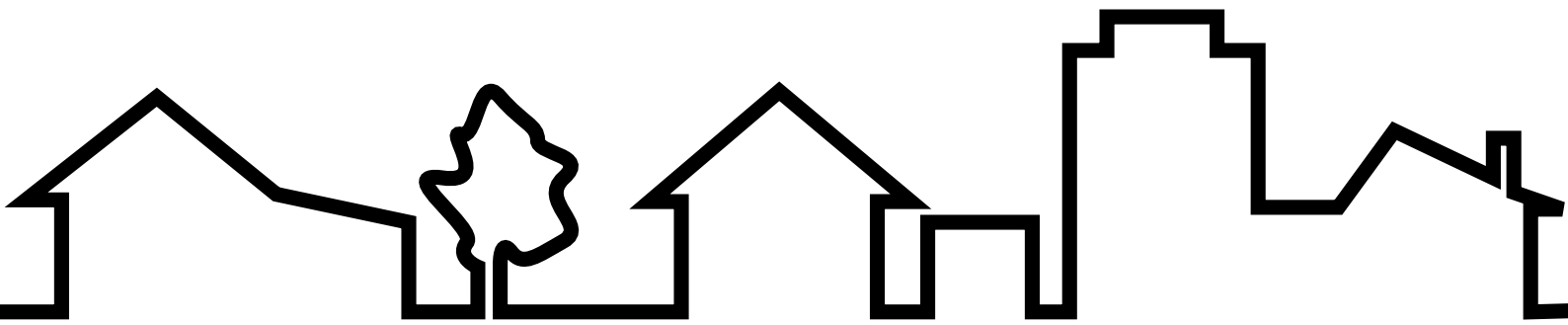


NATHERS assessor handbook

SUPERSEDED



Publication information

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The material in this document is to be followed by accredited assessors and is made available for assessors who use NatHERS accredited software in 'regulatory' mode only and on the understanding that the NatHERS Administrator, the state and territory governments, and the Commonwealth Government (the Participating Bodies) are not providing professional advice, nor indicating a commitment by the Participating Bodies to a particular course of action. While reasonable efforts have been made to ensure the information is accurate, correct and reliable, the Participating Bodies, and all persons acting for the Participating Bodies preparing this publication, accept no liability for the accuracy of, or inferences from, the material contained in this publication, and expressly disclaim liability for any person's loss arising directly or indirectly from the use of, inferences drawn, deductions made, or acts done in reliance on this document. The material in this document may include the views or recommendations of third parties, which do not necessarily reflect the views of the Participating Bodies, or indicate their commitment to a particular course of action.

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INTRODUCTION

The Nationwide House Energy Rating Scheme (NatHERS) provides building energy performance ratings and information to help improve Australian homes. By understanding how energy is used to heat and cool a home, NatHERS helps to make Australian homes more comfortable and helps you to save on energy bills through smarter design choices. This handbook explains how NatHERS assessments work and is an essential tool for NatHERS assessors.

Nationwide House Energy Rating Scheme

NatHERS supports improvements to the energy efficiency of Australia's residential dwellings by providing a national standardised approach for energy rating assessment tools used for rating dwellings. NatHERS is administered by the Australian Government on behalf of the state and territory governments.

NatHERS uses a 10-star rating system to provide estimates of a home's thermal performance (heating and cooling needs). Star ratings are based on information about the home's design, construction materials and the climate where it is built.

Each star band is defined by a maximum thermal energy load. Each energy load for a star band varies by climate zone. The star bands for different climate zones are available on the NatHERS website: [www.nathers.gov.au/files/publications/NatHERS Star bands.pdf](http://www.nathers.gov.au/files/publications/NatHERS%20Star%20bands.pdf).

NatHERS star ratings and information can be used by building surveyors and certifiers, homeowners, prospective home buyers, builders, developers and national, state and local governments for a number of purposes, including to:

- verify that the residential dwelling meets the mandatory thermal energy efficiency requirements for new homes and major renovations/building additions required under the National Construction Code (NCC) and state and territory requirements.
- compare the energy efficiency of various building designs.

NatHERS assessments are conducted by trained assessors using purpose-built assessment tools (see Section 1.1).

The Chenath engine

All NatHERS energy rating assessment tools are underpinned by, or benchmarked against, the Chenath engine. The Chenath engine has been developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and is based on decades of scientific research on the way residential dwellings operate in Australian conditions. It uses climate data and average user behaviour, among other factors, to predict annual energy requirements for residential dwellings.

A basic overview of how NatHERS assessment tools work is available on the NatHERS website: www.nathers.gov.au.

Understanding the workings of the Chenath engine may also be helpful to assessors. Behavioural settings and assumptions made by the Chenath engine include thermal properties of building materials, location climatic data, infiltration rate and air flow, internal heat gains, thermostat settings, and operational behaviours. More detail about these underlying assumptions can be found in the Chenath repository: <https://hstar.com.au/Home/Chenath>.

The handbook

This NatHERS assessor handbook has been developed by the NatHERS Administrator in conjunction with industry experts.

It is designed to help assessors navigate the NatHERS assessment process, by describing how assessments are to be conducted, including the mandatory and recommended steps of the process. Figure I-1 outlines the typical NatHERS assessment and rating process.

This handbook also presents information that can assist assessors, regardless of which assessment tool is used. For guidance on undertaking activities in a specific assessment tool, assessors should contact their software tool provider for a copy of their specific assessment tool manual or Frequently Asked Questions.

Release of the handbook

Chapters of this handbook will be released individually over time while more content is being developed. Initially, chapters will be released in draft form to allow comment. Following 4–6 weeks of consultation, each chapter will be reviewed and a final version released. Assessors can suggest the development of new content by contacting their Assessor Accrediting Organisation (AAO).

This handbook is designed to be a living document that will be updated occasionally, and in alignment with updates of the NatHERS Technical Note. It is the responsibility of assessors to ensure they are using the current version of the handbook. The version number of each Chapter can be found at the footer of each page. Notification of updates will be published on the NatHERS website, and communicated to state and territory building authorities, and to assessors. The latest version of the handbook is available for download on the NatHERS website: www.nathers.gov.au.

The NatHERS website also includes the Assessor Handbook version register outlining a summary of the latest versions and any previous updates. Minor amendments will be represented by a decimal point increment, and will not include fundamental changes to the assessment guidance. Major amendments will be represented by a whole number increment, and will represent significant content updates or amendments altering assessment guidance or processes.

Structure of the handbook

This handbook is divided into chapters based on building and environmental elements, and assessment tool functions:

1	Before you start	6	Walls
2	Data entry	7	Windows
3	Climate, terrain, exposure and orientation	8	Ceilings and roofs
4	Zoning	9	Shading and eaves
5	Floors	10	Finalising the assessment

The key requirements that must be followed to obtain a NatHERS assessment in regulatory mode are numbered and summarised at the beginning of each chapter.

Assessor requirements

Assessors who are accredited under NatHERS are professionals who are qualified to conduct NatHERS assessments using NatHERS-accredited software tools and are members of an AAO. As requirements differ between states and territories, assessors should contact the relevant state or territory building regulator about any specific requirements for that state or territory.

This handbook is intended to be a helpful resource for all assessors. When conducting assessments, assessors must still follow the requirements of the current NatHERS Technical Note and the relevant state or territory requirements.

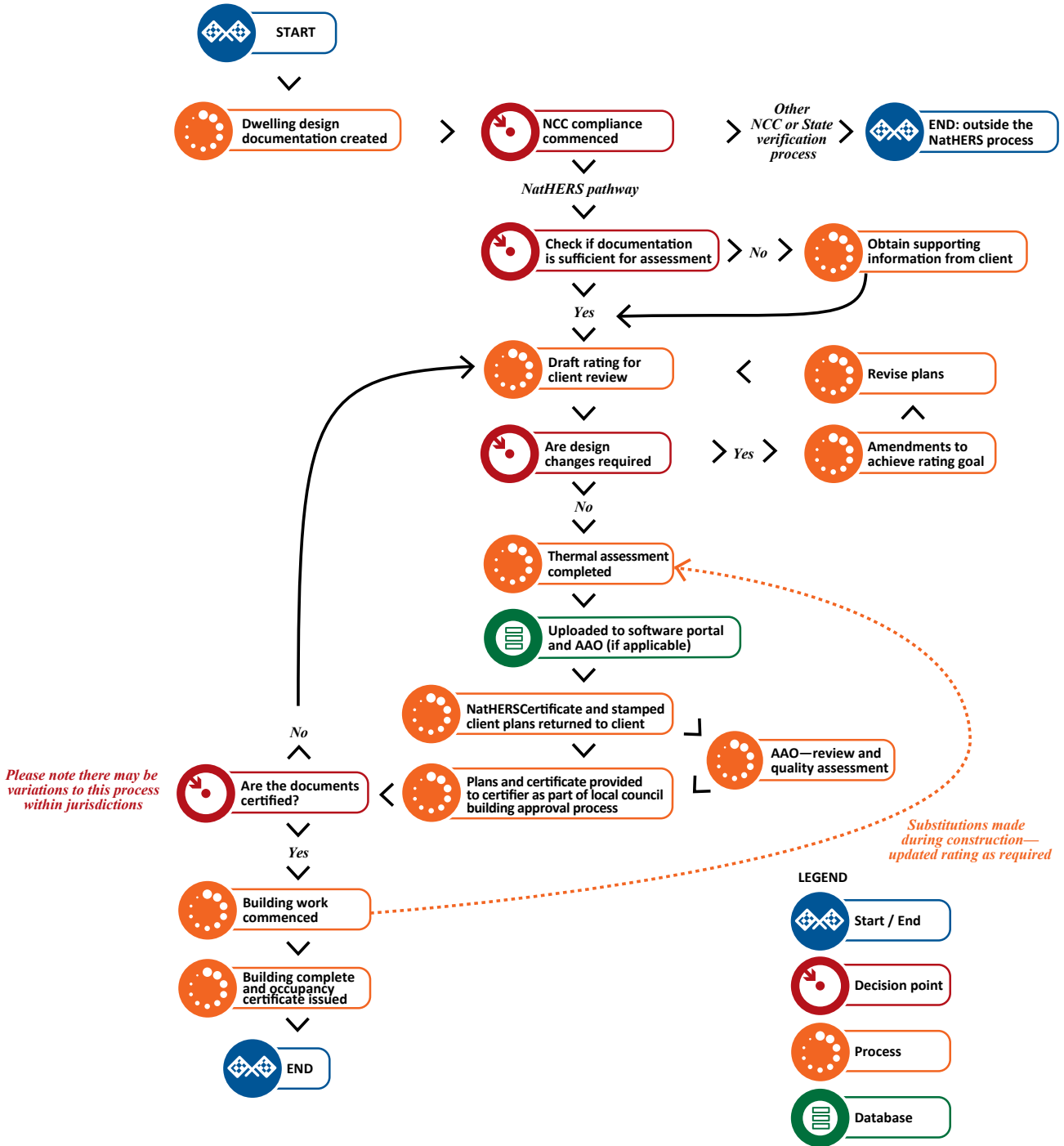


Figure I-1: NatHERS Assessment and Rating Process

NatHERS Technical Note

This handbook contains information that further explains or clarifies the NatHERS Technical Note (version June 2019). Where information relates directly to specific Tech Note clauses, the number of the clause has been provided as a reference.

Note that the guidance in this handbook is nonbinding; it supports and does not replace the use of the current Technical Note. Where there appears to be conflicting guidance between the current Technical Note and this handbook, the Technical Note takes precedence.

The NatHERS Technical Note is available on the NatHERS website: www.nathers.gov.au/publications/technical-note.

Jurisdictions

The information outlined in the NatHERS Technical Note must be used by all assessors, unless other state or territory regulatory obligations apply.

State or territory regulatory obligations prevail in all cases where there is a conflict between this handbook and the jurisdictional obligation, noting that jurisdictions may have alternate modelling methods to meet the NCC requirements. It is an assessor's responsibility to be aware of specific modelling requirements, and to seek guidance from the relevant jurisdiction regarding any conflicts between jurisdictional obligations and the guidance in this handbook. Refer to the NCC for jurisdictional variations, and the relevant state or territory authority, department and/or local council for requirements within that jurisdiction: www.abcb.gov.au.

Other guides

There may be some complex modelling situations and/or construction materials that are not covered in this handbook. Where a situation is not covered, assessors should refer to specific assessment tool manuals for guidance. If assessors are still unclear about how to proceed, or where there is uncertainty about construction material specification or how to interpret information, assessors should contact their AAO or the NatHERS Administrator at admin@nathers.gov.au, for modelling advice. Only assessment tool providers can provide guidance on specific software tool issues or questions.

Further information

All enquiries and requests for additional information should be referred to either:

- the relevant AAO
- the relevant state or territory building regulator.

All enquiries and comments specifically about this handbook should be referred to the NatHERS Administrator at admin@nathers.gov.au.



**For further information,
visit the NatHERS website:
www.nathers.gov.au.**



BEFORE YOU START

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BEFORE YOU START

1

Before starting an assessment, an assessor will need to be familiar with the requirements of the National Construction Code (NCC), NatHERS accredited software tools, project documentation, an understanding of the relevant state or territory and local authority requirements and the assessment goals the client requires.

This chapter provides introductory information on how the software tools are to be used, what documentation will be required for certification, provisional settings, individual rating requirements, assessment goals and the principles of thermal performance.

Summary of key requirements

This handbook is intended to be a helpful resource for all assessors. When conducting assessments, assessors must still follow the requirements of the current NatHERS Technical Note and the relevant state or territory requirements.

- 1a** Assessors must use NatHERS accredited software tools to obtain certification of a NatHERS assessment.
- 1b** Software tools accredited under NatHERS are intended to be used for assessing new and existing dwellings and renovations. This includes Class 1, 2 or 4 buildings and attached Class 10a buildings.
- 1c** Minimum documentation required to complete an assessment includes:
 - drawing set (site plan, floor plan, elevations and sections) with a true north point
 - lighting location plan/electrical schedule and details of any exhaust fans
 - construction details
 - window and door information.
- 1d** If the details in 1c are not present on the drawing set or in the documentation, the drawing set or documentation must be clarified with the client and the details to be added or amended (except where provisional values apply).
- 1e** If the drawing set and documentation is missing information, assessors must clarify the information. Where clarification has been sought but not received or is unknown, an assessment must be undertaken using the provisional values in the NatHERS Technical Note.
- 1f** Where information is ambiguous or inconsistent, clarification must be sought from the client and any appropriate revisions must be made to the design documentation before issuing the NatHERS Certificate.
- 1g** Assessors should advise the client if provisional values are used, and that some provisional values represent worst-case scenario and the rating may be adversely affected.
- 1h** Every dwelling must have its own individual rating and NatHERS Certificate.
- 1i** Where a number of Class 2 multi-unit buildings are located in close physical proximity, as part of the same development or where the strata plan identifies separate lots, a summary certificate must be completed for each building/lot separately.
- 1j** NatHERS software tools must not be used to rate only a part of a dwelling. Any rating for an addition to, or extension of, an existing dwelling must include both the existing and proposed areas of the dwelling.
- 1k** The drawing set and all documentation must be retained and produced if audited or quality assured.

1.1 Software tools

1a Assessors must use NatHERS accredited software tools to obtain certification of a NatHERS assessment.

There are currently three software tools in Australia that are accredited to assess compliance with the thermal energy efficiency requirements in the National Construction Code:

- AccuRate: developed by CSIRO
- BERS Pro: owned and maintained by Energy Inspection
- FirstRate5: developed by Sustainability Victoria.

All new assessments are to be undertaken in the latest version of the software. There may be some situations where an older version of software is acceptable; please check the relevant state or territory regulations.

1b Software tools accredited under NatHERS are intended to be used for assessing new and existing dwellings and renovations. This includes Class 1, 2 or 4 buildings and attached Class 10a buildings.

Class 1, 2 or 4 dwellings are defined in the Building Code of Australia (BCA) Volumes One and Two of the National Construction Code (NCC) and can be modelled in software tools accredited under NatHERS. Class 10a buildings attached to Class 1, 2 or 4 dwellings must be modelled as part of the assessment. If a Class 10a building is not attached to the dwelling, it is to be modelled as a shading device.

Information about the NCC, building classification categories and specific state or territory requirements are available on the Australian Building Codes Board website: www.abcb.gov.au.

Software support is provided by the software tool providers:

- AccuRate: provided by Energy Inspection and CSIRO
- BERS Pro: provided by Energy Inspection
- FirstRate5: provided by Sustainability Victoria.

1.2 Documentation

Assessors are to collect all information and documentation before starting the assessment. This will save time and ensure the project is fully understood before entering data into the software tool.

1c Minimum documentation required includes: (also see Section 1.2.1 for more detail) (**Tech Note clause 2.1**):

- drawing set (site plan, floor plan, elevations and sections) with a true north point
- lighting location plan/electrical schedule and details of any exhaust fans
- construction details
- window information; either an individual window and door size schedule or clearly noted floor plans or elevations showing the window operating type, height, head height, width and frame type, and skylight and roof window details.

1d If details in 1c are not present on the drawing set or in the documentation, the drawing set or documentation must be clarified with the client and the details to be added or amended (except where provisional values apply). Prior to producing the final NatHERS Certificate, details on the drawing set and relevant schedules, addendums and specifications must align with the assessment. (**Tech Note clauses 3.1, 3.3, 11.1**)

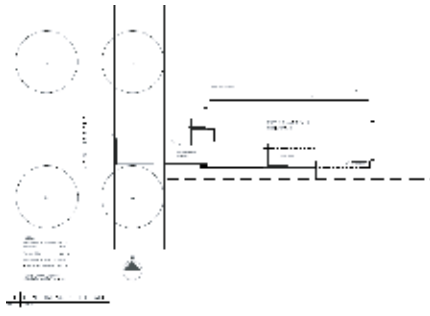
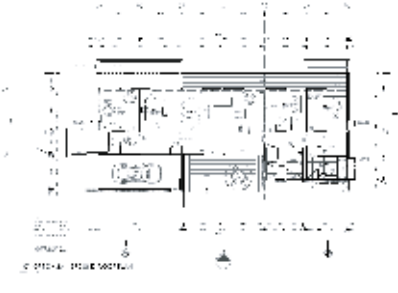

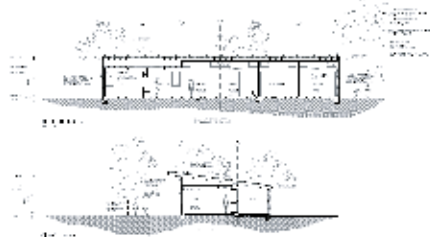
1e The drawing set and documentation must be retained by the assessor for auditing and quality assurance purposes.

All supporting information that informs an assessor's decision-making must be kept with the drawing set and documentation, and also be copied to the client so that it can be provided to the relevant building authority if required. (**Tech Note clause 2.4**)

1.2.1 Drawings

The drawing set provides the basis of design documentation used for the assessment and are essential for certification (see 1c and 1d). The set of drawings must be drawn to scale and should include a version number and/or date. If the design documentation does not ensure clarity of information and readability, assessors are encouraged to request an improved standard of documentation. The set should comprise of the items listed in Table 1-1 at a minimum, but not be limited to:

Table 1-1 Drawing set examples

<p>SITE PLAN</p> <p>Minimum requirements include:</p> <ul style="list-style-type: none"> - north point indicating true north (See Chapter 3) - location postcode - <p>Additional details may include:</p> <ul style="list-style-type: none"> - location of the dwelling in relation to the site - street address details - fences - contours - overshadowing structures such as adjacent buildings (see Chapter 9) - 	<p>Example—site plan*</p> 
<p>FLOOR PLAN/S</p> <p>Minimum requirements include:</p> <ul style="list-style-type: none"> - room layout and room names or types - building and room dimensions - window and door locations - numbering of individual dwellings (for Class 2 buildings) - <p>Additional details may include:</p> <ul style="list-style-type: none"> - window and door sizes - floor coverings - locations of ceiling penetrations such as exhaust fans and downlights - location of ceiling fans - shading structures such as eaves, pergolas and privacy screens 	<p>Example—floor plan*</p> 
<p>ELEVATIONS</p> <p>Minimum requirements include:</p> <ul style="list-style-type: none"> - window and door location, size and opening type - roof pitch, material and style - external wall materials - <p>Additional details may include:</p> <ul style="list-style-type: none"> - external wall and roof colours - window openability and offset - shading structures such as eaves, pergolas and privacy screens - ground level/s, floor level/s, and relative ceiling height/s 	<p>Example—elevation*</p> 
<p>SECTIONS</p> <p>Minimum requirements include:</p> <ul style="list-style-type: none"> - ground level/s, floor level/s, and relative ceiling heights - <p>Additional details may include:</p> <ul style="list-style-type: none"> - roof construction, materials and systems - location of insulation - subfloor construction - window head height - stair details 	<p>Example—section*</p> 

*Source: Design For Place www.yourhome.gov.au/house-designs

Other information provided as part of the design documentation to assist with the assessment may include, but is not limited to:

- Lighting location plan or electrical schedule, including details such as:
 - location of lighting
 - downlight or pendant type (light-emitting diode (LED), compact fluorescent light (CFL), fluorescent etc.)
 - location, type and size of ceiling or exhaust fans
 - specific insulation clearance and/or sealing details for ceiling penetrations

If recessed light fittings information is not provided and the assessment is completed, the assessment assumes pendant lighting and it must clearly state on the NatHERS Certificate the dwelling has been assessed without downlights. If downlights are present in the dwelling, the assessment will need to be updated for compliance purposes. (**Tech Note clause 9.4**) This may not be required in New South Wales and Victoria, assessors should check if jurisdictional requirements prevail. (**Tech Note—Introduction: Regulatory requirements**)

- construction details
 - detailing of the construction components of the floor, subfloor, walls, ceiling and roof
 - information on insulation installation, floor coverings, and finishes (including colours of roof, internal and external walls)
 - information and detailing of shading and overshadowing structures including neighbouring buildings
- window and door schedule
 - window and door types, including frame composition and opening style
 - windows and door sizes (sometimes shown as an abbreviated code on the floor plan i.e. 1820 may refer to a window that is 1800 width x 1200mm height)
 - glazing type and values
 - manufacturer name and window codes if specified
- notes and other details, including:
 - all communication with the client that has been used to inform the assessment.

1e If the drawing set and documentation is missing information, assessors must clarify the information. Where clarification has been sought but not received or is unknown, an assessment must be undertaken using the provisional values (previously termed 'default values') in the NatHERS Technical Note (See Section 1.3).

1f Where information is ambiguous or inconsistent, clarification must be sought from the client and any appropriate revisions must be made to the design documentation before issuing the NatHERS Certificate. (**Tech Note clause 3.4**)

This includes where there is inconsistency between any of the documentation provided to conduct the assessment. Inconsistencies must be clarified with the client and the client needs to issue revised documentation and drawing sets before finalising the NatHERS Certificate, to ensure the rating aligns with the documentation.

1.3 Provisional settings

There are situations where assessors may not have the information or specific details to undertake a detailed assessment, either because decisions have not yet been made or information is not yet available. Provisional settings (or 'provisional values') have been developed to be used in these situations (see also 1g; and **Tech Note clauses 3.6 and 3.7**).

Provisional values represent average practice (e.g. floor coverings) or worst-case option (e.g. roof colour).

A worst-case provisional value is where the documentation does not specify required details, and a choice must be made by an assessor to represent the worst performing option. For example, where the roof colour is not known, in tropical areas a 'dark' roof would be selected; conversely in a cool climate a 'light' roof would be selected. Choosing the worst case as the provisional value means that if additional information becomes available and is changed in the assessment, the rating can only improve.

Where provisional values represent a worst case scenario, assessors are to test the choice to ensure the rating provided with the provisional value is the minimum that can be achieved. The correct identification of the worst-case provisional value may require multiple simulations, because the outcome will be affected by other aspects of the assessment.

1g The client should be advised that some provisional values represent worst-case scenario and the rating may be adversely affected. Any provisional values used for the assessment must be detailed in the NatHERS Certificate 'additional notes.' (**Tech Note clauses 3.6 and 3.7**)

There are no NatHERS provisional values available for the average number and location of lights or ceiling penetrations within a dwelling; however, ratings can still be completed. In this case, the NatHERS Certificate will state that the dwelling has been rated without downlights or ceiling penetrations and clients should be told the dwelling will need to be rated again if these features are present.

1.4 Individual ratings

Dwelling designs are often repeated across projects. However, a wide range of features, such as the height, orientation, neighbouring obstructions and topography, will vary from dwelling to dwelling, which will change the rating.

1h Every dwelling must have its own individual rating modelled in accordance with the NatHERS Technical Note. This includes all Class 2 dwellings in a single building or development, even when a design that is repeated on the same or different projects. The assessment and rating of each individual dwelling must reflect the individual characteristics of the dwelling modelled. (**Tech Note clauses 2.2 and 11.6**)

1i Where a number of Class 2 multi-unit buildings are located in close physical proximity as part of the same development or where the strata plan identifies separate lots, a summary certificate must be completed for each building/lot separately.

At the request of the client, a single Class 2 summary certificate can be produced for buildings that are combined and share a lot (for example, by a bridge, shared underground space or an enclosed walkway) where NCC requirements for combined buildings are met. (**Tech Note clause 11.6.1**).

1.4.1 Re-using a base file

Where dwellings are similar, assessors can build on an existing assessment file.

- **For an entirely different design:** a new NatHERS software file must be created for each project.
- **For a design that is similar to another assessment, with features that affect the result:** an existing base NatHERS software file could be duplicated and adjusted to accurately represent each dwelling's specific characteristics (e.g. height above ground, shading, orientation). This especially applies to multi-unit dwellings. For example, units in a multistorey building may have the same layout, but other conditions can vary such as the wind-speed will increase and the height of a neighbouring obstruction will decrease further up the building.

If using a NatHERS software base file to duplicate units, remember to adjust the terrain exposure (see Chapter 3), orientation (see Chapter 3), height above ground (see Chapter 5) and shading from adjacent structures (see Chapter 9).

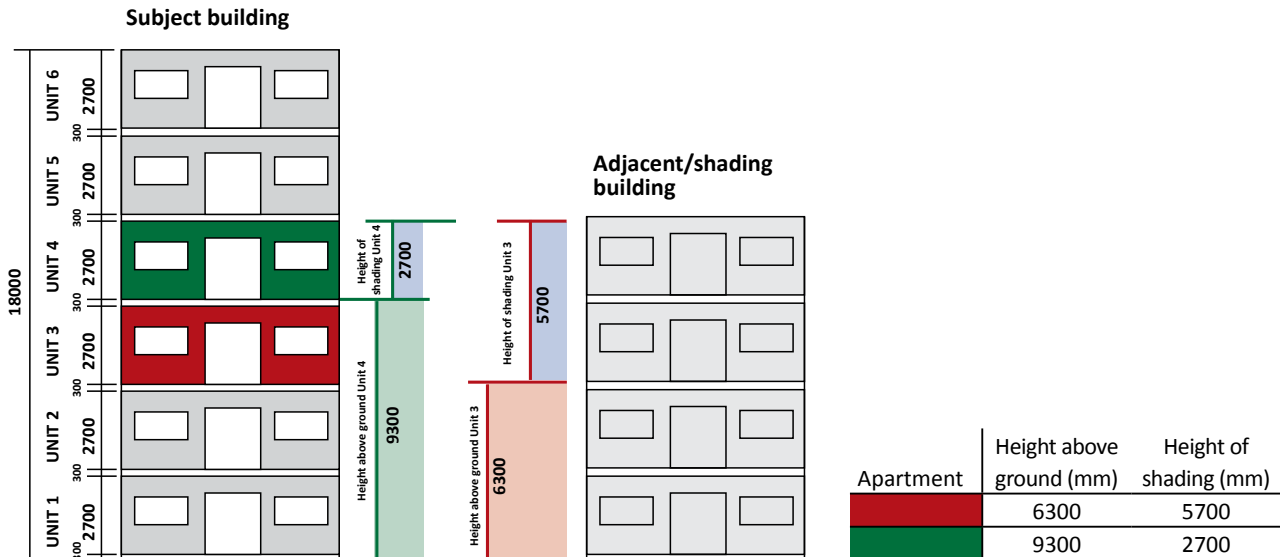


Figure 1-1 Considerations when duplicating base files for units

1.4.2 Modelling major renovations and building additions

A NatHERS assessment may be required for major renovations or additions. The requirements and definitions vary between jurisdictions and local councils; assessors should check the relevant jurisdictional regulations.

Different jurisdictions may also have different modelling methods to meet the requirement for the NCC energy efficiency requirements for additions. Assessors should refer to the NCC for jurisdictional variations and/or the relevant state or territory requirements in that specific area. **(Tech Note Introduction: Regulatory requirements)**

- 1| NatHERS software tools are used to assess an entire dwelling. An addition or renovation cannot be rated in isolation; it must be incorporated in a new rating for the entire dwelling. Class 10a structures are only to be included in the rating if it is attached to the dwelling. **(Tech Note clause 2.3)**

1.5 Assessment goal

The assessment goal is the outcome the assessor needs to achieve to meet the client’s requirements. When starting a project, discuss with the client the state or territory requirements and the client’s preferences.

The assessment goal may be:

- a regulatory goal for certification purposes:
 - to comply with the NCC
 - to comply with any state or territory building code requirements
- a particular star rating:
 - to meet a requirement set by the client, state or territory requirements or other body
 - to provide information for a project or other purpose
- specific heating and cooling loads:
 - to meet a requirement set by the client, state or territory requirements or other body
 - to provide information for a project or other purpose

- to provide the client with options:
 - to achieve jurisdiction compliance
 - to achieve better thermal efficiency
 - to reduce operating costs
 - to improve occupant comfort
 - to compare materials including glass, insulation and construction elements
 - to compare construction methods such as cavity brick, brick veneer, lightweight construction, reverse brick veneer etc.

1.6 Principles of thermal performance

Optimal thermal performance aims to keep the dwelling warm when it is cold outside and cool when it is hot outside. This is influenced by the climate zone where the dwelling is located—in colder climates the focus will be on keeping the dwelling warm, and in warmer climates the focus will be to keep the dwelling cool.

In adjusting the dwelling to meet a particular assessment goal, it is useful to think about some key principles of thermal performance (refer to the Your Home website for additional information: www.yourhome.gov.au). The following thermal performance principles should be considered to suit the particular climate zone and dwelling requirements of the client.

1.6.1 Maximise solar gain in cool months, minimise solar gain in hot months

Solar gain is heat transfer into the building that occurs because of solar radiation (or the sun) entering into the dwelling. Controlling the effects of solar radiation on the dwelling means controlling how much of the sun's energy reaches the internal spaces of the dwelling.

Factors affecting solar gain include:

- **orientation of the building:** Positioning the dwelling's orientation appropriately for the climate, will enable best use of sunlight to heat the dwelling in cold climates and in colder months.
- **window placement:** The placement of windows can affect the heat gains and losses into a dwelling. North-facing glazing can maximise solar gain in colder months and help to heat the dwelling. If coupled with thermal mass internally, north-facing windows can allow the sun in during the day to heat the mass, which allows the heat to be stored for release during the evening. There is however a balance with window placement; too much north-facing glazing can result in too much heat loss, or without appropriate shading can result in too much heat gain.
- **shading devices:** Shading can have a negative or positive effect on a dwelling. In some climates, particularly those dominated by cooler months, too much shading can prevent desirable solar gain, while in warmer climates adequate shading is essential all year round. The installation of adjustable shading devices is often the key to achieving different amounts of solar gain when needed throughout the year. Choosing tinted shading products suitable for the climate zone is also a way to achieve a more consistently comfortable dwelling.
- **external colour:** Darker colours absorb heat and lighter colours reflect heat. To assist with reducing indoor temperature extremes, it is preferable to use lighter and more reflective colours on the walls and roof. Some testing may be required to establish the optimum colour for the location and climate of the dwelling.
- **insulation:** Insulation is key to maintaining thermal comfort, as it ensures heat does not escape from the dwelling in cool temperatures, and retain the cooler air inside in hot temperatures. To maximise these benefits, insulation should be paired with reducing opportunities for air leakage (i.e. minimising ceiling penetrations, such as downlights, and carefully sealing construction junctions).

1.6.2 Maximise or minimise energy transfer

Energy transfer is energy moving through the dwelling envelope because of conduction (where heat from a warm area moves through an element to a cold area). Conductive heat transfer occurs through walls (both external and internal), floors, roofs, glazing and skylights. Controlling energy transfer through a dwelling means controlling the insulating qualities and/or size of these various elements.

Factors affecting energy transfer include:

- **dwelling shape:** Dwellings with less external wall area have a smaller surface area through which energy can be transferred. Option A, B and C in Figure 1-2 have the same floor area, however the shapes give different surface area of external wall.

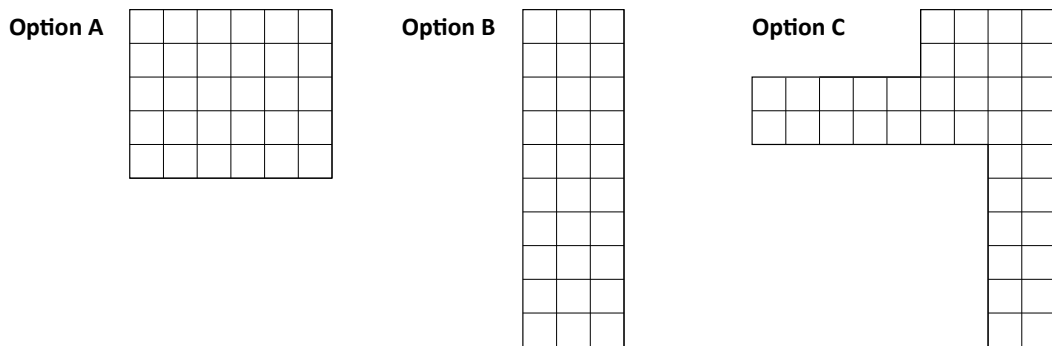


Figure 1-2 Minimising energy transfer through external surface area

- **dwelling design:** Grouping similar zones together means the energy transfers between the internal walls are more likely to travel from like zone to like zone. When the assumed temperature profile is the same on either side of the wall, energy transfers are minimal. Minimising the surface area of internal walls and/or adding insulation between zones with differing temperature profiles (such as bedrooms and garages), will also minimise the amount of energy transfer.

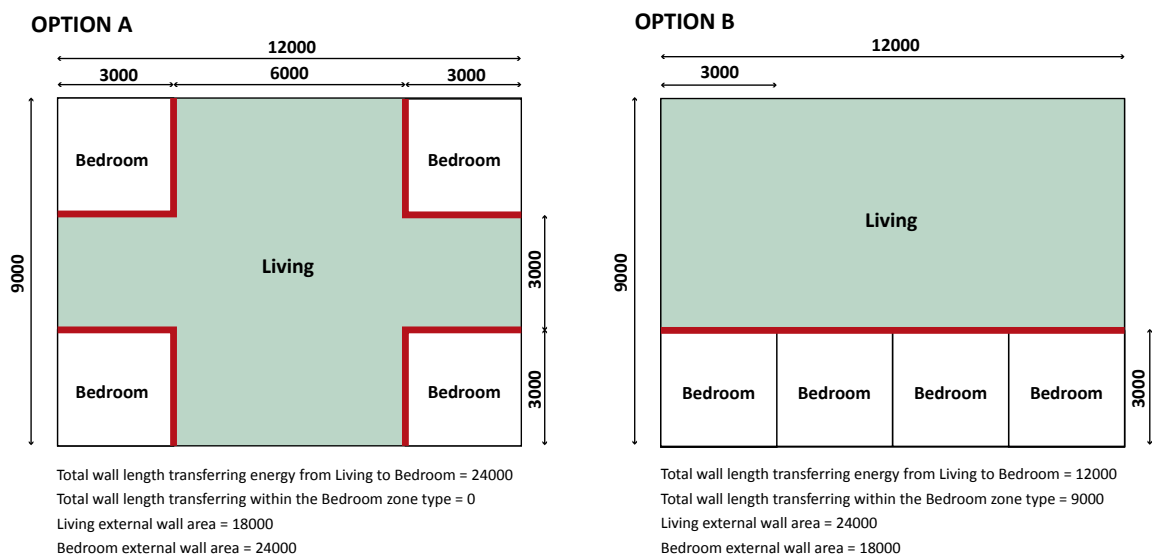


Figure 1-3 Minimising energy transfer through dwelling design

In Option A, the placement of bedrooms means that the total wall length between zones of differing temperature profiles (living and bedrooms) is 24,000 mm. In Option B, the new design achieves the same living space but the wall length between zones of differing temperature profiles is only 12,000 mm.

- **window to conditioned floor area ratio:** Depending on climate zone, design and orientation, a high ratio can have a significant impact on the rating if the windows are the weakest point of energy transfer in the external wall. This depends on the window system (glass and frame) selected, and other construction considerations.
- **type and location of floor coverings:** Softer floor coverings (soft vinyl, floating timber and carpet) insulate the floor and may be desirable in some rooms in colder climates. However, north-facing living areas should leave the concrete slab exposed or use hard coverings (tiles, hard vinyl) for increased thermal gain; these can heat up during the day and release heat at night. A north-facing slab in a cool climate that is covered by carpet and underlay will have no thermal mass benefit. Harder floor coverings (tiles, polished concrete, hard vinyl) over a concrete-on-ground slab, allows the temperature of the ground and the mass of the concrete slab to be used to regulate the temperature of the dwelling. In hot climates, large expanses of hard floor coverings can help to moderate the temperature of the dwelling, provided adequate shading is installed to prevent the hard surfaces from heating up from direct sun. In cold climates, the ground temperature may be too cold and have too few sunlight hours to heat up at all. If this is the case, then waffle pod slabs, edge slab insulation and under-slab insulation could be considered.

Approximately 80% of the heat loss from a concrete slab occurs through the slab edge. More information regarding this insulation option is available at www.yourhome.gov.au.

- **materials and construction methods:** The selection of construction methods and materials is extremely important to the thermal comfort of a dwelling. Ensuring appropriate insulation is key to maintaining thermal comfort, as this will minimise heat loss from the dwelling in winter and retain cool air inside the dwelling in summer. Also, avoid ceiling penetrations, such as downlights, as these provide opportunities for air leakage and will negatively impact the effectiveness of the insulation.

Increasing thermal mass internally to absorb and store heat energy can help to moderate the internal temperature of a dwelling. During hotter weather, it absorbs heat during the day and if the dwelling is vented overnight, the heat can be released to cooling breezes or clear night skies. In cooler weather, the same thermal mass can store the heat from the sun, or heaters, and release the stored heat back into the dwelling, especially at night. A slab-on-ground design is usually an effective way of achieving consistent temperatures through the dwelling. Elevated floors, by contrast, are subject to changes in climatic conditions. Elevated floors may be useful in warmer climates where ventilation under the floor, coupled with the cooler shaded air, is beneficial to thermal comfort. In colder climates, enclosing the subfloor and placing insulation on the underside of the floor can help to re-establish stable temperatures under elevated floors.

1.6.3 Maximise ventilation and minimise infiltration

Ventilation is the movement of air through air circulation or convection (e.g. through doors, windows, extraction fans). Infiltration is air movement due to the uncontrollable leakage (e.g. through construction gaps and/or unsealed penetrations). Controlling ventilation means controlling the potential air paths through a dwelling.

Factors affecting ventilation include:

- **orientation of the dwelling:** Positioning the dwelling's orientation appropriately for the climate can make best use of prevailing winds to cool the dwelling.
- **location of windows and doors:** Locating windows and doors opposite each other can allow a clear flow of air in and out of the dwelling. This cross ventilation can passively help to cool the dwelling. The placement of internal doors and zoning of spaces can also ensure that heat within a particular space can be controlled; for example, ensuring the living areas can be closed off can help improve winter comfort and reduce energy bills, as less energy will be needed to keep the room at a comfortable temperature.

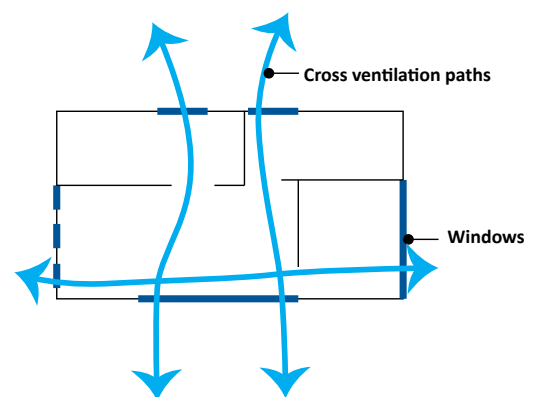
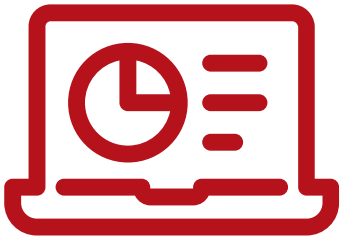


Figure 1-4 Cross-ventilation

- **the inclusion of downlights:** If unsealed, downlights can create an uncontrolled infiltration path from the rooms to the roof space, allowing warm or cool air in the room to escape into the roof space. In addition, downlights reduce the amount of ceiling insulation, as a clearance area without ceiling insulation is generally required around the downlights for safety purposes.
- **window type:** The opening type of a window or door affects its opening percentage and ventilation flow. For example, a single-pane casement window with a 90% opening percentage, will provide more ventilation than a double hung window, as its opening percentage is only 45%. (See Chapter 7—Windows)

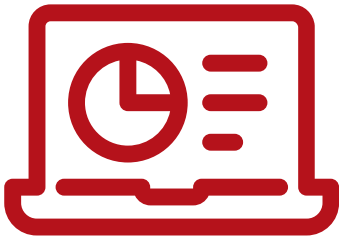


DATA ENTRY

IN THIS CHAPTER

- 2.1 Project details..... 3
- 2.2 Scaling and measurement..... 3





DATA ENTRY

Assessors are to use a consistent, systematic approach when entering data into the NatHERS software tools, to reduce errors and increase consistency and accuracy. Assessors should also check their work throughout the process.

Summary of data entry

A suggested approach for entering data into NatHERS assessment tools is:

- 1 Enter the project details (Section 2.1).
- 2 Enter the terrain and exposure (see Chapter 3).
- 3 Set the provisional settings and/or create, load or select the constructions to be used.
- 4 Scale the drawing canvas or plan tab and check that scaling is correct (this does not apply to non-graphical assessment tools) (see Section 2.2).
- 5 Zone the dwelling in accordance with the NatHERS Technical Note (see Chapter 4).
- 6 Adjust orientation appropriately (see Chapter 3).
- 7 Check the conditioning for each zone (see Chapter 4).
- 8 Enter or adjust the dwelling elements, including walls, windows and doors (see Chapters 6 and 7).
- 9 Enter or adjust the floors and ceilings, including floor coverings and under floor insulation (see Chapters 5, 6 and 8).
- 10 Check, enter or adjust the insulation details (see Chapters 6 and 8).
- 11 Enter or adjust roofs and skylights (see Chapter 8).
- 12 Enter eaves, overhangs, shading and overshadowing by adjacent dwellings and structures (see Chapter 9).
- 13 Simulate the project.
- 14 Correct any errors flagged by the assessment tool and re-simulate if applicable.
- 15 Use the dwelling and other reports to check the data.
- 16 Correct any errors.
- 17 Analyse and improve the assessment (see Chapter 10).
- 18 Check all documentation has been updated to reflect the final rating (if changes have been made to optimise thermal performance).
- 19 Certify the assessment (see Chapter 10).

For further information, consult the assessment tool manuals, inbuilt and online help, FAQs or documentation issued by training organisations or Assessor Accrediting Organisations.

2.1 Project details

Assessors are to complete the project details in the assessment tool accurately and include sufficient detail for every assessment. Project details are to be consistent with the dwelling documentation that is being used as the basis for the assessment.

2.2 Scaling and measurement

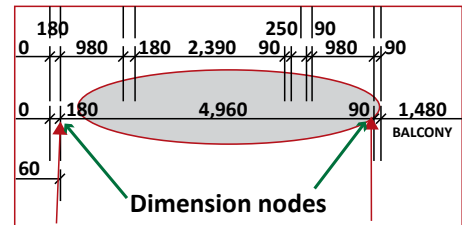
Assessors are to ensure the correct scaling is used in graphical assessment tools and that measurements from drawings being entered into assessment tools are accurate.

2.2.1 Scaling in graphical assessment tools

When using graphical assessment tools, before any data is entered it is important to take time with scaling, as it forms the basis of all data entry. If the incorrect scaling is applied when the plan is imported, the rating will be incorrect as the length of walls (from the plan) and heights (entered by the assessor) will not align. It is also difficult to rescale or change data later in the assessment process if the scale is incorrect.

Assessors may be provided with a PDF of the dwelling or can create one using a scanner or from design software. To scale drawings in graphical assessment tools:

- 1 Follow the assessment tool manual to import or paste the image into the assessment tool.
- 2 Zoom in on the image and select the dimension to be used for scaling. Selecting a large dimension line will generally give the most accurate measurement for scaling.
- 3 Select the nodes at each end of the dimension (see the appropriate assessment tool manual).
- 4 Zoom the drawing or plan canvas in on the dimension to be used as the scale.
- 5 Using the measuring or scaling tools, enter the dimension into the assessment tool (more detail on how to do this should be available in the assessment tool manual).



To check dimensions:

- 6 Draw a zone of known size (it can be a real zone or a test zone that can be deleted after the dimensions have been checked).
- 7 Click on at least two walls of the chosen zone (it is best to use perpendicular walls) to ensure scaling is correct in all directions.
- 8 If incorrect, adjust by repeating steps 1 to 5.
- 9 If correct, begin to enter data.

These steps are general and assessment tool manuals may provide more specific instructions.

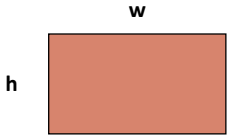
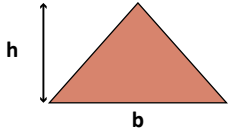
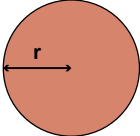
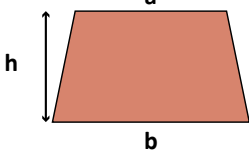
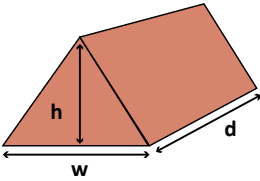
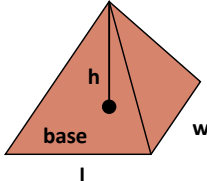
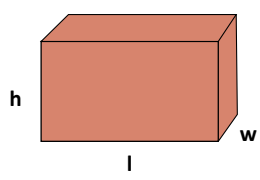
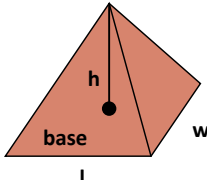
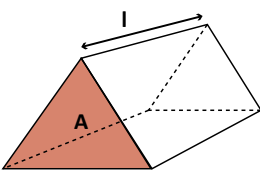
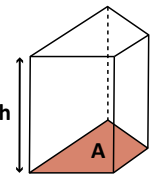
2.2.2 Measurements from drawings

Dimensions noted on drawings are to be used wherever possible. Where a dimension is not noted, use either a scale ruler or PDF software with a measuring function to obtain measurements. Take care to always use the correct scale for each drawing (e.g. a floor plan is usually 1:100, a site plan is usually 1:200).

- **If using printed drawings:** Use a scale ruler to check the drawings are printed to scale by measuring a number of the dimensions in both directions, as scanners can stretch images, or the dimension text may have been altered. If the drawing is not to scale, either:
 - print a scale ruler to the correct scale or make your own using techniques available on the internet.
 - scan the drawings to make a PDF and use the PDF measuring method.
- **If using electronic and PDF drawings:** Use the PDF software scaling function to enter the scale of a drawing. Check the scale is correct by measuring a number of dimensions on the drawing. If the drawing is not to scale, adjust the scale (e.g. 1:100 might need to be 1:99) and then check the dimensions again. Repeat this until the scale is correct.

Assessors may also be able to export Computer-Aided-Drawings or PDFs into a computer program for measuring. If assessors are unsure of the drawing scale or have difficulty confirming dimensions, it is best practice to request clarity from the client. See Section 2.2.3 for help in calculating measurements for complex shapes.

2.2.3 Common area and volume calculations

<p>Area of a surface $A = h \times w$</p>		<p>Area of a triangle $A = 1/2 bh$</p>	
<p>Area of a circle $A = \pi r^2$</p>		<p>Area of a trapezoid $A = h \times \frac{(a+b)}{2}$</p>	
<p>Area of a triangular prism $A = \frac{(w \times d \times h)}{2}$</p>		<p>Area of a pyramid $A = 1/3h \times \text{base area}$</p>	
<p>Volume of a room $V = l \times w \times h$</p>		<p>Volume of a pyramid $V = \frac{(1 \times w \times h)}{3}$</p>	
<p>Volume of a prism $V = \text{area of base} \times \text{length or height}$</p>			



CLIMATE, TERRAIN, EXPOSURE AND ORIENTATION

IN THIS CHAPTER

3.1	Climate zone selection	2
3.2	Terrain exposure	3
3.3	Orientation	4





CLIMATE, TERRAIN, EXPOSURE AND ORIENTATION

The location of a dwelling in the environment significantly affects its thermal performance. NatHERS assessment tools take this into account by factoring in the climate zone, terrain exposure and orientation of a dwelling in the assessment.

Summary of key requirements

This handbook is intended to be a helpful resource for all assessors. When conducting assessments, assessors must follow the requirements of the current NatHERS Technical Note and the relevant state or territory requirements.

- 3a** The principle climate zone must always be used where there is no alternative climate zone for the subject location. Assessors should only use an alternative climate zone where justification is detailed in the 'additional notes' section of the NatHERS Certificate.
- 3b** Regulatory assessments must not be carried out with an incorrect postcode. The postcode used must represent the location of the dwelling.
- 3c** Assessors must use the exposure category best suited to the terrain surrounding the dwelling. To calculate the terrain exposure for an individual high-rise unit, it is important to consider the height of the unit, as the exposure of multistorey dwellings generally increases with elevation. If an assessor is unsure whether the documentation is depicting true or magnetic north, assessors must clarify the direction of true north.
- 3d** Dwelling orientation is based on the rotation of the dwelling relative to true north, not magnetic north. If an assessor is unsure whether the documentation is depicting true or magnetic north, assessors must clarify the direction of true north.

3.1 Climate zone selection

NatHERS divides Australia into 69 different climate zones representing the varying climates across the country. Climate zones are generally aligned with postcode boundaries for convenience, except where there is likely to be a topographical or other feature within the postcode area that affects the local climate. In this situation, the assessment tool will offer alternative climate zone options for the postcode.

- 3a** The principle climate zone must always be used where there is no alternative climate zone for the subject location.
Assessor judgement is required where an alternative climate zone is given for a postcode. The selection of an alternative climate zone must be supported by justification detailed in the 'Additional Notes' section of the NatHERS Certificate. For example, if the subject site is in an elevated part of the postcode area not typical of the principle elevation of the given climate zone and the subject dwelling is located in an area more in line with the alternative climate zone.
(Tech Note clause 4.1)



Figure 3-1 NatHERS climate zones

- 3b** The postcode used must represent the location of the dwelling. If a newly developed suburb has not yet been allocated a postcode or the postcode is not available in NatHERS software tools, the postcode of the nearest existing suburb with similar climatic properties must be used. This must be detailed in the 'Additional Notes' section of the NatHERS Certificate. (**Tech Note clause 4.1**)

The NatHERS online climate zone map shows NatHERS climate zones: www.nathers.gov.au/nathers-accredited-software/nathers-climate-zones-and-weather-files. This map is for reference only and the NatHERS software tool selection of climate zones takes precedence.

3.2 Terrain and exposure

Exposure is defined as how open or protected the area surrounding a dwelling is. The exposure affects wind speeds and the dwelling's ability of air movement through ventilation and infiltration (air tightness) and thus can affect the temperature in a dwelling and its capacity to maintain heating/cooling loads. It is important to understand the different exposure types (see Table 3-1), as well as how to calculate the exposure in multistorey dwellings (see Section 3.2.1).

- 3c** Assessors must use the exposure category best suited to the terrain surrounding the dwelling.



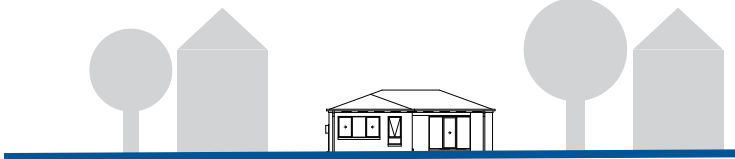

The key features influencing wind pressure and speeds for a specific site and dwelling will generally include the following;

- Terrain will increase wind speeds as it passes over or between hills, will accelerate over open/flat areas of land or water, and will slow down as it passes over rougher topography.
- Adjacent buildings and vegetation will decrease wind speeds at ground level when a dwelling is surrounded by taller buildings or vegetation, and will increase where it funnels around or between buildings.
- Wind speed and pressures increase with the height from the ground level. The higher the building, generally the more exposed it will also be to the stronger winds, particularly where the building is taller than adjacent buildings and vegetation (see Section 3.2.1).

A dwelling in a protected or suburban exposure category (ie. surrounded by other buildings and/or trees) will usually encounter a slower wind speed and thus low wind pressure than a building in an exposed or open exposure category. The exposure category in NatHERS software tools affect predicted air movement through ventilation and infiltration. (see Section 1.6.3)

If the exposure does not fit easily into one of the four categories used in the NatHERS software tools, the assessor is encouraged to use the above information to assist in selecting the exposure category best suited to the terrain surrounding the dwelling based on the above information and assumed behaviour of prevailing winds given the specific site information obtained. If the exposure is unclear, assessors are encouraged to use the site plan, site analysis (if available) and online maps including satellite and street view, to determine the terrain and exposure category.

Table 3-1 Terrain and exposure category guidance for single dwellings

Exposure	Terrain	Examples
Category 1	<p>Exposed terrain; few or no obstructions</p> 	<p>Flat grazing land, lake-side, ocean-frontage, desert, exposed high-rise unit above 10 floors</p>
Category 2	<p>Open terrain; grasslands with few well scattered obstructions below 10 m</p> 	<p>Farmland with scattered sheds, lightly vegetated bush blocks, medium-rise unit above 3 floors</p>
Category 3	<p>Suburban terrain; numerous closely spaced obstructions below 10 m</p> 	<p>Suburban housing, townhouses, heavily vegetated bushland areas</p>
Category 4	<p>Protected terrain; numerous closely spaced obstructions over 10 m</p> 	<p>City and industrial</p>

3.2.1 Exposure in multistorey buildings

The terrain and exposure of Class 2 and 4 dwellings is determined by the height of the dwelling above ground and the height of surrounding obstructions.

To calculate the exposure for an individual high-rise dwelling, it is important to consider the height of the specific dwelling above ground level. In many cases, lower-level dwellings will be more protected by surrounding buildings than a dwelling further up the building, so the exposure of multistorey dwellings generally increases with elevation.

For dwellings with higher elevation, assessors should first calculate the exposure for the entire building using the definitions in Table 3-1. Assessors should then calculate the exposure of the individual dwelling. (**Tech Note clause 4.1**)

3.3 Orientation

Orientation is the positioning of a dwelling in relation to seasonal variations in the sun’s path as well as prevailing wind patterns. Orientation, combined with the dwelling’s location, design, construction, shading elements and the size and type of windows, all affect how the Chenath engine calculates solar heat gain and ventilation. These interactions, in turn, can greatly affect the star rating.

A fundamental passive solar design principle is that dwellings south of the Tropic of Capricorn the living areas should be oriented so that the longest face is aligned as much as possible to solar north, to maximise winter sunshine and solar heat gain, and minimise solar radiation and heat gain in summer. A rectangular design that maximises exposure to winter sun is also often thought of as ideal.

Dwellings north of the Tropic of Capricorn, will receive sunshine from all directions at different times of the year, and therefore northern orientation is generally less important than shading the dwelling from the sun all year round and from all sides, and capturing the prevailing breezes.

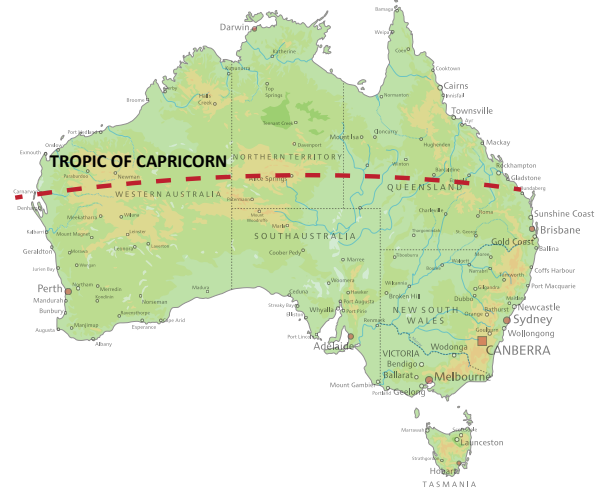


Figure 3-2 Tropic of Capricorn

3.3.1 True north versus magnetic north

3d Dwelling orientation must be based on the rotation of the dwelling relative to true north, not magnetic north. (Tech Note clause 4.4)

It is important to be aware of the difference between true north and magnetic north:

- **True north** is a constant direction based on the Earth’s axis and is used in NatHERS software tools.
- **Magnetic north** is the direction from any point on Earth towards the Earth’s magnetic north pole. As the magnetic pole continually moves over time, so does the direction of magnetic north.

The angular difference between true north and magnetic north is referred to as the angle of magnetic declination and varies with location and time. Plans and maps are generally drawn referencing true north and often include details on the magnetic declination in the area for a specified date.

The Figure 3-3 below shows the declination angle in degrees for 2015.0 and the rate of change of declination in minutes-of-arc per year for the period 2010–2020 for the Australian region.

For example, the magnetic declination of Sydney is +12.60° and Perth is -1.74°.

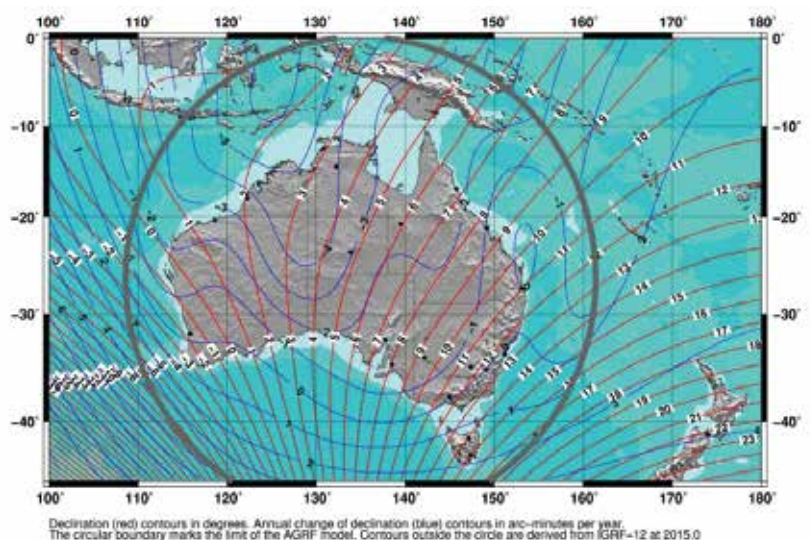


Figure 3-3 AGRF2015 Declination at Epoch 2015.0 (supplied by Geoscience Australia)

If the north point for a plot of land has been determined using a compass, it may be necessary to calculate the angle to correct for true north. To find the magnetic declination at a given location, visit Geoscience Australia's Australian Geomagnetic Reference Field model calculator: www.ga.gov.au/oracle/geomag/agrfform.jsp.

The best way to establish the orientation of a dwelling element, such as a wall or window, is to ensure that the bearings taken from the Certificate of Title are shown on the site plan. If the north point is unclear on any plans when assessing, it is recommended that assessors contact the client or surveyor for clarification. (**Tech Note clause 4.5**)

For further information on magnetic declination, see the Geoscience Australia's website:

www.ga.gov.au/oracle/geomag/agrfform.jsp

For more information about orientation, see the relevant section of the Your Home website:

www.yourhome.gov.au/passive-design/orientation



ZONING

IN THIS CHAPTER

- 4.1 Definition of a zone 3
- 4.2 Zoning the dwelling..... 6
- 4.3 Conditioning 8
- 4.4 Combining zones 10
- 4.5 Specific zoning scenarios 12
- 4.6 Floor and wall adjacency zones 18
- 4.7 Zoning ambiguous spaces 19
- 4.8 Determining a zone 20





ZONING

Zoning is one of the most important parts of the NatHERS data entry process and it is to be carried out as accurately as possible. The assumptions in the Chenath engine, coupled with the way the software models ventilation and airflow through a dwelling, can result in substantially different results if the zoning is incorrect.

Summary of key requirements

This handbook is intended to be a helpful resource for all assessors. When conducting assessments, assessors must follow the requirements of the current Technical Note and the relevant state or territory requirements.

- 4a** All parts within the dwelling envelope must be allocated or included in a zone. Table 4-1 outlines software zoning types and definitions—this replicates Appendix 1 of the NatHERS Technical Note.
- 4b** The minimum zoning requirements for any dwelling are:
 - It must contain a minimum of three zones excluding the garage. For example, a kitchen/living, bedroom and an unconditioned zone.
 - Each zone must have walls, a floor and a ceiling and/or roof.
- 4c** Workshops, store rooms and laundries may be combined with the garage if they:
 - are within the garage; and
 - can only be accessed from the garage and/or by an external door; and
 - does not contain an internal door to the dwelling.
- 4d** A large number of zones can slow down calculations in Chenath. If the dwelling contains more than 50 zones, adjacent zones (e.g. bedrooms) may be combined if they:
 - have external windows or doors to the same orientation; and
 - are the same zone type and conditioning; and
 - open to the same internal zone (i.e. an internal hallway); and
 - do not have external ventilation to more than one orientation.
- 4e** Small non-habitable spaces, such as small pantries (i.e. less than or equal to 700mm in depth), built-in robes, plumbing voids, wall voids and service ducts, are included in the zone they are attached to or located in.
- 4f** Small storage spaces located under a staircase can be included in the same zone as the staircase.
- 4g** Ensuites or WIRs accessible only from a bedroom are considered night-time zones as they are more likely to have similar temperature settings and occupancy patterns to the bedroom. This is regardless of if the ensuite or WIR has a window, or if it is accessed via a door or a permanent opening. (*continued overleaf...*)

4h An airlock may be modelled as an unconditioned space if it:

- is located at a dwelling entrance; and
- has one or more external walls; and
- has one or more internal walls; and
- has an external door; and
- has one or more internal doors, of which only one opens to a conditioned zone.

4i Studios, bedsits and open-plan apartments must be modelled with at least three zones; a kitchen/living zone, bedroom zone and unconditioned zone.

4j When there are no obvious features by which to zone the open-plan studio or bedsit, the following minimum conditioned zone areas must apply:

- kitchen/living zone area(s) = minimum of 30% of the total floor area
- bedroom zone area = minimum of 20% of the total floor area

4k An outdoor living area must be considered within the dwelling and zoned accordingly if:

- It can be fully enclosed by solid construction elements (walls, windows, bi-fold doors), and;
- It is mechanically heated or cooled.

4l Unconditioned outdoor living areas, semi-open ‘alfresco’ spaces and detached garages are not allocated a zone, but must be considered for shading purposes.

4.1 Definition of a zone

A zone is defined as a space or group of spaces within a dwelling that have particular properties. Each zone type in NatHERS software tools (Table 4.1) has different inbuilt assumptions and thermostat settings based on the function of the room and how the different rooms within the dwelling will be used throughout the day (usage patterns). For example, the Chenath engine assumes particular zones are heated and cooled to different temperatures at different times to living zones, and that cooking, occupancy, and lighting at certain times of the day will affect heat loads.







To ensure an assessment is accurate, every space in a dwelling that is physically separated from other spaces with walls should be a separate zone. An exception to this is if the space is considered a small air space, in which case it may be combined with the zone it is entered from or attached to (see Section 4.5.2), or if the specific parameters for combining zones are successfully met (See Section 4.4).




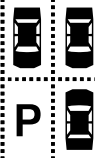


A space within a dwelling must only be split into two zones for the following reasons:

- to accurately model a change in floor coverings, or floor or ceiling construction/properties,
- to accurately model a change in wall properties (e.g. zone boundary is half external wall and half internal wall), or
- studios, bedsits and open-plan apartments, which can be artificially divided if required, to achieve at least three zones (see Section 4.5.6). (**Tech Note clause 5.3**)

In some jurisdictions, different zoning rules take precedence over the NatHERS zoning rules. To find more information about specific jurisdictional requirements, visit the Australian Building Codes Board website: www.abcb.gov.au/ABCB/State-and-Territory-Building-Administrations.

Table 4-1 NatHERS Software tool zone type definitions (Appendix 1 of the NatHERS Technical Note)

Zone type	Example room names* *see description for correct classification	Description	Conditioning status
	Living, lounge, dining, family, rumpus, media, home theatre.	Any room shown on a plan as living, lounge, dining, family, rumpus, media or home theatre. If there are more than two living areas (excluding kitchen/living), the two largest living areas are zoned as living. The other areas are zoned as daytime.	Conditioned
	Kitchen or kitchen & dining, kitchen & meals, kitchen & lounge, kitchen & living.	Any room shown on a plan as a kitchen or a kitchen combined with one or more living areas. This zone must include the main kitchen area and may include a lounge, meals or dining area. All dwellings must contain one main kitchen/living zone. There can be no more than one kitchen/living zone. All additional smaller kitchens/kitchenettes within the dwelling must be zoned as another zone type.	Conditioned
	Study, gym, lift, pool, sauna, cellar, pantry, storage, hall, hallway, corridor.	<p>This is the default zoning for internal zones not covered by any other zone type.</p> <p>Daytime zones include studies (without a built-in wardrobe), gymnasiums, internal domestic lifts, indoor pool rooms, saunas, above ground wine cellars, walk-in pantries, storage areas or conditioned outdoor living areas capable of being fully enclosed (i.e. considered within the dwelling envelope).</p> <p>This zone type includes hallways and corridors (either fully enclosed by doors or open to other zones) as they are circulation areas that allow access to other zones. This includes zones such as ensuites or walk-in wardrobes that can be accessed by a hallway or corridor (e.g. a two-way bathroom accessible by both a bedroom and the hallway).</p> <p>This zone type could also include any living, lounge, dining, family, rumpus, media or home theatre room, if they are in addition to the two largest living areas.</p> <p>This zone may be selected when a laundry, WC, bathroom or powder room is not ventilated by a door or window on an external wall.</p>	Conditioned
	Bed, study.	<p>Any room shown on the plan as a bedroom, whether or not it has any built-in wardrobes.</p> <p>Bedroom zoning must also be used for a study with either a built-in wardrobe, walk-in wardrobe or attached ensuite. In this case, the 'study' becomes a bedroom zone with the built-in wardrobe part of the same zone. A walk-in wardrobe or ensuite is to be zoned as night-time.</p>	Conditioned
	Ensuite, WIR, parent's retreat, WC.	This applies to areas that can only be accessed from a bedroom or from a zone, which itself, is only accessed from a bedroom. These include ensuites, walk-in wardrobes, parent's retreats and WCs accessed from an ensuite.)	Conditioned
	Laundry, WC, bathroom, powder room, airlock, cellar.	<p>Every dwelling must have at least one unconditioned zone.</p> <p>Laundries, bathrooms, airlocks, WCs or powder rooms that have an external wall with at least one or more ventilation openings (window or door). Underground cellars may also be considered an unconditioned zone.</p> <p>If there are no rooms that fit this description, then the smallest daytime zone must be modelled as an unconditioned zone.</p> <p>An airlock is a small, relatively airtight space that can be modelled as unconditioned space if:</p> <ul style="list-style-type: none"> • it is located at a dwelling entrance and • has one or more external walls and • has one or more internal walls and • has an external door and • has one or more internal doors, of which, only one opens to a conditioned zone. <p>Where an area labelled as an 'airlock' does not meet the above conditions, it is to be modelled as a daytime zone.</p>	Unconditioned

Zone type	Example room names* *see description for correct classification	Description	Conditioning status
Garage 	Garage	Where a garage is shown on the documentation as attached to the dwelling, and does not have any heating or cooling indicated.	Unconditioned
Garage—conditioned 	Garage	This zone type only applies when a garage has heating ducts, hydronic heating elements or air conditioners.	Conditioned
Glazed common area 	Corridor or hall or common area (Class 2 or 4 only)	This zone type applies to unconditioned common corridors with glazing (e.g. enclosed corridors with the external wall being partly or fully glazed) in an apartment building or similar. This zone type must only be used in Class 2 and 4 dwellings. (See Section 4.6.1, Chapter 6, and Table 3 of NatHERS Technical Note or for more information).	Unconditioned
Shared basement carpark 	Basement, shared carpark (Class 2 or 4 only)	Where there is a shared carpark underneath an apartment, and the carpark is equal to or greater than 50 per cent closed from the outdoor air, then the area directly under the apartment must be zoned as 'shared basement carpark'. Where a carpark under the apartment is greater than 50 per cent open to the outdoor air then this zone must be modelled as 'above outdoor air'. This zone type must only be used in Class 2 and 4 dwellings. (See Section 4.6.2, Chapter 5, and Table 2 of NatHERS Technical Note or for more information). This zone type must not be used when Class 2 dwellings have individual garages.	Unconditioned
Small air spaces 	Pantry, robe, duct, storage.	Small air spaces such as small pantries (not walk-in i.e. less than or equal to 700mm in depth), built in robes, plumbing voids, wall voids, service ducts and other small non-habitable areas are included in the zone that they are attached to or located in. (See Section 4.5.2) Storage areas located under a staircase can be included in the same zone as the staircase.	As per parent zone
Outdoor living areas 	Verandah, portico, sunroom, wintergarden, conservatory or balcony (if enclosable)	Unconditioned outdoor areas are treated as shade, not a zone. Where the outdoor living area is capable of being fully enclosed by solid construction elements (e.g. walls, windows, bi-fold or sliding doors) and is shown on the documentation as conditioned (i.e. mechanically heated or cooled), it must be zoned as daytime. (See Section 4.5.7)	-

As briefly mentioned above, these zone descriptions are based on the Chenath engine assumptions and thermostat settings based on the main purpose of the room and the usage patterns of how the rooms within the dwelling will be used throughout the day. For example, the Chenath engine assumes that bedroom zones are heated and cooled to different temperatures at different times to living zones, and that cooking at certain times of the day will add heat to the kitchen.

Table 4-2 provides a summary of total sensible and latent heat load assumptions, that differ depending on the zone type—including considerations of heat obtained through appliances and cooking, lighting, and occupancy. More detailed information of these assumptions, heat gains and thermostat settings can be found at Chenath repository at <https://hstar.com.au/Home/Chenath>

If after consulting Table 4-1 it is still unclear as to which zone type is to use for a particular space, assessors may want to consider how the space is heated/cooled and how often and when it may be primarily occupied, to assist in making a decision.

Table 4-2 Summary of Chenath assumptions for internal heat gains

Time	Total heat loads (Watts)		
	Living space with kitchen	Living space without kitchen	Bedroom
Midnight–7am	100	0	300
7am–8am	1260	600	0
8am–9am	760	600	0
9am–5pm	340	210	0
5pm–6pm	760	615	0
6pm–7pm	2360	615	0
7pm–10pm	910	615	100
10pm–Midnight	100	0	300

4.2 Zoning the dwelling

There are a number of zoning requirements that must be met when conducting NatHERS assessments. These take into account the various assumptions mentioned in Section 4.1 of how the rooms within the dwelling will be used throughout the day. Depending on your software tool, zoning may be defined by the room floor are, or may include internal walls within the zone boundary.

4a All parts within the dwelling envelope must be allocated or included in a zone. Table 4-1 outlines software zoning types and definitions—this replicates Appendix 1 of the NatHERS Technical Note. (**Tech Note clause 5.1.1**)

Assessors must assign zones to all parts of the dwelling that can be fully enclosed by the dwelling envelope, which is defined for NatHERS purposes as the physical separator between the dwelling being assessed and the outside environment or neighbour. The dwelling envelope comprises of a dwellings’ walls/windows/doors, roofs and floors, and includes the resistance to air, water, heat, light and noise transfer. When modelling in NatHERS software tools, the dwelling envelope includes both conditioned and unconditioned zones. This is different to the NCC definition of a building/thermal envelope, which is defined as the buildings’ fabric that separates artificially heated and cooled spaces from the exterior of the building or other spaces that are not artificially heated or cooled. Zones of the same type cannot be combined unless the parameters outlined in Section 4.4 (**Tech Note clause 5.4**) are met.

For NatHERS modelling purposes, all dwellings must contain a minimum of three zones excluding the garage. All dwellings must also contain only one main kitchen area zone, with all other smaller kitchens or kitchenettes within the building zoned as daytime. There is to be a maximum of two living areas, which must be the two largest living areas, all other living areas zoned as daytime. These requirements are just a few of the principles outlined in more detail in Table 4-1. (**Tech Note Appendix 1**)

4b The minimum zoning requirements for any dwelling are:

- It must contain a minimum of three zones excluding the garage. For example, a kitchen/living, bedroom and an unconditioned zone.
- Each zone must have walls, a floor and a ceiling and/or roof. (**Tech Note clause 5.2**)

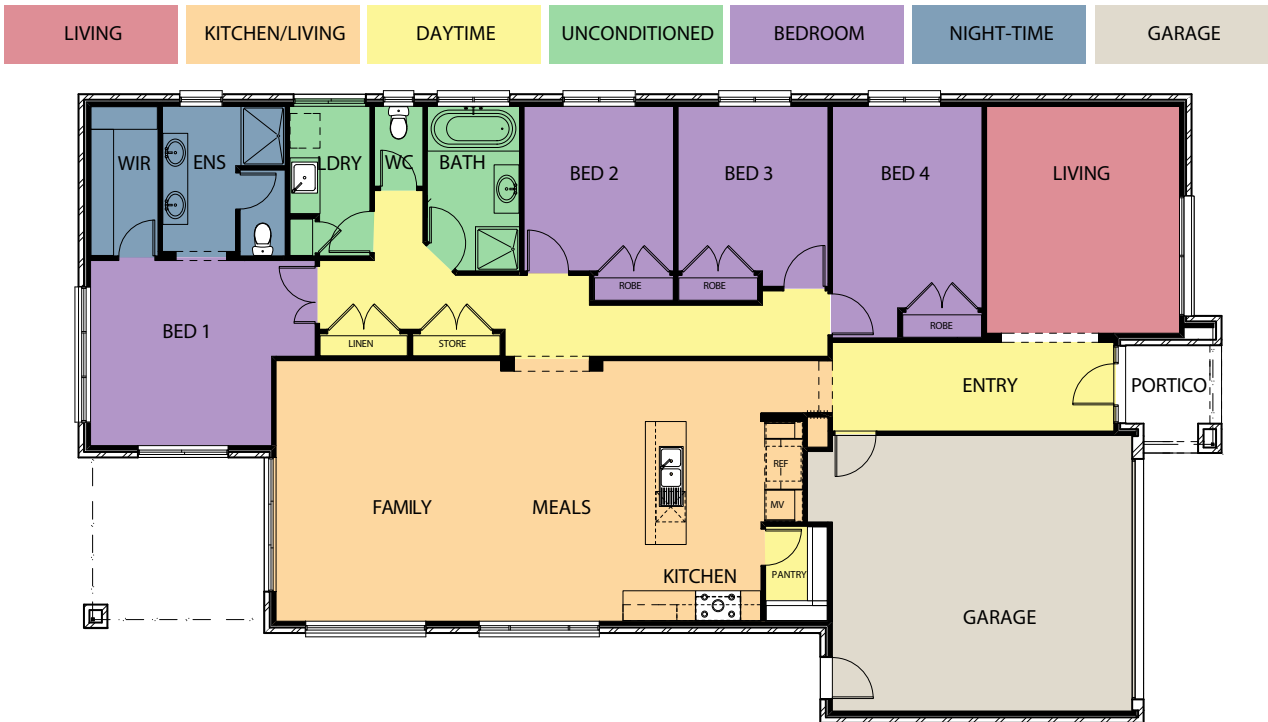


Figure 4-1 Example single-storey dwelling zoning

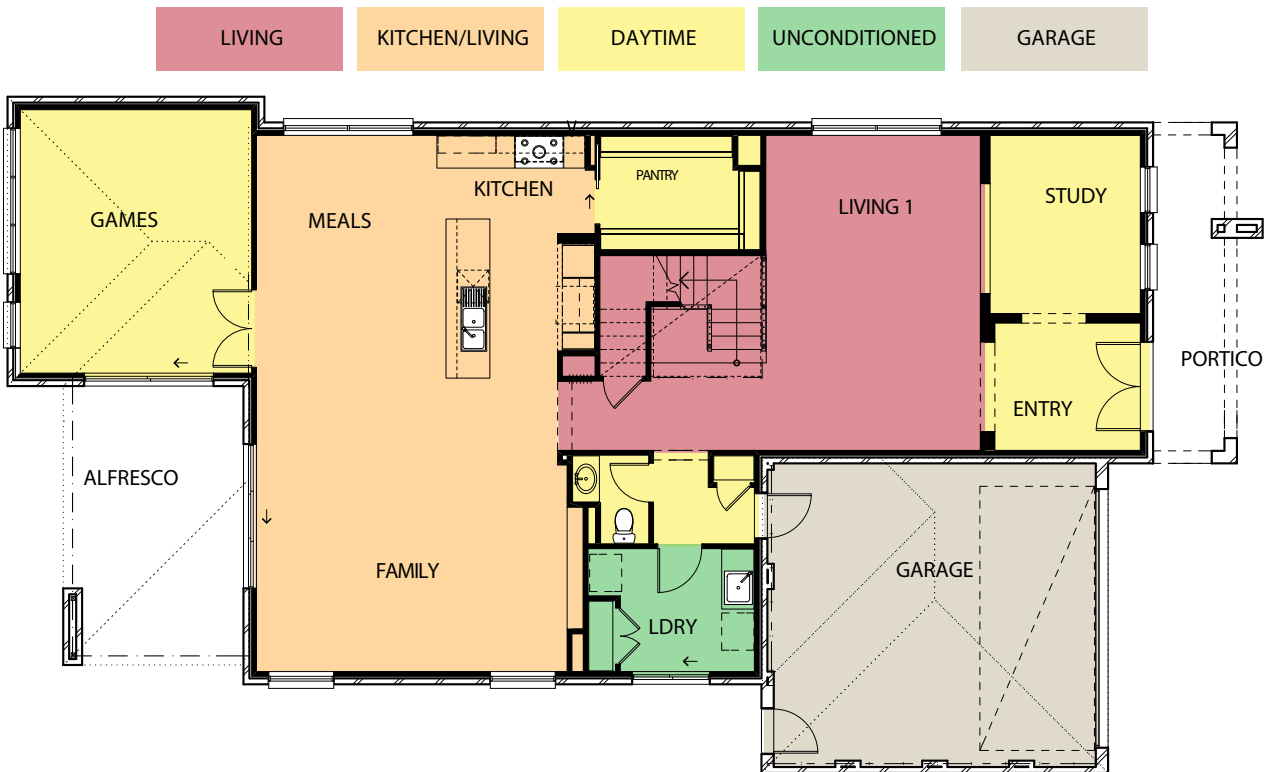


Figure 4-2 Example double-storey dwelling zoning—downstairs

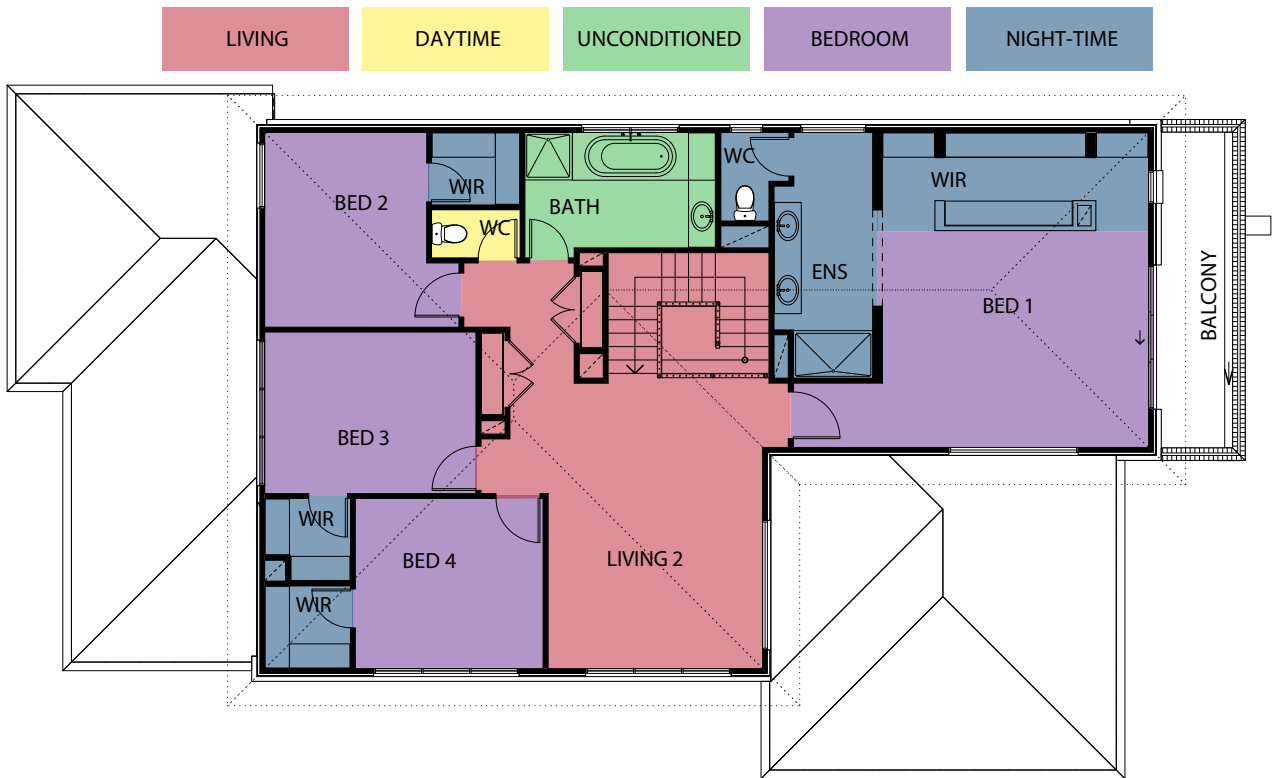


Figure 4-3 Example double-storey dwelling zoning—upstairs

4.3 Conditioning

Each zone is considered to be ‘conditioned’ or ‘unconditioned’ (see Table 4-1).

Assessors are to ensure the correct terminology is used when referring to conditioned and unconditioned zones, and to heated and cooled zones. The terminology has slightly different meanings in different scenarios (i.e. NatHERS, BASIX, or the NCC). The words may also be used with a different meaning by different sectors of the building industry, or different state and territory governments.

In NatHERS, ‘conditioning’ relates to room use and the assumptions around usage patterns for that room. The installation of heating and cooling appliances does not affect the conditioning of the space when determining conditioning for NatHERS zoning. In NatHERS software tools, most spaces within the building envelope are considered to be conditioned, except the bathrooms, WC, laundry and garages (see Table 4-1).

Zones are considered to be either heated and cooled or not heated and cooled at all. Assessors cannot select a zone to be heated and not cooled or vice versa.

- **Conditioned:** an area that is considered to be heated and cooled when assessed using NatHERS software tools.

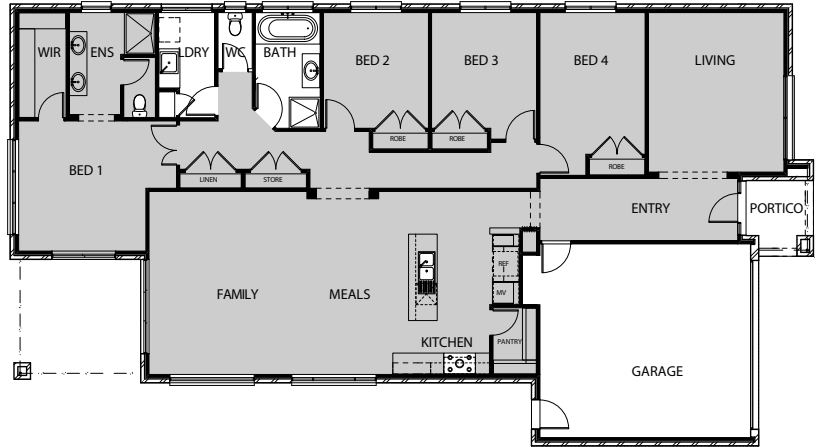


Figure 4-4 Conditioned zones of example dwelling

- **Unconditioned:** an area that is not considered to be heated and cooled at all when assessed using NatHERS software tools.

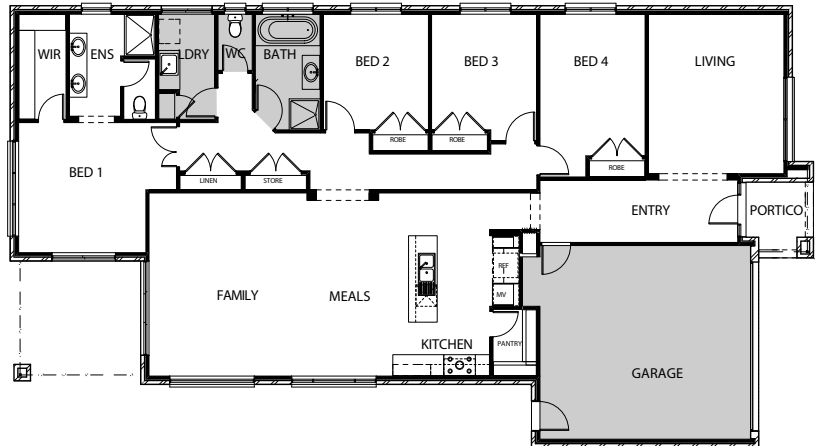


Figure 4-5 Unconditioned zones of example dwelling

4.4 Combining zones

The accuracy of a rating improves as the number of zones increase. Zones must not be combined, even when the zoning types are the same. In Figure 4-6 for example, even though the laundry, WC and bathroom are all unconditioned zones, they must be zoned separately and not as one combined zone.

There are only two circumstances where zones may be combined, other than small air spaces (see Section 4.5.2).

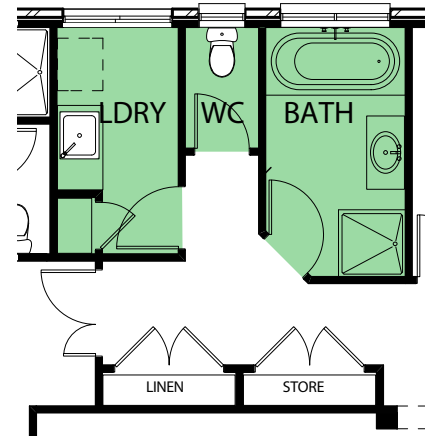


Figure 4-6 Zoning rooms separately

4c Workshops, store rooms and laundries may be combined with the garage if they:

- are within the garage; and
- can only be accessed from the garage and/or by an external door; and
- does not contain an internal door to the dwelling. (**Tech Note clause 5.4.1**)

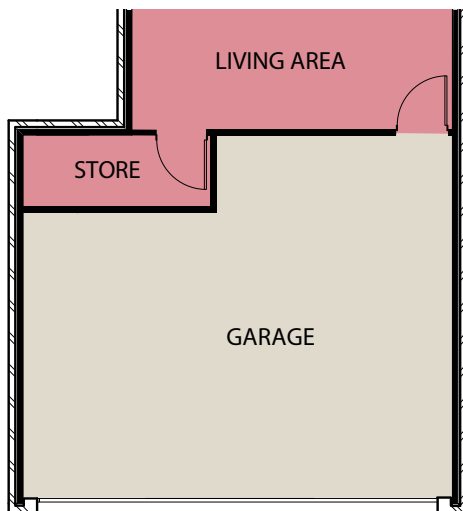


Figure 4-7 Store room modelled as small air space in Living zone

In figure 4-7, the store room cannot be zoned combined with the garage as it is accessible from the living zone. In this instance, the store room is considered a small air space (see Section 4.5.2) and is modelled included in the living zone.

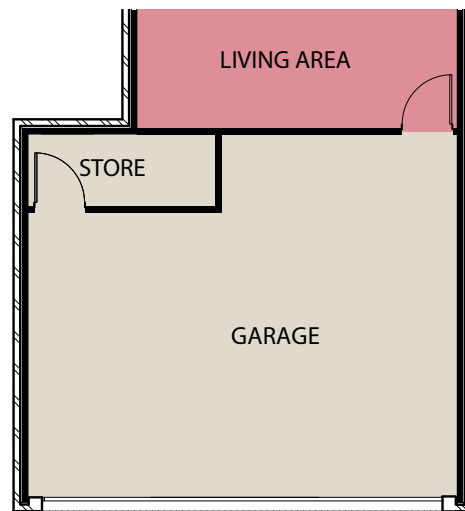


Figure 4-8 Store room modelled as combined with garage zone

Figure 4-8 shows the store room and garage as one combined zone. The store room may be combined with the garage as it is within the garage, and only accessible from the garage.

4d A large number of zones can slow down calculations in Chenath. If the dwelling contains more than 50 zones, adjacent zones (e.g. bedrooms) may be combined if they:

- have external windows or doors to the same orientation; and
- are the same zone type and conditioning; and
- open to the same internal zone (i.e. an internal hallway); and
- do not have external ventilation to more than one orientation. (**Tech Note 5.4.2**)

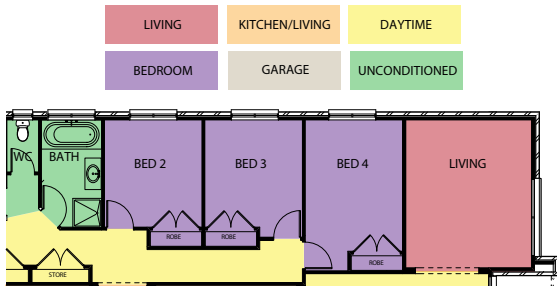


Figure 4-9 Example of combining zones of the same type when dwelling has more than 50 zones

If the dwelling in Figure 4-9 has more than 50 zones, bedrooms 2, 3 and 4 can be combined as one zone. This is because all the bedrooms are the same zone type, are open to the same zone (hallway), and all external windows are facing the same orientation.

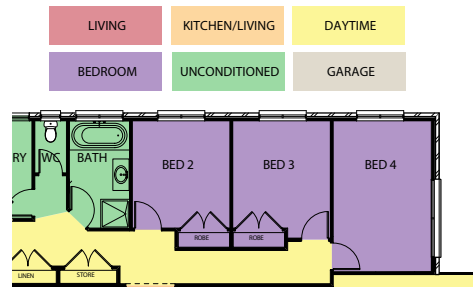


Figure 4-10 Example where only bed 2 and 3 can be combined when dwelling has more than 50 zones

In Figure 4-10, if the dwelling has more than 50 zones, only bedrooms 2 and 3 can be combined as one zone.

Although all the bedrooms are the same zone type, and are open to the same zone (hallway), bedroom 4 cannot be combined as it has a window to a different orientation.

4.5 Specific zoning scenarios

The following section provides guidance about specific zoning scenarios that may occur.

4.5.1 Stairwells

Depending on where a stairwell is located in a zone, it can be treated either as part of an existing zone or its own zone. The design documentation should contain details of the stairwell—where this information is not available, assessors are to contact the client for more information.

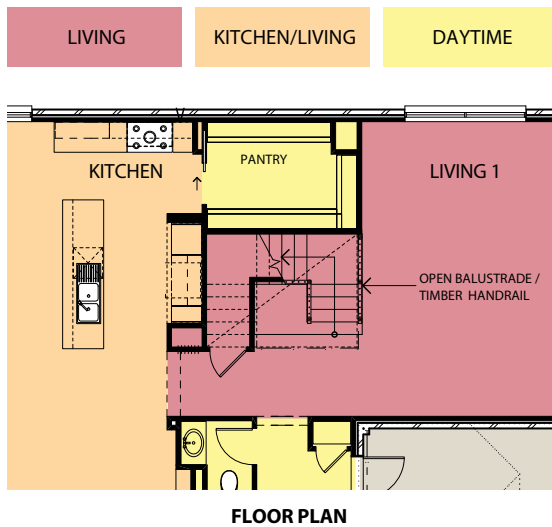


Figure 4-11 Example stairwell with open balustrade—zoning combined

The stairwell in Figure 4-11 has exposed stringers and an open balustrade. Although the hallway area of the stairs is open to the living, as there is no permanent boundary between the stairwell itself and the living zone, the stairwell is included in the living zone.

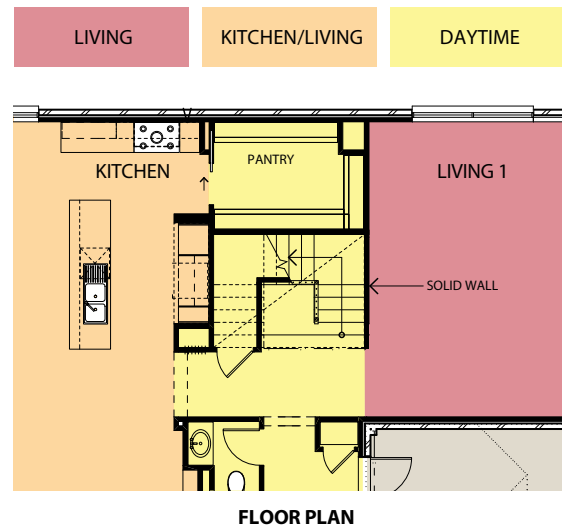


Figure 4-12 Example stairwell partly divided by wall—zoning separate

The stairwell in Figure 4-12 is separated from the living zone by a wall. Although the hallway area remains open to the living, as there is predominantly a permanent boundary (solid wall) between the stairwell itself and the living zone, the stairwell becomes a separate daytime zone.

4.5.2 Small spaces

As a general rule, a small non-habitable space is a space that is not large enough to walk into (i.e. less than or equal to 700mm in depth). Where a cupboard or other space is bigger than this, it will become its own zone (see Section 4.5.3).

4e Small non-habitable spaces, such as small pantries (i.e. less than or equal to 700mm in depth), built-in robes, plumbing voids, wall voids and service ducts, are included in the zone they are attached to or located in. (**Tech Note Appendix 1**)

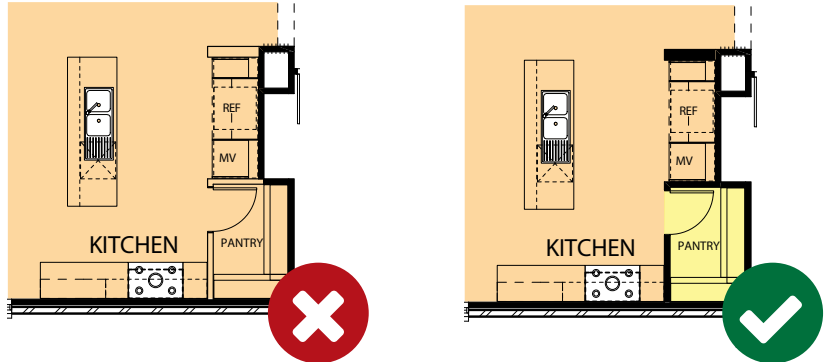
4f Small storage spaces located under a staircase can be included in the same zone as the staircase. (**Tech Note Appendix 1**)

As these small storage spaces do not usually contain ventilation, they will have the same conditioning as the zone they are attached to. Powder rooms and WCs are not classified as small air spaces (predominantly because of ventilation assumptions) and must be zoned accordingly.

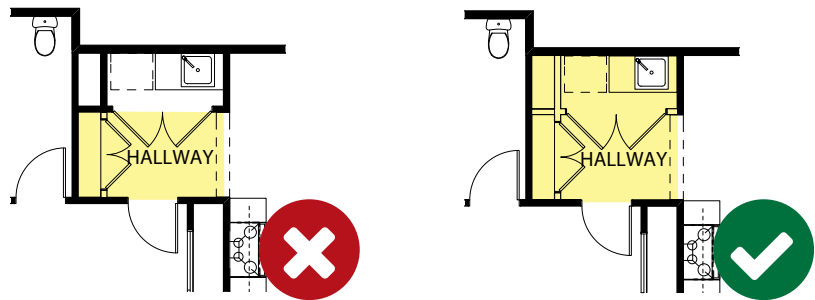
The treatment of small air spaces may vary between jurisdictions. To find more information about specific jurisdictional requirements, visit the Australian Building Codes Board website: www.abcb.gov.au/ABCB/State-and-Territory-Building-Administrations.

Figure 4-13 gives some examples of small spaces and the correct zoning and modelling guidance

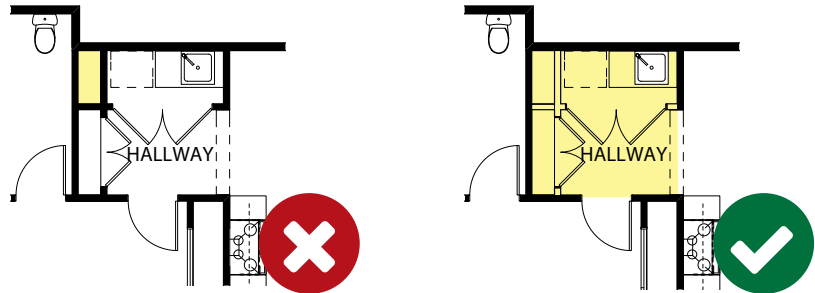
Walk-in cupboards and pantries are separate zones.



Laundry cupboards are part of the adjacent zone.



Service ducts are zoned with the adjacent zone.



Cupboards are part of the adjacent zone.

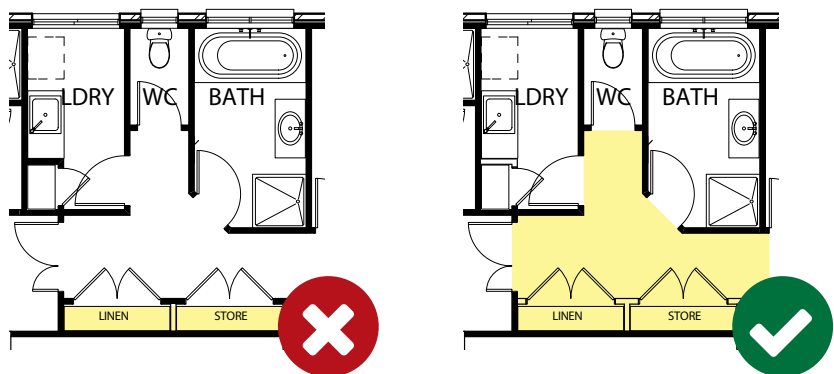


Figure 4-13 Zoning small spaces

4.5.3 Ensuites, walk-in robes and cupboards

Ensuites, walk-in robes (WIR) and cupboards large enough for a person to walk into (i.e. greater than 700mm in depth) must be modelled as individual zones, regardless of whether they have a ventilation opening. Cupboards or storage that cannot be walked into are considered small air spaces and to be included in the zone they are accessed from (see Section 4.5.2). In the case of studio, bed-sits and open plan apartments however, there may be an acceptable exception to this requirement if appropriate as outlined in Section 4.5.6.

- 4g** Ensuites or WIRs accessible only from a bedroom are considered night-time zones as they are more likely to have similar temperature settings and occupancy patterns to the bedroom. This is regardless of if the ensuite or WIR has a window, or if it is accessed via a door or a permanent opening. (**Tech Note Appendix 1**)

In Figure 4-14 the WIR, ensuite and WC are each zoned separately. The WIR and ensuite are only accessed from the bedroom, therefore they are both zoned as 'night-time' zones. The WC is accessed only from a night-time zone and therefore assumes the same zoning (night-time).



Figure 4-14 Zoning for ensuites, WIRs and WCs

4.5.4 Parent's retreats and similar walk-in robes

A parent's retreat or walk-in robe (WIR) can be either a daytime or night-time zone, depending on how the zone is accessed:

- If a person must travel through the parent's retreat or WIR to access the bedroom from a kitchen, living or daytime zone (or other space with similar features), the space is zoned as daytime.
- If the only access to the parent's retreat or WIR is through the bedroom, the space is zoned as night-time. (See Section 4.5.3)

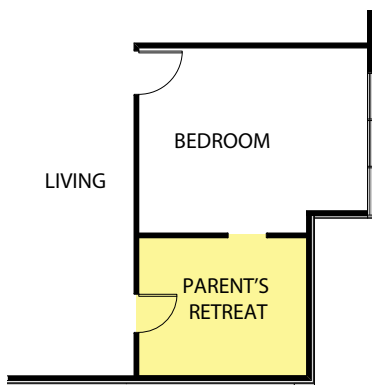


Figure 4-15 Daytime zoning—accessible from a conditioned zone

The parent's retreat in Figure 4-15 is zoned 'Daytime' as it is accessible from a kitchen, living or daytime conditioned zone (living).

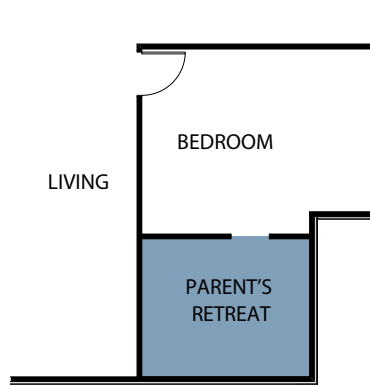


Figure 4-16 Night-time zoning—only accessible from a night-time zone

The parent's retreat in Figure 4-16 is zoned 'Night-time' as it is only accessible from a night-time zone (bedroom).

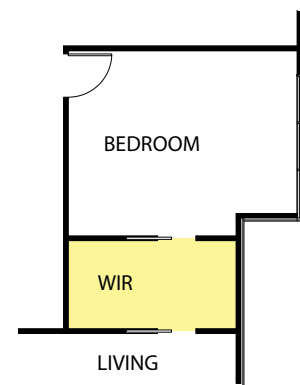


Figure 4-17 Daytime zoning—WIR accessible from a conditioned zone

The WIR in Figure 4-17 is zoned 'Daytime' as it is accessible from a kitchen, living or daytime conditioned zone (living).

4.5.5 Airlocks

An airlock is defined as a small, relatively airtight space that is not a hallway. An airlock is a space that separates the outside from conditioned zones (e.g. a boot/mud room). An airlock can be zoned as an unconditioned space if it meets all of the following defined requirements.

4h An airlock may be modelled as an unconditioned space if it:

- is located at a dwelling entrance; and
- has one or more external walls; and
- has one or more internal walls; and
- has an external door; and
- has one or more internal doors, of which only one opens to a conditioned zone. (**Tech Note Appendix 1**)

Some airlocks shown on plans are not genuine airlocks (i.e. airtight spaces). A space that can be used to access two conditioned zones will function as a hallway and is to be modelled as such (e.g. daytime). If an assessor is in doubt, then the space is to be zoned as daytime.

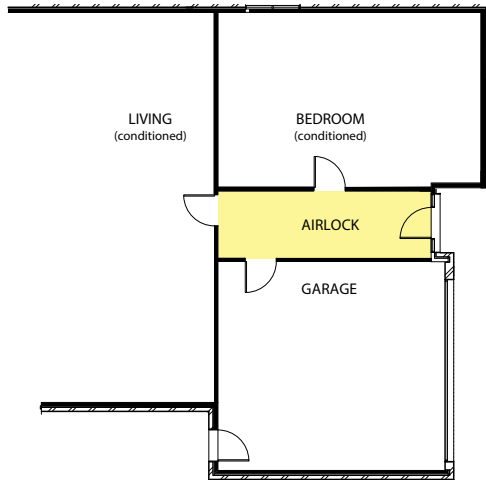


Figure 4-18 Airlock modelled as daytime

The airlock shown in Figure 4-18 opens to the outside, an unconditioned zone (garage) and two conditioned zones (living and bedroom). Although the plan calls it an ‘airlock’, as it opens to two unconditioned zones it does not meet the NatHERS airlock requirements. In this case the airlock is essentially a hallway, and must be zoned as **daytime**.

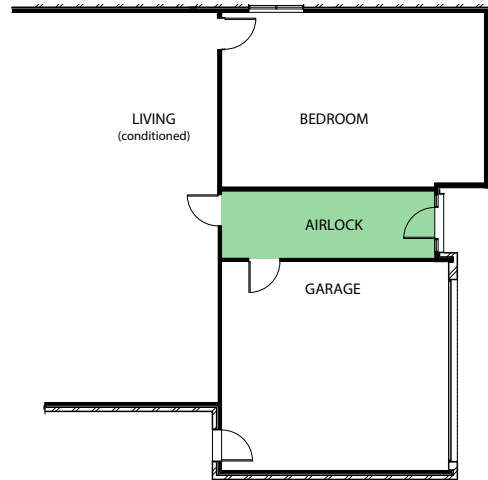


Figure 4-19 Airlock modelled as unconditioned

The airlock shown in Figure 4-19 opens to the outside, an unconditioned zone (garage) and a conditioned zone (living). It meets the NatHERS airlock requirements as it only opens to one conditioned zone. In this case the airlock can be zoned as **unconditioned**.

4.5.6 Studios, bedsits and open-plan apartments

4i Studios, bedsits and open-plan apartments must be modelled with at least three zones:

- kitchen/living zone
- bedroom zone
- unconditioned zone. (**Tech Note clause 5.3.1**)

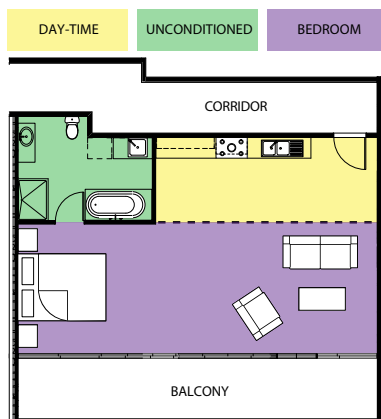


Figure 4-20 Incorrect zone division

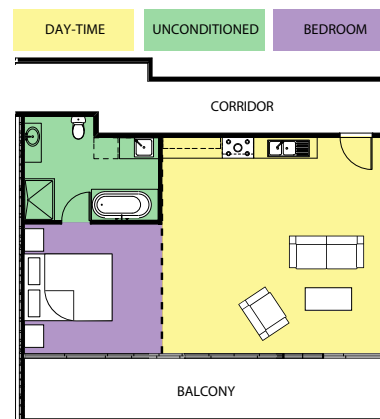


Figure 4-21 Correct zone division

Note: The NatHERS Administrator is currently investigating the possibility of revising the NatHERS requirement for an unconditioned zone in studios, bedsits and open-plan apartments for situations where the entire apartment is conditioned. As this consideration would be a major change in intent of the NatHERS Technical Note this is being explored, and the impacts and implications of this change assessed so it can be considered as an option for future NatHERS updates.

Zone divisions must occur where a feature exists that would indicate the zone, and/or where furniture is likely to be located. For example, the permanent wall between the unconditioned and kitchen zones in the Figures below, is the feature in the room that indicates the line of a separate zone. The likely location of the bed is identified to make the bedroom zone as indicated in Figure 4-20 rather than the kitchen/living zone as shown in Figure 4-21.

Between these zones with an open-plan division, assessors must model a plasterboard-on-stud internal wall with permanent openings no greater than 60% of the wall area. (**Tech Note clause 5.3.2**)

4j When there are no obvious features by which to zone the open-plan studio or bedsit, the following minimum conditioned zone areas must apply:

- kitchen/living zone area(s) = minimum of 30% of the total conditioned floor area
- bedroom zone area = minimum of 20% of the total conditioned floor area (**Tech Note clause 5.3.3**)

4.5.7 Outdoor living areas

An 'outdoor living area' may be shown on documentation as a glazed verandah, portico, sunroom, wintergarden, conservatory, enclosed balcony/porch or other similar descriptions to these. Depending on the characteristics of the outdoor living area however, for NatHERS modelling purposes these spaces may be required to be zoned, or just incorporated as a shading element.

4k An outdoor living area must be considered within the dwelling and zoned accordingly if:

- It can be fully enclosed by solid construction elements (walls, windows, bi-fold doors), and;
- It is mechanically heated or cooled. (**Tech Note clause 5.1.2**)

4l Unconditioned outdoor living areas, semi-open 'alfresco' spaces and detached garages are not allocated a zone, but must be considered for shading purposes. (**Tech Note clause 5.1.3**)

If the outdoor living area is unconditioned, or not fully enclosed, or both, it is not to be zoned but must be considered for shading purposes where applicable. (See Chapter 9)

For example, if a portico is attached to the dwelling by solid construction elements, and capable of being enclosed, but has plastic blinds as wall elements along one side, it is not capable of being fully enclosed entirely by solid construction elements, and therefore is only to be modelled for shading and not as a zone.

Another example would be an enclosed sunroom attached to the dwelling, with large bi-fold or concertina doors opening up the space to the garden. Even though the space may have a fan for cooling, or fireplace for heating for example, unless it is documented as being mechanically heated or cooled (e.g. air conditioner unit, ducted heating/cooling system or evaporative cooling specified), this space would not be zoned.

Note in both these examples it is assumed the spaces can be closed off to the rest of the dwelling. If the space was open to other zones of the dwelling and therefore permanently open to the dwelling envelope, it is not capable of being fully enclosed and is therefore required to be modelled as a zone within the dwelling, regardless of if the documentation shows it as mechanically heated or cooled.

When modelling outdoor living areas with glazed roofs for shading purposes, the assessor may wish to use their professional judgement about the impacts of this on the dwelling. For example, it may be appropriate to apply a 10% shading factor when modelling a horizontal shading element/device with a clear glass material. This is similar to editing the shading factor when modelling polycarbonate shading surfaces or lattice/slats, if this feature is available in the software tool. Solid structures/materials would have a shading factor of 100%.

4.5.8 Double height voids

When modelling a double height zone that extends across two levels of the dwelling, the upper void area is incorporated into the parent zone so that the void and the zone below effectively become one zone. This has been a recent improvement in the capability of the Chenath engine in version 3.21.

Modelling double height voids using this improved method provides improved accuracy for ratings, and consistency across all NatHERS assessments and climate zones. Some of the implications for this include correct calculation of air flow between vertical and horizontal openings between adjoining zones, as this approach also allows heat from windows in the upper portion of the zone to be correctly allocated to the floor of the zone.

Figure 4-22 shows the correct modelling of a double height void –incorporated into the parent zone below. Figure 4-23 demonstrates less accurate modelling methods, which should only be used if using Chenath engine 3.13

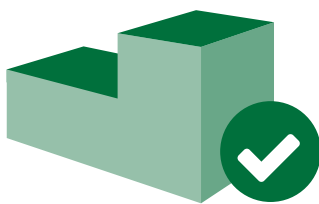


Figure 4-22 Correct double height void modelling

Figure 4-22 shows correct modelling of a double height void, as one combined zone. See relevant software tool manual for more guidance on modelling correct heights and specific data input.

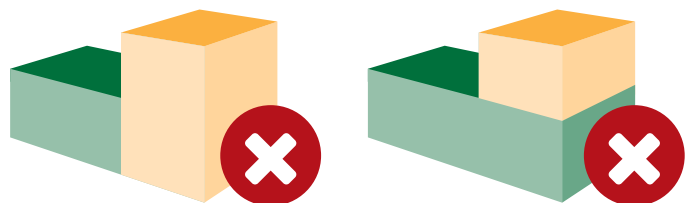


Figure 4-23 Incorrect double height void modelling

Figure 4-23 shows incorrect modelling of a double height void, as two zones. These methods were acceptable when using Chenath engine version 3.13, however the improvements to version 3.21 allow the more accurate modelling method demonstrated in Figure 4-22.

For detailed guidance on how to model double height voids, assessors should refer to the relevant software tool manual.

4.6 Floor and wall adjacency zones

Chenath engine version 3.21 incorporates two new zones that are required when modelling particular scenarios of floor or wall adjacency. These are the only two situations where assessors must model a zone outside the dwelling envelope.

4.6.1 ‘Glazed common area’ zone

In Class 2 or 4 buildings, a dwelling wall may be adjacent to an external wall, another dwelling (neighbour), enclosed stairs and lifts, or a common corridor (conditioned or unconditioned).

The ‘glazed common area’ zone is to be used for unconditioned common corridors with glazing, when the dwelling wall does not have open air or another dwelling on the other side of the zone. Therefore if the common corridor is unconditioned and has glazing (and thus solar heat gain). This zone is not to be used if the corridor is only semi-enclosed (e.g. verandah-style). And if the common corridor is specified as conditioned, the new zone does not need to be used and the dwelling wall is modelled as adjacent to ‘neighbour’.

When modelling this zone where the glazed common area/corridor is longer than the dwelling wall, the zone is to be at least the length of the dwelling, and each end modelled with internal walls adjacent to ‘neighbour’. The exception to this would be where an external wall is shown, then it should be modelled accordingly. If assessors prefer to model more of the corridor than the length of the apartment, for example if there was a window opening at the end of the corridor, they decided might be beneficial to model, this is also acceptable.

The characteristics of the zone's floor, external walls and ceiling are to be modelled (e.g. construction materials, windows and zone adjacency). The entrance door to the dwelling is not to be modelled, as no ventilation to the outdoor air is assumed. The area of this zone does not contribute to the dwelling's total floor area calculations (shown on the NatHERS Certificate).

See Section 6.5 of Chapter 6 for more information on wall adjacency and its application and modelling, as well as the NatHERS requirements outlined in the NatHERS Technical Note clause 7.3 and Table 3.

4.6.2 'Shared basement carpark' zone

In Class 2 or 4 buildings, a dwelling's floor may be adjacent to earth, another dwelling (neighbour), or carpark or shared basement (unconditioned).

The 'shared basement carpark' zone is to be used for dwellings directly above an underground carpark (or unconditioned space), when:

- the zone floor is in contact with the ground (or another level of carpark),
- the zone ceiling is shared with the ceiling above, and
- external wall are either fully adjacent to earth, or less than 50% of the wall height is exposed to air.

The Chenath engine assumptions are that these underground carpark unconditioned spaces will be more protected than assuming adjacent to 'outdoor air' and the carpark walls should be included for ground heat loss calculations. This zone is not to be used when the carpark is entirely above ground, external walls are greater than 50% above ground, or there are openings on two opposing external walls which is greater than 50% of the wall area.

When modelling this zone the entire 'shared basement carpark' level (including areas adjoining other dwellings, shared common areas or open areas) must be included in the NatHERS assessment. If there is more than one 'shared basement carpark' level, assessors are to model the uppermost level directly under the dwelling and assume it is on ground. Assessors are to model the underground external walls as retaining walls with a 5m thick soil layer at the back of the wall.

The characteristics of the zone's floor, external walls and ceiling are to be modelled (e.g. construction materials, windows and zone adjacency). The area of this zone does not contribute to the dwelling's total floor area calculations (shown on the NatHERS Certificate).

See Section 5.4 of Chapter 5 for more information on floor adjacency and its application and modelling, as well as the NatHERS requirements outlined in the NatHERS Technical Note clause 6.4 and Table 2.

4.7 Zoning ambiguous spaces

Sometimes it can be hard to determine the zoning of a particular room, especially when its purpose is very specific or ambiguous on the plans (e.g. a music room, hobby room, storage room, bar, butler's pantry, play room, cat room, reading room or other rooms creatively named by the designer).

Assessor discretion is required in some instances where the name of a space given on the drawings may be different from the way an assessor would categorise the space for modelling purposes.

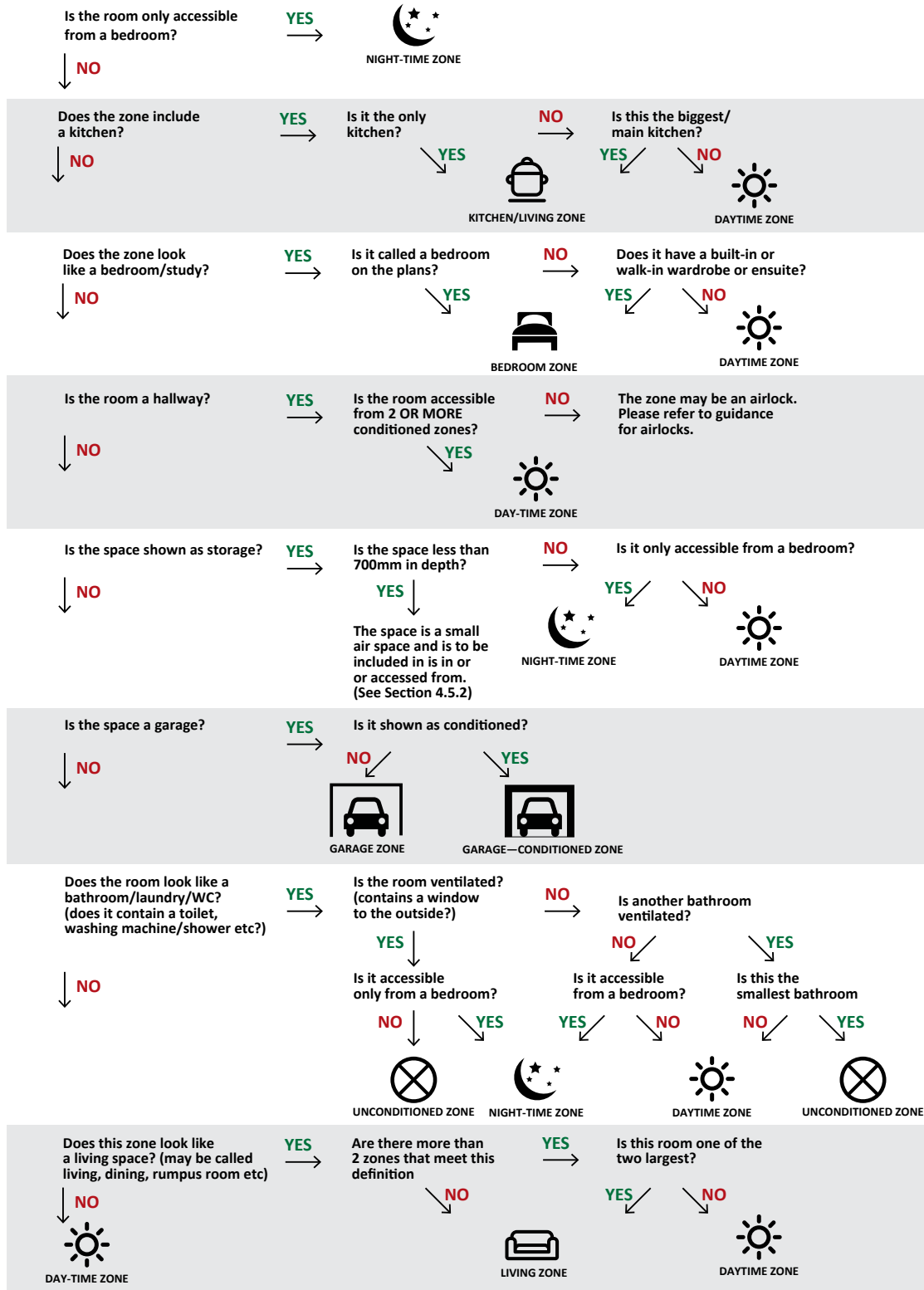
The key to determining the zoning of such spaces is to ignore the name given to the space on the drawings and instead look at the features and intended use of the room.

Answering the following questions may help to determine the zoning of an ambiguous space:

What is its possible use?

- Is the room likely to be used as a daytime or night-time space?
- What zoning does the room resemble if the name on the drawings are removed?
- Could the room be used as a bedroom?
- Does it have a cupboard or wardrobe?
- What are the adjacent spaces?

4.8 Determining a zone



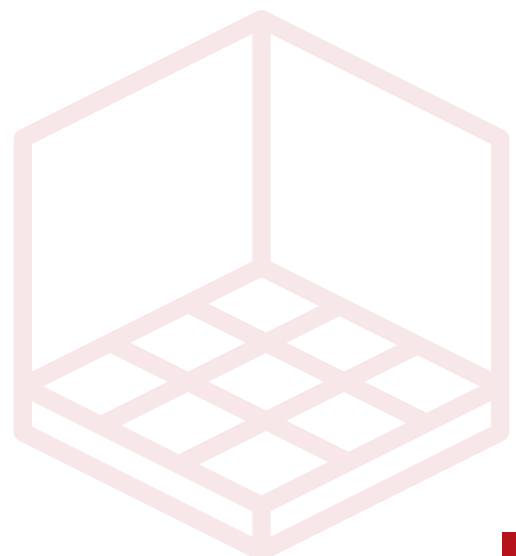
NOTE: This guidance does not include the shared basement carpark zone (See Section 4.6.2), glazed common area zone (See Section 4.6.1), or conditioned outdoor living areas (See Section 4.5.7). Assessors should consult with Appendix 1 of the NatHERS Technical Note for detailed definitions of software tool zone types.



FLOORS

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FLOORS

5

Modelling floors involves calculating floor heights and adding details of floor types, coverings and adjacency (situations where there may be a neighbour or open air underneath a floor).

Summary of key requirements

This handbook is intended to be a helpful resource for all assessors. When conducting assessments, assessors must follow the requirements of the current NatHERS Technical Note and the relevant state or territory requirements.

5a Where Expanded Polystyrene(EPS) waffle pods are specified, assessors must model the waffle pod thickness:

- closest to what is on the design documentation, but never higher; and
- measured from the underside of the top slab to the bottom of the waffle pod construction.

5b Where no floor coverings are specified in the documentation, assessors must use the following provisions:

- garages have concrete floors
- wet areas and kitchens have ceramic tiles
- all other areas have carpets with rubber underlay.

5c For Class 2 buildings, the classification of the adjacency depends on what is below the floor (outdoor air, neighbour or garage).

5.1 Floor height

For NatHERS software tools to calculate a rating, a height above ground must be entered for the ground or lowest floor, including dwellings with a concrete slab on ground. If the lowest space of the dwelling is a floor level below ground (ie. basement), the floor level height may be entered as a negative figure. The height is primarily used to determine the extent of which the dwelling is exposed to wind. For example, the higher the dwelling is off the ground, the higher the wind speed exposed to the dwelling. This is most relevant to Class 2 dwellings where apartments are higher above ground and significantly impacted by a change in exposure and wind speed. (see Chapter 3).

5.1.1 Floor height for individual dwelling

The height of a floor above ground for an individual dwelling is one of the following:

- the finished floor level (FFL) of the concrete slab thickness above the natural ground (if known)
- an assumed FFL of the concrete slab thickness above ground (minimum 150mm)
- the average height of the FFL of a suspended floor above the ground
- the height of the FFL of the storey within a multi-level dwelling.

For multi-level dwellings, assessors should consult their relevant software tool manual and ensure correct floor and ceiling heights are modelled.

5.1.2 Floor heights on sloping sites

Floor heights on sloping sites may vary across the building footprint. The floor height above ground level on a sloping site is to be the average floor height across the building footprint.

Contours are the lines on a site plan representing the slope of the land. The closer together the contour lines are drawn, the steeper the land. Information on heights above ground level for sloping sites may also be available on elevations and sections as part of the design documentation.

To calculate the average floor height on complex sloping sites, assessors may measure the dwelling height above ground at four corners of the dwelling, and calculate the average. If the slope is only in one direction, and relatively even across the length of the dwelling, assessors may choose to use a simply method of calculating the average as shown below in Figure 5-2.

Add the lowest and highest points of the dwellings floor, above natural ground level and divide by two.

- A = 1000 mm, B = 3000 mm
- Average height above ground = $\frac{A+B}{2} = 2000$ mm

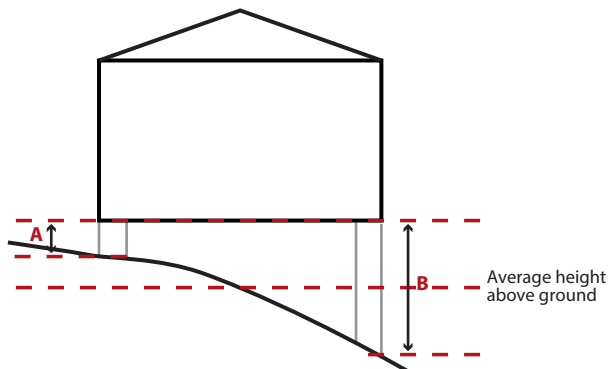


Figure 5-2 Calculating average floor height above ground

5.1.3 Floor height for dwellings in a multi-unit building

The floor height for a specific apartment in a multi-unit building must use the FFL for that specific apartment. Apartments are considered as an individual dwelling. The FFL height above ground is entered in the same way as a dwelling with a suspended floor.

To calculate the floor height for an apartment within a multi-unit building, floor heights and floor thicknesses of each level below the apartment being assessed, are to be added to the building FFL to determine the FFL of the apartment.

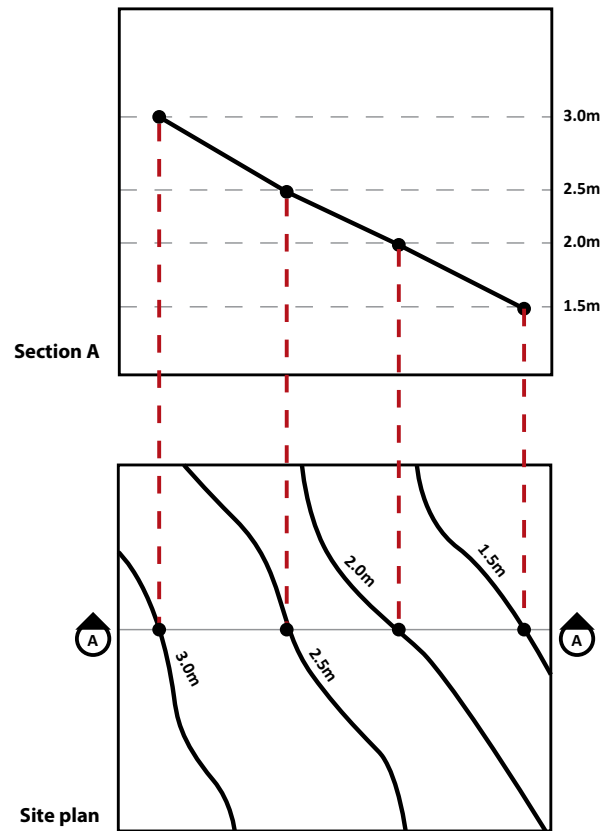


Figure 5-1 Sloping sites

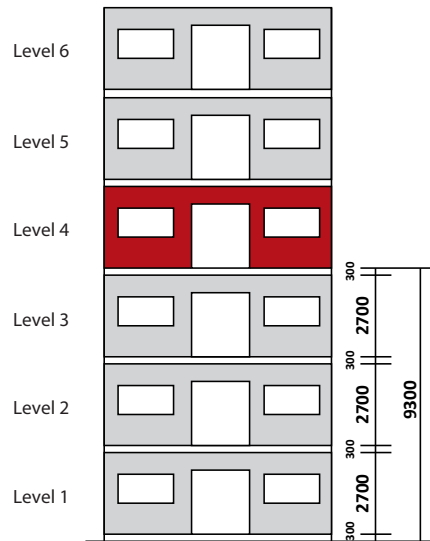


Figure 5-3 Calculating floor height in multi-unit buildings

Figure 5-3 shows an example of how to calculate floor heights in multi-unit dwellings.

The floor height of level 4 is 9300 mm (300 + 2700 + 300 + 2700 + 300 + 2700 + 300).

The exception to this calculation is when assessors are calculating the second storey floor level of a two-storey apartment. In this case, assessors are to use the same method as the second storey floor level of a two-storey dwelling and should consult their relevant software tool manual and ensure correct floor and ceiling heights are modelled as outlined in Section 5.1.1.

5.2 Floor types

Floor types can have a significant impact on the thermal performance of a dwelling, particularly through the addition of thermal mass. In Australia, the floors of residential dwellings are usually concrete or timber, either on ground (e.g. waffle pods) or suspended. For information on other floor types, visit the Your Home website: www.yourhome.gov.au/materials.

5.2.1 Concrete slab floors

A concrete slab that receives good solar radiation (direct sun) in winter can be a significant source of thermal mass to store heat in cold climates that need heating. As long as it is protected from the summer sun, it can also be a cooling source in hot weather.

When concrete slab floors are connected to the ground they can receive additional benefits from the ground temperature, which is generally more moderate than the air temperature—cooler than the air in summer and warmer than the air in winter.

Concrete slab floors on the ground can be insulated at the sides to prevent heat loss or gain to the air. Depending on the climate, adding under-slab insulation may also prevent heat loss. However, this may not be the case in extremely hot or cold climates, where the ground temperature may be more extreme. The Chenath engine does have some limitations in modelling the ground-coupled heat transfer of slab edge insulation scenarios accurately. If this type of insulation is specified on the documentation and you are unsure how to model it, please refer to your software tool manual or contact your Assessor Accrediting Organisation for advice.

Some concrete slabs are suspended above the ground, because the slope of the site makes a single continuous slab at the same level difficult. This can also provide cooling benefits when constructed in hotter climates. When a suspended concrete slab floor is used:

- insulation under the slab may be beneficial in colder climates (that require heating), to prevent the loss of heat through the bottom of the slab to the air
- insulation under the slab may not be beneficial in milder climates if the subfloor is enclosed and there is no central heating or air conditioning used in the dwelling, because there will not be significant heat loss or gain through the slab
- insulation under the slab may not be beneficial in warmer climates (that require cooling), as it is more beneficial for air to circulate under the elevated floor to increase the loss of heat to the slab and keep it cooler.

5.2.2 Timber floors

Timber floors are often used in light-weight construction and may be good in hotter climates. However, they provide very little thermal mass (which can help to maintain consistent temperatures inside the dwelling) and the open, ventilated subfloor results in greater heat loss or gain through the timber floor, which is not ideal in colder climates.

Timber floors, when used in colder climates that require predominantly heating, should ideally be enclosed to restrict air flow under the floor, while still allowing sufficient air movement for healthy ventilation to the floor timbers. They should also be well insulated to reduce the loss of heat through the floor. When a timber floor is used in a brick veneer construction, it is also ideal to reduce air flow between the roof space and the subfloor via the wall cavity.

In hotter climates, a raised timber floor can provide cooling by allowing heat that has built up in the dwelling to escape through the floor by the cooling effect of convection. If this is the desired effect, then the floor should not be insulated. If, however, a dwelling in a hotter climate has air conditioning, insulation should be included under the floor to reduce the entry of heat from the outside air and the loss of air conditioning through the floor.

5.2.3 Waffle pods

Waffle pods are a construction method that uses expanded polystyrene (EPS) blocks under the concrete slab. There are a number of reasons why waffle pods may be used, including good insulation qualities, reduced amount of concrete required and assisting with particular requirements of a construction site.

5a Where Expanded Polystyrene (EPS) waffle pods are specified, assessors must use the waffle pod thickness:

- closest to what is on the design documentation, but never higher; and
- measured from the underside of the top slab to the bottom of the waffle pod construction.
(**Tech Note clause 6.1**)

Where the thickness of a waffle pod is not indicated on the documentation, the provisional 175mm thickness (R value 0.57) must be used. (**Tech Note clause 6.2**)

Depending on your software tool, the respective R value of these waffle pods may be built into the material/construction types or options available. If your software tool allows this information to be entered however, the thermal resistance of is to be:

- 175mm waffle pod thickness = R 0.57
- 225mm waffle pod thickness = R 0.60
- 300mm waffle pod thickness = R 0.63
- 375mm waffle pod thickness = R 0.65.

The above R values are for waffle pods only and cannot be used for other underfloor insulation types.

5.2.4 Other floor insulation

Knowledge of insulation and airgaps is essential to getting the data entry correct because it will affect the total R value of the element.

Assessors should have a sound working knowledge of the available insulation products and how, when and where the products can be used, including those that can be used under the floor. Information to assist assessors is available from manufacturers, suppliers and on the internet.

Assessors should also know how to calculate the total R value of an element, such as a floor, and how to calculate the depth of an air gap and the emissivity associated with it. For more information about insulation, including definitions, insulation types and calculating R values, see Section 6.3.

5.3 Floor coverings

There are a variety of floor coverings available in NatHERS software tools. The most common floor coverings include carpet, tile, vinyl and floating timber floorboards. There may be some variation between software tools in how coverings are entered—refer to the relevant software tool manual for more information.

5b Where no floor coverings are specified, assessors must use the following provisions:

- garages have concrete floors
- wet areas and kitchens have ceramic tiles
- all other areas have carpets with rubber underlay. (**Tech Note clause 6.3**)

When applying these provisions, assessors should inform the client that these may not represent the best possible performance and that different floor coverings may improve the rating in some climate zones.

5.4 Adjacent floors

Care needs to be taken when rating apartments to ensure that adjacent spaces and their conditioning are correctly classified. In Class 1 buildings, it is unlikely floors will be adjacent to anything other than the ground or another storey of the same dwelling. In Class 2 and Class 4 buildings, beneath the dwelling floor may be another apartment or a shared carpark or unconditioned public space. Common carparks and basements below Class 2 and 4 dwellings cannot be treated as subfloor zones or garages.

5c Assessors must model floor adjacency of dwellings directly above carparks or unconditioned public spaces as per Table 5-1 (Table 2 of the NatHERS Technical Note). (**Tech Note clause 6.4**)

The 'shared basement carpark' zone is available when using Chenath engine V3.21. It is to be used when the dwelling is above an underground car park or unconditioned space and the zone floor is in contact with the ground (or another level or carpark), the zone ceiling is shared with a dwelling above, and the external walls are either fully adjacent to earth, or less than 50% of the wall height is exposed to air. This zone type is therefore not to be used when the carpark is entirely above ground, external walls are greater than 50% above ground, or there are openings on two opposing external walls which is greater than 50% of the wall area.

These underground carpark unconditioned spaces will be more protected than assuming adjacent to 'outdoor air', and the carpark walls should be included for ground heat loss calculations. The area of this modelled zone will not be included in the total floor area calculations, and external wall openings do not need to be modelled as these openings form part of the zone algorithms. The specifications of the carpark zone's floor, external wall and ceiling details are required to be modelled. When the ceiling area of the zone is to neighbouring or other dwellings, it will need to be modelled as adjacent to 'neighbour'.

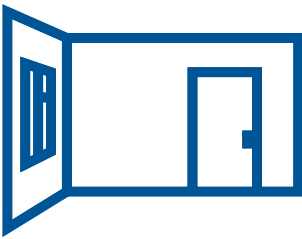
If your software tool version is using Chenath engine V3.12, model dwellings directly above carparks and unconditioned public spaces as per Table 5-2 (Appendix 2 of the NatHERS Technical Note). This guidance is not to be used if your software is using Chenath engine V3.21.

Table 5-1 Floor adjacency in Class 2 and 4 buildings

Floor type	How to model
Dwelling above a highly ventilated car park that is greater than 50 per cent open to the outdoor air (e.g. an open car park with minimal or no external walls).	<ul style="list-style-type: none"> Treat dwelling as above outdoor air.
Dwelling above an underground car park (e.g. a car park which is less than 50 per cent open to the outdoor air and with more than 50 per cent wall area adjacent to earth).	<ul style="list-style-type: none"> Treat the dwelling as above 'Shared Basement Carpark'. Include the entire 'Shared Basement Carpark' level in the rating of the apartment, including the floor, external walls, and the ceiling of the carpark. Treat the underground external walls as retaining walls with a 5m thick soil layer at the back of the wall. Include the entire 'Shared Basement Carpark' including those areas adjoining other dwellings, shared common areas or open areas. If there is more than one 'Shared Basement Carpark' level, model the uppermost level directly under the dwelling and assume it is on ground.
Dwelling above commercial premises, or mostly enclosed common public areas.	<ul style="list-style-type: none"> Treat dwelling as above a neighbour.
Dwelling above a highly ventilated common public area.	<ul style="list-style-type: none"> Treat dwelling as above outdoor air.
Dwelling with a fully enclosed garage for its exclusive use, where it is accessed from the dwelling and shares floors, walls or ceilings with the dwelling, and has a separate vehicular access door.	<ul style="list-style-type: none"> Treat the relevant dwelling's wall or floor as adjacent to a 'Garage' and include the garage as a zone within the rating.

Table 5-2 Floor adjacency in Class 2 and Class 4 buildings when using Chenath engine V3.13

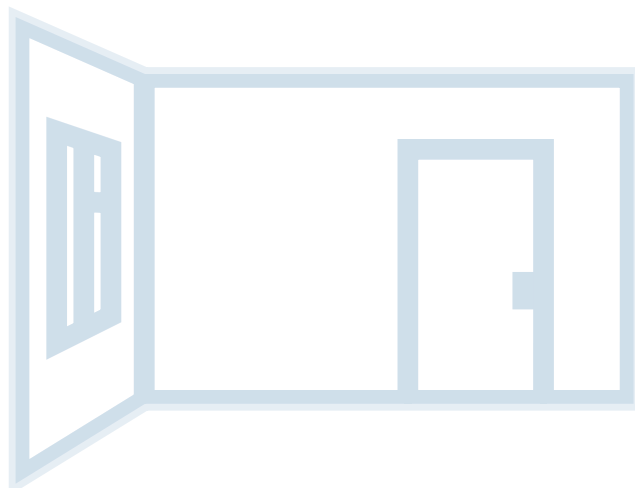
Floor type	How to model
Floors above a shared car park, common basement, highly ventilated common public areas.	<ul style="list-style-type: none"> Treat dwelling as above outdoor air.
Floors above commercial premises, minimum or partially ventilated common public areas.	<ul style="list-style-type: none"> Treat dwelling as above a neighbour.
Any Class 2 or 4 car park that is different from a fully enclosed space with one or more entrance points (i.e. an open car park with minimum or no external walls).	<ul style="list-style-type: none"> Treat dwelling as above outdoor air.
A Class 2 or 4 dwelling that has a fully enclosed garage for its exclusive use, where it is accessed from and shares floors walls or ceilings with the dwelling and has a separate vehicular access door.	<ul style="list-style-type: none"> Treat the other side of the dwellings wall or floor, as applicable, as adjacent to a 'Garage' and include the garage in the rating of the apartment.

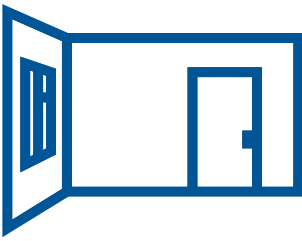


WALLS

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WALLS

There are numerous combinations of wall constructions and insulation that can make up a dwelling. This chapter looks at the most common wall types, explains how to calculate the height of walls and provides a basic understanding of the types of insulation. This chapter also looks at wall adjacency, in terms of what is on the other side of a wall, which is particularly important in multi-dwelling buildings.

Summary of key requirements

This handbook is intended to be a helpful resource for all assessors. When conducting assessments, assessors must still follow the requirements of the current NatHERS Technical Note and the relevant state or territory requirements.

- 6a** If recommending changes to insulation, all documentation must be updated to reflect the changes before a NatHERS Certificate is finalised. Assessors must ensure recommended bulk insulation will fit within the wall cavity.
- 6b** Where no external wall colour is specified, assessors must model the provisional colour 'medium'.
- 6c** Where no internal wall colour is specified, assessors must model the provisional colour 'medium'.
- 6d** Dwelling walls adjacent to other dwellings, enclosed stairs and lifts, conditioned common corridors or unconditioned common corridors with no glazing, are to be modelled as adjacent to 'neighbour'. Adjacent dwellings are modelled as a conditioned space, regardless of the NatHERS zoning that would apply.
- 6e** Dwelling walls adjacent to common corridors open to external air (i.e. corridors with permanent openings) are to be modelled as an external wall with eaves the depth and length of the corridor adjacent to the dwelling.
- 6f** Dwelling walls adjacent to an unconditioned common corridor with glazing are to be modelled as a 'glazed common area' zone. The zone must be the same width as the corridor and at a minimum, the length of the dwelling.

6.1 Wall types

Although there are many different types of walls, most homes in Australia are built using one of several common construction methods. Some of the main construction methods used in Australia are:

- **Cavity brick or double brick**, in which two layers of brickwork are built side by side (with a larger gap between the layers in the case of cavity brick) and tied together at intervals for strength. This wall type has good thermal mass properties, but lacks insulation properties.
- **Light weight**, in which the walls are constructed of timber or steel framing, with timber or another kind of cladding outside, insulation in the middle, and plasterboard or other lining inside. This wall type can have good insulation properties, but lacks thermal mass properties.
- **Brick veneer**, in which the walls are constructed of timber or steel framing, with brick cladding outside, insulation in the middle, and plasterboard or other lining inside. This wall type is similar to light-weight walls—it can have good insulation properties, but lacks thermal mass properties inside the room.

- **Reverse brick veneer**, in which the walls are constructed of timber or steel framing, with brick lining inside, insulation in the middle, and timber or other kind of cladding outside. This wall type can have good insulation and has good thermal mass properties inside the room.

Other construction methods for walls include concrete blocks, composite construction systems, straw bales, autoclaved aerated concrete and mud bricks.

It is important to understand the advantages and disadvantages that construction methods may have in different climates, locations and for construction practices. More information about different construction systems is available at the Your Home website: www.yourhome.gov.au/materials/construction-systems.

The different NatHERS software tools have different types of walls available—some have the option to build walls from different wall elements, while others have a static list of options. Refer to the relevant software tool manual for more information about wall types or contact your Assessor Accrediting Organisation for modelling advice if the wall type shown on the documentation is not available in the software and you are unsure on what wall type to model.

6.2 Wall height

Wall height is the measurement between the finished floor level (FFL) and the finished ceiling level (FCL). Assessors should be aware of any variation between walls and ensure the wall height of each wall is entered accurately.

6.2.1 Wall heights in rooms with raked ceilings

Rooms or zones with a raked ceiling will have one shorter and one taller wall, and two walls that are not square. The actual wall heights of the shorter and taller walls are to be entered into the software tool. An average height is to be used for the walls that are not square, unless your software tool has a raked wall function.

Figure 6-1 demonstrates this calculation method. The wall heights to be modelled in the software are:

- shorter wall (a) = 2400 mm
- taller wall (b) = 2800 mm (also maximum ceiling height)
- (c) = walls joining wall (a) and (b) = $\frac{a+b}{2} = \frac{2400 + 2800}{2} = 2600$ mm

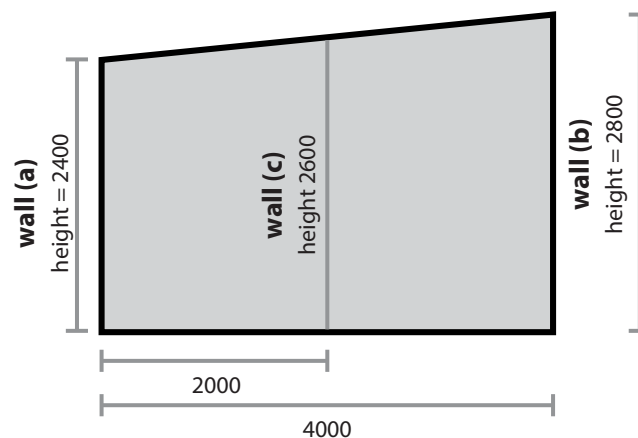


Figure 6-1 Raked ceiling calculations example—section view

6.3 Insulation

Knowledge of insulation and airgaps is essential to getting the data entry correct, as it will affect the total R value of the element.

There are some key concepts that assessors should understand about insulation and air gaps:

- **Emissivity**—Emissivity is a measure of how a surface emits or reflects heat energy and is calculated by the amount of energy emitted or radiated from a material's surface.
Emissivity is a measure of how reflective a surface is; it is expressed as a number between 0 and 1.
Low emissivity is more reflective, high emissivity is less reflective.
Lower emissivity will produce a higher R values in the adjacent enclosed air space.
- **k value—Thermal conductivity**, or the measure of the rate of heat flow through a material and the ability of a material to allow the flow of heat from its warmer surface through the material to its colder surface.
- K value is determined as the heat energy transferred per unit of time and per unit of surface area divided by the temperature gradient, which is the temperature difference divided by the distance between the two surfaces (the thickness of the material), expressed in watts per meter-kelvin. A material with a low k value transmits low levels of heat (good insulator); a material with a high k value transmits high levels of heat (poor insulator).
- **R value—Thermal resistance** per unit area, or the measure of the resistance to heat flow through a specific thickness of a material.
Higher numbers indicate better insulating properties. Thermal resistance (R value) is the reciprocal of thermal transmittance (U value). 'Total R value' refers to the addition of each material/component's R value. 'Added R value' refers to the insulation material/component to be added to a wall, roof or floors to improve the thermal resistance of that system.

Assessors should have a sound working knowledge of the available insulation products (see Section 6.3.1) and how, when and where the products can be used. Information to assist assessors is available from manufacturers and suppliers. There is a difference between imperial and metric calculations of R value, and when researching products it is important the assessor confirms the R value applied is suitable for Australia, particularly if the specification includes non-standard products or systems.

Assessors should also know how to calculate the total R value of an element, such as a wall (see Section 6.3.2), and how to calculate the width of an air gap and the emissivity associated with it (see Section 6.3.3). NatHERS software tools contain default R values for different elements. Where assessors do not have R values for an element, NatHERS software tools contain features and calculators that allow the calculation and/or use of an element to be based on the K value.

6.3.1 Insulation types

There are two main types of insulation:

- **Bulk insulation**—Bulk insulation reduces heat flow by creating small pockets of still air or another gas that is not a good conductor of heat. This trapped air or gas provides most of the R value, rather than the material itself. For example, 100mm thick glass fibre insulation provides around R 2.3, while 100mm glass without small pockets of air provides only R 0.1. The thicker the bulk insulation, the higher the R value. The higher the R value, the slower the transfer of heat through the material.
The main types of bulk insulation used in Australia are:
 - batts and blankets, for example fibreglass, rockwool, natural wool, jute and polyester
 - loose fill insulation, such as cellulose fibre, natural wool or granulated rockwool
 - boards (e.g. extruded and expanded polystyrene insulating boards)
 - some building materials, such as autoclaved aerated concrete blocks, strawboard and straw bales, act as both a construction system and provide insulation as well.

- **Reflective insulation (foils)**—Reflective foil insulation usually consists of a thin layer of aluminium foil bonded onto the sides of a reinforced base (Figure 6-2). Reflective foil insulation reduces heat flow by using surfaces that are highly reflective, with low thermal emittance (does not emit heat) and absorptance (does not absorb heat). The emissivity is generally expressed as two values which describe the reflective orientation.

It is not so much the material itself that provides the thermal resistance, but the impact of the low emittance surface that reduces heat flows across an air space. Therefore, unless reflective foil insulation faces an air space, it adds no additional thermal resistance.

The amount of reflection is measured as emissivity. The more reflective the surface, the less thermal radiation is emitted through the surface, so the lower the emissivity value (e.g. 0.9 is not reflective, 0.05 is very reflective).

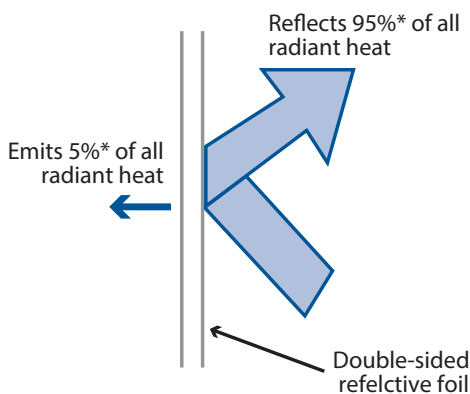
The main types of reflective insulation used in Australia are:

- rolls, (e.g. single- or double-sided rolls used for sarking)
- multi-cell insulation, consisting of two, three or four layers of laminated foil separated by partitioning
- expandable insulation (e.g. double-sided reflective foil laminate formed into an expandable concertina)
- bonded to bulk (e.g. reflective foil bonded to insulating blankets or polystyrene board).

Table 6-1 contains information that may be useful when using insulation in a NatHERS assessment.

Table 6-1 Insulation in NatHERS software

Unit of measurement	Bulk insulation		Reflective insulation (with air gap)	
	R value (R)	Conductivity (k)	Emissivity (E)	R value (R)
Value is represented as	>0	0–1	0.05–0.9*	>0
Format of value	To one decimal place	To two decimal places	To two decimal places	To one decimal place
Examples of values	R 0.5, R 1.5, R 3.0	0.23, 0.33	0.9, 0.05	R 1.5, R 0.5, R 3.0
Related to	Density (D or ρ)—Kg/m ³		Reflection into an adjacent air space	
Thickness of material	<ul style="list-style-type: none"> • measured in millimeters and dependent on R value 		<ul style="list-style-type: none"> • 0–2mm and requires at least a 13mm air gap • May be attached to bulk product or another surface 	



*example only—check with specification/documentation to confirm this information and accurate percentage

Figure 6-2 Thermal effect of reflective foil insulation

When recommending insulation changes, assessors must ensure the product is suitable. In particular, it is important the insulation modelled as part of the assessment will fit into the designed space (e.g. wall cavity), as the NCC and Australian Standard require that bulk insulation is not compressed.

6a If recommending changes to insulation, all documentation must be updated to reflect the changes before a NatHERS Certificate is finalised. Assessors must ensure suggested bulk insulation will fit within the wall cavity. (Tech Note clauses 3.3 and 7.5)

Details of insulation products, including thickness, R value and k value, are generally available from the manufacturer’s website. Further information about R and k values is available from the *ICANZ insulation handbook*: icanz.org.au/standards-research-and-publications

6.3.2 Calculating the R value of a wall

R value means the thermal resistance (m²K/W) of a material, which is calculated by dividing the thickness by its thermal conductivity. The total R value of a wall is the linear total of the R value of each element. Any variation in the R value of a layer within the element, including any air gap, will change the total R value. If an air gap is increased, the overall R value will vary, which will also differ depending on whether reflective insulation is used adjacent to the air gap (see Section 6.3.3). As the total R value increases, the insulation benefit improves. Depending on your software tool, these R value components may be automatically calculated.

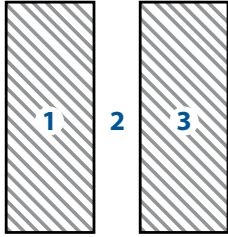
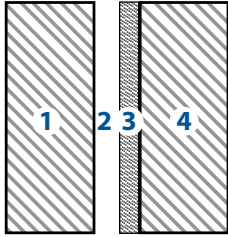
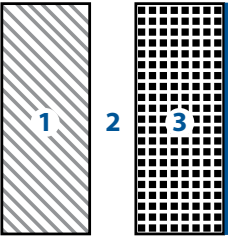
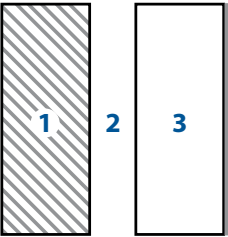

Table 6-2 provides a list of common materials with example thickness and R value. Assessors should always use the R value recommended by the manufacturer or included in the specification/documentation. Table 6-3 provides a list of common wall constructions with example thickness and R values, if your software tool allows custom wall construction or modification.

Table 6-2 Example material thickness and R value

Material	Thickness (mm)	R value (m ² /W)
Brick (generic extruded)	110	0.18
Brick (pressed clay)	110	0.12
Plasterboard	10	0.06
Fibre cement cladding	4.5–14	0.06
Metal cladding	1–2	0
Timber Weatherboard	9.5	0.05
Reflective air gap	13	0.6
Non-reflective air gap	13	0.16

Source: Collated by Efficiency Assessments (examples only, assessors should always use the R value provided by the manufacturer)

Table 6-3 Example wall constructions

Cavity brick with no insulation				
				
Layer	1	2	3	
Material	Brick	Non-reflective airgap	brick	
Width	110 mm	50 mm	110 mm	
R value	0.18	0.16	0.18	
Total R value	0.52			
Cavity brick with expanded polystyrene insulation				
				
Layer	1	2	3	4
Material	Brick	Non-reflective airgap	Expanded polystyrene	Brick
Width	110 mm	30 mm	20 mm	110 mm
R value	0.18	0.16	0.51	0.18
Total R value	1.03			
Brick veneer with added R 2.5 studs				
				
Layer	1	2	3	4
Material	Brick	Non-reflective airgap	Insulation added to stud R 2.5	Plasterboard
Width	110 mm	50 mm	90 mm	10 mm
R value	0.18	0.16	2.5	0.06
Total R value	2.9			
Brick veneer with no insulation				
				
Layer	1	2	3	4
Material	Brick	Non-reflective airgap	Studs (with air gap)	Plasterboard
Width	110 mm	50 mm	90 mm	10 mm
R value	0.18	0.16	0.18	0.06
Total R value	0.58			
Fibre cement sheet wall with foil				
				
Layer	1	2	3	4
Material	Fibre cement	Single-sided foil	Reflective airgap	Plasterboard
Width	8 mm	1 mm	90 mm	10 mm
R value	0.06	0	0.6	0.06
Total R value	0.72			

6.3.3 Calculating air gaps in walls

An air gap is the empty space in-between construction materials. Such gaps can provide a small level of insulation. An air gap can also be reflective or non-reflective:

- **Reflective air gap**—NatHERS software interprets the use of foils as a reflective airspace. This means there is a reflective surface facing the airgap and providing insulative qualities. Depending on the emissivity of the reflective insulation, it may be considered a ‘semi-reflective air gap’. Where an air gap is accompanied with a reflective surface (i.e. foil insulation), it can have a bigger impact on the insulation properties of the wall.
- **Non-reflective air gap**—Where an air gap is not accompanied by a reflective surface, the air gap is considered non-reflective.

The width of an air gap in a wall should be adjusted when insulation is added:

$$\text{Modelled air gap} = (\text{width of air gap without insulation}) - (\text{thickness of uncompressed insulation})$$

Depending on your NatHERS software tool, the width of air gaps may need to be manually adjusted by the assessor. In others, a separate wall type is chosen to assess the changed R value (refer to the relevant software tool manual). Assessors may also be able to specify in NatHERS software whether the air gap is ‘ventilated’ or ‘unventilated’ if this information is specified on the documentation.

6.4 Wall colour

The colour of walls affects how the dwelling reflects or absorbs heat and can be used to assist in heating or cooling the dwelling.

Darker colours absorb heat and lighter colours reflect heat. It is therefore preferable to use darker colours on the walls in colder climates and lighter, more reflective colours in warmer climates. For moderate climates, medium colours may be the most effective. Some testing may be required to identify the correct palette for the location and climate of the dwelling.

- 6b** Where no external wall colour is specified, assessors must model the provisional colour ‘medium’.
(Tech Note clause 7.1)
- 6c** Where no internal wall colour is specified, assessors must model the provisional colour ‘medium’.
(Tech Note clause 7.2)

6.5 Adjacent walls

Care must be taken when rating dwellings in multi-dwelling buildings to ensure that adjacent spaces and their conditioning are correctly classified. In most Class 1 dwellings, adjacency is not a consideration, because the software will assume that external walls are adjacent to ‘outdoor’. This is what the software will default to unless altered by the assessor. However in townhouses/terraces with shared walls, or Class 2 dwellings, an external wall may be shared with a neighbour and treated differently by the software. It is therefore important to enter adjacency information into the software tool.

6.5.1 Adjacent to neighbour

6d Dwelling walls adjacent to other dwellings, enclosed stairs and lifts, conditioned common corridors or unconditioned common corridors with no glazing, are to be modelled as adjacent to ‘neighbour’. Adjacent dwellings are modelled as a conditioned space, regardless of the NatHERS zoning that would apply. (Tech Note clause 7.3 and Table 3)

An example of this is shown in Figure 6-3, where Unit 6 is adjacent to dwellings, enclosed stairs and lifts, all of which are modelled as adjacent to ‘neighbour’ (red, yellow, green walls). Where the hallway has other apartments opposite and no ventilation (e.g. windows), the dwelling corridor wall (blue) is modelled as adjacent to ‘neighbour’.

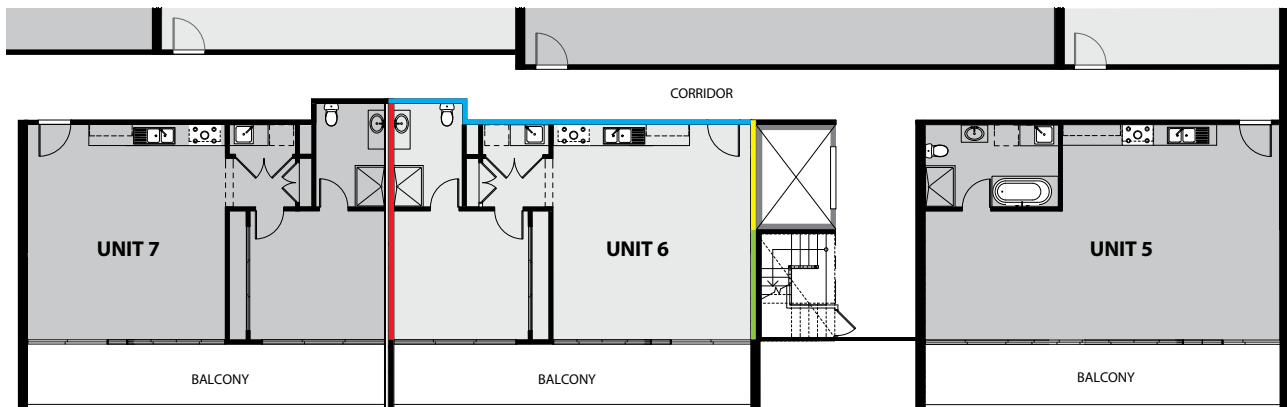


Figure 6-3 Adjacent to neighbour

6.5.2 Adjacent to external wall

6e Dwelling walls adjacent to common corridors open to external air (i.e. corridors with permanent openings) are to be modelled as an external wall with eaves the depth and length of the corridor adjacent to the dwelling. (Tech Note clause 7.3 and Table 3)

For example, if the common corridor in Figure 6-3 did not have apartments opposite, and the corridor had permanent openings (i.e. partly/fully open verandah-style), the dwelling wall (blue) is modelled as an external wall with shading the same size as the corridor or as appropriate. This is because ventilation flow is to open air when the corridor wall is only semi-enclosed.

6.5.3 Adjacent to glazed common areas

6f Dwelling walls adjacent to an unconditioned common corridor with glazing are to be modelled adjacent to a ‘glazed common area’ zone. The zone must be the same width as the corridor and at a minimum, the length of the dwelling. (Tech Note clause 7.3 and Table 3)

The ‘glazed common area’ zone is to be used for unconditioned common corridors with glazing, when the dwelling wall does not have open air or another dwelling on the other side of the zone.

The area of this zone does not contribute to the total floor area calculations, and the characteristics of the zone’s floor, external walls and ceiling are to be modelled. The entrance door to the dwelling is not to be modelled, as no ventilation to the outdoor air is assumed.

An example of this is shown in Figure 6-4, where Unit 6 is adjacent to a dwelling and enclosed stairs and lifts, which are modelled as adjacent to 'neighbour' (red, yellow, green walls). Where the adjacent corridor is glazed, the corridor dwelling wall (blue) is modelled with a 'glazed corridor area' zone that is the same width and length as the corridor (at a minimum), and with wall adjacency to 'neighbour' or as appropriate at both ends.

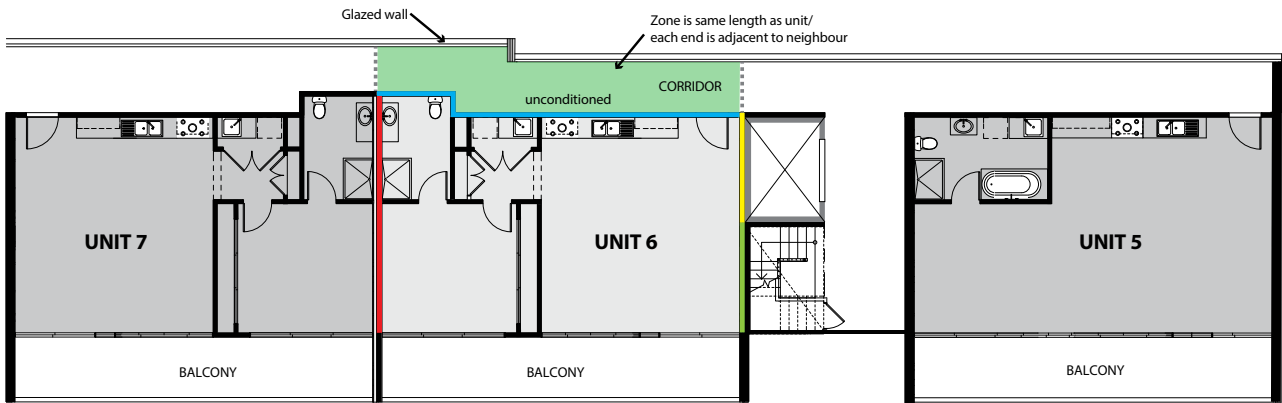
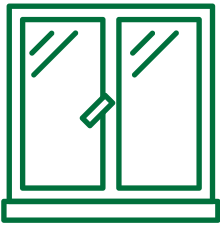


Figure 6-4 Adjacent to glazed common corridor



WINDOWS AND DOORS

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Windows have a substantial effect on the thermal performance of a dwelling. They can improve the performance by allowing ventilation, cross-breezes and solar heat gain, but can also reduce the performance by allowing heat in during hotter seasons or heat to escape during colder seasons. Up to 40% of a home's heating energy can be lost and up to 87% of its heat can be gained through windows. As windows can severely affect the heating and cooling loads of a dwelling, improving the thermal performance of windows can greatly reduce energy costs and greenhouse gas emissions.

The effect of glazing on the thermal performance of a dwelling is complex. Several factors contribute to the effectiveness of windows:

- local climatic conditions—temperature, humidity, sunshine and wind
- design—the orientation, form and layout of the dwelling
- materials—the amount of mass and insulation (such as using thermal mass to store the entering sun's heat and providing night-time warmth in cold conditions)
- size and location of windows and shading—to let sunshine in when the outdoor temperature is cold, exclude it when it is hot, and allowing natural cooling by cross-ventilation
- thermal properties of glazing systems—such as double-glazed, thermally broken window frames.

As glazing can significantly affect the rating, it is essential that window/door information is as accurate as possible. In NatHERS software, glazed doors are treated as windows and selected from the window libraries.

Summary of key requirements

This handbook is intended to be a helpful resource for all assessors. When conducting assessments, assessors must follow the requirements of the current NatHERS Technical Note and the relevant state or territory requirements.

- 7a** Windows or glazed doors must be modelled as from either the NatHERS default window library, or the NatHERS custom windows library.
- 7b** If the glazing supplier/manufacturer is unknown, or the specified custom window is not available in the NatHERS custom window library, assessors must model a default window with the specified opening type and an available custom window that meets all of the parameters outlined in Tech Note clause 8.3.
- 7c** The minimum design documentation required when modelling windows and glazed doors should comprise window, skylight, roof window and door details, including size, glass type, frame type, openable percentage, opening style and location.
- 7d** When using default windows, clear glass must be used in lieu of obscure glass.

- 7e** When using custom windows, assessors can model obscure glass either as a default clear window, or a clear window from the same range of custom windows that are being used in the assessment.
- 7f** When using default windows, assessors must apply the provisional openable percentages listed in Table 7-1.
- 7g** When using custom windows, assessors must use the manufacturer’s ventilation charts to determine the openability of the window/door. If this information is not available, apply the provisional percentages listed in Table 7-1.
- 7h** The glazed portion of a fully or partially glazed doors is modelled as a window in NatHERS software tools. If the glazed component is less than 25% of the door, the door may be modelled as a solid door.

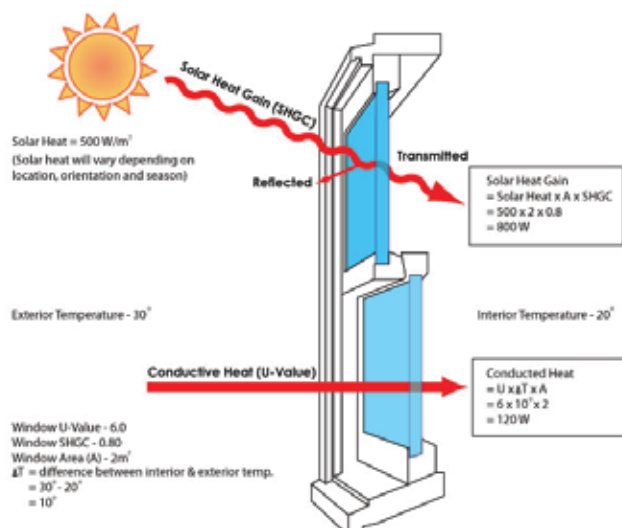
7.1 Window performance values

The factors often considered the most important in measuring the energy performance of a window are its U value and solar heat gain coefficient (SHGC). These factors indicate the ways in which windows react thermally.

The U value (often expressed as U_w when referring to the total window system) is a measure of how readily a window conducts heat, and the rate of nonsolar heat loss or gain through the window unit (see Figure 7-1). The U value includes the effect of the frame, glass, seals and any spacers. The lower the U value, the greater a window’s resistance to heat flow and the better it is at insulating and keeping the heat in or out.

The SHGC is a measure of how readily heat from direct sunlight flows through a window (see Figure 7-1); it is often expressed as SHGC_w when referring to the total window system (i.e. frame and glazing values combined). The SHGC is the fraction of incident solar radiation transmitted through a window, as well as the amount absorbed by the window and subsequently released inwards. The SHGC is expressed as a number between 0 and 1, where a lower SHGC equates to less solar heat transmitted. For example, 0 SHGC indicates that none of the available solar heat will pass through the window, while an SHGC of 1 indicates that 100% of the available solar heat will pass through the window.

In NatHERS software, the U value and SHGC are expressed as total window system values, which includes the individual window frame component and glazing values.



Source: Australian Glass and Window Association

Figure 7-1 Window conduction and solar heat gain

The angle at which solar radiation strikes glass—the angle of incidence—has a major effect on the amount of heat transmitted inwards. It is influenced by the position of the sun according to location, season and time of day, and the orientation of the glazing. When the sun is perpendicular to the glass it has an angle of incidence of 0°. For standard clear glass, 85% of solar heat is transmitted. As the angle increases, more solar radiation is reflected and less is transmitted, and the effective area of exposure to solar radiation also reduces. The SHGC declared by glazing manufacturers is always calculated as having a 0° angle of incidence—that is, the maximum solar heat gain.

The same window can have a vastly different solar gain depending on the angle of incidence. For example, a north-facing window in summer, when the sun is high in the sky, may have an angle of incidence of 80°. In winter, the angle of incidence at midday is about 35° and the glass is exposed to a greater effective area of solar radiation. The window can transmit more solar heat in winter than in summer.

A west-facing window on a summer’s afternoon has an angle of incidence from near 0° up to 30° depending on latitude, with a large effective area of solar radiation. A north-facing window in summer has a high angle of incidence and a low solar irradiation striking the window area, so can transmit less heat than a west-facing window.

In temperate and cool temperate climates such as Adelaide, Hobart, Melbourne, Perth and Sydney, northerly glazing should have a high SHGC. This is standard passive solar practice for these climates. Northerly windows are the home’s solar collectors. However, these windows should also have fixed shading designed to shade as little of the glass in winter as possible, while shading as much as possible in summer (see Chapter 9).

It is a common misconception that north-facing windows should be clear and single glazed to obtain the best house energy rating. Maximising passive solar gain does not necessarily lead to the lowest annual heating energy load. Low-emissivity (low-e) double glazing (see Section 7.2.1) with high solar transmission provides a better annual result due to the small drop in solar gain is often more than outweighed by the lower U value of the insulating glass. In net terms, the low-e double glazing is considerably better and returns a lower annual heating energy load while providing superior thermal comfort.

The Your Home website provides further information in the Your Home glazing section at www.yourhome.gov.au.

7.2 Window elements

The elements that make up a total window system include glazing type, frame material and operating type. These elements work together to contribute to the window performance values.

7.2.1 Glazing type

Glazing type refers to the type of glass in the window system. Different types of glazing will affect the performance values of a window. The thickness of glass has negligible impact on its U value and SHGC; however, it does have a significant effect on noise transmission and the strength of the glazing. Many other types of glass are also available to improve impact resistance such as laminated glass and toughened or safety glass. However the key types applicable to modelling in NatHERS software tools can be divided into these main categories:

- **Clear glass** refers to a single pane of standard manufactured glass.
- **Low-emissivity glass** (commonly known as low-e glass) has either a vacuum-deposited thin-film metal coating or a pyrolytic coating. As vacuum-deposited coatings are soft, for protection and longevity they must only be deployed inside an insulating glass cavity. Pyrolytic coatings are baked onto the surface in the factory while the glass is still hot to make it hard and durable.

The key purpose of applying low-e coating is to control the impact of heat transmitted through the glass. Hence, depending upon the need (either to keep the heat out or trap the heat inside), the low-e coating glass of appropriate nature is used. The thermal values of low-e glass will differ depending on which surface within the glazed unit the coating is applied to. The location of the low-e coating shown in figure 7-2 is just one example—in double glazed units it could be applied to either cavity surface, or the interior surface of the glazing. For single glazing, it would be applied on the internal surface of the glazing.

High transmission/low-e glass has a coating that allows daylight and solar heat gain to pass into the house, while reducing the amount of long wavelength infrared heat from escaping from the dwelling. This type of low-e is generally clear, and primarily of benefit in colder climates to capture maximum solar heat gain within the dwelling.

Low transmission/low-e glass has a coating that allows daylight to pass into the house, while reflecting long wavelength infrared heat to reduce the amount of solar heat gain into the dwelling. This type of low-e is generally grey or tinted etc. and primarily of benefit in warmer climates to reduce solar heat gain from entering the dwelling.

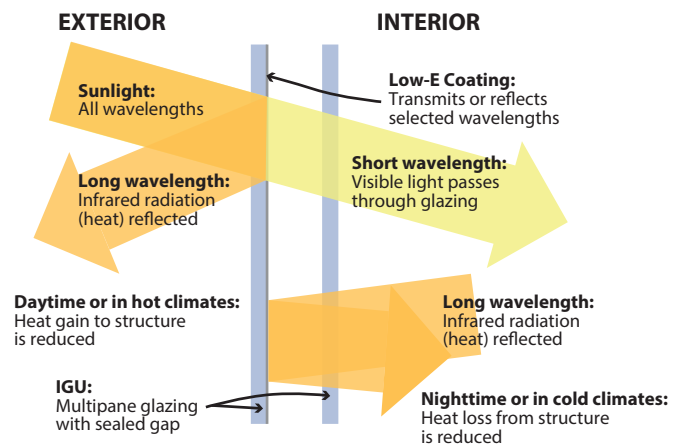


Figure 7-2 Low-emissivity coated glass to reduce solar heat gain

- **Obscure glass** generally describes rolled glass with a pattern embedded into its surface. Patterns can vary, and are typically used as a form of decoration or for added privacy in bathrooms. (See Section 7.4.2)
- **Tinted glass** has colouring additives included during manufacture. It is available in various colours, usually bronze, grey, blue and green. The different colours provide different SHGCs. The tinting does not change the U value of the glass as glass conductivity is unaffected by the presence of a pigment in the glass.
- **Insulated glass units (IGUs)**, also known as double- or triple-glazed products, are the combination of two or three glazing panes sealed with a gap between the panes (Figure 7-3). The performance of IGUs depends on the properties of each pane of glass, the width of the cavity, the seal type and the gas (air or argon) in the cavities between the glass layers. IGU cavities may be filled with air or an inert, low-conductivity gas such as argon or krypton. IGUs with argon-filled air gaps give the best performance as argon is a denser gas and reduces the heat loss by slowing down convection of air inside the air gap. Cavity thickness usually ranges from 6 mm to 18 mm. Wider cavities provide lower (better) U values, with 12 mm normally accepted as the preferred gap. Triple-glazed units have a better U value than double-glazed units because of the extra air gap and layer of glass, however they generally tend to have lower SHGC values.

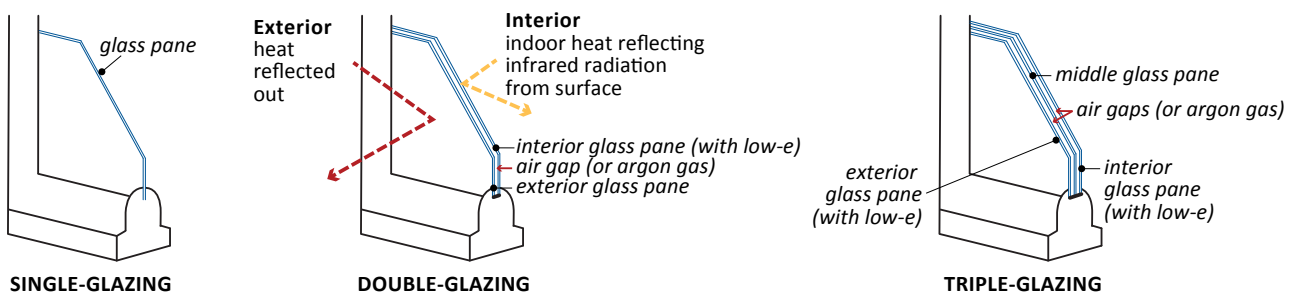


Figure 7-3 Comparison of composition between single, double and triple glazing

7.2.2 Frame material

After glazing, the frame material has the greatest effect on the thermal performance of windows. For example, aluminium frames are more conductive than timber frames and will transfer cold or heat from the outside of the frame to the inside of the room. This will be reflected in their U value. Frame materials options in NatHERS and WERS are generally divided into five main categories:

- **Aluminium frames** are light, strong and durable, with a variety of powdercoated and anodised finishes. However, aluminium is a good conductor of heat or cold and can decrease the insulating value of a glazing unit. Aluminium frames, especially dark coloured ones in full sun, absorb a lot of solar heat and conduct it inside, while during cold weather they can conduct the cold inside and cause condensation. Aluminium window and door frames can decrease the insulation value of the glazing unit.
- **Thermally broken aluminium frames** are light, strong and durable, with a variety of powdercoated and anodised finishes. They have a thermal break to separate the exterior and interior pieces of the frame, using a low-conductivity component (typically urethane or other low-conductivity polymer). This reduces the heat or cold from being conducted through the frame.
- **Timber frames** are a good natural insulator, but they require larger tolerances in openings to allow for the natural expansion and contraction of the timber. This can result in gaps that allow air infiltration, unless good draught sealing (weather stripping) is installed. They also require regular maintenance to ensure their durability, and the timber species must have naturally high durability or be treated to prevent decay and deformation.
- **uPVC (unplasticised polyvinyl chloride) frames** are light, durable, low maintenance and becoming increasingly popular in Australia. Their insulating properties are similar to timber, and they can be moulded into complex profiles that provide excellent air seals. Unlike aluminium, uPVC is non-conductive, meaning its use in window frames does not transfer heat, and is available in a range of opening types including tilt and turn. The colour range is more limited than powdercoated aluminium.
- **Fibreglass frames** are not readily available in Australia at present, but are common overseas. They are made of glass-fibre-reinforced polyester or other fibreglass composites, which gives them strength, durability and a low U value. Some fibreglass frames have hollow cavities within the frame that can be filled with insulation for higher thermal performance compared with timber or uPVC.
- **Composite frames** are manufactured using two or more different frame materials. For example, these frames could use thin aluminium profiles on the outer sections with a timber inner section. These can combine the low maintenance and durability of aluminium with improved thermal performance.

7.2.3 Operating type

Windows and doors come in a wide range of operating types, styles and configurations that affect the thermal performance of a dwelling in several ways. For example, different styles provide different opening areas, which determine how much cross-ventilation can be gained.

Window and door information needs to be obtained before modelling a dwelling. If the documentation only includes window/door sizes and locations, and the glass and frame type and/or opening style are not specified, a NatHERS Certificate should not be finalised. (**Tech Note clause 2.1**). This information is required for modelling either default or custom windows. See Section 7.3.1 and Figure 7-4 for more information on the standard default window operating type classifications.

7.3 Window libraries

7.3.1 Default windows

7a Windows or glazed doors must be modelled as from either the NatHERS default window library, or the NatHERS custom windows library.

In NatHERS software tools, assessors must model windows and glazed doors using either:

- The Australian Fenestration Rating Council (AFRC) custom window codes corresponding to the windows specified on the design documentation; or
- default windows. (**Tech Note clause 8.2**)

Windows from the NatHERS default window library are used when the window manufacturer or supplier is not detailed in the documentation. Default windows can also be used if the window manufacturer or supplier has been specified in the documentation, but the specific window required is not in the range of windows available in the custom window library. However, in this situation, it may be more accurate for the assessor to choose to use an appropriate custom window substitution. (**Tech Note clause 8.3**) (See Section 7.3.2)

Default windows database

There are currently 136 default windows available in NatHERS software, comprising 6 frame types and 12 glazing types. These default windows were originally developed by analysing more than 10 000 custom windows from the Australian Fenestration Rating Council (AFRC) database of frame types, glazing combinations and operating type. Therefore, the default window performance values do not represent actual windows on the market but are only a statistical representation of products available.

Default window groups and operating types

The default windows are divided into two groups based on their operating type (see Section 7.2.3), predominantly to account for the effect this has on the frame fraction of the window/door. Frame fraction refers to the ratio of frame to glass in a fenestration product. Having two groups of windows accommodates the large variations in frame fractions across the products that were derived from the statistical analysis.

Group A and B type windows are the NatHERS terminology used to define which default window should be selected for a specific openable sash. A- and B-type default windows do not necessarily align with window IDs in NatHERS software tools, and have no association or significance to AFRC ratings or window manufacturers.

- A** **Group A**—windows and doors with a larger frame fraction, such as awning windows, bifold windows and doors, casement windows, tilt'n'turn windows, entry doors, french doors and hinged doors.
- B** **Group B**—windows and doors with a smaller frame fraction, such as fixed windows, double-hung windows, louvre windows, sliding windows and doors, and stacker doors.

Figure 7-4 provides a visual representation of these windows and their corresponding window group types.

Each group has representative performance values (U value and SHGC), each with a U value derived at the 75th percentile of the sample of rated windows and doors that were analysed. The SHGC values are the adjusted median from the same sample of rated windows and doors; 50% have a SHGC value less than the default value and 50% have a value greater than the default value.

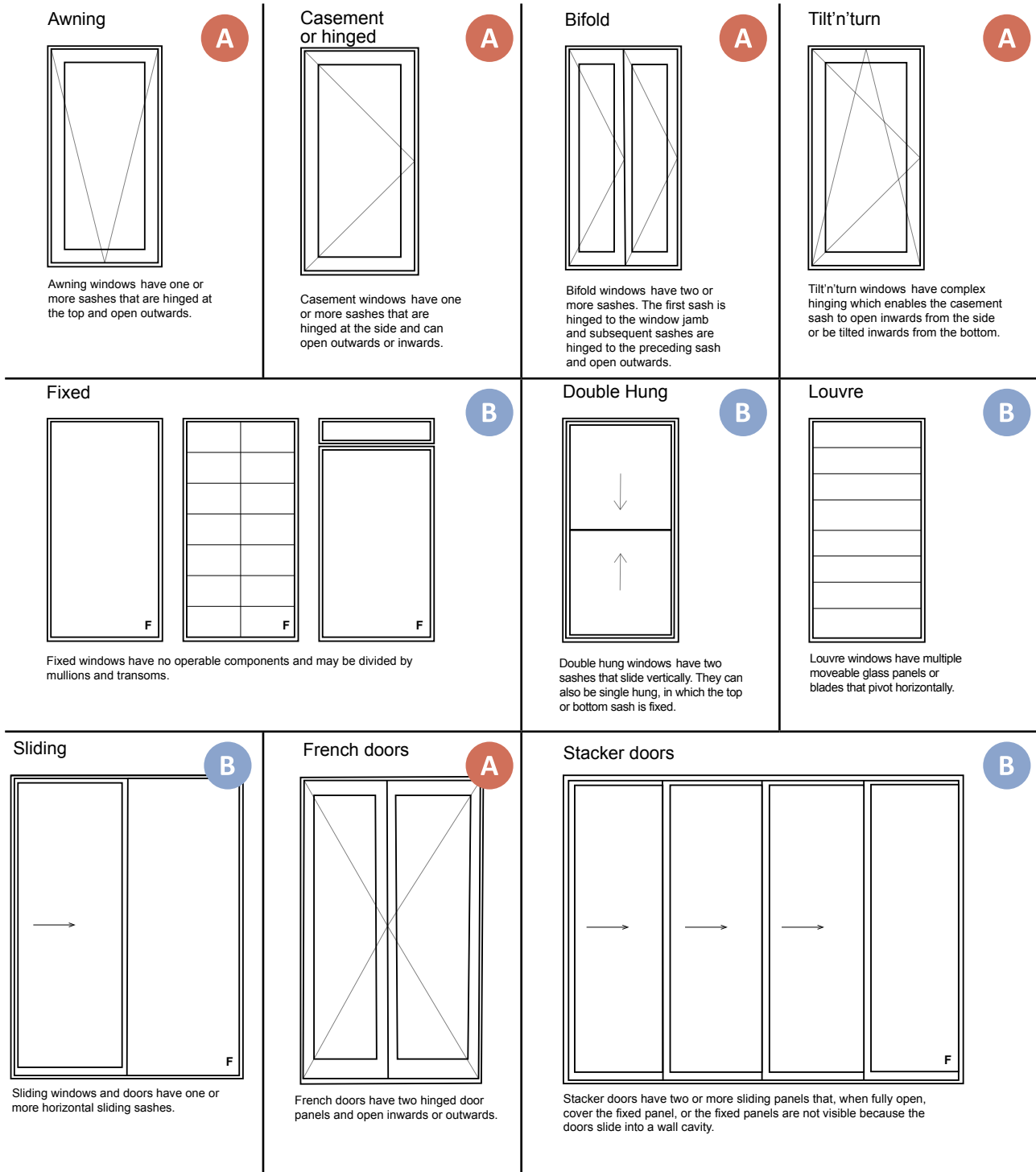


Figure 7-4 NatHERS default window and glazed door operating types

Default window codes

Default window codes are built in to NatHERS software. These codes are for modelling in NatHERS software and cannot be used to order windows. Each default window has a code consisting of three letters, five digits and an additional letter:

ALM-001-01 A

Material Glass
Group, Glazing Type, Air Gap

The first three letters of the window code represent the frame material of the default window:

- ALM—aluminium
- ATB—aluminium thermally broken
- TIM—timber
- uPVC—unplasticised polyvinyl chloride
- CMP—composite (these can be aluminium and timber, uPVC and timber, or uPVC and aluminium)
- FIB—fibreglass.

See Section 7.2.2 for more information on each frame type.

The first three numerals of the window code represent the group the default window is assigned to, the type of glazing (single or double glazing) and the type of air gap (air or argon):

- 001—Group A single glazing
- 002—Group B single glazing
- 003—Group A double glazing with air fill
- 004—Group B double glazing with air fill
- 005—Group A double glazing with argon fill
- 006—Group B double glazing with argon fill.

The last two numerals indicate the coating of the glass:

- 01—clear
- 02—tint
- 03—high solar gain low-e (HSG low-e)
- 04—low solar gain low-e (LSG low-e).

See Section 7.2.1 for more information on each glazing type.

In NatHERS software, HSG and LSG refer to high and low SHGC.

The last letter is used by the Chenath engine when the rating of the frame material is calculated in the rating simulation process:

- A—aluminium frame with no thermal break
- B—aluminium frame with thermal break
- I—composite frame
- W—uPVC, timber or fibreglass frame.

For example, a window with an aluminium frame and Group A single clear glazing would have a code of ALM-001-01-A, and a timber awning window with double glazing and argon fill with HSG low-e would have a code of TIM-005-03-W. A full list of the current default windows is in Table 7-2 in Section 7.7.

7.3.2 Custom windows

Custom windows from the NatHERS custom window library are used when (**Tech Note clause 8.2 and 8.3**):

- the window manufacturer or supplier and actual window specifications are included in the window schedule and/or documentation
- there is a request from the client for a particular window manufacturer or supplier, and actual window specifications and updated documentation to specify this has been received
- the assessor recommends window values or characteristics (e.g. U and SHGC values) to demonstrate an improvement in the thermal performance of the dwelling. In this case, the client must agree to the change and provide revised documentation to include these details before the assessor produces the NatHERS Certificate.

Custom windows database

Custom windows are manufactured window products available on the Australian market that have been tested and approved using NFRC protocols, and are (or were) listed on WERS database. Each custom window is a unique product, which includes the performance values for the frame material, the operating type and the glazing.

Assessors should note not all windows/doors available on the market in Australia are included in the NatHERS custom window library. Additionally, assessors may notice that the manufacturer’s full range of products is not listed in the custom window library. See ‘Custom windows substitution’ for more information on modelling requirements in these situations.

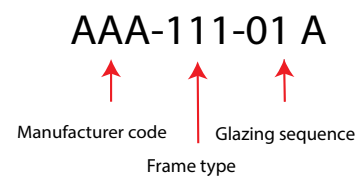
The custom window performance data is available in the AFRC database file used in NatHERS software. Custom windows are also listed on the Window Energy Rating Scheme (WERS) database. The main difference between the AFRC and WERS databases is that the AFRC database is formatted for use in NatHERS software and the WERS database is consumer based and formatted for online viewing. Refer to your relevant NatHERS software manual and windows training documents for more information on how to model custom windows.

Note: Although efforts are being taken to ensure alignment between the AFRC and WERS databases, there may be times where specific windows are in the online WERS database but not yet available in the AFRC database used in NatHERS software.

Custom window codes

Each AFRC-rated product in the custom window library consists of a nine-letter alpha-numerical code. These codes are for the software to read and cannot be used to order windows, in the WERS database or anywhere outside NatHERS software. Each code is unique to the frame, operating type and glazing:

- the first three letters represent the manufacturer’s three-letter abbreviated name
- the first three numerals represent the frame type
- the last two numerals represent the glazing type
- the last letter represents the frame material code within the software, and must not be used as a stand-alone selection tool.



Custom windows substitution

A new requirement outlined in the NatHERS Technical Note (version June 2019) allows assessors to substitute custom windows. This interim rule, is one of a number of enhancements to improve modelling of windows in NatHERS software, while the NatHERS Administrator continues to actively work with Australian Glass and Window Association (AGWA), AFRC and NatHERS software tool providers to ensure the best outcome is achieved.

Assessors can apply this when the window specified is not available in the NatHERS custom window library. This can also cover substitution at the building certifier stage, when a window installed is different (but within the outlined parameters) from the one used in the assessment.

7b If the glazing supplier/manufacturer is unknown, or the specified custom window is not available in the NatHERS custom window library, assessors must model (**Tech Note clause 8.3**):

- a default window with the specified opening type; or
- an available custom window that meets all of the following parameters:
 - identical opening type (e.g. fixed, awning, casement, sliding) to the window specified on the documentation; and
 - a total window system U-value equal to, or greater than, the window specified on the documentation (e.g. if the U-value of the specified custom window is 0.2, the modelled window selected could be 0.25); and
 - a total window system Solar Heat Gain Coefficient (SHGC) +/-5% of the window specified on the documentation.

This allows flexibility to model a different custom window to that specified if these specific parameters are met (i.e. same opening type, a U-value equal to or greater than, and an SHGC +/-5%). During construction, certifiers will be checking the custom window type, size and details (i.e. SHGC, U-value) to confirm compliance.

Updates to the custom windows database

The AFRC has committed to regularly updating the NatHERS custom window library files with new products in collaboration with NatHERS software providers. The timing of updated versions of the window library files for each software tool is as agreed between the NatHERS administrator and the software tool developer. For more information about the updates schedule, please contact the relevant software tool provider.

7.4 Entering windows into software

To enter windows and glazed doors into NatHERS software, details about their glass type, frame material, operating type, openable percentage, size and location need to be noted in the documentation. This information is required for modelling either default or custom windows. Assessors will also need to select each window from either the default or custom window library (see Section 7.3).

7c The minimum design documentation required when modelling windows and glazed doors should comprise window, skylight, roof window and door details, including size, glass type, frame type, openable percentage, opening style and location. (**Tech Note clause 2.1**)

If any of these basic window/door details are not specified, the documentation must be referred to the client for clarification. The documentation must be updated to include the necessary information before the NatHERS assessment is completed. (**Tech Note clauses 3.1 and 3.4**)

Assessors should note that the methods of modelling default windows in NatHERS software tools, are for the purposes of NatHERS simulation and assessment only, and not representative of specific window products.

7.4.1 Size

Given window/door specifications may have a significant effect on a dwelling's thermal performance and are available in a large range of sizes, it is essential that the correct sizes are entered. It is therefore essential for assessors to check that the sizes of each window/door are included in the documentation before commencing a NatHERS assessment. The size modelled must be the overall window size including the frame (e.g. not just the dimensions of the opening component or glazing area). This information is required to be modelled regardless of whether default or custom windows are used.

7.4.2 Glass and frame types

Specific window information is required to be documented when assigning a default window. The information needed is the glazing type (single or double glazed), the gas (air or argon) in the gap between glass panes, the coating of glass (clear, tint, LSG low-e or HSG low-e) and the specified frame type, which consists of the material of the frame (aluminium, timber, uPVC, composite) and whether the frame is thermally broken. This information is always required; however, these window/door details can be included in the documentation as general values (for use with NatHERS default windows) or can be specific manufacturer window specifications (for use with NatHERS custom windows). If the information is unknown, assessors must request updated documentation, including these specifications, before starting an assessment. **(Tech Note clause 3.4)**

Obscured glass (frosted, fritted, film) is classified as a complex glazing system, which is not yet approved internationally through the National Fenestration Rating Council (NFRC). Therefore, the Australian Fenestration Rating Council (AFRC) cannot obtain WERS ratings for these types of products at the moment. The custom window library is managed and provided to NatHERS software by the AFRC and is based on WERS ratings, these systems are not in the current window library.

When using default windows, it is therefore best to select the appropriate default ‘clear’ window option. This is because the performance values of clear glass better align with standard obscure glass properties than with the other options, such as the tinted glazing, available in the default window library.

7d When using default windows, clear glass must be used in lieu of obscure glass. **(Tech Note clause 8.4)**

7e When using custom windows, assessors can model obscure glass either as a default clear window, or a clear window from the same range of custom windows that are being used in the assessment. **(Tech Note clause 8.5)**

Similarly with custom windows, assessors may model a default clear, but also have the option to model a clear window from the same range of custom windows that are being used (i.e. the same supplier, same frame type and frame material).

Complex glazing systems may be approved internationally through the NFRC and subsequently the AFRC in the future, allowing products such as obscure glass to be better incorporated into the NatHERS software and the energy assessment.

7.4.3 Location and offset

Assessors must ensure that the location of windows/doors is modelled to align with the documentation by accurately entering the locations and head heights shown on the floor plan(s), window/door schedule, specifications and elevations into the NatHERS software.

Offset refers to the positioning or dimension in the documentation that outlines where the window/door is located along a wall. For example, the window may be 250 mm from the end of the wall or external dwelling corner. Refer to the relevant software tool manual for more information on correctly modelling windows/doors. This information is always required, and is not affected by whether the assessor is using default or custom windows.

7.4.4 Opening style and openability

Opening style refers to the type of opening of the window/door (e.g. awning, casement, sliding) and is required for both default and custom windows. Openability (or opening percentage) refers to the percentage of the area of the window that can open—not how far the window can open for the user—and relates to ‘ventilation’ rates in the NatHERS simulation. Table 7-1 lists the typical opening percentages used in NatHERS software, which are applicable to both default and custom windows.

Even if a window can open fully, the opening percentage will not be 100% as the frame that remains when the window is open prevents the full size of the window from creating an area of available ventilation.

7f When using default windows, assessors must apply the provisional openable percentages listed in Table 7-1. **(Tech Note clause 8.7)**

When modelling custom windows, manufacturer’s ventilation charts must be used to calculate window/door openability. Manufacturer’s ventilation data may give an opening percentage of total window size, but more commonly they will give square metres of total window size and total openable area. This can then be used to determine the available ventilation percentage.

7g When using custom windows, assessors must use the manufacturer’s ventilation charts to determine the openability of the window/door. If this information is not available, apply the provisional percentages listed in Table 7-1. (**Tech Note clause 8.6**)

Table 7-1 lists the provisional window/door opening percentages that assessors must use when using default windows in assessments or if the opening percentage for custom windows cannot be determined from the manufacturer’s ventilation charts. These percentages equate to openability and frame fraction considerations that relate to ventilation in Chenath engine simulations.

Table 7-1 Provisional window opening percentages (Table 5 of NatHERS Technical Note)

Type	Single-pane window	Double-pane window (half fixed, half openable)
Awning	90%	45%
Casement / tilt’n’turn	90%	45%
Double-hung	45%	22%
Louvre	90%	45%
Sliding	N/A	45%
All window types shown with safely restrictors (Tech Note clause 8.9)	10%	10%

For more complex configurations or if the window comprises varying window types and opening styles, and therefore fall outside the parameters of Table 7-1, assessors must use judgment in calculating and applying opening percentages. (**Tech Note clause 8.8**)

Table 7-1 also includes treatment of window types that may affect ventilation assumptions in NatHERS software tool simulations. Assessors must adjust opening percentages to windows with restricted opening percentages to windows with restricted opening safety requirements and no complying security screen. If the restricted opening percentage is not specified in the design documentation, assessors must use the provisional opening percentage of 10% for all window types. (**Tech Note clause 8.9**)

Section 7.4.5 gives examples of how to manually calculate the openability of complex window configurations or when combining similar windows for modelling. For more information on modelling complex opening configurations, assessors can seek guidance from their relevant software provider, Assessor Accrediting Organisation or AFRC windows training material.

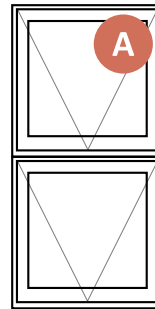
7.4.5 Combining default windows

The preferred method to accurately model the impact of windows in NatHERS software is to enter each window component separately; however, since this is not always practical, a window with multiple glazing components can be entered as one window if certain parameters are met. When a window configuration consists entirely of Group A or Group B elements, it can be entered as a single window.

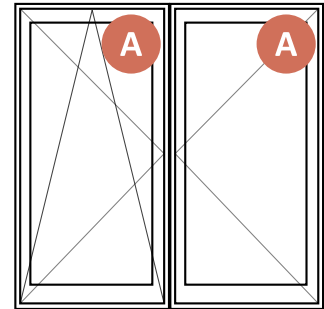
If assessors choose to model one window because all components consist entirely of Group A or B elements, similar to the examples (right), care must be taken to accurately calculate the window openability.

The examples (right) would be modelled with a 90% openability as approximately 90% of the window area can be opened. Window 01 is two awning windows, and window 02 is a tilt'n'turn window and a casement-glazed door.

A window configuration that includes Group A and B components can also be entered as a single window, using data for the window group that makes up the larger area of the window.



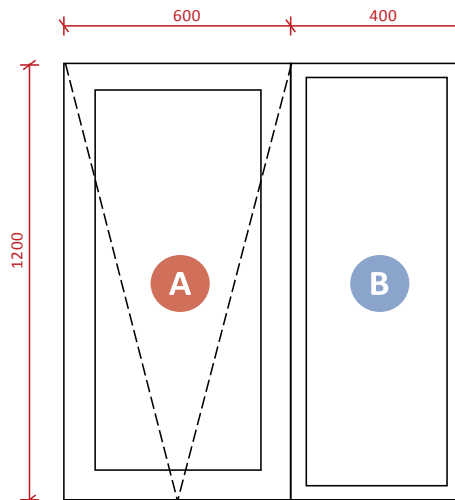
WINDOW 01



WINDOW 02

For example, the window below could be modelled as a single Group A window because the awning component (Group A) is larger than the fixed component (Group B).

Should an assessor decide to do this, the openability of the single modelled window would be calculated as follows:



$$\text{awning window area} = 0.6 \times 1.2 = 0.72 \text{ m}^2$$

$$\text{provisional opening percentage of awning window} = 90\% (0.9) \text{ (see Table 7-1)}$$

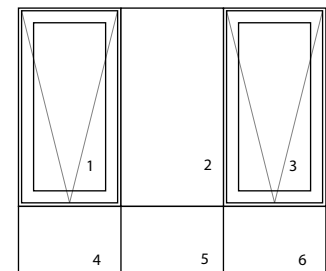
$$\text{openability} = (0.72 \times 0.9) \times 100 = 64.8\%$$

The window could be modelled as a 1.0 × 1.2 Group A window with 65% openability.

7.4.6 Combining complex default windows

When assessors are faced with complex window combinations, it may not always be practical to enter each window pane separately and it may be appropriate to split the window into groups of individual components. In some circumstances assessors may also choose to model complex window combinations as one window, and adjust characteristics appropriately (e.g. opening percentage).

It is important for assessors to note that these methods of either splitting or combining default windows in NatHERS software tools are for NatHERS modelling purposes only. They are not to be used for ordering windows, nor are they representative of compliance with the NCC, or realistic window construction/ installation methods.



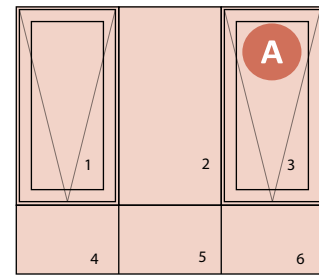
Assessors should ensure the actual location of each window component in the parent wall is accurate, and each component has a correct head height, and vertical and horizontal offsets within the wall. This will ensure factors such as vertical and horizontal shading and air flow are correctly applied.

A window with multiple glazing components can also be entered as one window in situations such as described below.

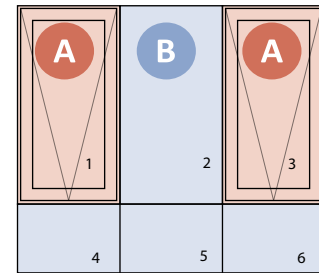
For example, in a complex transom window configuration that includes both Group A and Group B components (below), different elements could be combined to avoid modelling all six components as separate windows.

Options for calculating the size and openability to provide accurate modelling, using the principles used in Section 7.4.4 to model the window elements, are as follows:

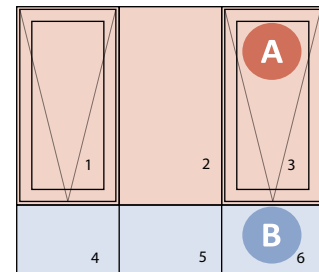
Model the entire window as a Group A element and calculate appropriate openability as the total area of the two awning components.



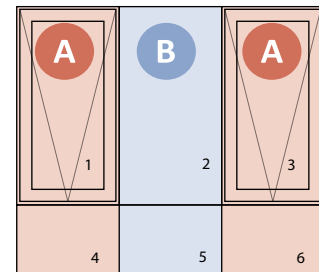
Combine the Group A and Group B elements. Model 1 and 3 as two Group A windows, 2 as a Group B window, and combine 3, 5 and 6 and model as a Group B window.



Split the window horizontally and model as Group A and Group B elements. Combine 1, 2 and 3 and model as a Group A window and calculate appropriate openability as the total area of the three components. Combine 4, 5 and 6 and model as a Group B window.



Split the window vertically and model as combined Group A and Group B elements. Combine 1 and 4 as a Group A window and calculate appropriate openability of the combined window components. Combine 3 and 6 as a Group A window in the same way, and combine 2 and 5 as a Group B window.



When modelling a window with multiple glazing that includes both Group A and Group B components, it is good practice for assessors to identify the individual elements when naming the windows entered into NatHERS software. For example, if an assessor is splitting a window identified as W01 in the documentation, components may be identified as W01a and W01b. These window IDs will appear on the NatHERS Certificate and help certifiers, the client, other consultants and any other stakeholders to align the dwelling with the data used in the NatHERS assessment. Splitting or combining windows is to be used for correctly modelling window characteristics in the software for NatHERS modelling purposes only. The NatHERS assessment and modelling information should not be used for ordering windows from a manufacturer, or to accurately represent products available on the market.

7.5 Doors

In NatHERS software simulations, doors and windows allow for air movement and are assumed to be opened and closed, as appropriate, to allow the dwelling to be naturally ventilated before the Chenath engine calculations determine the energy load required for mechanical heating/cooling.

7.5.1 Non glazed doors

It is important that all doors in a dwelling are modelled accurately, including their size and location, because they contribute to both air movement and zoning of the dwelling. Where the door is solid with no glazing elements, there are options in NatHERS software to enter internal and external solid doors where specified in the documentation. Refer to the relevant software tool manual for more information.

7.5.2 Glazed doors

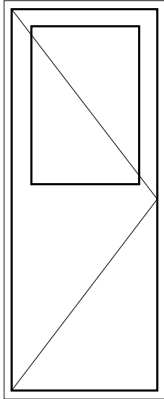
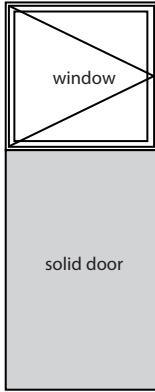
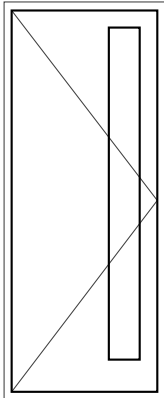
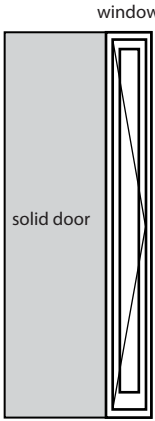
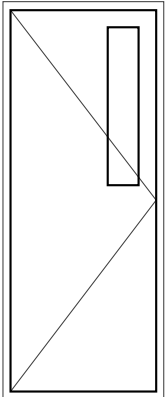

Doors that include glazing elements should be accurately captured in the assessment. If modelling a fully glazed hinged or pivot door, the appropriate door should be selected from either the default or custom window library. If the custom window manufacturer has a glazed hinged door, assessors must use that custom window product code. Otherwise, it is entered as a Group A casement window with the appropriate default window code for the frame type and glazing.

If the documentation includes an internal glazed door, it is to be modelled as a solid internal door in NatHERS software. This is because the Chenath engine does not currently treat these as a glazing component (or glass wall), and solar transmission is not taken into account or applied.

7h The glazed portion of a fully or partially glazed doors is modelled as a window in NatHERS software tools. If the glazed component is less than 25% of the door, the door may be modelled as a solid door. (**Tech Note clause 8.1**)

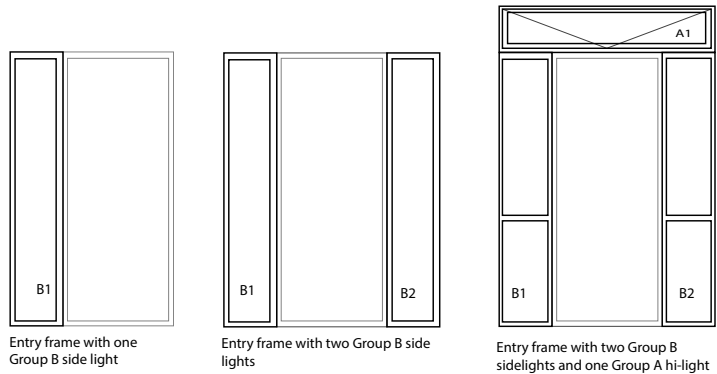
For partially glazed entry doors, assessors should model the glazing effect when the glazed component equates to 25% or more of the door. When modelling these types of doors, a suggested method is to enter a solid door (adjusting the door height/width to not include the glazing component) and then model the glazing component as a separate window. The combined door and glazing size should align with the door size detailed in the documentation, and the glazing component is to be modelled as a Group A casement window to ensure the openability is similar to that of the parent door. If the glazed component is modelled as a fixed window, the Chenath engine will not treat the entire door as being able to open to provide ventilation.

Examples of how to model partially glazed entry door in NatHERS software are as follows:

	<p>This is a half-light door. The glazing is entered as a Group A casement window, and the rest of the door is entered as a solid door with the appropriate horizontal and vertical positioning of the glazing and solid door components.</p> <p>The size of the door is reduced by the total calculated glass size, and the glazing is modelled separately.</p> <p>It is appropriate for the casement window component modelled, to have the same opening percentage to align with the assumptions of an openable door (i.e. 100%). Noting this is only to be edited when modelling a partially glazed door component, and is not appropriate when modelling a window that is located next to the door.</p>	
	<p>This is a partially glazed door. Since the glazing component equates to greater than 25% of the door size, the door should be modelled as two individual components: a solid door with decreased width and a Group A casement window.</p> <p>The size of the door is reduced by the total calculated glass size, and the glazing is modelled separately.</p> <p>It is appropriate for the casement window component to be modelled, to have the same opening percentage to align with the assumptions of an openable door (i.e. 100%). Noting this is only to be edited when modelling a partially glazed door component, and is not appropriate when modelling a window that is located next to the door.</p>	
	<p>In this partially glazed door the glazing component is less than 25% of the overall door size; therefore, it can be modelled as a solid door. (Tech Note clause 8.1.1)</p>	

7.5.3 Glazing around doors

Openable or fixed glazing components to either side or above an entry door frame (sidelights) are entered as separate Group B default fixed windows or as custom windows. It is important to locate each glazing component in the parent wall with the applicable vertical and horizontal positioning/offset within the wall. See examples (right) of glazing treatment for entry door sidelights.



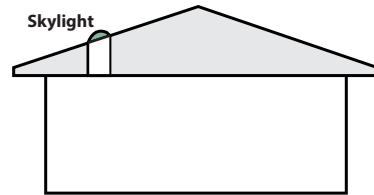
7.6 Roof and high-level glazing

NatHERS software allows assessors to enter details about glazed areas in the roof and at higher levels in the walls.

Four types of glazed areas are available for roofs and at high levels:

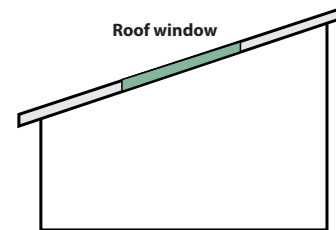
skylights—a glazed or perspex element, either fixed or openable, penetrating the roof construction and connected to a zone by a shaft that passes through the roof/attic space. Some skylights may be tubular or domed, with reflective shafts.

This definition is specific to NatHERS modelling and may differ from a broader definition of skylight characteristics and products available on the market.

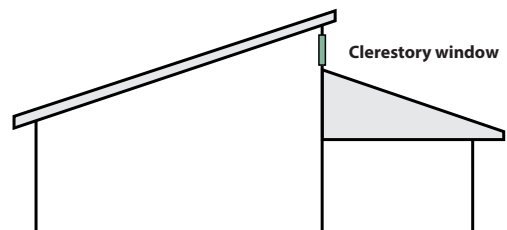


roof windows—a glazed element in a roof that does not have a roof/attic space; it is either fixed or openable, and penetrates the roof construction. Roof windows are generally pitched in alignment with the roof.

This definition is specific to NatHERS modelling and may differ from a broader definition of roof window characteristics and products available on the market.



clerestory windows—a high window, either fixed or openable, in an external vertical wall to a zone. The external wall that contains the clerestory window and the window must both be modelled. They are typically fixed, but may be openable to create cross-ventilation within the dwelling.



highlight windows—a glazed element located high in a wall, typically above another window or door in the same wall (see Section 7.5.3). A highlight window is entered as a window, not as roof-level glazing. This type of glazing must always be entered into the NatHERS software, as it can contribute significantly to the amount of solar radiation entering the dwelling and create a path for heat to flow in and out of the dwelling.

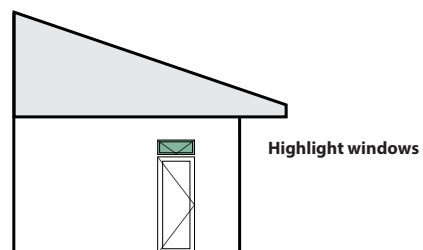


Figure 7-5 defines roof glazing terminology that may be required when inputting data into NatHERS software to model skylights or roof windows. Depending on your software tool, additional information and modelling may be required for complex scenarios. For example, a roof window modelled into an attic space, may require assessors to add internal walls to the rood space for the shaft. Please refer to your software tool manual or contact your Assessor Accrediting Organisation for guidance.

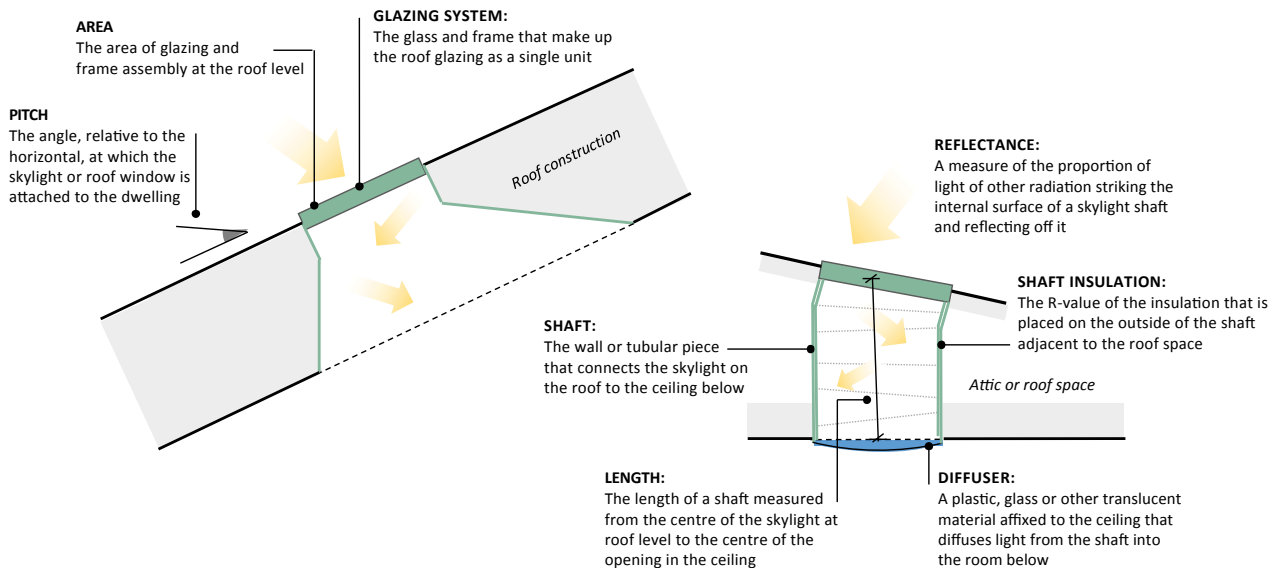


Figure 7-5 Roof glazing terminology

The relevant U value and SHGC are determined by NatHERS software based on the selection of the roof glazing system. Both default and custom window selections will apply U and SHGC values to the NatHERS simulation as appropriate. It is important to note that in NatHERS software tools, default/generic window types must be used for all roof glazing unless when there is a custom windows available for the skylight or roof window product specified.

Depending on your software tool and the documentation of the skylight or roof window, assessors may not be able to edit all characteristics. However, it is worth noting that assessors may want to advise clients (and recommend changes to documentation) to ensure skylight shafts are adequately insulated and that performance glazing is used, to minimise heat loss in winter and heat gain in summer.

Depending on the NatHERS software tool, clerestory windows can be entered using a special feature or by creating additional walls with suitable height and width, and adding windows to those walls. Depending on the software, there may also be restrictions on the inclusion of roof windows. Refer to the software tool manual for more information on modelling roof windows and to determine if any restrictions apply.

7.6.1 Double-height windows

When a highlight window crosses storeys of a dwelling, such as in a stairwell or double-void area, to ensure accuracy the entire area of the window must be modelled. Two windows with the same specifications or window code should be created, one on each of the two levels that it crosses. Depending on the software tool, assessors may or may not have to include the internal floor thickness in the modelled height of the window. This means the head height of the window on the upper level may be higher than drawn on the plans by an amount equal to the specified floor thickness.

Refer to the relevant software tool manual or windows training for modelling guidance.

7.7 List of current default window specifications

Table 7-2 lists frame, operating and glazing types, and window performance values for all current default windows in the NatHERS default window library. The default window library is used for both windows and glazed doors.

Table 7-2 Specifications of current default windows in NatHERS software

Type	Code ^a	Frame and operating type (Group A or B)		Glazing description	Uw	SHGCw	
Aluminium	Aluminium Group A single glazing	ALM-001-01 A	Aluminium A		Clear	6.7	0.57
		ALM-001-02 A	Aluminium A		Tint	6.6	0.41
		ALM-001-03 A	Aluminium A		HSG low-e	5.4	0.49
		ALM-001-04 A	Aluminium A		LSG low-e	5.6	0.36
	Aluminium Group B single glazing	ALM-002-01 A	Aluminium B		Clear	6.7	0.70
		ALM-002-02 A	Aluminium B		Tint	6.6	0.49
		ALM-002-03 A	Aluminium B		HSG low-e	5.4	0.58
		ALM-002-04 A	Aluminium B		LSG low-e	5.6	0.41
	Aluminium Group A double glazing air fill	ALM-003-01 A	Aluminium A	DG	Clear/air fill/clear	4.8	0.51
		ALM-003-02 A	Aluminium A	DG	Tint/air fill/clear	5.2	0.35
		ALM-003-03 A	Aluminium A	DG	HSG low-e/air fill/clear	4.3	0.47
		ALM-003-04 A	Aluminium A	DG	LSG low-e/air fill/clear	4.9	0.33
	Aluminium Group B double glazing air fill	ALM-004-01 A	Aluminium B	DG	Clear/air fill/clear	4.8	0.59
		ALM-004-02 A	Aluminium B	DG	Tint/air fill/clear	5.2	0.39
		ALM-004-03 A	Aluminium B	DG	HSG low-e/air fill/clear	4.3	0.53
		ALM-004-04 A	Aluminium B	DG	LSG low-e/air fill/clear	4.9	0.33
	Aluminium Group A double glazing argon fill	ALM-005-01 A	Aluminium A	DG	Clear/argon fill/clear	4.5	0.50
		ALM-005-02 A	Aluminium A	DG	Tint/argon fill/clear	5.1	0.32
		ALM-005-03 A	Aluminium A	DG	HSG low-e/argon fill/clear	4.1	0.47
		ALM-005-04 A	Aluminium A	DG	LSG low-e/argon fill/clear	4.8	0.34
	Aluminium Group B double glazing argon fill	ALM-006-01 A	Aluminium B	DG	Clear/argon fill/clear	4.5	0.61
		ALM-006-02 A	Aluminium B	DG	Tint/argon fill/clear	5.1	0.36
		ALM-006-03 A	Aluminium B	DG	HSG low-e/argon fill/clear	4.1	0.52
		ALM-006-04 A	Aluminium B	DG	LSG low-e/argon fill/clear	4.8	0.34
Aluminium thermally broken	Aluminium thermally broken Group A double glazing air fill	ATB-003-01 B	Aluminium TB A	DG	Clear/air fill/clear	3.6	0.47
		ATB-003-02 B	Aluminium TB A	DG	Tint/air fill/clear	3.6	0.23
		ATB-003-03 B	Aluminium TB A	DG	HSG low-e/air fill/clear	3.1	0.39
		ATB-003-04 B	Aluminium TB A	DG	LSG low-e/air fill/clear	3.1	0.27
	Aluminium thermally broken Group B double glazing air fill	ATB-004-01 B	Aluminium TB B	DG	Clear/air fill/clear	3.6	0.54
		ATB-004-02 B	Aluminium TB B	DG	Tint/air fill/clear	3.6	0.30
		ATB-004-03 B	Aluminium TB B	DG	HSG low-e/air fill/clear	3.1	0.49
		ATB-004-04 B	Aluminium TB B	DG	LSG low-e/air fill/clear	3.1	0.27

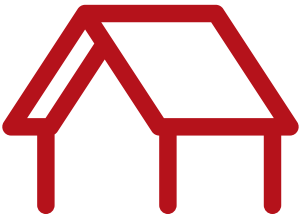
Type		Code ^a	Frame and operating type (Group A or B)		Glazing description	Uw	SHGC _w
Aluminium thermally broken	Aluminium thermally broken Group A double glazing argon fill	ATB-005-01 B	Aluminium TB A	DG	Clear/argon fill/clear	3.5	0.47
		ATB-005-02 B	Aluminium TB A	DG	Tint/argon fill/clear	3.4	0.32
		ATB-005-03 B	Aluminium TB A	DG	HSG low-e/argon fill/clear	2.9	0.44
		ATB-005-04 B	Aluminium TB A	DG	LSG low-e/argon fill/clear	3.0	0.27
	Aluminium thermally broken Group B double glazing argon fill	ATB-006-01 B	Aluminium TB B	DG	Clear/argon fill/clear	3.5	0.64
		ATB-006-02 B	Aluminium TB B	DG	Tint/argon fill/clear	3.4	0.40
		ATB-006-03 B	Aluminium TB B	DG	HSG low-e/argon fill/clear	2.9	0.51
		ATB-006-04 B	Aluminium TB B	DG	LSG low e/argon fill/clear	3.0	0.26
Composite	Composite Group A single glazing	CMP-001-01 I	Composite A		Clear	5.9	0.57
		CMP-001-02 I	Composite A		Tint	6.2	0.41
		CMP-001-03 I	Composite A		HSG low-e	4.6	0.36
		CMP-001-04 I	Composite A		LSG low-e	4.6	0.36
	Composite Group B single glazing	CMP-002-01 I	Composite B		Clear	5.9	0.65
		CMP-002-02 I	Composite B		Tint	6.2	0.45
		CMP-002-03 I	Composite B		HSG low-e	3.7	0.61
		CMP-002-04 I	Composite B		LSG low-e	4.6	0.46
	Composite Group A double glazing air fill	CMP-003-01 I	Composite A	DG	Clear/air fill/clear	3.9	0.51
		CMP-003-02 I	Composite A	DG	Tint/air fill/clear	3.9	0.32
		CMP-003-03 I	Composite A	DG	HSG low-e/air fill/clear	3.4	0.47
		CMP-003-04 I	Composite A	DG	LSG low-e/air fill/clear	3.4	0.32
	Composite Group B double glazing air fill	CMP-004-01 I	Composite B	DG	Clear/air fill/clear	3.9	0.59
		CMP-004-02 I	Composite B	DG	Tint/air fill/clear	3.9	0.37
		CMP-004-03 I	Composite B	DG	HSG low-e/air fill/clear	3.4	0.53
		CMP-004-04 I	Composite B	DG	LSG low-e/air fill/clear	3.4	0.33
	Composite Group A double glazing argon fill	CMP-005-01 I	Composite A	DG	Clear/argon fill/clear	3.9	0.50
		CMP-005-02 I	Composite A	DG	Tint/argon fill/clear	3.9	0.33
		CMP-005-03 I	Composite A	DG	HSG low-e/argon fill/clear	3.2	0.46
		CMP-005-04 I	Composite A	DG	LSG low-e/argon fill/clear	2.2	0.32
	Composite Group B double glazing argon fill	CMP-006-01 I	Composite B	DG	Clear/argon fill/clear	3.9	0.63
		CMP-006-02 I	Composite B	DG	Tint/argon fill/clear	3.9	0.40
		CMP-006-03 I	Composite B	DG	HSG low-e/argon fill/clear	3.2	0.49
		CMP-006-04 I	Composite B	DG	LSG low-e/argon fill/clear	2.2	0.39
Fibreglass	Fibreglass Group A single glazing	FIB-001-01 W	Fibreglass A		Clear	5.4	0.56
		FIB-001-02 W	Fibreglass A		Tint	5.4	0.41
		FIB-001-03 W	Fibreglass A		HSG low-e	4.3	0.42
		FIB-001-04 W	Fibreglass A		LSG low-e	3.7	0.35

Type		Code ^a	Frame and operating type (Group A or B)		Glazing description	Uw	SHGC _w
Fibreglass	Fibreglass Group B single glazing	FIW-002-01 W	Fibreglass B		Clear	5.4	0.63
		FIW-002-02 W	Fibreglass B		Tint	5.4	0.49
		FIW-002-03 W	Fibreglass B		HSG low-e	4.3	0.50
		FIW-002-04 W	Fibreglass B		LSG low-e	3.7	0.38
	Fibreglass Group A double glazing air fill	FIB-003-01 W	Fibreglass A	DG	Clear/air fill/clear	3.0	0.48
		FIB-003-02 W	Fibreglass A	DG	Tint/air fill/clear	2.9	0.33
		FIB-003-03 W	Fibreglass A	DG	HSG low-e/air fill/clear	2.3	0.26
		FIB-003-04 W	Fibreglass A	DG	LSG low-e/air fill/clear	2.3	0.19
	Fibreglass Group B double glazing air fill	FIB-004-01 W	Fibreglass B	DG	Clear/air fill/Clear	3.0	0.56
		FIB-004-02 W	Fibreglass B	DG	Tint/air fill/Clear	2.9	0.42
		FIB-004-03 W	Fibreglass B	DG	HSG low-e/air fill/clear	2.3	0.32
		FIB-004-04 W	Fibreglass B	DG	LSG low-e/air fill/clear	2.3	0.25
	Fibreglass Group A double glazing argon fill	FIB-005-01 W	Fibreglass A	DG	Clear/argon fill/clear	2.6	0.50
		FIB-005-02 W	Fibreglass A	DG	Tint/argon fill/clear	2.5	0.25
		FIB-005-03 W	Fibreglass A	DG	HSG low-e/argon fill/clear	2.0	0.25
		FIB-005-04 W	Fibreglass A	DG	LSG low-e/argon fill/clear	2.0	0.18
	Fibreglass Group B double glazing argon fill	FIW-006-01 W	Fibreglass B	DG	Clear/argon fill/clear	2.6	0.53
		FIW-006-02 W	Fibreglass B	DG	Tint/argon fill/clear	2.5	0.28
		FIW-006-03 W	Fibreglass B	DG	HSG low-e/argon fill/clear	2.0	0.31
		FIW-006-04 W	Fibreglass B	DG	LSG low-e/argon fill/clear	2.0	0.23
uPVC	uPVC Group A single glazing	PVC-001-01 W	uPVC A		Clear	5.4	0.56
		PVC-001-02 W	uPVC A		Tint	5.4	0.41
		PVC-001-03 W	uPVC A		HSG low-e	4.3	0.42
		PVC-001-04 W	uPVC A		LSG low-e	3.7	0.35
	uPVC Group B single glazing	PVC-002-01 W	uPVC B		Clear	5.4	0.63
		PVC-002-02 W	uPVC B		Tint	5.4	0.49
		PVC-002-03 W	uPVC B		HSG low-e	4.3	0.50
		PVC-002-04 W	uPVC B		LSG low-e	3.7	0.38
	uPVC Group A double glazing air fill	PVC-003-01 W	uPVC A	DG	Clear/air fill/clear	3.0	0.48
		PVC-003-02 W	uPVC A	DG	Tint/air fill/clear	2.9	0.33
		PVC-003-03 W	uPVC A	DG	HSG low-e/air fill/clear	2.3	0.26
		PVC-003-04 W	uPVC A	DG	LSG low-e/air fill/clear	2.3	0.19
	uPVC Group B double glazing air fill	PVC-004-01 W	uPVC B	DG	Clear/air fill/clear	3.0	0.56
		PVC-004-02 W	uPVC B	DG	Tint/air fill/clear	2.9	0.42
		PVC-004-03 W	uPVC B	DG	HSG low-e/air fill/clear	2.3	0.32
		PVC-004-04 W	uPVC B	DG	LSG low-e/air fill/clear	2.3	0.25

Type		Code ^a	Frame and operating type (Group A or B)		Glazing description	Uw	SHGCw
uPVC	uPVC Group A double glazing argon fill	PVC-005-01 W	uPVC A	DG	Clear/argon fill/clear	2.6	0.50
		PVC-005-02 W	uPVC A	DG	Tint/argon fill/clear	2.5	0.25
		PVC-005-03 W	uPVC A	DG	HSG low-e/argon fill/clear	2.0	0.25
		PVC-005-04 W	uPVC A	DG	LSG low-e/argon fill/clear	2.0	0.18
	uPVC Group B double glazing argon fill	PVC-006-01 W	uPVC B	DG	Clear/argon fill/clear	2.6	0.53
		PVC-006-02 W	uPVC B	DG	Tint/argon fill/clear	2.5	0.28
		PVC-006-03 W	uPVC B	DG	HSG low-e/argon fill/clear	2.0	0.31
		PVC-006-04 W	uPVC B	DG	LSG low-e/argon fill/clear	2.0	0.23
Timber	Timber Group A single glazing	TIM-001-01 W	Timber A		Clear	5.4	0.56
		TIM-001-02 W	Timber A		Tint	5.4	0.41
		TIM-001-03 W	Timber A		HSG low-e	4.3	0.42
		TIM-001-04 W	Timber A		LSG low-e	3.7	0.35
	Timber Group B single glazing	TIM-002-01 W	Timber B		Clear	5.4	0.63
		TIM-002-02 W	Timber B		Tint	5.4	0.49
		TIM-002-03 W	Timber B		HSG low-e	4.3	0.50
		TIM-002-04 W	Timber B		LSG low-e	3.7	0.38
	Timber Group A double glazing air fill	TIM-003-01 W	Timber A	DG	Clear/air fill/clear	3.0	0.48
		TIM-003-02 W	Timber A	DG	Tint/air fill/clear	2.9	0.33
		TIM-003-03 W	Timber A	DG	HSG low-e/air fill/clear	2.3	0.26
		TIM-003-04 W	Timber A	DG	LSG low-e/air fill/clear	2.3	0.19
	Timber Group B double glazing air fill	TIM-004-01 W	Timber B	DG	Clear/air fill/clear	3.0	0.56
		TIM-004-02 W	Timber B	DG	Tint/air fill/clear	2.9	0.42
		TIM-004-03 W	Timber B	DG	HSG low-e/air fill/clear	2.3	0.32
		TIM-004-04 W	Timber B	DG	LSG low-e/air fill/clear	2.3	0.25
	Timber Group A double glazing argon fill	TIM-005-01 W	Timber A	DG	Clear/argon fill/clear	2.6	0.50
		TIM-005-02 W	Timber A	DG	Tint/argon fill/clear	2.5	0.25
		TIM-005-03 W	Timber A	DG	HSG low-e/argon fill/clear	2.0	0.25
		TIM-005-04 W	Timber A	DG	LSG low-e/argon fill/clear	2.0	0.18
	Timber Group B double glazing argon fill	TIM-006-01 W	Timber B	DG	Clear/argon fill/clear	2.6	0.53
		TIM-006-02 W	Timber B	DG	Tint/argon fill/clear	2.5	0.28
		TIM-006-03 W	Timber B	DG	HSG low-e/argon fill/clear	2.0	0.31
		TIM-006-04 W	Timber B	DG	LSG low-e/argon fill/clear	2.0	0.23

DG = double glazed; HSG = high solar gain; low-e = low-emissivity; LSG = low solar gain; SHGCw = solar heat gain coefficient for total window system; Uw = U value for total window system

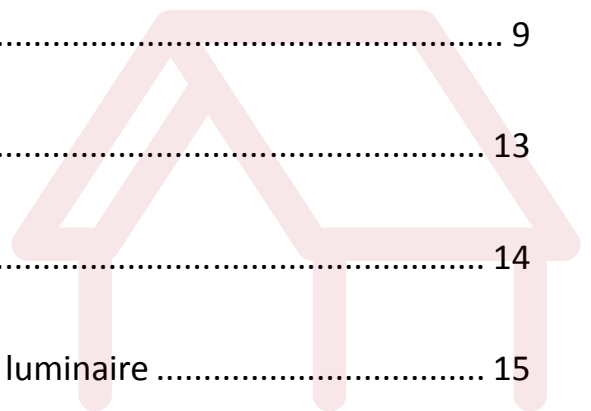
^a Refer to Section 7.3.1 for a description of the window codes.

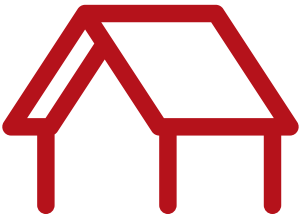


CEILING AND ROOFS

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CEILING AND ROOFS

This chapter looks at common roof and ceiling types found in dwellings, gives an overview of types of roof and ceiling insulation, and details the impact of ceiling penetrations. It also includes information about ceiling elements, roof coverings, and treatment of roof/attic spaces.

Summary of key requirements

This handbook is intended to be a helpful resource for all assessors. When conducting assessments, assessors must follow the requirements of the current NatHERS Technical Note and the relevant state or territory requirements.

- 8a** Ensure that roof volumes are modelled according to the documentation; consult your relevant software tool manual as necessary.
- 8b** If recommending changes to insulation, all documentation must be updated to reflect the changes before a NatHERS Certificate is produced.
- 8c** Roof colour or roof solar absorptance must be modelled as detailed in the documentation. Where this is not detailed, assessors must apply the worst-case scenario.
- 8d** Ceiling colour—where there is an option to nominate a ceiling colour in the software and the colour has not been specified, assessors must model the provisional ceiling colour as ‘medium’.
- 8e** If no electrical schedule or ceiling plan is available and the assessment is completed, it must clearly state on the NatHERS Certificate the dwelling has been modelled without recessed light fittings.
- 8f** All recessed light fittings, vents and exhaust fans must be modelled as ceiling penetrations.
- 8g** Unless otherwise stated by the manufacturer, assessors must include a minimum 50mm insulation clearance around ceiling penetrations.
- 8h** When recessed light fittings are specified in the documentation as insulated (or capable of being covered by insulation), model as ‘insulated’ or with no insulation clearance.
- 8i** Unless otherwise stated by the manufacturer, assessors must model ceiling penetrations as ‘unsealed’.
- 8j** Permanent static ventilation openings in the building fabric (e.g unflued gas heaters) are to be modelled as a wall or ceiling vent.
- 8k** Where a gas cooker is specified, model as a ‘sealed’ exhaust fan.
- 8l** Recessed light fittings must be modelled regardless of the adjoining zone (i.e. roof space, neighbour or second-storey floor).
- 8m** Recessed light fittings can be treated as ‘sealed’ where the documentation specifies that it is sealed to prevent movement of air between a zone and another zone, attic or roof space.
- 8n** Ceiling fans must only be modelled if they are included in the documentation. If the ceiling fan size is unknown, model fans as 900 mm diameter.

8.1 Roof types

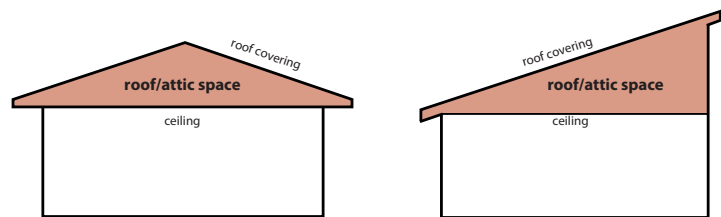
Many different types of roof construction are used in dwellings in Australia.

It can be helpful to understand the advantages and disadvantages that construction methods may have in different climates and locations, and for construction practices. More information about different construction systems is available on the Your Home website: www.yourhome.gov.au/materials/construction-systems.

In NatHERS software tools, roofs are referred to by how open they are. Roofs can be solid, or have attic spaces between the roof and ceiling. NatHERS software tools also have different types of roofs/ceilings available—some have the option to build roofs and ceilings using different elements, while others have a static list of options. Refer to the relevant software tool manual for more information about modelling roof/ceiling constructions.

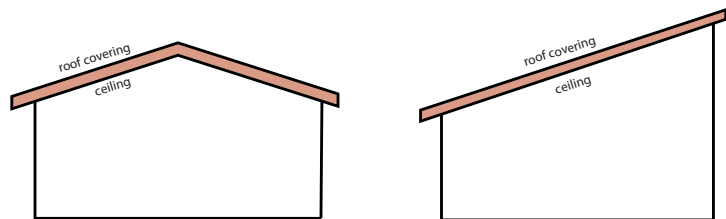
8.1.1 Roof/attic space

The typical roof/ceiling construction has a separate roof space or attic space, and may use roof trusses. The ceiling lining is generally horizontal (i.e. flat) or can be sloped/raked at a different angle to the roof pitch (but still creating a separate roof space). The roof/attic space needs the degree of ventilation to be nominated (see Section 8.3).



8.1.2 Raked/cathedral roof

Raked roofs/ceilings, also known as cathedral ceilings, typically have the ceiling lining parallel to the roof covering; there is no separate roof space. The roof/ceiling construction may be an insulated composite roof product (e.g. a solid product that includes ceiling lining, insulation and roof covering).



8.2 Ceiling types

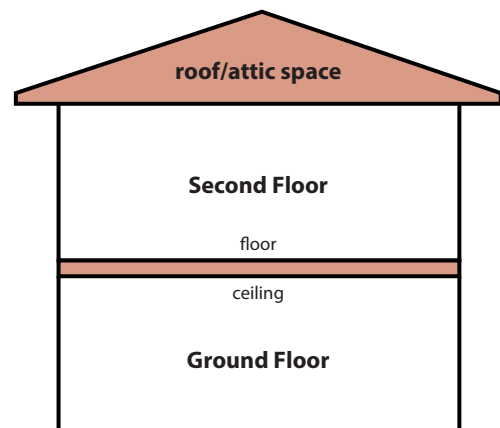
Ceilings are defined as the lower part of a roof, the lower part of the attic space, or the underside of the floor in a multi-level construction.

8.2.1 Multi-level dwellings

NatHERS software tools have two types of ceiling construction for multi-level dwellings.

Ceiling to multi-level dwelling

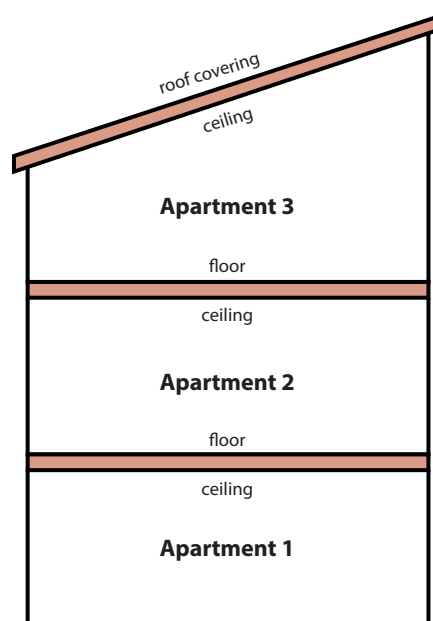
In multi-level dwellings, because the ceiling to the underside of the floor between levels does not have an attic space above, it is to be modelled differently to the ceiling of the upper floor. This is because when the assessor selects what is above each ceiling (i.e. either another floor or an attic/roof space), the software calculates different assumptions for these spaces, such as predicted heat transfer, and air movement of ventilation and infiltration.



Ceiling to neighbour above

In Class 2 dwellings, the ceiling to the underside of the floor between the modelled dwelling and the dwelling above is modelled as 'Neighbour' (or 'Another Apartment', depending on the software tool). The exception to this approach is the top or uppermost Class 2 dwelling in a building that would be appropriately treated as noted in Section 8.1. In the figure on the right, for example, apartments 1 and 2 would be modelled with ceilings to 'neighbour'; however, if apartment 3 is the top Class 2 apartment of the building, it would be modelled with a ceiling to attic/roof space.

Refer to the relevant software tool manual for more information on modelling ceilings.



8.2.2 Raked/cathedral (sloping) ceiling

In NatHERS software tools, when a raked or sloping ceiling is modelled, the ceiling area is greater than the floor area and must be increased to model it correctly. Depending on the software tool, the ceiling area may be calculated automatically once the slope of the ceiling is entered by the assessor. In some software tools this calculation needs to be done manually.

For a manual calculation, the plan area is multiplied by a factor for the relevant roof pitch (see Table 8-1 for area factors for typical roof pitches):

$$\text{ceiling area} = \text{plan area} \times \text{area factor.}$$

For example, for a 3 m × 3 m room with a 20 degree pitch ceiling, the ceiling area is 9.576 m²:

$$\begin{aligned} (3 \times 3) \times \text{area factor} &= 9 \times 1.064 \\ &= 9.576. \end{aligned}$$

Table 8-1 Area of sloping ceilings

Slope/pitch (degrees)	Area factor
05.0	1.004
10.0	1.015
15.0	1.035
17.5	1.049
20.0	1.064
22.5	1.082
25.0	1.103
30.0	1.155
35.0	1.221
40.0	1.305
45.0	1.414

For roof pitches not listed in Table 8-1, the ceiling area can be calculated by using the formula ceiling area = plan area / cosine (ceiling pitch).

For example, for a 3 m × 3 m room with a 12 degree pitch ceiling, the ceiling area is 9.20 m²:

$\cos(12^\circ) = 0.9781476$, so
 $(3 \times 3) / 0.9781476 = 9.20$.

8.3 Roof ventilation

The level of ventilation or openness to the roof space or attic significantly affects the thermal performance of a dwelling. The Chenath engine applies ventilation and air leakage assumptions in terms of air change rates, depending on the combination of roof material, ventilation options and if sarking is used as a continuous vapour barrier membrane.

NatHERS software tools treat roof ventilation in different ways, so the relevant software tool manual should be referenced for more information on roof ventilation.

Five ventilation types for a roof space or attic are used:

- **Discontinuous**—roof material covering a roof/attic space that allows ventilation through gaps in the covering (e.g. roof tile construction without sarking). Tiled roof construction for example, allows significant ventilation of the attic space through the gaps between the tiles.
- **Continuous**—a continuous roof material covering a roof (e.g. metal deck roofing or roof tile construction with sarking under the tiles). These roofs limit ventilation to the attic space and therefore have a lower air changes per hour assumption in the software.
- **Ventilated**—a roof/attic space with ventilators and eave vents. The attic spaces of these roofs are assumed more ventilated than the discontinuous type.
- **Highly Ventilated or Parasol**—a roof/attic space that is very well ventilated and considered not to be enclosed. For example, a roof that is completely shaded by a parasol like shade that still allows the roof to be exposed to outdoor air. These attic spaces have the highest air changes per hour assumption.

The following roof/ceiling types are listed in NatHERS software tools, but do not have a roof space or attic:

- **Flat framed**—flat roof or timber construction, also used for raked/cathedral (sloping) ceilings and skillion roofs.
- **Slab**—suspended slab, flat roof of concrete construction.
- **SlabExt**—suspended slab, flat roof of concrete construction with external insulation.
- **Unvented, no cavity**—roof and ceiling construction with a still air gap.
- **Neighbour/Another apartment**—ceilings adjacent to other dwellings that are not part of the dwelling being modelled.

8.4 Roof shape and volume

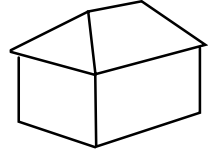
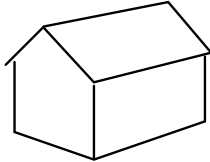
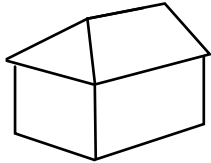
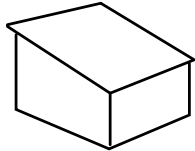
It is important to ensure that the volume of the roof/attic space is calculated and modelled correctly, as it can have a significant effect on the dwelling's thermal performance.

The shape of a roof/attic space determines the volume of the roof/attic space of the dwelling.

8.4.1 Roof shape

Four typical roof shapes are used in NatHERS software tools.

Table 8-2 Typical roof shapes are used in NatHERS software tools

<i>Hip roof</i>	All sections of the roof slope downwards to the walls. Hip roofs model minimal roof space volume. Refer to the relevant software tool manual for details on how to model a hip roof.	
<i>Gable roof</i>	Two roof sections slope in opposite directions with the highest horizontal edges forming the roof ridge; vertical roof sections are at each end. Refer to the relevant software tool manual for details on how to model a gable roof and gable end walls.	
<i>Hip/gable roof</i>	A combination of the above two types, where one roof end is vertical and one is sloped. Refer to the relevant software tool manual for details on how to model a hip/gable roof.	
<i>Skillion (raked/cathedral) roof</i>	Unlike a hip or gable roof, where each has at least two sloping sides, a skillion roof is mono-pitched, with only one slope and no centre ridge. Refer to the relevant software tool manual for details on how to model a skillion roof.	

Calculating complex roof shapes and volumes (such as those with multiple valleys and half hips) may require additional measuring from the assessor, as well as an understanding of basic formula calculations. Refer to your software tool manual for advanced roof modelling guidance.

8.4.2 Roof volume

Depending on the NatHERS software tool being used, the roof space volume may need to be entered, or may be calculated automatically.

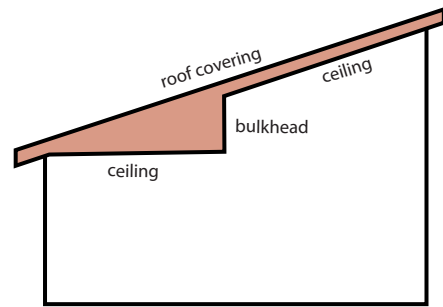
The roof space volume is generally calculated within the external walls—it does not typically include the eave overhangs, but does include the roof of the dwelling where it extends over covered outdoor areas (also known as alfrescos, patios, porticos or verandas) when these areas have a ceiling.

Whether the volume is calculated from within the external walls depends on the roof construction as to if the eave overhangs should be modelled. In most conventional housing, the volume of the main roof space will be closed off from the eave roof space and so the eaves overhangs should not be modelled. In some constructions however, the roof volume within the eaves is open to the main roof volume and should be modelled (such as in tropical climates when ventilated eaves are used).

8.4.3 Combinations within a zone

A dwelling sometimes has different roof/ceiling construction types within a zone. It is important to model these vertical walls or bulkheads because they result in a larger ceiling surface area.

The method and adjustments required to correctly model these properties differ depending on the software tool. Refer to the relevant software tool manual for more information on modelling wall to roof spaces or splitting zones to allow for different roof/ceiling properties.



8.5 Insulation

The key concepts of insulation have been covered in Section 6.3. The application of insulation for roofs and ceilings is detailed below.

8.5.1 Insulation types

Three main types of insulation are used in roof/ceiling construction:

- **Bulk insulation** reduces heat flow by creating small pockets of trapped air that is a poor conductor of heat. Bulk insulation is commonly used on ceilings and between floors in multi-level and Class 2 dwellings. The main types of bulk insulation used in Australia are:

- batts and blankets (e.g. glasswool, rockwool, natural wool, jute, polyester)
- loose fill insulation (e.g. cellulose fibre, natural wool, granulated rockwool)
- boards (e.g. extruded and expanded polystyrene insulating boards).

Some building materials may act as both a construction system and provide insulation as well.

- **Reflective insulation (foils)** consists of a thin layer of aluminium foil bonded onto one or both sides of a paper base. As noted in Section 6.3, reflective foil insulation must be associated with an air gap to improve thermal performance.

Sarking may also be defined as a foil if it has reflective/emissivity properties, and in this case should be treated as such in NatHERS software tools (i.e. modelled with an appropriate air gap). However, modern sarking may be vapour-permeable if it does not include a thin layer of foil. In this case it has different properties to those included in NatHERS software tools.

The type of sarking used under a roof will vary according to the climate and location of the dwelling. Manufacturer's specifications should be consulted to ensure that the correct emissivity values are modelled for air gaps.

The main types of reflective insulation used in Australia are:

- rolls (e.g. single- or double-sided rolls used for sarking)
 - multi-cell insulation, consisting of two, three or four layers of laminated foil separated by partitioning
 - expandable insulation (e.g. double-sided reflective foil laminate formed into an expandable concertina)
 - bonded to bulk (e.g. reflective foil bonded to insulating blankets or polystyrene board).
- **Composite insulation** comprises one or more materials combined to make a single insulation product. The main types of composite insulation used in Australia are
- single-sided, foil-faced blanket (e.g. reflective foil bonded to a single side of glasswool insulation)
 - double-sided, foil-faced blanket (e.g. reflective foil bonded to both sides of glasswool insulation)
 - bonded to bulk (e.g. reflective foil bonded to expanded polystyrene board).

If recommending insulation changes, assessors should ensure that the product is suitable. As the NCC requires that bulk insulation must not be compressed, it is important that the insulation modelled as part of the assessment will fit into the designed space.

8a If recommending changes to insulation, all documentation must be updated to reflect the changes before a NatHERS certificate is produced. (**Tech Note clause 3.3**)

Details of insulation products, including thickness, R value, k value and emissivity of surfaces are generally available from the manufacturer’s website. Further information about R and k values is available from the Insulation Council of Australia and New Zealand *Insulation handbook* (www.icanz.org.au/standards-research-and-publications).

8.5.2 Insulation to perimeter of a roof space

In colder climates in Australia, it is common to specify ceiling insulation of R4.1 or greater.

R4.1 glasswool insulation is 210 mm thick in its uncompressed form. Insulation with higher R values is thicker. Around the perimeter of a dwelling, this thick ceiling insulation may be in contact with the underside of the roof covering and/or sarking, acting as a path for moisture between the roof and ceiling into the dwelling.

Insulation installation also notes requirements for bulk insulation to not be compressed. Therefore, where the roof slopes down to meet the ceiling on the perimeter of the dwelling, a thinner bulk insulation might need to be installed (see the example installation in Figure 8.1). This ensures that the bulk insulation is not compressed and does not contact the underside of the roof, thereby reducing the likeliness of condensation.

Refer to the relevant software tool manual for more information on modelling perimeter ceiling insulation, also often referred to as edge batt insulation.

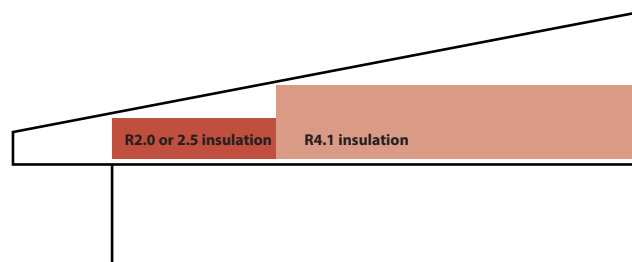


Figure 8-1 Example perimeter insulation installation in cool to cold climates

If the documentation specifies a change to the bulk insulation in the ceiling at the perimeter of the roof space, assessors should model as detailed in the documentation. If the documentation does not indicate perimeter edge insulation, assessors should notify the client and request updated documentation if it is to be included. If only bulk insulation is specified, an assessor should note that perimeter insulation was not included in the rating. Including perimeter insulation will give a more accurate rating and may affect the overall star rating.

8.6 Roof colour

The roof colour affects how the building reflects or absorbs heat, and can be used to help heat or cool the dwelling.

In general, darker colours absorb heat and lighter colours reflect heat. However, depending on the dwelling location, size and whether the roof space is insulated, the roof colour may have only a minimal effect on the dwelling’s rating, particularly in cooler climates. In some warmer climates, roof colour may have a greater effect on the rating. Multiple testing in NatHERS software tools may be required to ensure that the worst-case scenario for the location and climate of the dwelling has been applied.

8b Roof colour or roof solar absorptance must be modelled as detailed in the design documentation. Where this is not detailed, assessors must apply the worst-case scenario. (Tech Note clauses 9.1 and 9.2)

Multiple testing in NatHERS software tools may be required to ensure that the worst-case scenario for the location and climate of the dwelling has been applied. This may, as an example, be a dark roof in tropical areas and a light roof in temperate or cool climate. These details must be recorded in the 'Additional Notes' section of the NatHERS Certificate.

8.7 Ceiling colour

Some NatHERS software tools require the finished colour of ceilings to be modelled, while in others, this is built into the software and does not need to be entered by the assessor. If the software tool requires a ceiling colour to be entered and the documentation does not specify one, the ceiling colour must be entered as 'medium'.

8c When a ceiling colour is not specified, and your software provides an option to nominate a colour, the provisional colour of 'medium' is to be modelled. (Tech Note clause 9.3)

8.8 Ceiling penetrations

Assessors must model all recessed light fittings, vents and exhaust fans as ceiling penetrations. (Tech Note clause 9.5) Penetrations affect the thermal performance of a dwelling in two ways:

- loss of ceiling insulation, which may significantly reduce the average R value of the ceiling insulation across a roof space
- increased, uncontrolled air infiltration between zones and the roof/attic space.

The NatHERS Technical Note clauses 9.4–9.13 outlines these specific requirements on modelling and categorising ceiling penetrations.

Many jurisdictions require assessors to input information in accordance with a ceiling plan/electrical schedule, but for some state/territories, this level of detail may not be required for compliance purposes. Should this information be unavailable and the assessment is completed, it must be clearly state on the NatHERS Certificate the dwelling has been assessed without recessed light fittings. If these features are present in the dwelling, the assessment will need to be updated for compliance purposes.

8e If no electrical schedule or ceiling plan is available and the assessment is completed, it must clearly state on the NatHERS Certificate the dwelling has been modelled without recessed light fittings.

It is a NatHERS requirement that assessors input information about ceiling penetrations in accordance with the dwelling's lighting location plan/electrical schedule. However, if this information is unavailable because the jurisdiction does not require a lighting location plan/electrical schedule as part of the approvals process, it may be appropriate to use suitable assumptions. If this is the case and assumptions are used, they must be stated on the NatHERS Certificate. If the dwelling has lighting features installed that do not align with the NatHERS Certificate (for example downlights), the assessment will need to be updated for compliance purposes. (Tech Note clause 9.4)

An updated assessment may then be required once electrical information is available to confirm the number of ceiling penetrations for the approvals process or for compliance of the completed dwelling. If the number of ceiling penetrations exceeds the number shown on the NatHERS Certificate, the certificate may become non-compliant, depending on jurisdictional requirements and the stage of compliance as briefly mentioned above. This compliance is primarily the client's responsibility, however assessors should be aware of this and may want to speak with your state or territory jurisdiction to confirm the relevant state/territory requirements.

8.8.1 Loss of insulation

Ceiling penetrations, such as recessed light fittings, are modelled in the software with a specified clearance to surrounding bulk insulation as a clearance area without insulation is generally required around the fitting for safety purposes. Depending on your software tool, this may be displayed as selecting 'insulated' or 'uninsulated' when modelling the penetration. If a clearance distance is required in your software tool, and the penetration is specified as being covered by insulation, it may be appropriate to enter a clearance of zero.

NatHERS software tools require all ceiling penetrations to be modelled, whether ceiling insulation is specified or not, including an intermediate floor between levels in a multi-level dwelling. NatHERS software tools model the ceiling area with the specified insulation and without insulation where penetrations occur.

If the documentation does not specify insulation clearances, assessors can check manufacturer product information for guidance. Manufacturer's data information and clearances must be referenced when the model numbers of the recessed fittings are known. If the provided documentation has limited electrical details for the recessed light fittings specified, the following provision must be followed as per the NatHERS Technical Note.

8g Penetrations affecting insulation must be modelled as stated by the fitting manufacturer. If unspecified, assessors must include a minimum 50mm insulation clearance around ceiling penetrations. (**Tech Note clause 9.7**)

8.8.1.2 Exhaust fans

Where an exhaust fan is specified, model the size of the duct or flue shown on the documentation or manufacturers specification. A typical exhaust fan may have a diameter of 200–250 mm. Fanlight heaters must also be modelled as exhaust fans. A typical square fanlight heater may have a diameter of approximately 300–350 mm.

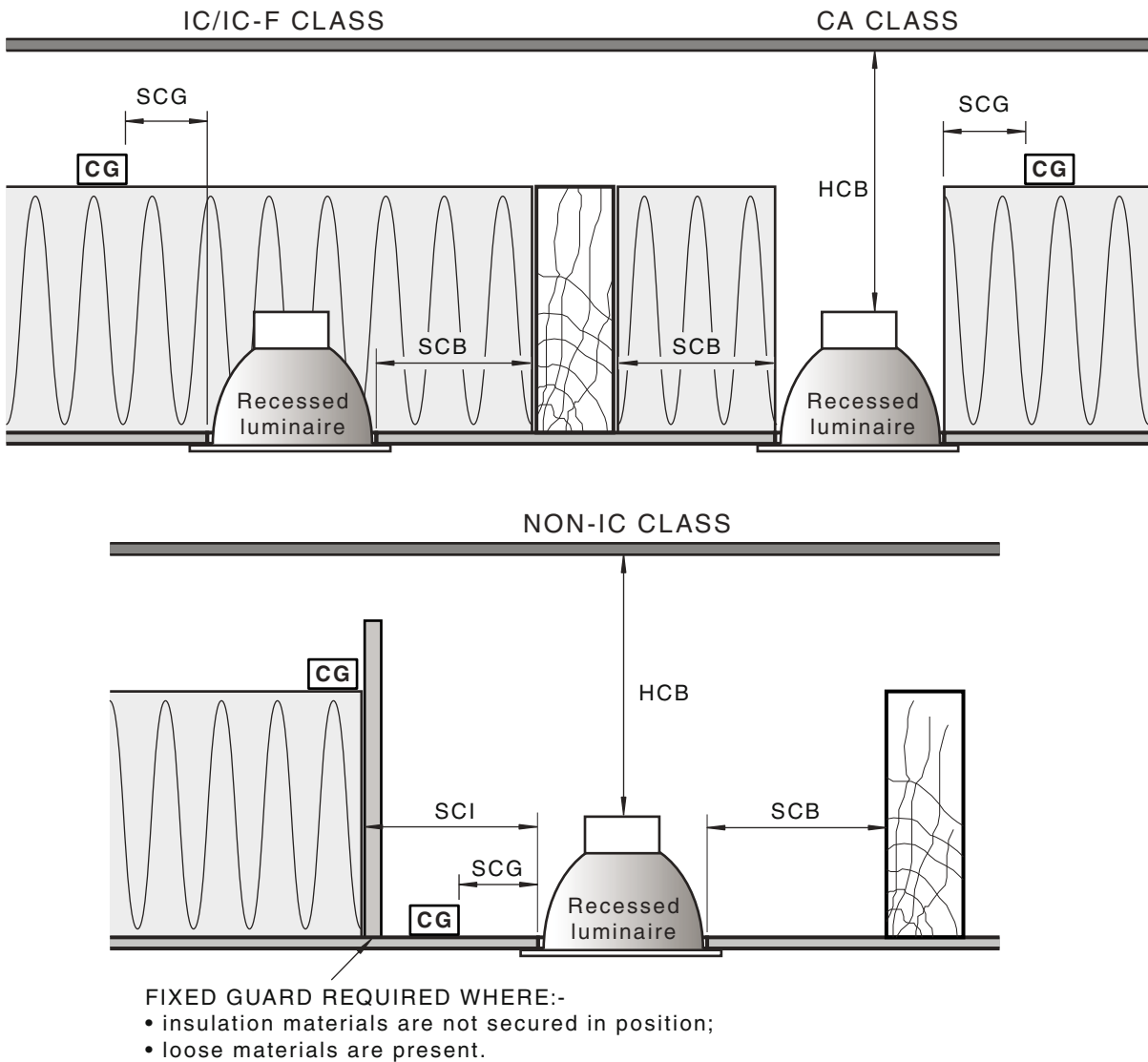
It is worth noting that the National Construction Code requires internal (ie. without a window or door) bathrooms, WCs and ensuites to have mechanical ventilation. If an exhaust fan is not shown on the documentation, it would be best practice for assessors to check with the client and confirm whether an exhaust fan should be present and request updated documentation if necessary.

8.8.1.3 Recessed light fittings

For NatHERS purposes, recessed luminaires are described as recessed light fittings, although they are more commonly referred to as downlights, and must be modelled as shown in the documentation.

Generic electrical plans are sometimes used for the modelling, and the type and/or model number of the recessed fittings are often not specified. If the client is unable to provide these details, the recessed light fittings must be modelled as worst case for size, clearance and air infiltration. A typical recessed light fitting has a diameter of 80–120 mm.

Recessed light fittings may be modelled in three ways (depending on what is specified on the documentation): with added side clearance, without added side clearance (i.e. the insulation is abutted to the light fitting), or without side clearance and covered over by the ceiling insulation. Figure 8-2 provides guidance on minimum clearances for recessed light fittings (luminaires).



Dimension	Any lamp up to 100 W
HCB—height clearance to building element	100 mm
SCB—side clearance to building element	100 mm
SCI—side clearance to insulation	100 mm
SCG—side clearance to auxiliary equipment [control gear (CG)]	50 mm

Source: AS/NZS AS/NZS 3000:2018 Fig 4.9. © Standards Australia Limited. Copied by the Dept of Environment and Energy with the permission of Standards Australia and Standards New Zealand under Licence 1902-c025

Figure 8-2 Minimum clearances for recessed luminaires

With added side clearance—recessed light fittings generate heat, and clearance is required between fittings and thermal insulation and roof framing members.

Without added side clearance—some types of recessed light fittings, may be specified as capable of being abutted to insulation with no added side clearance required. If specified as such in the documentation, the light fitting may be modelled with a clearance value the same as the light fitting size.

Without added side clearance and covered—some types of recessed light fittings may be specified as capable of being covered by insulation, and can be modelled as ‘insulated’ or with no added side clearance and covered by insulation. When these are specified the fitting will have no impact on loss of insulation.

8h When recessed light fittings are specified in the documentation as insulated (or capable of being covered by insulation), treat as ‘insulated’ or with no insulation clearance. (**Tech Note clause 9.8.3**)

In 2016, Standards Australia published the joint Australian/New Zealand Standard AS/NZS 60598.2.2-2016, Luminaires—Part 2.2: Particular requirements—Recessed luminaires (IEC 60598-2-2, Ed. 3.0 (2011) MOD). Part of Appendix ZD1 is included in Section 8.11 of this Chapter. It gives guidance on the classifications, symbols, applications and general restrictions on recessed luminaires.

Refer to the relevant software tool manual for more information on modelling recessed light fittings.

8.8.2 Increased infiltration

In NatHERS software tools, the control of air infiltration is specified by sealing or not sealing a penetration. Ceiling penetrations are therefore modelled as ‘sealed’ or ‘unsealed’, which refers to the assumption of uncontrolled air infiltration or movement calculated in the Chenath engine. If unsealed, ceiling penetrations can create a ventilation path from the rooms to the roof/attic space, allowing hot or cool air from the room to escape into the roof/attic space. For example, if the exhaust fan has a damper specified, or the rangehood includes filters, the assumption of air movement through the penetration is less than if these are determined as unsealed and there are greater levels of assumed air movement.

Unsealed penetrations—if the documentation does not indicate that a recessed light, ceiling mounted exhaust fan, ceiling vent or open fireplace chimney contains a damper or similar, it is treated as worst case—that is, ‘unsealed’.

8i Unless specified in the documentation or by the fitting manufacturer, all ceiling penetrations (including vents, exhaust fans and recessed downlights) must be treated as unsealed. (**Tech Note clause 9.6**)

This is a NatHERS worst-case scenario assumption, as ceiling penetrations can significantly affect thermal performance, and assessors must not assume penetrations are sealed or insulated if the documentation does not specify this.

Refer to the relevant software tool manual for more information on unsealed penetrations.

Sealed penetrations—if the documentation indicates a ceiling-mounted exhaust fan, or open fireplace chimney contains a damper or similar, it can be treated as ‘sealed’ in NatHERS software tools.

Slow-combustion fireplaces are considered to be sealed, but require loss of insulation around the flue to be modelled. If the documentation does not specify insulation clearances, assessors can check manufacturer product information for guidance.

8j Treat permanent static ventilation openings in the building fabric (e.g. unflued gas heaters) as a wall or ceiling vent (**Tech Note clause 9.9**)

8k Where a gas cooker is specified, treat as a ‘sealed’ exhaust fan. (**Tech Note clause 9.10**)

Where a gas cooker exhaust is specified on the documentation, assessors can model it as a ‘sealed’ exhaust fan. This aligns with the principle in the National Construction Code requirement that gas cookers must be ventilated to outside air.

Rangehoods or electric cookers with a flue can also be modelled as sealed/closed if specified as such on the documentation. Ductless rangehoods that recirculate the air back into the room and do not penetrate the ceiling are not required to be modelled as a penetration.

8l Recessed light fittings must be modelled regardless of the adjoining zone (i.e. roof space, neighbour or second-storey floor). (**Tech Note clause 9.8**)

8m Recessed light fittings can be treated as 'sealed' when the documentation specifies that it is sealed to prevent the movement of air between a zone and another zone, attic or roof space. (**Tech Note clause 9.8.2**)

Although the Chenath engine does not currently distinguish a difference in air movement and infiltration between whether the ceiling penetration is to a ceiling with dwelling above or a ceiling with roof above, it must still be modelled for NatHERS purposes.

As there is generally a path of air movement through floor/ceiling spaces, it is accurate to assume that if there are recessed light fittings (downlights), there will be subsequent effects on air infiltration and loss of insulation no matter what is located above. However, a recessed light fitting which allows air transfer between the zone and roof/attic space, may be modelled as 'unsealed', while a fitting which does not allow air transfer between the zone and the roof/attic space, may be modelled as 'sealed'.

8.9 Ceiling fans

Ceiling fans provide a cooling benefit to a dwelling and reduce the cooling load component of the thermal performance. They are often more beneficial in warm to hot climates than in cool to cold climates in Australia.

In NatHERS software tools, ceiling fans are not assumed to affect air leakage or infiltration, rather they affect air movement, and are assumed not to penetrate the ceiling insulation. The larger the fan, the greater the air speed the fan produces and therefore the greater the area in the zone affected by the ceiling fan. The Chenath engine averages the summer comfort benefit over the total area of the room. Therefore in larger rooms, using ceiling fans with a greater diameter and/or multiple fans will be more effective. Zone temperatures within the software tool simulations do not include air movement effects. When the zone temperature is above the cooling thermostat setting, the Chenath engine will not activate cooling if turning on ceiling fans or opening windows will create a comfortable zone temperature.

One limitation of the Chenath engine is that of the impact of air speed on comfort is not shown within the calculations. Although the Chenath engine calculates the impact of air movement from ceiling fans and cross-ventilation on comfort when calculating energy use, it does not output the comfort temperatures affected by air speed. Therefore there may be times when a zone appears to be uncomfortable, but this is potentially incorrect because of the reduction in perceived temperature due to air movement of the ceiling fan.

Ceiling fans can be added to each zone. The diameter of each fan needs to be entered into the software tool.

The diameters available are 900mm, 1200mm and 1400mm. These determine the air speed generated in the vicinity of the fan and hence the cooling benefit.

8n Ceiling fans must only be modelled if they are included on the documentation. If the ceiling fan size is unknown, model fans as 900 mm diameter. (**Tech Note clause 9.13**)

Refer to the relevant software tool manual for more information about modelling ceiling fans.

8.10 Glazing

Glazed or perspex elements such as skylights and roof windows introduce natural light and can improve ventilation within a zone. However, the inclusion of a glazed roof element may improve or be detrimental to the thermal performance of a dwelling, depending on the location and orientation of the element.

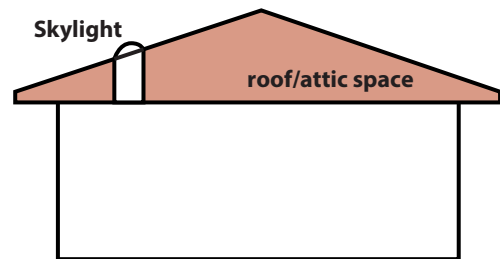
Refer to the relevant software tool manual for more information about modelling skylights and roof windows. Clerestory windows also introduce natural light and can improve ventilation, and are covered in Chapters 6 and 7 of this Handbook. Chapter 7 also covers more detailed information on skylights and roof windows.

The definitions of skylights and roof windows outlined in Section 8.10.1 and 8.10.2 are specific to NatHERS software modelling. This may differ from the broader definition of these products available on the market and their corresponding characteristics. Assessors must not rely on the product title, and must understand the characteristics of the product specified to confirm the correct feature is used within the NatHERS software.

8.10.1 Skylight

For the purposes of modelling in NatHERS, a skylight is a fixed glazed or perspex element, penetrating the roof construction and connected to a zone by a built-in shaft that passes through a roof/attic space.

Inclusion of a skylight can reduce the area of roof and ceiling with insulation, increasing the heat flow and air movement to the zone. The example skylight shown to the right is a tubular/dome skylight, however skylights can also be rectangular.



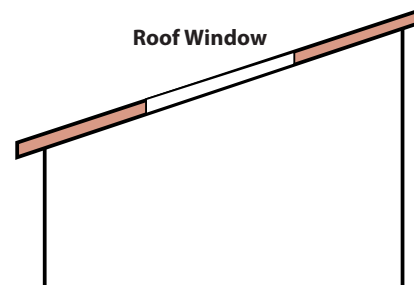
8.10.2 Roof window

For the purposes of modelling in NatHERS, a roof window is a glazed element in a roof that does not have a roof/attic space; it can be either fixed or openable, and penetrates the roof construction.

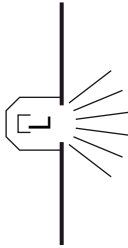
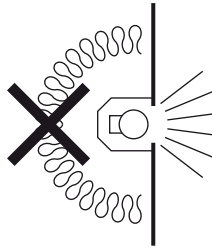
Roof windows can also be quite complex, for example if a window is surrounded by a 'thicker' ceiling/roof construction that may look like a skylight shaft. It is recommended assessors seek modelling advice from their software provider or relevant Assessor Accrediting Organisation.

The area of roof/ceiling with insulation is reduced where a roof window is located, increasing the heat flow and air movement to the zone. It is also important to note that depending on your software tool, it may not be possible to model roof windows.

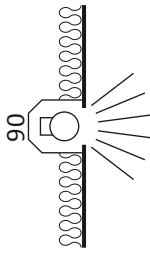
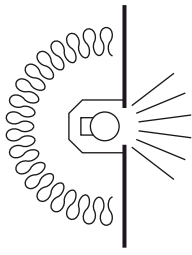
Refer to Chapter 7 and the relevant software tool manual for more information on how to model the properties of skylights and roof windows.



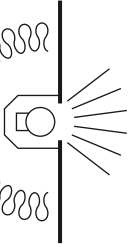
8.1.1 Australian Standards guide to recessed luminaire classification (excerpt from AS/NZS 60598.2.2-2016)

Type	Symbol	Abutted*	Normal use† Covered	Use with insulation ‡	Accessibility to high temperature parts §	Surface of luminaire normal operating temperature limit	Comments
Non-IC		No	No	No	Fully accessible	No limit on side or top surface of luminaire Mounting surface of luminaire limited to 90°C	Suitable for use in Australia and New Zealand—intended for commercial industrial use only. Not for residential use. Not for use in residential dwellings or other places where building insulation may be installed (now or in the future). These luminaires have not been tested for use with building insulation.
Do Not Cover		No	No	No	Fully accessible	No limit on side of top surface of luminaire Mounting surface of luminaire limited to 90°C	Suitable for residential or commercial use in Australia. Cannot be covered. Manufacturer's stated clearance distances from sides of luminaire to insulation, and clearance above luminaire, will be in the installation instructions supplied with the luminaire, indicating clearances have to be observed at all times for correct installation. These luminaires have been tested to show that they are for use with building insulation present, observing manufacturer's stated installation clearance distances. They cannot be covered with building insulation, however, they have been tested to show that if inadvertently covered they should not become a fire hazard.

8.1.1 Australian Standards guide to recessed luminaire classification (excerpt from AS/NZS 60598.2.2-2016)

Type	Symbol	Abutted*	Normal use† Covered	Use with insulation ‡	Accessibility to high temperature parts §	Surface of luminaire normal operating temperature limit	Comments
CA90		Yes	No	Yes	Limited access In this Standard, this is assessed for access to high temperature parts by use of a 5.6 mm probe to side and top of luminaire	90°C limit on side or top or mounting surface of luminaire	Suitable for residential or commercial use in Australia and New Zealand. Cannot be covered. Insulation can be placed against the sides of the luminaire. Manufacturer's stated clearance above the luminaire will be in the instructions provided with the luminaire, indicating clearance has to be observed for correct installation. These luminaires have been tested to show that they are for use with building insulation present and placed against the sides of the luminaire. They cannot be covered in building insulation, however, they have been tested to show that if inadvertently covered they should not become a fire hazard.
IC		Yes	Yes	Yes	Limited access In this Standard, this is assessed for access to high temperature parts by use of a 5.6 mm probe to sides and top of luminaire	90°C limit on side or top or mounting surface of luminaire	Suitable for residential or commercial use in Australia and New Zealand. Used where some air transfer is allowed or desired between living space and roof space (there will be some air transfer between the spaces if the luminaire is not fully covered in insulation). These luminaires have been tested to show they are suitable for normal use when covered in building insulation.

8.11 Australian Standards guide to recessed luminaire classification (excerpt from AS/NZS 60598.2.2:2016)

Type	Symbol	Abutted*	Normal use† Covered	Use with insulation ‡	Accessibility to high temperature parts §	Surface of luminaire normal operating temperature limit	Comments
IC-4	IC-4 	Yes	Yes	Yes	Restricted access In this Standard, this is assessed for access to high temperature parts by use of a IP4X—1 mm probe to sides, top and front face of luminaire	90°C limit on side or top or mounting surface of luminaire	Suitable for residential or commercial use in Australia and New Zealand. Used where air transfer is not permitted or not desired between living space and roof space (there will be no air transfer between spaces even if there is no insulation covering the luminaire). Typical use is passive house design where no air transfer is allowed. These luminaires have been tested to show that they are suitable for normal use when covered in building insulation.
No Marking		No	No	No	No		Not verified as tested/compliant to Australian/New Zealand standards. Marking is required by standards —no marking indicates non-compliance. Installation instructions specifying any clearance distance is required by this Standard. Do not install any luminaire that does not have one of the marking symbols or instructions specifying any clearance distances. NOTE: For luminaires installed prior to the publication of this Standard (AS/NZS 60598.2.2:2016), which do not have marking and/or installation instructions with clearance distances specified, refer to AS/NZS 3000.

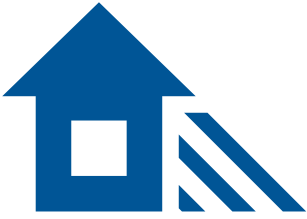
* May be abutted against normally flammable building elements or insulation.

† Intended and tested for use under building insulation as part of normal operation.

‡ May be used where building insulation may be installed (now or in the future).

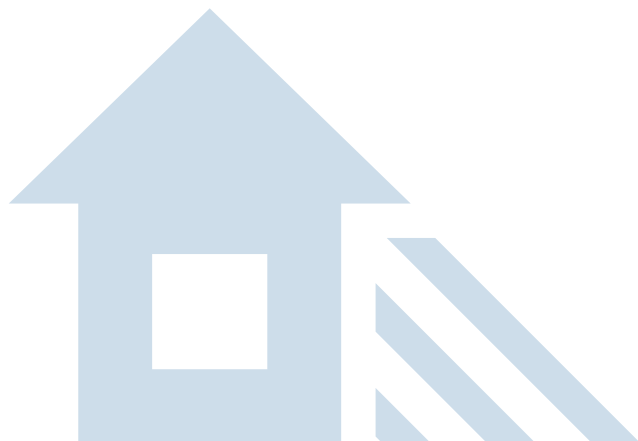
§ Classification and probe to determine access of insulation etc., to high temperature parts.

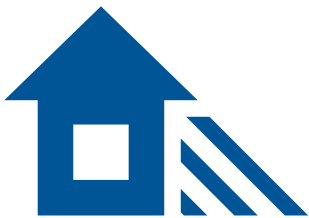
Source: AS/NZS 60598.2.2:2016 Appendix Fig ZD1. © Standards Australia Limited. Copied by the Dept of Environment and Energy with the permission of Standards Australia and Standards New Zealand under Licence 1902-c025



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SHADING

9

Shading can make the difference between a dwelling being comfortable or uncomfortable.

The shade cast onto a dwelling can limit the amount of solar radiation striking the external surface and then being transferred to the inside of the dwelling. Large shadows can be beneficial in summer and in warmer climates. Conversely, small shadows and higher solar gain can be beneficial in winter and in colder climates.

There are different types of shading devices, including those built onto a dwelling (such as eaves or pergolas) or those separate to the dwelling, including screens or neighbouring buildings. Shading is an area where NatHERS software tools vary considerably, it is important to refer to the relevant software tool manual for guidance.

Summary of key requirements

This handbook is intended to be a helpful resource for all assessors. When conducting assessments, assessors must follow the requirements of the current Technical Note and the relevant state or territory requirements.

- 9a** Assessors must model all shade features shown in the documentation. Where there is a limit to the number of shading devices that can be modelled in the software tool, model the three that have the largest impact on the rating.
- 9b** Assessors must model the width of an eave or shading device from the face of the external wall to the outermost protrusions, including gutters. If the gutter width is not specified, assume a 100 mm width.
- 9c** If the fascia board will cast a greater shadow than the gutter, assessors must model shading from the bottom of the fascia.
- 9d** Model neighbouring buildings and surrounding topographical features which obstruct the sun, including considering the impact of level changes and retaining walls.
- 9e** If the dwelling is located north of the Tropic of Capricorn, assessors are required to model high-rise/topographical features located between the midpoints SSE and S, and S and SSW; or within the range of 168°45' to 191°15'. This is not required for dwellings south of the Tropic of Capricorn.
- 9f** Where information on neighbouring buildings is not shown on the documentation, assessors must request the documentation be updated or obtain supporting evidence of existing neighbouring buildings for the purpose of modelling.
- 9g** Where neighbouring buildings are unknown because the dwelling is located in a new development site, NatHERS Technical Note provisions must be applied.
- 9h** Balconies or similar spaces with solid, glazed or partially glazed walls to either side of the parent wall, are to be modelled as wing walls. Balcony walls with solid building elements directly in front of the parent wall, are to be modelled as an external screen with 100% shading for the portion of the wall that is solid, and 10% shading for the portion of the wall that is glazed.
- 9i** Trees with an existing preservation order or heritage protection must be modelled.

9.1 Applying shading

In NatHERS software tools, shading can be applied to walls and/or windows. When discussing shading elements in this chapter, we refer to the term ‘subject wall’. This is the wall to which shading is applied or which has the window the shading is applied to. Multiple shading devices can apply to a single subject wall, however there may be a maximum limit depending on the software tool.

Shading affects the subject walls and elements within the wall. Shading is described as either horizontal (including eaves, pergolas and verandahs; see Section 9.2) or vertical (including neighbouring buildings, privacy screens and wing walls; see Sections 9.3 and 9.4). Heritage listed vegetation must also be modelled as shading devices (see Section 9.5).

Shading from external structures can have a significant impact on the thermal performance in a NatHERS assessment. Shading data must be correctly entered to obtain a clearer assessment result.

9a Assessors must model all shade features shown in the documentation. Where there is a limit to the number of shading devices that can be modelled in the software tool, model the three that have the largest impact on the rating. (**Tech Note clauses 10.1 and 10.2**)

The shade features to be modelled include shading devices from both the dwelling being assessed, and nearby structures that will cause a sun or wind obstruction, such as neighbouring buildings (**9d**), retaining walls, fences and heritage listed trees (**9i**). If one shading device overshadows another shading device, and the second does not contribute to additional shading impact, assessors may not need to model both when faced with limitations on the number of shading devices that can be modelled. For example, if the neighbouring building casts a shadow greater than the boundary fence shadow, the fence may not need to be modelled if it is not one of the most appropriate three shading devices creating the largest impact on the rating.

If an assessor suggests shading devices to improve a rating, the client must update the documentation with the suggested inclusion before the assessor completes the assessment and issues the NatHERS Certificate. (**Tech Note clause 3.3**)

9.2 Horizontal shading

Horizontal shading is generally any external structure that provides shading to the dwelling in the horizontal plane, including eaves, verandahs, pergolas, carports and overhangs or balconies from upper levels. There are limitations in the Chenath engine that may only allow for one horizontal shading device per wall component. In some situations, there may be multiple shading devices, such as an eave and a pergola. It may not be necessary to enter the shading for both elements if the main shading device completely covers the other (**9a**). However this may depend on the details of the shading scheme materials and transparency.

All covered outdoor living areas should be entered into NatHERS software tools as shade features, predominantly as eaves. Proposed permanent installations using construction-grade materials such as metal and timber, or fabric shading devices if shown on the documentation, should be modelled. Noting that if fabric shading devices are shown in the documentation and energy assessment, the device will need to be in place before building certification.

The terminology that assessors need to accurately model horizontal shading devices includes:

- **Height of the subject wall**—this is the distance from the finished floor level (FFL) to the top of the external wall construction.
- **Projection of the horizontal shading device**—this is the distance the shading device protrudes from the subject wall (see Section 9.2.1). For example, the projection of the roof eave (shading device) in Figure 9-1 is greater than the projection of the second horizontal shading device.
- **Furthest point**—this is the maximum extent of shading projection from the subject wall. It may include parts of the structure not shown in the floor plan (e.g. the fascia board and gutter). For example, the furthest point in Figure 9-1 is the roof eave (shading device) rather than the horizontal shading device. However, in Figure 9-2, the furthest point is the horizontal shading device.

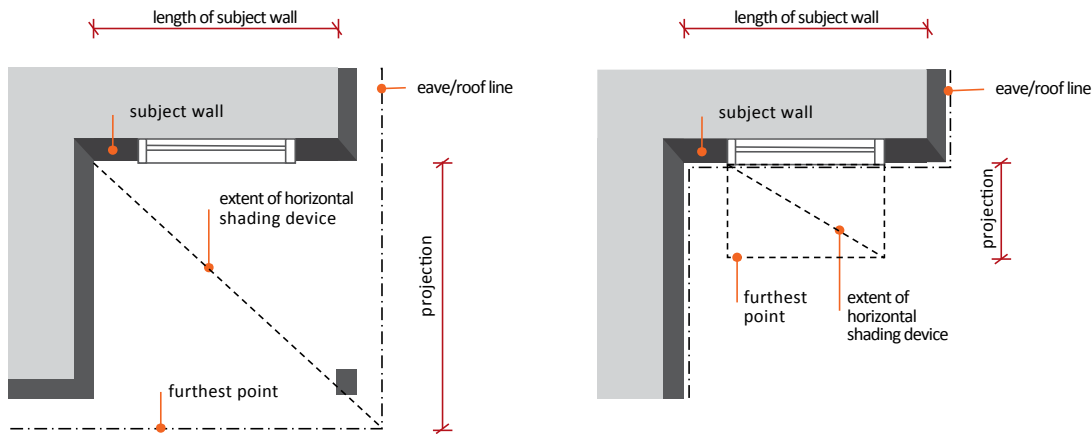


Figure 9-1 Shading terminology example 1—floor plan view (left)

Figure 9-2 Shading terminology example 2—floor plan view (right)

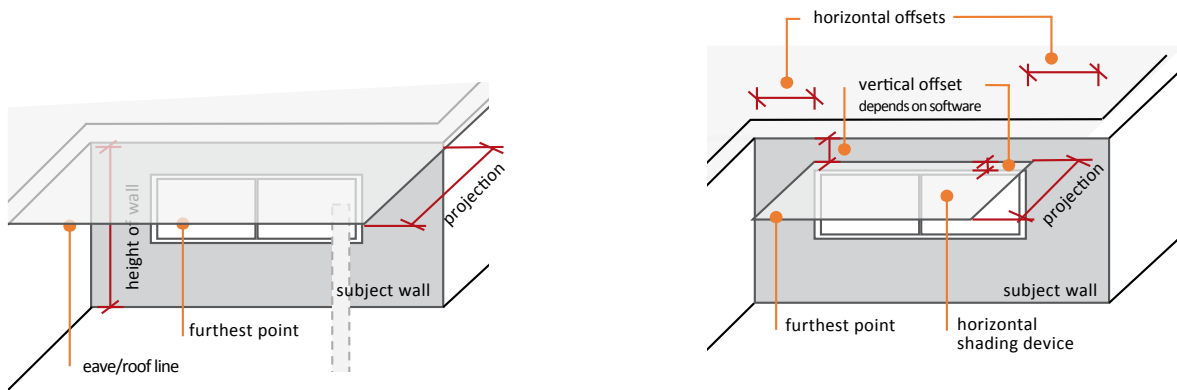


Figure 9-3 Shading terminology example 1—perspective view (left)

Figure 9-4 Shading terminology example 2—perspective view (right)

9.2.1 Projection for horizontal shading

Projection for horizontal shading is the distance (or width) that the shading device protrudes from the external surface of the subject wall to the furthest point of the shading structure. This should include the gutter and fascia width as appropriate. For example, where the gutter provides shade additional to the fascia, the effective shade is to be modelled.

If the horizontal shade structure is non-rectangular, the projection may be calculated as an average.

Assessors should take into account the thickness or depth of the construction elements when modelling shading. This ensures the shading device is accurately modelled, including any construction obstructions of the sun on the dwelling and the solar impact.

9b Assessors must model the width of an eave or shading device from the face of the external wall to the outermost protrusions, including gutters. If the gutter is not specified, assume a 100 mm width. **(Tech Note clause 10.3)**

9c If the fascia board casts a greater shadow than the gutter, assessors must model shading from the bottom of the fascia. **(Tech Note clause 10.4)**

Shading from the width of eaves is the horizontal distance from the wall to the furthest point on the shadow casting edge on the vertical plane, at right angles to the wall.

If the gutter is on a deep fascia board where the board will cast a greater shadow than the gutter (Figure 9-5), the projection and offset measurements must be taken from the bottom of the fascia. If these details are unknown, assessors are to assume the gutter casts the greatest shadow and apply the provisional value of 100 mm to the eave dimension.

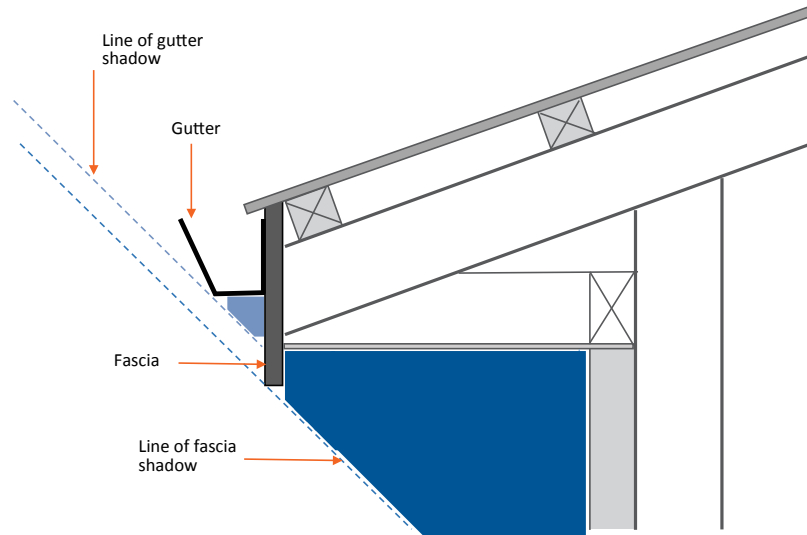


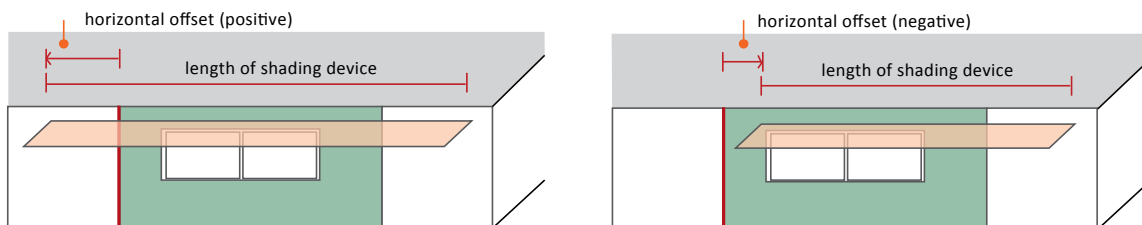
Figure 9-5 Gutter and fascia board shading impacts

9.2.2 Horizontal offset for horizontal shading

The horizontal offset for horizontal shading is the distance beyond the subject wall/window that the shading device extends. This is entered and treated differently depending on which software tool is being used and the type of shading device being entered, because some tools measure this based on the wall and others based on the window. Assessors are to refer to the relevant software tool manual and training resources to see how the tool treats this information, and for advanced modelling advice.

There are four methods used by the software tools to enter the horizontal offset:

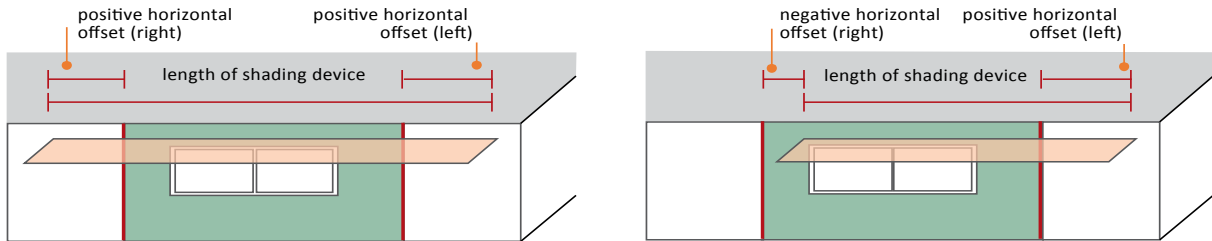
- **Method A**—entered as one offset value taken from the right, assuming you are inside the dwelling looking out (entered for each wall it affects). In Figure 9-6, the horizontal shading device is shaded orange and the subject wall in which the shading is being applied to is shaded green. A positive offset would see the shading device extend further to the right than the subject wall, and a negative offset would see the shading device begin to the left of this point (assuming you are inside the dwelling looking out).



Horizontal shading device shaded orange and subject wall (*wall that shading is being applied to*) shaded green.

Figure 9-6 Method A—treatment of horizontal offset

- Method B**—entered as two values taken from the left and right of the device, assuming you are inside the dwelling looking out. In Figure 9-7, the horizontal shading device is shaded orange and the subject wall in which the shading is being applied to is shaded green. A positive offset would see the shading device extend further than the subject wall, and a negative offset would see the shading device begin or end within the length of the subject wall.



Horizontal shading device shaded orange and subject wall (wall that shading is being applied to) shaded green.

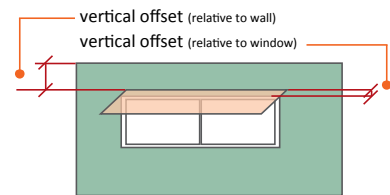
Figure 9-7 Method B—treatment of horizontal offset

- Method C**—entered as two values from an axis reference point to each end of the shading device in plan view.
- Method D**—automatically calculated for eaves based on roof/eave details entered.

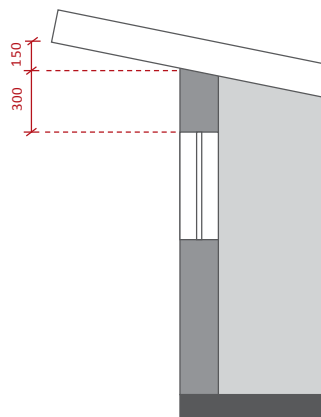
9.2.3 Vertical offset for horizontal shading

The vertical offset of horizontal shading is the height between the shading device and the external top of the subject wall/window.

Whether the measurement is taken relative to the top of the wall or window, depends on which NatHERS software tool is being used. In the example shown here, if measuring relative to the wall the vertical offset would be negative as the shading device is below the top of the wall. However, if measuring relative to the window, the vertical offset would be positive as the shading device is above the top of the window.



Figures 9-8 to 9-10 show examples of the difference in the vertical offset calculations for horizontal shading through a wall section, and how these measurements differ depending on whether the offset is measured from the top of the wall, or relative to the window. See the relevant software tool manual for modelling advice.



Relative to top of wall:

The shading element is located above the top of the wall and therefore the offset is positive.

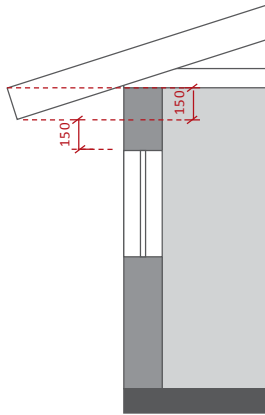
Vertical offset = +150

Relative to top of window

The shading element is located above the top of the window and therefore the offset is positive.

Vertical offset = +450

Figure 9-8 Section example A—an eave vertical offset for horizontal shading



Relative to top of wall:

The shading element is located below the top of the wall and therefore the offset is negative.

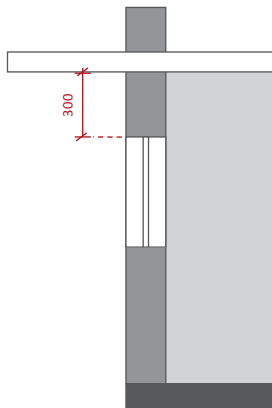
Vertical offset = -150

Relative to top of window:

The shading element is located above the top of the window and therefore the offset is positive.

Vertical offset = +150

Figure 9-9 Section example B—an eave vertical offset for horizontal shading



Relative to top of wall:

The shading element is located in line with the top of the wall and therefore the offset is zero.

Vertical offset = 0

Relative to top of window:

The shading element is located above the top of the window and therefore the offset is positive.

Vertical offset = +300

Figure 9-10 Section example C—an eave vertical offset for horizontal shading

9.3 Vertical shading

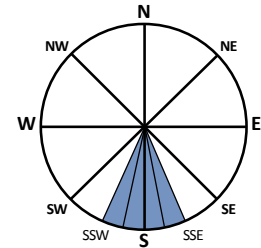
Vertical shading is any external structure that provides shading to the dwelling in the vertical plane, and can be parallel or perpendicular to the subject wall/window including:

- privacy screens—see Section 9.3.1
- other walls in the dwelling (wing walls)—see Section 9.3.2
- adjacent structures (fences, other buildings)—see Section 9.4
- vegetation (heritage listed trees)—see Section 9.5.

It is important that assessors consider changes in floor height when measuring screens and wing walls, as all vertical shading devices are relative to the floor height of the zone or room being assessed.

The modelling requirements differ if the dwelling is located in the tropics, defined as north of the Tropic of Capricorn. In these locations the southern orientation is generally the maximum solar orientation.

9e If the dwelling is located north of the Tropic of Capricorn, assessors are required to model high-rise/topographical features located between the midpoints SSE and S, and S and SSW; or within the range of 168°45' to 191°15'. This is not required for dwellings south of the Tropic of Capricorn. **(Tech Note clause 10.6)**



9.3.1 External screens (parallel vertical shading)

External screens are vertical shading devices and are modelled parallel to the subject wall of the dwelling. Examples of vertical shading devices include privacy screens, fences, retaining walls and other screens that may be detailed in the documentation. Neighbouring buildings are also modelled as vertical shading devices (see Section 9.4 for more information on specific treatment and provisions). They may also include other walls of the subject dwelling that face the subject wall such as a parallel courtyard wall.

Assessors must model vertical shading devices such as external screens, neighbouring buildings and topographical features that obstruct the sun. For example, on level ground, assessors must model at least all single-storey neighbours and features within 10m and two storey neighbours or features within 20m. **(Tech Note clause 10.5)**

The terminology assessors need to accurately model external screens includes:

- **Width of a vertical shading device**—this is the distance from one end of the shading device to the other.
- **Projection of a vertical shading device**—this is the distance from the external surface of the subject wall to the surface of the shading device. The software tool may display this as positive and negative, or left and right.
- **Horizontal offset of a vertical shading device**—this is the distance from the right-hand end (if the user is standing inside the dwelling) of the subject wall/window to the right-hand end of the shading device. If the right-hand end of the device is to the right of the end of the subject wall, it is a positive offset; if it is to the left it is a negative offset. Depending on the software tool, the vertical shading device may be drawn, and the software calculates the horizontal offset automatically, provided it is connected to the relevant wall(s).
- **Vertical offset of a vertical shading device**—this is the distance from the bottom of the wall or the window to the bottom of the screen, depending how the software operates. The vertical offset will be positive if it is above the building element (wall or window) and negative if below. Depending on the software tool, the vertical offset may be set as zero and assessors must adjust their modelling techniques to reflect this accurately. See software tool manuals for more information.

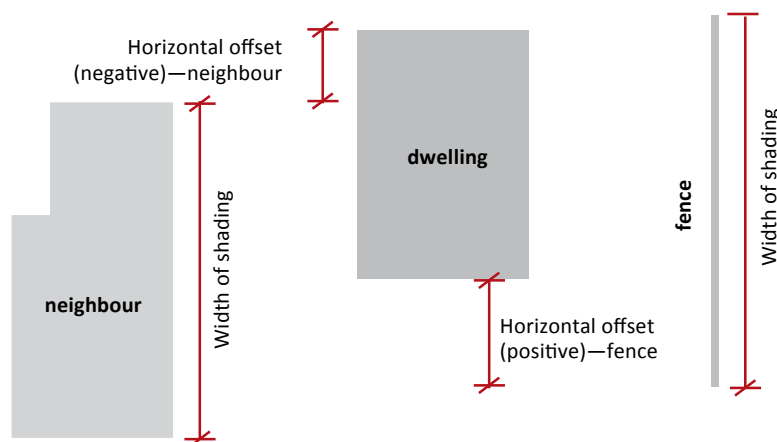


Figure 9-11 Site plan of vertical shading measurements

- Height of the vertical shading device:** This is measured relative to the bottom of the subject wall of the storey or dwelling. An assessor must therefore consider this and any change in level or site slope when calculating the modelled height of vertical shading devices. See the software tool manual for modelling guidance.

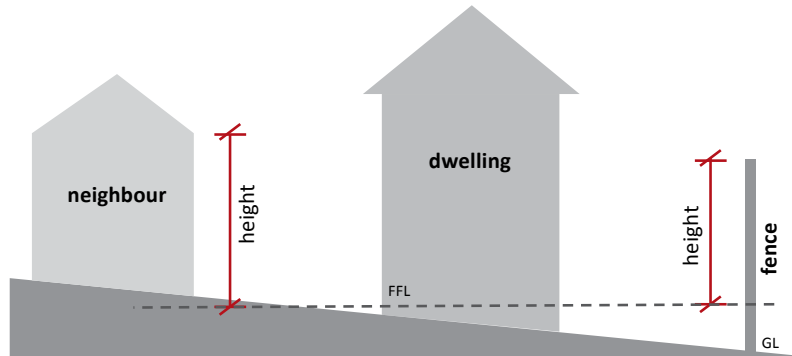


Figure 9-12 Example elevation of vertical shading device heights effected by site topography.

Similar to the projection measurement of a horizontal shading device, the height of a vertical shading device is to be measured from the point where the shadow will be created. For example, if the neighbour eave edge or roof line will cast a greater shadow than the wall height, the height of the neighbour is to be modelled accordingly, rather than the height of just the closest neighbour wall.

For multi-storey buildings, vertical shading is usually measured relative to the bottom of the subject wall, unless your software tool allows for a negative vertical offset. For example, Figure 9-13 shows:

- modelling vertical shading of neighbour for the lower level (subject wall/window A) will have a height relative to the bottom of the wall on the ground level of the subject dwelling shown as height A.
- modelling vertical shading of neighbour for the upper level (subject wall/window B) will have a height relative to the bottom of the wall on the second-storey of the subject dwelling.

*The exception to this is if your software allows a negative vertical offset, i.e instead of adjusting the shading device to be relative to the bottom of the subject wall, the assessor can enter that the shading device begins below the bottom of the shading device. For example, in Figure 9-13, the modelling of shading for subject wall B, could be entered as height A, but with a negative offset equal to the height of subject wall A.

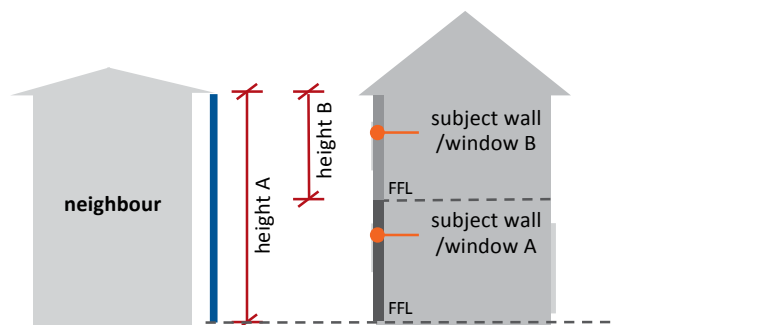


Figure 9-13 Elevation of vertical shading height differences for multistorey dwellings*

This is similar to the treatment of Class 2 dwellings, and will differ for each dwelling depending on its relative measurement to the vertical shading device. Two examples of this are shown in Figure 9-14 (the subject dwellings being assessed are shown in orange). As mentioned above, if your software tool allows a negative vertical offset, this would be modelled slightly differently, and it would be best to refer to your software tool manual.



Figure 9-14 Elevations of vertical shading height for Class 2 dwellings*

9.3.2 Wing walls (perpendicular vertical shading)

Wing walls or vertical fins are vertical shading devices that are attached perpendicular to the subject wall of the dwelling. Wing walls also affect the wind around and air flow through the dwelling, and are therefore required to be modelled for all dwellings (including those located north of the Tropic of Capricorn). They can be another wall of the same dwelling, or a balcony wall, fence or external construction protruding outside the dwelling envelope. Each wall section cannot have more than two wing walls, one at each end.

Wing wall location in the software is determined based upon the user standing inside the dwelling and looking out. If the wall is on the user's right-hand side it must be entered as a right wing wall, and vice versa.

Projection

Projection for wing walls is measured from the outside of the subject wall to the furthest point of the wing wall. When measuring the projection of a wing wall, ensure the projection (or length) includes the whole wing wall, which may include multiple wall sections. Wing walls are entered in different ways for graphic and nongraphic software tools.

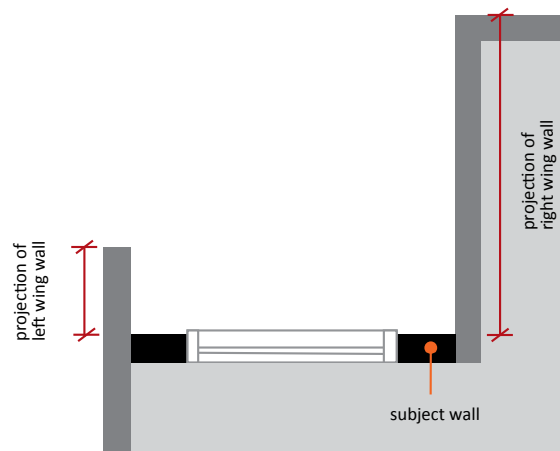


Figure 9-15 Wing wall projection

Depending on the software tool, it may automatically add wing walls for other walls of the same dwelling based on the measurement of an adjacent zone. In some cases, this measurement can be adjusted or removed when necessary, to correctly model or achieve more accurate results.

For example, in Figure 9-16 the software tool may automatically calculate the effect of the adjacent zone (family room—green wall) as a wing wall to the subject wall (the kitchen—red wall), but has not included the impact of the bedroom (blue wall). The assessor needs to manually enter the combined length of the green and blue wall to correctly enter the effect of the wing wall on the subject wall.

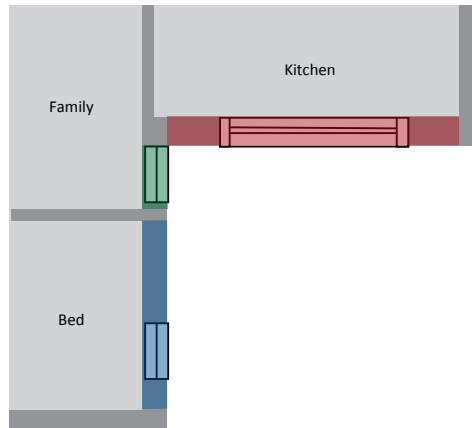


Figure 9-16 Wing wall shading for non-adjacent spaces

If the software tool does not automatically add wing walls, or the wing wall is something other than an adjacent dwelling wall, such as a nib wall, assessors will need to enter wing wall information for each wall it may affect. For manual measurement, ensure the drawings are correctly to scale, and suitable for measuring accurate distances relative to subject walls, or use nominated dimensions shown on the documentation.

Horizontal offset

The horizontal offset for wing walls is the distance from the edge of the subject wall/window (on the side that the wing wall projects) to the wing wall. For wing walls, offsets are always positive and relate to the distance from each end of the subject wall or window (assuming the user is standing in the dwelling looking out). The horizontal offset is relative to either the edge of the wall or the edge of the window, depending on the software tool used. Figure 9-17 shows an example of how horizontal offset measurements differ depending on the software tool. See the software tool manual for more modelling advice.

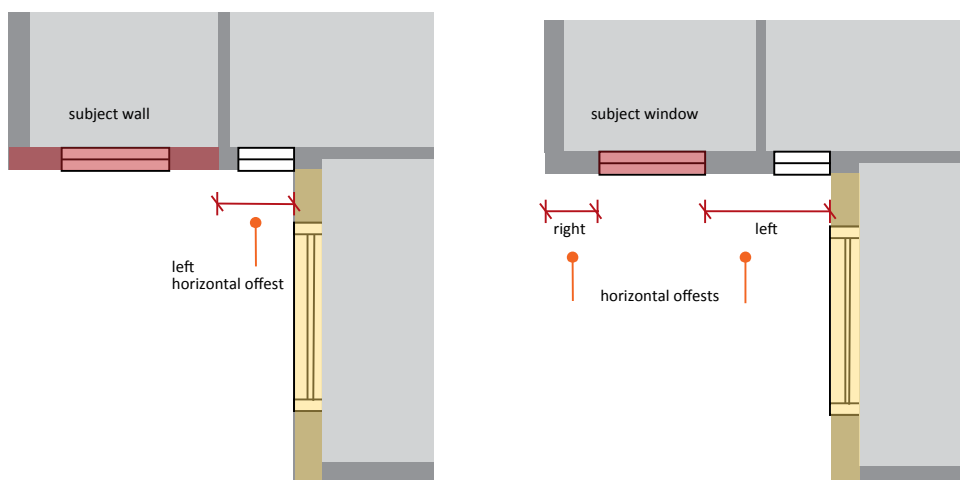


Figure 9-17 Horizontal offset wing wall measurements relative to subject wall or window

Vertical offset

The vertical offset for wing walls is the distance from the top of the subject wall/ window to the top of the wing wall. This may be a positive or negative number and is the same as external screens (see Section 9.3.1). If the wing wall is lower than the subject wall/window, the vertical offset entered is negative, and if it is above it is entered as a positive. If it is level, the vertical offset is 0. Again, this measurement differs depending on the software tool. Figure 9-18 shows an example of how vertical offset measurements differ depending on the software tool. See the software tool manual for more modelling advice.

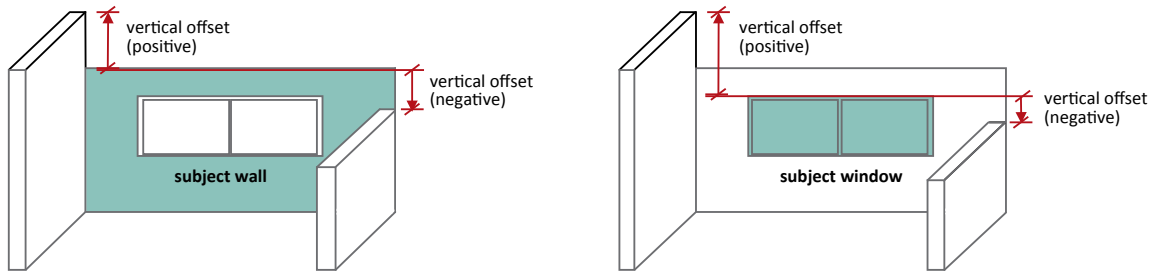


Figure 9-18 Vertical offset wing wall measurements relative to subject wall or window

Balcony walls

In the case of balconies, glazed verandahs, porticos or similar spaces, assessors must model these as wing walls on either side of the parent wall. This is because these are modelled primarily for the effect on ventilation, rather than that of shading or solar transfer. These attached balcony or glazed verandah walls are assumed opaque in the Chenath engine.

9h Balconies or similar spaces with solid, glazed or partially glazed walls to either side to either side of the parent wall, are to be modelled as wing walls.

Assessors must treat balcony walls with solid building elements directly in front of the parent wall as a vertical shading device (i.e. external screen), and model:

- 100% shading for the portion of the wall that is solid
- 10% shading for the portion of the wall that is glazed (**Tech Note clauses 10.9 and 10.10**)

Balcony walls parallel to the dwelling wall are modelled primarily for the effect on shading, and therefore are to be modelled as a vertical shading device with 100% shading for the solid wall portion and 10% shading for the glazed wall portion. This 10% is specified given a glazed wall will provide minimal shade to the dwelling, compared to a solid material. The current Chenath engine assumptions do not calculate the impact of solar transfer for these glazed elements like it does for windows. However, this is currently being explored for potential inclusion in future chenath updates.

Outdoor living areas such as verandahs, porticos, sunrooms, winter gardens, conservatories or balconies, may need to be included in the zoning of the dwelling if they are capable of being fully enclosed by solid construction elements (e.g. walls, windows, bi-fold or sliding doors) and is specified as a conditioned space (i.e. mechanically heated or cooled). If the space is semi-open, enclosable only be fabric blinds for example, or shown as unconditioned, they are required to be modelled for shading purposes only. (**Tech Note clause 5.1**)

9.4 Neighbouring buildings

Neighbouring buildings may affect the dwelling, particularly in regard to shading. All features detailed on the documentation that may cause a sun obstruction must be modelled.

9d Neighbouring buildings and surrounding topographical features detailed which obstruct the sun must be modelled, including the impact of level changes and retaining walls.

As mentioned in Section 9.3.1, guidance for this includes that on level ground, assessors must model at least all single-storey neighbours and features within 10m and two storey neighbours or features within 20m. (Tech Note clause 10.5)

It is best practice to model all sun obstructions to encourage accurate modelling. If a feature may cause a sun obstruction because of topography, building site levels and the location/orientation of the dwelling, it must be modelled. Assessors are to use their judgement about the impact of such features and keep a record of the supporting information.

Where the documentation does not show surrounding features and neighbours, assessors must investigate further to establish if any are present that will cause an obstruction to the dwelling being assessed.

9f Where information on neighbouring buildings is not shown on the documentation, assessors must request the documentation be updated or obtain supporting evidence of existing neighbouring buildings for the purposes of modelling. (Tech Note clause 10.7)

Assessors could request this information from the client, either as supporting documentation or as updated documentation drawings. Alternatively, the assessor could research online platforms, such as maps and street view, and this information can be considered for the purpose of NatHERS modelling. If assessors source this information other than from the documentation drawings, supporting evidence must be obtained and kept.

9g Where neighbouring buildings are unknown, because the dwelling is located in a new development site, provisions must be applied. (Tech Note clause 10.8)

The provisions to apply are as follows:

- The **size of the neighbouring building** is to fit into a square or rectangle having the same floor, wall and roof height (e.g. a two-storey building should presume a two-storey neighbour), length and width as the one being modelled; no other allowance is to be made for courtyards or building offsets of the dwelling being rated. (Tech Note clause 10.8.1)
- The **setback from the street** is to have the same setback from the street as the dwelling being rated. (Tech Note clause 10.8.2)
- The side and rear **fence heights** are to be 1.8 m if local planning requirements are unknown. (Tech Note clause 10.8.3)
- **Height changes** are to include all known level changes between lots that will affect the rating. (Tech Note clause 10.8.4)
- **Neighbouring building's setbacks** must be located parallel to the fence line and at a distance equal to the shortest distance between the rated building and the fence line. This setback is to be calculated independently for each boundary where a neighbour is required to be modelled. Ignore dwellings to the south except if the dwelling is north of the Tropic of Capricorn (see 9e). (Tech Note clause 10.8.5)

Figures 9-19 and 9-20 show examples of how to apply default settings when information for the neighbouring dwellings are unknown. The dark shaded area is the dwelling being modelled, and the light grey shapes refer to the default neighbouring dwellings. The yellow shaded area shows the rectangular size to use for neighbouring dwellings (addressing item **i.** of 9g).

Dimensions **a** and **b** represent equal distance setbacks from the shared boundary line for neighbours to each side of the dwelling. The dimensions are taken from the shortest distance between the dwelling and boundary, and this should remain parallel to the boundary line for the length of the dwelling. Dimension **c** in both figures shows the rear setback to be calculated using the same method to dimensions **a** and **b**. Dimensions **a**, **b** and **c** are to be calculated independently based on each of their respective boundaries. Dimension **d** demonstrates applying the same setback from the street for each neighbouring dwelling to that of the dwelling being modelled (addressing item **v.** of 9g).

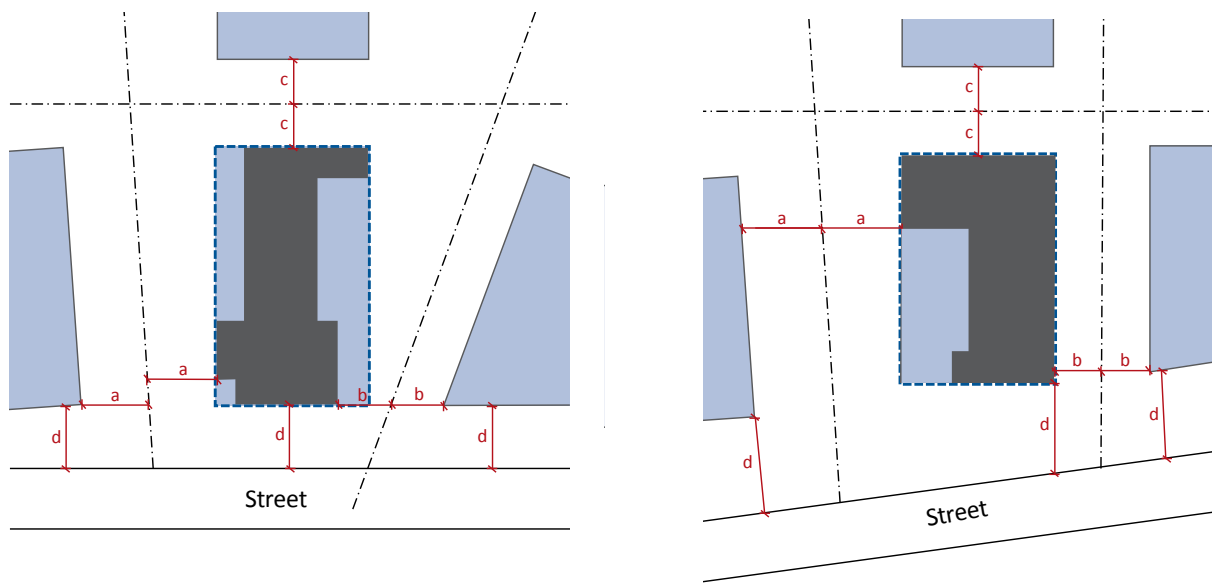


Figure 9-19 Applying neighbouring buildings setback example 1 (left)
Figure 9-20 Applying neighbouring buildings setback example 2 (right)

9.5 Vegetation

Vegetation can have significant shading implications. It can also provide windbreaks and assist with cooling by transpiration, and ground cover or wall vines can insulate against summer heat and reduce reflected radiation.

9i Trees with an existing preservation order or heritage protection must be modelled. (Tech Note clause 10.11)

Only the shading effects from trees with an existing preservation order or heritage protection are to be modelled in NatHERS assessments for compliance purposes.

Interested clients may also request an analysis or inclusion of the impact of vines and suggested future plantings to review the potential effect on different rooms in the dwelling. In this case, the assessor can model these to provide advice to clients, but unless the vegetation has an existing preservation order or heritage protection, this assessment cannot be used to produce a NatHERS certificate for regulatory purposes.

The canopy of protected or heritage-listed trees must be indicated with a dimension or drawn to scale on the documentation. Supporting information listing the existing preservation order or heritage listing must be provided to the assessor, and may include a species shading schedule.

To model vegetation in NatHERS software tools, the assessor must create a vertical shading feature measuring the full tree height from the ground and the width of the tree canopy. The canopy width used for the ‘shading box rectangle’ and the species shading schedule used to reflect the monthly shading factor to allow for deciduous trees, should be provided by the client in the supporting information.

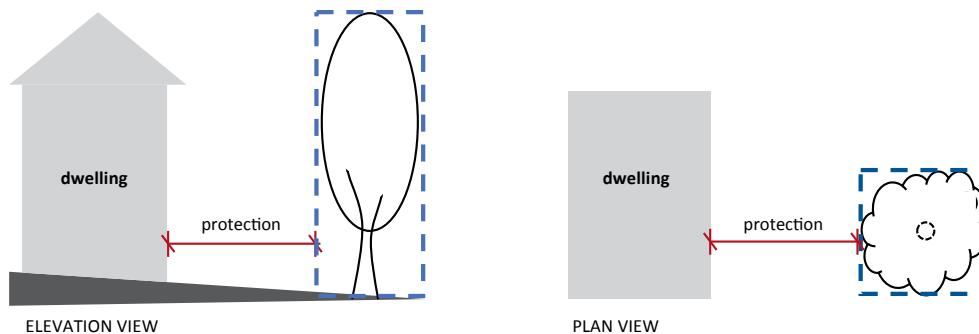


Figure 9-21 Example guidance for modelling the extent of heritage listed trees



FINALISING THE ASSESSMENT

10

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FINALISING THE ASSESSMENT

There are various stages to finalising a NatHERS assessment including interpreting and adjusting the results (if necessary), and producing a certificate and stamping the documentation.

Summary of key requirements

This handbook is intended to be a helpful resource for all assessors. When conducting assessments, assessors must follow the requirements of the current NatHERS Technical Note and the relevant state or territory requirements.

- 10a** Assessors must ensure that any recommendations are agreed to by the client and any amendments are included in the final drawing set and documentation.
- 10b** Assessors must ensure that all the information used in the rating is on the final set of approved drawings. This detail may be documented by the architect or building designer as:
 - graphical representations (standard industry drawing of wall types, material types, etc.
 - notations either in a list or throughout the drawing set.
- 10c** For Class 2 buildings, each individual dwelling or unit must have an individual NatHERS Certificate, and the entire building must have a NatHERS summary Certificate.
- 10d** Buildings that are combined or share a lot (e.g. by a bridge, an enclosed walkway or a joint underground carpark), may when requested by the clients, be assessed together with a single Class 2 summary certificate, where NCC requirements for combined buildings are met.
- 10e** Before stamping drawing sets with the NatHERS QR code stamp or issuing a NatHERS certificate, assessors must confirm all requirements detailed in the NatHERS Technical Note has been met; and that the information in the assessment aligns with the design documentation.
- 10f** If any details are not present on the drawings, or differ from the rating assessment, the assessor must return the drawing set to the client or author of the drawings for the information to be added and new drawing versions issued.
- 10g** For all dwellings, the unique NatHERS QR code stamp linking the certificate to the drawings and documentation is to be electronically added to each page of the documentation that relates to the assessment (e.g. site plan, floor plans, elevations, sections and specifications).
- 10h** Assessors must follow directions from their AAO and include their AAO stamp when required.
- 10i** For Class 2 dwellings, the NatHERS stamp must be the average dwelling and is to be stamped on each page of the documentation that relates to the assessments.

10.1 Interpreting results

Once an assessment has been completed, it is important to interpret the results. For example, this may be to adjust the design to meet the particular rating goal (see Section 1.5), or to assess existing conditions for the intent of upgrade recommendations.

There are three main outputs produced by NatHERS software tools. These are:

- star rating
- adjusted annual heating load (MJ/m²)
- adjusted annual cooling load (MJ/m²).

Although the star rating indicates compliance and the rating goal if required, the heating and cooling loads hold the information needed to interpret and adjust the star rating results.

Interpreting the results has two main steps:

- **Determining if the results are correct:** Assessors should consider whether the results are consistent with what would be expected based on the dwelling design, climate, orientation, materials, glazing, insulation and other factors.
In a cold climate, the heating load should be greater than the cooling load, as dwellings in colder areas are usually focused on keeping warm in winter. The use of heaters to maintain comfort is expected.
In a warm climate, the cooling load should be higher than the heating load, as dwellings in warmer areas are usually focused on keeping cool in summer (and sometimes winter). The use of artificial cooling such as air-conditioning is expected.
In some locations, where the climate is mild, the loads should almost be equal.
- **Checking data:** If the results are not what should be expected, it is important to ensure the data entered is accurate and consistent with the documentation.

Once the data entry and assessment has been reviewed and are correct, assessors need to decide in collaboration with the client, whether the results are within the parameters of the relevant compliance requirements or rating goal, and whether adjustment of the design is needed.

If the assessor and the client decide an adjustment is needed, the steps in the following section should be followed. Some general information about thermal performance is provided in Chapter 1.

10.2 Improving a rating

There are a series of steps to follow to adjust the rating results.

When considering these steps, assessors should remember that any adjustment should still take into account:

- **regulatory requirements**—adjustments should be made within state or territory jurisdictional requirements and compliance, and within the application of the National Construction Code.
- **liveability**—adjustments should not be made if they will reduce comfort or amenity for the occupants. For example, suggesting an unreasonable reduction in window size or placement, or reducing ceiling heights to an uncomfortable level.
- **feasibility** (can be built, is cost effective, etc.)—adjustments should be feasible or the design fully adjusted to make them feasible. For example, specifying higher insulation thickness without adjusting wall cavity thickness will not be possible, or recommending products that cannot be installed or are unsuitable for the use suggested could lead to legal action.

10.2.1 Step 1: Review the heating and cooling loads of the initial rating

The first step to improve a rating is to review the heating and cooling loads from the rating, to identify whether it is the heating or cooling load (or a combination of both) that is driving the star rating result.

- If the heating load is much higher than the cooling load, then the winter cycle may be affecting the outcome and lowering the star rating.
- If the cooling load is much higher than the heating load, the summer cycle may be affecting the outcome and lowering the star rating.
- If the heating and cooling loads are close and the star rating is low, both summer and winter cycles may be affecting the star rating.

10.2.2 Step 2: Analyse the performance by zone

NatHERS software contains analysis tools that allow an assessor to analyse the performance of each zone and produce detailed annual temperature profiles along with other useful data. These tools allow comparisons by zone of internal temperatures, outdoor temperature, energy use, etc. This stage involves reviewing the detailed reports or the detailed simulation outputs, and identifying specific areas of interest. Depending on your software tool, this information may be displayed differently.

Once the areas of interest have been identified, an assessor can start to put together reasons why the zones have been affected (see Section 1.6). For example, the following scenarios may be identified:

- a very small zone is contributing a disproportionately high amount of energy to the overall result
- a zone, such as a bedroom, is consuming the most amount of energy where this would be expected more of a living area
- all zones are performing equally poorly, indicating there is a whole-dwelling issue, such as poor dwelling orientation, window placement and/or shading.

10.2.3 Step 3: Test improvement options

In this stage, assessors should apply a range of options depending on the results of steps 1 and 2, with reference to the principles of dwelling thermal performance (see Section 1.6) and tips on achieving the rating goal according to whether the issue is with the heating or cooling load (see Section 10.3).

It is best practice for assessors to test options on a base file and only make one change at a time. The base file (initial rating) should be saved separately and a copy should be used for analysis and testing. Assessors should record each test conducted. Recording this information in a table can be useful for incorporating possible changes into a report and/or discussing with the client.

The result of each change may also need to be evaluated for cost versus benefit, and a table can assist an assessor and client to see which changes are cost effective in relation to the impact they have on the rating. For example, if an expensive option such as double glazing only makes a difference of 5 Mj/m² per year, the assessor (and client) may decide the cost outweighs the benefit.

Table 10.1 Example analysis to explore rating improvement options

Run #	Inclusions	Heating	Cooling	Total	Star rating	Change in heating	Change in cooling	Change in total	Change in star rating	Cost
Base	Base specification	102	43	145	5					
2	Base + R 3.5 ceiling	80	40	120	5.5	22	3	25	0.5	\$\$
3	Base + dark roof	98	44	142	5	4	-1	3	0	\$
4	Run 2 + R 2.0 wall	65	35	100	6	15	5	20	0.5	\$

10.2.4 Step 4: Select the final inclusions

The process outlined in Step 3 should be repeated, in consultation with the client, until the design reaches the rating goal. Assessors can also consider options for going beyond the rating goal, because some minor design changes can deliver a much higher rating at no, or at a reduced, cost. For example, moving windows in a particular design from the east and west to the north wall of bedrooms can deliver a significant no-cost increase in the rating of the dwelling.

Consultations with the client may involve presenting:

- a single cost-effective and feasible option to achieve regulatory compliance
- several options for the client to select their preference
- a detailed analysis of rating options with a suggested option and reasons why
- some ratings and outputs to facilitate a discussion of options that could be tested to achieve the desired outcome (especially on a difficult or noncompliant rating)
- design advice (and associated rating evidence) to enable further design to take place (this is best if the assessor is involved early in the project).

10.2.5 Step 5: Amend the drawing set

10a Assessors must ensure that any recommendations are agreed to by the client and any amendments are included in the final drawing set and documentation. If details are missing from the drawings, they are to be returned to the client or author of the drawings for completion. (**Tech Note clauses 3.3 and 3.4**)

Assessors should return a marked-up set of drawings or a list of notations to the client or author to allow the drawings to be amended. The new drawings then become part of the formal documentation for certification and the new version number on the re-submitted drawings are the ones that should be cited on the NatHERS Certificate.

Assessors must not amend the drawings unless they are the original author.

10.3 Tips to achieving the rating goal

Options for adjusting the heating and cooling load are listed below. The lists are in no particular order. Assessors should be aware of the approximate financial impact of any suggestions, and free or low-cost options should be selected before more costly changes, depending on the budget and client preferences. For further information about cost savings options, see the NatHERS *Cost savings through building redesign* report:

www.nathers.gov.au/publications/research-report-cost-savings-through-building-redesign-part-1 and www.nathers.gov.au/publications/research-report-cost-savings-through-building-redesign-part-2.

10.3.1 Improving the heating load

If the heating load is much higher than the cooling load, the winter cycle may affect the outcome and lower the star rating. Options to improve this if possible at the relevant design stage, may include but is not limited to:

- selecting **dark colours** on the roof and external walls
- improving **dwelling sealing** including weather seals, draft stopper on exhaust fans and sealed downlights (or removing downlights) (note: the NCC contains requirements for sealing dwellings; ensure suggestions do not contradict these requirements)
- increasing wall, ceiling and roof **insulation**, including deleting downlights that create holes in the ceiling insulation coverage (insulation is a relatively cost-effective way of improving a rating and minimising energy transfer, however some high-performance ceiling and wall batts can be expensive and improving other elements such as glazing could prove more cost effective)
- insulating **internal walls** between conditioned and unconditioned spaces, including the wall between the house and the garage
- insulating **under floors** and using soft **floor coverings** such as carpet, cork, vinyl and floating timber to help to insulate the floor, or try deleting the carpet if the bedrooms or living areas face north and a thermal mass floor is included (discuss with the client the impact and role that removable rugs could play)
- ensuring the **glazing to floor area ratio** is moderate; depending on the glazing systems used
- using **glazing units** with a low U value (less than 4.0) and high solar heat gain coefficient (SHGC; more than 0.5); always use the best glazing the budget allows
- limiting **glazing** to the south (reduces heat loss) and/or increase glazing to the north (increases solar heat gain)
- decreasing the width of **shading** devices to allow more heat from the sun in during winter
- installing **operable shading** devices that allow shading in summer and maximum solar heat gain in winter
- decreasing **roof ventilation** (note: the NCC has requirements for roof spaces that are not ventilated; exhaust fans must be ducted externally to prevent condensation in the roof, which can ultimately lead to material decay and structural failure; ensure suggestions do not contradict these requirements)
- decreasing **subfloor ventilation** (note: the NCC contains minimum ventilation requirements for areas under raised floors; ensure your suggestions do not contradict these requirements)
- decreasing **thermal mass**, as the climate and sun hours available may not be enough to heat the materials sufficiently
- investigating the use of **under-slab insulation** or a **waffle pod slab** (a waffle pod slab will not significantly affect the cost, but the design provides both insulation and ground coupling and will benefit the rating in both summer and winter)

- re-positioning the dwelling's **orientation or windows** to ensure living areas and/or the longer face of the dwelling have north-facing windows
- **re-designing** to incorporate northern orientation of living areas, zoning of the dwelling and suitable construction and materials.

10.3.2 Improving the cooling load

If the cooling load is much higher than the heating load, the summer cycle may affect the outcome and lower the star rating. Options to improve this may include but not limited to:

- selecting **light colours** on the roof and external walls
- using **reflective insulation** in the walls and roof (reflecting the heat away from the dwelling reduces the amount of energy available for transfer through the building elements)
- adding **sarking** under a tiled roof
- using **hard floor coverings** including polished concrete and ceramic tiles (these help to keep the spaces cooler if they do not receive direct sun)
- ensuring the **glazing to floor area ratio** is moderate; a value of between 20% and 35% is recommended, depending on the glazing systems used
- using **glazing units** with a moderate U value (more than 4.0) and low SHGC (less than 0.5); always use the best glazing the budget allows
- limiting **glazing** (or adding shading devices) to the east and west to reduce heat gain
- installing or increasing the width of **shading** devices, especially to the north, west and east
- installing **operable shading** devices that allow full shading in summer and maximum solar gain in winter where appropriate
- relocating doors and other **openings** to maximise cross-ventilation paths from one side of the dwelling to the other
- installing **ceiling fans** to mechanically circulate and move the air inside the dwelling (note: there may be variations between how states and territories treat ceiling fans in the NCC; ensure your suggestions do not contradict these requirements)
- increasing roof **ventilation** using whirly birds and eave vents (note: eave vents are necessary for whirly birds to function correctly, and the NCC also contains fire safety requirements for sealing eaves; ensure suggestions do not contradict these requirements)
- increasing **thermal mass** by installing feature walls or changing the floor construction to a slab-on-ground design, which 'couples' the dwelling with the earth and provides stable temperatures under the floor
- investigating the use of **under-slab insulation** or a **waffle pod slab** (a waffle pod slab will not significantly affect the cost, but the design provides both insulation and ground coupling and will benefit the rating in both summer and winter).

10.3.3 Improving both the heating and cooling loads

If both loads require adjustment, a combination of the previous suggestions should be tested.

10.4 Certification

When an assessor has finalised the design and rating, a NatHERS certificate can be produced to demonstrate the dwelling has achieved compliance with the NCC or other requirements, and generate stamps to include on the dwelling documentation.

Assessors are to supply the client with stamped plans that include the NatHERS QR code and the AAO stamp (if required), and a hard copy or electronic format (PDF) of the NatHERS Universal Certificate.

10.4.1 Certification requirements

The following items must be produced for certification of a NatHERS assessment:

- a set of drawings (see Section 1.2.1), comprising of (at a minimum):
 - site plan
 - floor plan/s
 - elevations
 - sections
 - electrical or lighting layout/information (See **Tech Note clause 9.4**)
 - window schedule or information (including size, glass and frame type and opening style)
- construction material details and/or specification (if in addition to the information provided on drawings)
- NatHERS stamp (stamped on each page of the documentation that relates to the assessment)
- QR code (within the certificate and stamp)
- AAO stamp (if required by the AAO)
- NatHERS Certificate (previously referred to as the 'Universal Certificate').

10b Assessors must ensure all the information used to produce the rating is on the final set of approved drawings. This detail may be documented by the architect or building designer as:

- graphical representations (standard industry drawing of wall types, material types, etc).
- notations either in a list or throughout the drawing set (for example, the designer may notate the insulation specification details on the sections or roof plan, rather than providing an additional specification document).

Assessors may want to consider how the NatHERS Certificate and stamped documentation are going to be used, and to ensure any modelling assumptions that have been made are well documented throughout the process and communicated clearly. Additionally, it may be appropriate for assessors to provide the stamped drawings and NatHERS Certificate together as one pdf package for example, to ensure the documents are kept together.

10.4.2 Producing a certificate

The NatHERS software tools can be used in conjunction with an online certification portal to produce a certificate once all the data has been entered and the design finalised. Assessors should refer to the relevant software tool manual on how to generate the certificate.

10c For Class 2 buildings, each individual dwelling or unit must have an individual NatHERS Certificate, and the entire building must have a NatHERS summary Certificate.

Each dwelling in a Class 2 dwelling must have an individual NatHERS Certificate and star rating. In addition to this, each building requires a NatHERS summary Certificate, which produces an average star rating and lists all dwellings included. Where a number of Class 2 multi-unit buildings are located in close physical proximity as part of the same development, or where the strata plan identifies separate lots, a Class 2 summary certificate must be completed for each building/lot separately. (**Tech Note clause 11.6.1**)

Many states and territories require a minimum star rating for each individual dwelling, as well as an average rating for all the dwellings in a building. The summary certificate must show this information. Please note, requirements differ between jurisdictions and assessors should refer to specific requirements of the relevant jurisdiction.

Some examples of the current NatHERS Certificate (formatted in the 'Universal Certificate' layout), are shown in Figures 10-1 and 10-2 below. NatHERS accredited software tools will be transitioning to a new NatHERS Certificate and layout. Once the new NatHERS Certificate is available, examples will be provided on the NatHERS website www.nathers.gov.au.

Nationwide House Energy Rating Scheme* Certificate
 Certificate number: 87654321 Date of certificate: 12 April 2014 ★ Star rating: 6.5

Assessor details
 Accreditation number: 12345678
 Name: Fred Williams
 Organisation: Capital Building Assessors
 Email: frederick.williams@cbassessors.com.au
 Phone: 1234 567 890
 Declaration of interest: Employed by designer of the building
 Software: FirstRate5 v5.5.11
 AAO: ABSA

Overview
6.5
 The more stars the more energy efficient
NATIONWIDE HOUSE ENERGY RATING SCHEME
 Predicted annual energy load for heating and cooling based on standard occupancy assumptions
1234 MJ/m²
 For more information on your dwelling's rating see: www.nathers.gov.au

Dwelling details
 Address: Unit 15, 237 Edwina Mountbatten Drive
 Suburb: West Wyndham
 State: NSW Postcode: 2345
 Type: New dwelling NCC Class: 01
 Lot/DP number: 9/53 Exposure: Suburban NatHERS climate zone: 14

Key construction and insulation materials
 Construction: Brick veneer, Ceramic tile roof, Slab on ground
 Insulation: R1.5 wall insulation, R3.5 ceiling insulation
 Glazing: Timber frame, Single glaze clear

Ceiling penetrations
 Sealed: 5
 Unsealed: 18
 TOTAL: 23
 Principle downlight type: Compact fluorescent

Net floor area (m²)
 Conditioned: 55
 Unconditioned: 23
 Garage: 12
 TOTAL: 90

Annual thermal performance loads (MJ/m²)
 Heating: 576
 Cooling: 658
 TOTAL: 1234

Window selection – default windows only
 Note on allowable window values: With a 10% tolerance to the nominated SHGC window values shown on page 2, the following ratings are achieved:
 -10% SHGC 6.3
 +10% SHGC 6.6
 NB: This tolerance ONLY applies to SHGC, the U-value can always be lower but not higher than the values stated on page 2.
 If the rating listed above falls below 6.0 stars or the required rating, then the window with this tolerance can NOT be selected.

Plan ref/date: Ref24/88
 Prepared by: Wyndham Sustainable Homes

* Nationwide House Energy Rating Scheme (NatHERS) is an initiative of the Australian, state and territory governments. For more details see www.nathers.gov.au Page 1 of 5

House Energy Rating — NON-ACCREDITED*
 Rating document number: 87654321 Date of rating: 12 April 2014 Star rating: 6.5

Completed by
 Name: Fred Williams
 Organisation: Capital Building Assessors
 Email: frederick.williams@cbassessors.com.au
 Phone: 1234 567 890
 Declaration of interest: Employed by designer of the building
 Software used: FirstRate5 v5.5

Overview
6.5
 The more stars the more energy efficient
NATIONWIDE HOUSE ENERGY RATING SCHEME
 Predicted annual energy load for heating and cooling based on standard occupancy assumptions
1234 MJ/m²
 For more information on your dwelling's rating see: www.nathers.gov.au

Dwelling details
 Address: Unit 15, 237 Edwina Mountbatten Drive
 Suburb: West Wyndham
 State: NSW Postcode: 2345
 Type: New dwelling NCC Class: 01
 Lot/DP number: 9/53 Exposure: Suburban NatHERS climate zone: 14

Key construction and insulation materials
 Construction: Brick veneer, Ceramic tile roof, Slab on ground
 Insulation: R1.5 wall insulation, R3.5 ceiling insulation
 Glazing: Timber frame, Single glaze clear

Ceiling penetrations
 Sealed: 5
 Unsealed: 18
 TOTAL: 23
 Principle downlight type: Compact fluorescent

Net floor area (m²)
 Conditioned: 55
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 TOTAL: 90

Annual thermal performance loads (MJ/m²)
 Heating: 576
 Cooling: 658
 TOTAL: 1234

Window selection – default windows only
 Note on allowable window values: With a 10% tolerance to the nominated SHGC window values shown on page 2, the following ratings are achieved:
 -10% SHGC 6.3
 +10% SHGC 6.6
 NB: This tolerance ONLY applies to SHGC, the U-value can always be lower but not higher than the values stated on page 2.
 If the rating listed above falls below 6.0 stars or the required rating, then the window with this tolerance can NOT be selected.

Plan ref/date: Ref24/88
 Prepared by: Wyndham Sustainable Homes

* This rating has been completed by a non-accredited rater. For more details see the Australian Government Nationwide House Energy Rating Scheme (NatHERS) website www.nathers.gov.au Page 1 of 5

Figure 10-1 Universal Certificate produced by an Accredited Assessor (left) and Figure 10-2 Universal Certificate produced by a non-accredited Assessor (right)

10d Buildings that are combined or share a lot (e.g. by a bridge, an enclosed walkway or a joint underground carpark), may when requested by the client, be assessed together with a single Class 2 summary certificate, where NCC requirements for combined buildings are met. (Tech Note clause 11.6.2)

This requirement means that each dwelling (or sole-occupancy unit) will still be required to have individual certificates, but only one summary certificate that covers all the buildings is required. This is to only occur when requested by the client, as the client needs to be mindful of NCC and state/territory jurisdictional requirements that may be affected by this decision for compliance purposes.

10.4.3 Stamping requirements

10e Before stamping drawing sets with the NatHERS QR code stamp or issuing a NatHERS certificate, the assessor must confirm all requirements detailed in the NatHERS Technical Note has been met; and that the information in the assessment aligns with the design documentation. In addition to this, the assessor must ensure all provisions (previously termed 'defaults') are noted in the 'additional notes' section of the NatHERS Certificate. (**Tech Note clause 11.1**)

To be complete, the drawing set must include the requirements outlined in the NatHERS **Technical Note clause 2.1** (also noted in Section 1.2.1 of this handbook).

10f If any details are not present on the drawings, or differ from the rating assessment, the assessor must return the drawing set to the client or author of the drawings for the information to be added and new drawing versions issued. (**Tech Note clause 3.4**)

Details on the drawing set and relevant schedules, addendums and specifications must align with the assessment and vice versa. The only exception to this is where provisional values have been applied (see Section 1.3).

10.4.4 Stamping of design documentation

10g For all dwellings, the unique NatHERS QR code stamp (sometimes also referred to as a mini-certificate) linking the certificate to the drawings and documentation is to be electronically added to each page of the documentation that relates to the assessment (e.g. the site plan, floor plans, elevations, sections and specifications). The stamp must not obscure any information on the plans or the mark of any other practitioner. (**Tech Note clause 11.2**)

10h Assessors must follow directions from their AAO and include their AAO stamp when required, generally below the NatHERS stamp, to verify their accreditation currency. The AAO stamp cannot be a larger size than the NatHERS stamp or obscure the NatHERS stamp. (**Tech Note clause 11.3**)

10i For Class 2 dwellings, the NatHERS stamp must be the average dwelling and is to be stamped on each page of the documentation that relates to the assessments. (**Tech Note clause 11.4**)

This glossary is intended to assist readers with understanding terms and acronyms mentioned throughout the handbook. Definitions are expressed within the context of energy efficiency and conducting a NatHERS thermal performance assessment.

<p>A- & B-type windows (NatHERS definition)</p>	<p>NatHERS terminology used to define which default window should be selected for a specific openable sash.</p> <p>A- and B-type windows do not necessarily align with window IDs in NatHERS software tools, and have no association or significance to Australian Fenestration Rating Council ratings or window manufacturers. For typical classifications of A- and B-type windows, refer to ‘Chapter 7—Windows’ of this handbook.</p>
<p>air tightness</p>	<p>The level of uncontrolled air movement or infiltration into and out of a building, measured as the air tightness metric of air changes per hour (ACH).</p> <p>For example, ACH50 is the number of times the air volume in a building changes at 50 pascals of pressure. The Chenath engine underpinning NatHERS software tools automatically calculates air tightness infiltration based on the terrain specified, stack and wind infiltration factors, and weather file data (e.g. hourly wind speed).</p>
<p>angle of incidence</p>	<p>In relation to windows, the angle that solar radiation strikes glass.</p> <p>When the sun is perpendicular to the glass it has an angle of incidence of 0°. As the sun angle increases, the effective area of exposure to solar radiation reduces, more solar radiation is reflected and less is transmitted through the glass.</p>
<p>artificial heating or cooling</p>	<p>Heating or cooling that is not from a passive heating or passive cooling source, such as mechanical heating, and cooling equipment or appliances.</p>
<p>assessor</p>	<p>The person assessing the energy rating using a NatHERS software tool to determine the thermal performance of a dwelling. An assessor is sometimes referred to as a thermal performance assessor (or TPA).</p> <p>To practice as a NatHERS Accredited Assessor, assessors must hold a Certificate IV in NatHERS Assessment qualification and maintain accreditation with an assessor accrediting organisation.</p> <p>Accredited assessors will have also completed training in one or more relevant NatHERS-accredited software tool(s).</p> <p>State and territory building regulators have specific requirements as to whether assessments for compliance purposes must be completed by an accredited assessor or can be completed by non-accredited assessors.</p> <p>In this handbook, the term ‘assessor’ refers to accredited and non-accredited assessors, unless stated otherwise.</p>

assessor accrediting organisation (AAO)	A professional organisation with responsibility for accrediting assessors and ensuring they deliver reliable and consistent energy ratings. The AAOs currently operating in Australia are listed on www.nathers.gov.au
Australian Building Codes Board (ABCB)	A Council of Australian Government (COAG) standards writing body that is responsible for the development of the National Construction Code .
Australian Building Sustainability Association (ABSA)	An assessor accrediting organisation responsible for accrediting assessors and ensuring that they deliver reliable and consistent energy ratings.
Australian Fenestration Rating Council (AFRC)	The Australian arm of the National Fenestration Rating Council . The role of the AFRC is to develop, administer and approve comparative energy and related fenestration rating programs that serve the public and satisfy the needs of its private sector partners. They do this by providing fair, accurate, credible and user-friendly information on fenestration product performance.
Australian Glass and Window Association (AGWA)	A membership association of the Australian fenestration industry, comprising nearly 600 window manufacturers and industry suppliers throughout Australia. In 2019, Australian Window Association (AWA) merged with Australian Glass and Glazing Association (AGGA) to form AGWA.
Australian Standard	Documents that set out specifications, procedures and guidelines that aim to ensure that products, services and systems are safe, consistent and reliable. Australian Standards® are developed by a national standards body (like Standards Australia) or other accredited bodies, or are adoptions of international standards. These standards become mandatory when referred to in Australian or state and territory legislation. For Australian Standards® referenced in legislation, visit www.standards.org.au . Standards Australia is recognised through a memorandum of understanding with the Australian Government as the peak nongovernment standards development body in Australia. Standards Australia has produced a Glossary of Building Terms (HB 50—2004) of approximately 11,000 construction industry terms.
average energy consumption per unit area per year (MJ/m²/yr)	The thermal energy load measurement used for NatHERS star bands relevant to each climate zone . It measures a predicted energy consumption per unit area—megajoules per square metre per year.
buildability	The measure of the ease and efficiency with which dwellings can be built. Also sometimes referred to as constructability.
Building Code of Australia (BCA)	Minimum technical provisions for the design and construction of buildings and other structures in Australia. The BCA forms volume one and volume two of the National Construction Code . It is produced and maintained by the Australian Building Codes Board on behalf of the Australian Government and state and territory governments. State and territory variations from the national provisions are included in appendixes within each volume of the National Construction Code .
Building Designers Association Victoria	An assessor accrediting organisation responsible for accrediting assessors and ensuring that they deliver reliable and consistent energy ratings.
Building Sustainability Index (BASIX)	An online assessment tool used as part of the development application process in New South Wales when seeking approval to build. BASIX assesses elements of a proposed design against sustainability targets and is implemented under the <i>Environmental Planning and Assessment Act 1979</i> .

Chenath engine	<p>The software engine developed by CSIRO that underpins the NatHERS Benchmark Tool and other accredited NatHERS software tools.</p> <p>The engine is based on decades of scientific research into the way residential buildings operate in Australian conditions, and uses climate data and average user behaviour, among other factors, to predict the annual energy loads for dwellings. Factors used in the engine, such as underlying assumptions, air infiltration and how air flow is modelled, can be found in the Chenath repository at https://hstar.com.au/Home/Chenath.</p>
clerestory window	<p>A window or series of windows along the top of a dwelling’s wall, usually at or near the roof line and commonly considered above ‘eye level’.</p> <p>Clerestory windows are a type of fenestration or glass window placed to let in light or allow ventilation.</p>
climate zone (NatHERS definition)	<p>Regions of similar climatic conditions.</p> <p>NatHERS divides Australia into 69 different regions of similar climatic conditions; each is referred to as a NatHERS climate zone. Climate zones are generally aligned with postcode boundaries for convenience, except where there is likely to be a topographical or other feature within the postcode area that affects the local climate. An interactive climate zone map is available at www.nathers.gov.au.</p>
Commonwealth Scientific and Industrial Research Organisation (CSIRO)	<p>An Australian Government corporate entity responsible for scientific research to improve the economic and social performance of industry for the benefit of the community.</p> <p>CSIRO is constituted by and operating under the provisions of the Science and Industry Research Act 1949. CSIRO developed and maintains the Chenath engine used in NatHERS software tools.</p>
compact fluorescent lamp	<p>A type of lamp using a phosphor-coated tube technology, designed to replace an equivalent sized general-service incandescent lamp/globe with greater efficiency and life span.</p>
conduction	<p>The transfer of heat from one substance to another by direct contact.</p> <p>Conductive loss or gain is the loss or gain of heat directly through contact with a person, object or floor.</p>
construction systems	<p>The combination of materials used to build the main elements of a dwelling—roof, floor and walls.</p>
convection	<p>The transfer of heat though the circulation of currents from one region to another by the movement of fluids (gas or liquid).</p> <p>In dwellings, convective heating is the process of using the natural circulation of air across a heat source to warm a space. Convective cooling (or stack ventilation) is the upward or downward movement of air through openings in the dwelling envelope, resulting from thermal buoyancy and/or negative pressure generated by the wind when there is a height difference between the air intake and the air outlet.</p>
cooling load	<p>The predicted amount of heat energy that would need to be removed from a space (through cooling) to maintain the temperature in an acceptable range.</p> <p>Cooling and heating loads, sometimes referred to as ‘thermal loads’, take into account the dwelling’s construction and insulation (including floors, walls, ceilings and roof), and the dwelling’s glazing and opening details (including size, performance and shading).</p>

<p>custom window (NatHERS definition)</p>	<p>Terminology used by NatHERS to define a fenestration product on the market that has obtained an Australian Fenestration Rating Council (AFRC) rating, has properties and description detailed on the Window Energy Rating Scheme website and has been included in the AFRC Custom Window Library used in NatHERS software tools.</p> <p>Custom windows should not be confused with ‘custom-made’ products, or a product that may be available on the market or has obtained an AFRC rating but has not been included in the AFRC window library file used in NatHERS software tools.</p>
<p>default window (NatHERS definition)</p>	<p>Terminology used by NatHERS to define a generic fenestration product considered representative of a specific range of window products, whose properties have been derived by statistical methods and is included in the Default Window Library in NatHERS software tools.</p> <p>Previously known as ‘generic windows’, these products have no correlation with actual fenestration products supplied by any company, but allow a thermal assessment to be conducted when the actual fenestration product is not known or the custom window is not available in the Custom Window Library.</p>
<p>documentation</p>	<p>The set of materials that describe the dwelling to be built and are used in a NatHERS assessment. Documentation consists of plans, drawings, specifications, schedules and addendums that may relate to the rating or assessment. The terms ‘documentation’, ‘design documentation’, ‘drawing sets’ and ‘plans’ may be used interchangeably in this handbook.</p>
<p>dwelling</p>	<p>A self-contained unit of accommodation used by its occupants to reside in.</p> <p>For the purposes of NatHERS and this handbook, this refers to a house, unit or apartment that is undergoing a NatHERS assessment.</p>
<p>dwelling envelope</p>	<p>The physical separator between the dwelling being assessed and the outside environment or neighbour.</p> <p>The dwelling envelope comprises a dwellings’ walls/windows/doors, roofs and floors, and includes the resistance to air, water, heat, light and noise transfer. When modelling in NatHERS software tools, the dwelling envelope includes both conditioned and unconditioned zones. This is different to the National Construction Code definition of a building/thermal envelope, which is defined as the buildings’ fabric that separates artificially heated and cooled spaces from the exterior of the building or other spaces that are not artificially heated or cooled.</p>
<p>emissivity</p>	<p>The amount of energy radiated from a material’s surface.</p> <p>Emissivity is a measure of how reflective a surface is; it is expressed as a number between 0 and 1. Low emissivity is more reflective, high emissivity is less reflective. Lower emissivity will produce a higher total R value in the adjacent enclosed air space.</p>
<p>energy efficiency</p>	<p>The ratio of the amount of energy required to provide a given service.</p> <p>For example, a 5 watt LED lightbulb produces the same amount of light as a 75 watt incandescent lightbulb, while using 93% less energy, resulting in higher energy efficiency. An energy-efficient dwelling will use less energy to achieve thermal comfort compared with a dwelling that is less energy efficient.</p>
<p>energy transfer</p>	<p>The movement of energy through the dwelling envelope.</p> <p>Energy transfer occurs mainly because of conduction.</p> <p>Energy transfer can also occur by radiation from surfaces and through windows, and by convection, such as in roof spaces. Conductive energy transfer occurs through walls (both external and internal), floors, ceilings roofs, glazing and skylights. Controlling energy transfer through a dwelling means controlling the insulating qualities and/or size of these various elements, the dwelling design (i.e. grouping similar zones) and dwelling shape (i.e. less external wall area).</p>

fenestration	Any glass opening in a dwelling envelope , most notably windows, doors, louvres and skylights.
frame fraction	The ratio of frame to glass in a fenestration product.
ground reflectance	The amount of solar radiation reflected by the ground. Reflectance of the surface of a material is its effectiveness in reflecting radiant energy.
heating load	The predicted amount of heat energy that would need to be added to a space (through heating) to maintain the temperature in an acceptable range. Heating and cooling loads, sometimes referred to as ‘thermal loads’, take into account the dwelling’s construction and insulation (including floors, walls, ceilings and roof), and the dwelling’s glazing and opening details (including size, performance and shading).
infiltration	Uncontrolled air movement due to breaks in the dwelling’s envelope, such as air leakage through construction gaps and unsealed penetrations. For example, unsealed downlights can create an uncontrolled infiltration path by allowing air to escape from the rooms to the roof. This affects the air tightness of the dwelling. Infiltration should not be confused with controlled air movement or ventilation .
insulated glass unit (IGU)	Combination of two or more glazing layers sealed with a gas-filled or vacuum gap between the layers (e.g. double or triple glazing).
k value	Thermal conductivity , or the measure of the rate of heat flow through a material and the ability of a material to allow the flow of heat from its warmer surface through the material to its colder surface. k-value is determined as the heat energy transferred per unit of time and per unit of surface area divided by the temperature gradient, which is the temperature difference divided by the distance between the two surfaces (the thickness of the material), expressed in watts per meter-kelvin. A material with a low k-value transmits low levels of heat (good insulator); a material with a high k-value transmits high levels of heat (poor insulator).
light emitting diode (LED)	A form of lighting that illuminates through the movement of electrons in a semiconductor material.
low emissivity (low e) glass	A type of glass that has a low thermal emissivity coating applied to reduce the transmission of heat.
mullion	A vertical element of a window frame that forms a division between units of a window, door or screen. A mullion can be used decoratively, or to provide added rigid support to the glazing of large glass windows.
NatHERS Certificate	A document produced by NatHERS-accredited software tools that summarises the predicted thermal performance of a dwelling and lists the features contributing to the calculated NatHERS star rating . NatHERS certificates are produced by an accredited NatHERS assessor or a non-accredited assessor, and are primarily used to verify compliance with the National Construction Code . NatHERS previously referred to this as the NatHERS Universal Certificate, or UC.
National Construction Code (NCC)	A set of documents that outline the minimum necessary requirements that all new dwellings (and new work to existing dwellings) throughout Australia must meet. The NCC is a performance-based code comprising the Building Code of Australia , volume one and volume two; and the Plumbing Code of Australia, volume three.

National Fenestration Rating Council (NFRC)	<p>A United States nonprofit organisation that establishes objective window, door and skylight energy performance ratings to help the public compare products and make informed decisions.</p> <p>The Australian Fenestration Rating Council is the Australian arm of the NFRC, with a signed memorandum of understanding so that the intellectual property of the NFRC can be shared with their Australian counterpart.</p>
Nationwide House Energy Rating Scheme (NatHERS)	<p>The national scheme in Australia that provides a star rating system for the potential energy efficiency of dwellings.</p> <p>NatHERS accredits residential building thermal modelling software tools used to estimate a dwelling’s potential heating and cooling use, to verify compliance with the NCC or for design purposes. NatHERS also accredits assessor accrediting organisations.</p>
north—true and magnetic	<p>True north, also known as true geographic north, is a constant fixed direction on Earth’s axis. True north is used in NatHERS software tools, and is usually displayed on drawings of dwelling plans.</p> <p>Magnetic north is the direction from any point on Earth towards Earth’s magnetic north pole. Magnetic north therefore varies in position as the magnetic pole moves continually over time. A compass is based on magnetic north, whereas Google Earth is based on true north.</p>
orientation	<p>Positioning of a building in relation to north, seasonal variation in the sun’s path and prevailing wind patterns.</p>
party wall	<p>A dividing partition between two adjoining buildings or units; also a division between separate units in a multi-unit apartment complex. This is sometimes called a ‘common wall’ when used for adjoining dwellings.</p>
passive cooling	<p>A system of features and/or technologies incorporated into a dwelling’s design to use and maximise the effects of prevailing breezes to cool the dwelling, with the aim of minimising the need for mechanical cooling that consumes power.</p>
passive design	<p>Design that takes advantage of the climate to maintain a comfortable temperature range in the dwelling with minimal need for mechanical heating and cooling that consumes power.</p>
passive heating	<p>A system of features and/or technologies incorporated into a dwelling’s design to use and maximise the effects of the sun’s natural capability to heat the dwelling, with the aim of minimising the need for mechanical heating that consumes power.</p>
photovoltaic	<p>A method of generating electrical power by converting solar radiation into direct current electricity.</p>
provisional values or provisions	<p>Standard values in NatHERS software tools for modelling certain elements of a dwelling, so an assessment can be completed when some aspects of the design are unknown.</p> <p>Provisional values are only to be used where specified in the NatHERS Technical Notes, or when there is insufficient information in the design documentation and the client cannot clarify the specific details. Some provisions are worst case, and the rating may be adversely affected. For more information on provisions, refer to the current NatHERS Technical Notes. Previous NatHERS Technical Notes and NatHERS guidance referred to these as ‘default settings’ or ‘defaults’.</p>
R value	<p>Thermal resistance per unit area, or the measure of the resistance to heat flow through a specific thickness of a material.</p> <p>Higher numbers indicate better insulating properties. Thermal resistance (R value) is the reciprocal of thermal transmittance (U value). ‘Total R value’ refers to the addition of each material/component’s R value. ‘Added R value’ refers to the insulation material/component to be added to a wall, roof or floors to improve the thermal resistance of that system.</p>

recessed light fitting	A light placed or designed to throw illumination downwards, also known as downlights or luminaires. It partially or wholly sits within the roof space so that its face is flush, or nearly flush with the internal surface of the ceiling.
residential building	A structure used by its occupants to reside in. When modelling in NatHERS software tools, residential buildings refer to Class 1 buildings, attached Class 10a buildings, and sole-occupancy units of Class 2 or Class 4 parts of a building, as defined in the Building Code of Australia .
sarking	A foil product that is often, but not always, reflective and is used to wrap around buildings to provide thermal insulation, moisture barrier and/or air tightness . It may also refer to a layer of boards or bituminous felt placed beneath tiles or other roofing to provide thermal insulation.
skylight (NatHERS definition)	A glazed element that is fixed and therefore not ventilated, penetrating the roof construction and connected to a zone by a built-in shaft that passes through a roof/attic space. This may differ from a broader definition of skylight characteristics, and specifically differs to the NatHERS definition of a roof window .
small air space	An area in a dwelling, such as small pantries, built-in robes, plumbing voids, wall voids, return air ducts and other small nonhabitable areas. For example, a small pantry is one that cannot be walked into, as defined in the NatHERS Technical Notes .
solar absorptance	A measure of the ability of an object to absorb solar radiation. For example, the proportion of the total incident solar radiation that is absorbed by roofing material (the remainder is reflected).
solar heat gain coefficient (SHGC)	The fraction of incident solar radiation admitted through a window, both directly transmitted as well as absorbed and subsequently released inward. SHGC is expressed as a number between 0 and 1. The lower a window's SHGC, the less solar heat it transmits. SHGC _w refers to the glazing measurement of how readily heat from direct sunlight flows through a window system.
stack ventilation or stack effect ventilation	The upward or downward movement of air through openings in a dwelling envelope due to thermal buoyancy and/or negative pressure generated by the wind over the roof. It is a type of convective air movement that occurs when there is a height difference between the air intake and the air outlet.
star band	The range of star ratings set for each NatHERS climate zone . Star bands allow fair comparisons of dwellings despite regional variability in weather conditions across Australia. Each star band is based on the average energy consumption load per unit area per year (MJ/m ² /yr). The star bands for different climate zones are available on the NatHERS website: www.nathers.gov.au/files/publications/NatHERS Star bands.pdf .
star rating or NatHERS stars	The system used by NatHERS to score the thermal comfort of a dwelling, ranging from 0 to 10. NatHERS software tools model the average total energy load for a building and this determines its star rating. A 0-star-rated dwelling gives practically no protection from hot or cold weather; a 5-star dwelling indicates a moderate level of thermal performance, but still requires artificial heating and cooling; a 10-star dwelling is unlikely to need any artificially heating or cooling.
roof window (NatHERS definition)	A glazed element, either fixed or openable, penetrating the roof construction and located in a roof/ceiling that does not have a roof/attic space. This may differ from a broader definition of roof window characteristics, and specifically differs to the NatHERS definition of a skylight .

(NatHERS) Technical Notes	<p>The document that sets out the NatHERS requirements for undertaking thermal performance assessments and rating dwellings in regulatory mode (e.g. <i>Technical Notes version 1.2 2014</i>)</p> <p>The NatHERS Technical Notes ensure that ratings are conducted consistently.</p>
terrain exposure	<p>How open the area surrounding a dwelling is.</p> <p>The terrain exposure affects the dwelling's access to ventilation and thus can affect the temperature in a dwelling.</p>
thermal bridging	<p>A path of least resistance for heat transfer between conductive materials.</p> <p>This occurs when a more conductive (or poorly insulating) material allows heat flow between a conditioned and unconditioned space or outside.</p>
thermal comfort	<p>A person's subjective feeling of how comfortable the surrounding environment is, in response to a mix of properties such as temperature, air flow and humidity.</p>
thermal conductivity	<p>The capacity of a material to conduct heat and allow the flow of heat from its warmer surface through the material to its colder surface, also known as k value.</p> <p>It is determined as the heat energy transferred per unit of time and per unit of surface area divided by the temperature gradient, which is the temperature difference divided by the distance between the two surfaces (the thickness of the material), expressed in watts per meter-kelvin. A material with a low k value transmits low levels of heat (good insulator); a material with a high k value transmits high levels of heat (poor insulator).</p>
thermal mass	<p>The ability of a material to absorb and store heat energy (e.g. from the sun), or moderate the temperature of a space by remaining cool and heating slowly.</p> <p>A lot of heat energy is required to change the temperature of high-density materials such as concrete, bricks and tiles, so they are said to have high thermal mass. Lightweight materials, such as timber, do not store a lot of heat energy so have low thermal mass.</p>
thermal performance	<p>The effectiveness of a dwelling envelope to maintain acceptable levels of human comfort inside the building, relative to the outside weather conditions, through minimising the need for artificial heating or cooling.</p> <p>In relation to a particular building material or element, the extent to which the material or element reduces or promotes heat loss or heat gain.</p>
thermal resistance	<p>The measure of the resistance to heat flow through a specific thickness of a material, also known as R value.</p> <p>Higher numbers indicate better insulating properties. Thermal resistance (R value) is the reciprocal of thermal transmittance (U value).</p>
thermal transmittance	<p>Also known as U value, thermal transmittance is a measure of the heat transfer or flow per square meter through a specific thickness of material, divided by the difference in temperature across the material (measured in watts). Well-insulated elements of a dwelling have a low thermal transmittance, whereas poorly insulated parts of a dwelling have a high thermal transmittance. Thermal transmittance (U value) is the direct inverse to thermal resistance (R value) $-U = 1/R$.</p>
transom	<p>A transverse horizontal structural beam or bar, or a crosspiece, separating glazed panels (e.g. a door with a window above).</p> <p>A transom is generally used to allow additional light and increase glazing without increasing the glazed door size. It can also occur within larger window frames to separate dissimilar glazed panels.</p>

<p>U value</p>	<p>The measure of the heat flow per square meter (measured in watts) through a specific thickness of material, such as a wall, floor, ceiling, roof or window;</p> <p>U value is also known as thermal transmittance and is often expressed as U_w in windows. It demonstrates how well parts of a dwelling transfer heat. The lower the U value, the better the insulating ability. Thermal transmittance (U value) is the direct inverse to thermal resistance (R value)—$U = 1/R$.</p>
<p>ventilation</p>	<p>The controllable movement of air through convection.</p> <p>Controlling ventilation means controlling the potential air paths through a dwelling. Factors such as dwelling orientation and location, window and door placement, window/door type and operability, and extraction fans can affect ventilation. Ventilation should not be confused with uncontrollable air movement through infiltration.</p>
<p>waffle pod</p>	<p>A type of concrete slab floor constructed by pouring concrete over a grid of polystyrene blocks known as ‘void forms’.</p>
<p>Window Energy Rating Scheme (WERS)</p>	<p>A scheme that enables Australian Fenestration Rating Council (AFRC)–rated windows of member fabricators to display star rating and comparable annual energy impact on a dwelling, in any climate of Australia.</p> <p>To participate in the scheme, window manufacturers must obtain energy ratings for their products from a rating organisation that is accredited by the AFRC and be a member of the Australian Glass and Window Association (AGWA). WERS is managed by the AGWA.</p>
<p>wing wall</p>	<p>Solid projections that are perpendicular to the plane of the ‘subject wall’ and cast shade on that wall.</p> <p>Wing walls may be created by the other walls of the dwelling, by a courtyard wall or adjoining structures. As well as shade, they also affect the flow of air around and through a dwelling. The Chenath engine modifies air flow through a dwelling based on the location and size of wing walls.</p>
<p>zone (NatHERS definition)</p>	<p>A defined space within a dwelling that is assumed to be operated in a particular way and is predominantly defined by permanent boundaries.</p> <p>For example, the kitchen zone assumes a higher heat load within the dwelling at 6–7 pm each day, to account for the predicted increase in appliance use while cooking.</p>

Acronyms and abbreviations

AAO	assessor accrediting organisation
ABCB	Australian Building Codes Board
ABSA	Australian Building Sustainability Association
AFRC	Australian Fenestration Rating Council
AS	Australian Standard
AWA	Australian Windows Association
BASIX	Building Sustainability Index
BCA	Building Code of Australia
BDAV	Building Designers Association Victoria
CSIRO	Commonwealth Scientific and Industrial Research Organisation
IGU	insulated glass unit
MJ/m²	millijoule per square metre
NatHERS	Nationwide House Energy Rating Scheme
NCC	National Construction Code
NFRC	National Fenestration Rating Council
SA	solar absorbance
SHGC	Solar Heat Gain Coefficient
WERS	Window Energy Rating Scheme