2).

Appendix E Relevant reports and standards

- ABCB (2023) Condensation in buildings Handbook.
- ABCB (2023) Indoor air quality Verification Methods Handbook.
- ABCB (2022) Standard – NatHERS Heating and Cooling Load Limits, Version 2022.1
- ABCB (2022) Standard - NCC 2022 Housing Provisions.
- ABCB (2022) Standard – Whole-of-Home Efficiency Factors
- ANSI/ASHRAE (2007) ANSI/ASHRAE Standard 140 Standard method of test for the evaluation of building energy analysis computer programs.
- ASTM International (2016) ASTM-E96 Standard Test Methods for Water Vapor Transmission of Materials (Procedure B – Water Method).
- Energy Efficient Strategies Pty Ltd (2022) NCC 2022 Update: Whole-of-home Component.
- Standards Australia (2014) AS 2047 Windows and external glazed doors in buildings (incorporating amendments 1 and 2).
- Standards Australia (2015) AS 3999 Bulk thermal insulation – installation.
- Standards Australia (2021) AS 4254.1 Ductwork for air-handling systems in buildings Part 1: Flexible duct.
- Standards Australia (2012) AS 4254.2 Ductwork for air-handling systems in buildings Part 2: Rigid duct.
- Standards Australia (2017) AS/NZS 4200.1 Pliable building membranes and underlays Part 1: Materials (incorporating amendment 1).
- Standards Australia (2021) AS/NZS 4234 Heated water systems — Calculation of energy consumption.
- Standards Australia (2018) AS/NZS 4859.1 Thermal insulation materials for buildings Part 1: General criteria and technical provisions.
- Standards Australia (2018) AS/NZS 4859.2 Thermal insulation materials for buildings Part 1: Design.
- Standards Australia (2021) AS/NZS 5033 Installation and safety requirements for photovoltaic (PV) arrays.
- Standards Australia (2013) AS/NZS 5601.1 Gas installations Part 1: General installations.
- Standards Australia (2015) AS/NZS ISO 9972 Thermal performance of buildings — Determination of air permeability of buildings — Fan pressurization method.

- Tony Isaacs Consulting Pty Ltd (2022) Principles and methodology for setting NCC heating and cooling load intensity limits & draft heating and cooling load intensity limits for all NatHERS climates.
- Tony Isaacs Consulting Pty Ltd (2022) Technical Report: DTS Elemental Provisions for NCC 2022.
- University of Wollongong (2022) Repeating Thermal Bridges in Ceilings and Floors: Simulation and Calculation: Stage 1 Final Report.
- University of Wollongong (2022) Repeating Thermal Bridges in Ceilings and Floors: Modified Calculation Method: Stage 2 Final Report.