Building Sustainable Design Guidelines

NORTHERN TERRITORY GOVERNMENT

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1.0	12 April 2021	J. Kieboom	
1.1	25 June 2021	J. Kieboom	Replacement of Section 3.3 with Section 2, Section 5 update and minor edits elsewhere.
2.0	14 December 2021	J. Kieboom	Inclusion of thermal bridging in R-Value calculations and removal of NCC2016 Section J references

Acronyms	Full form
ABCB	Australian Building Codes Board
DIPL	Department of Infrastructure, Planning and Logistics (NT Government)
NCC	National Construction Code
MDS	DIPL Minimum Design Standard
SA	Solar Absorptance
SHGC	Solar Heat Gain Coefficient
WERS	Window Energy Rating Scheme

Contents

Introduction

Priority 1.5 of the NT Government Climate Change Response Three Year Action Plan is "Reduce emissions associated with the Territory Government's operations and services"[1]. In addition, the Territory Economic Reconstruction Commission set a target in December 2020 for NT Government operations to be carbon neutral by 2030[2].

A large proportion of the NT Government's greenhouse gas emissions are the result of building energy use.

The least cost approach to achieving carbon neutral new buildings is to target the most energy efficient, cost effective, design concepts possible from as early as possible in the design process. Then, as policies evolve and resources become available, investments in renewable energy can supply the remaining, necessary, energy use.

This approach is aligned with the former Council of Australian Governments *Trajectory for Low Energy New Buildings* goals[3] and the Australian Building Codes Board's plans for triennial updates to the National Construction Code.

Reducing the climate change impact of buildings is a key aspect of Ecologically Sustainable Development (ESD). ESD processes and requirements aim to simultaneously deliver economic, environmental and social outcomes. In relation to new NT Government building works, this can be interpreted as building designs that achieve the lowest possible life cycle costs whilst meeting the Government's environmental and service delivery objectives.

The design guidelines focus on building envelope thermal performance and should be read in conjunction with the DIPL Sustainability Minimum Design Standard (MDS) for new NT Government building works –available on the Technical Specifications - Department of Infrastructure, Planning and Logistics[4] internet page. The content of the guidelines will be expanded over time. Applications for exemptions from the Sustainability MDS will be considered on a case by case basis.

DIPL has included energy efficiency requirements within all core building Minimum Design Standards and is committed to the continuous improvement of NT Government building performance over time.

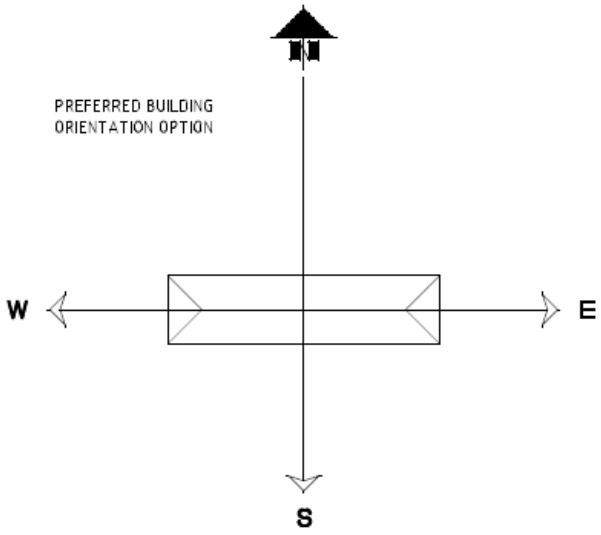
Queries and feedback regarding the Sustainability MDS are welcome – contact:

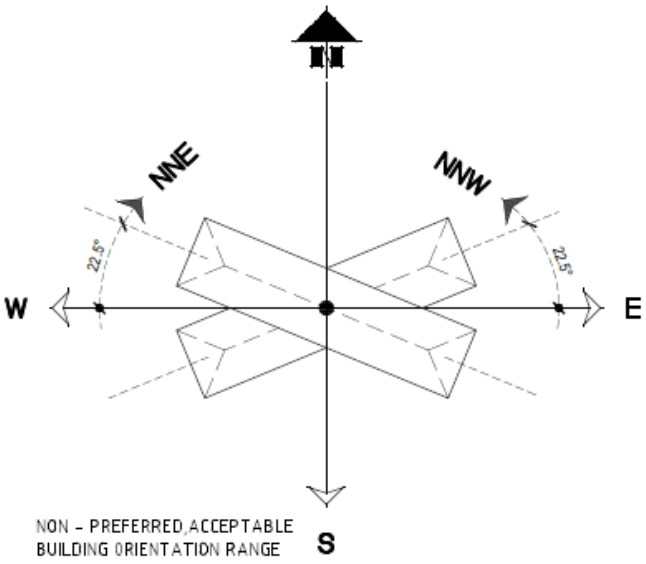
Strategic Asset Management - ESD
Infrastructure, Investment and Contracts
Department of Infrastructure, Planning and Logistics
assetmanagement.dipl@nt.gov.au (Attn: ESD); or (08) 8999 2506

[1] Climate Change Response: Towards 2050 - Department of Environment, Parks and Water Security
[2] https://ntrebound.nt.gov.au/__data/assets/pdf_file/0020/952301/terc-final-report.pdf (p. 51)
[3] https://www.energy.gov.au/government-priorities/energy-productivity-and-energy-efficiency/trajectory-low-energy-buildings
[4] https://dipl.nt.gov.au/industry/technical-standards-guidelines-and-specifications/technical-specifications/buildings

Section 1 – Building Orientation

Preferred and non-preferred, but acceptable, building orientations for new NT Government buildings are depicted below.





Section 2 – Insulation Values and Consideration of AS/NZS 4859.2: 2018 Requirements

Nationally, the calculation of roof and wall insulation effective R Values has evolved to improve how the effects of ambient temperature, thermal bridging and compression are accounted for.

From Version 2.0 onwards, wall and roof insulation R Values used in these Guidelines take these effects into account.

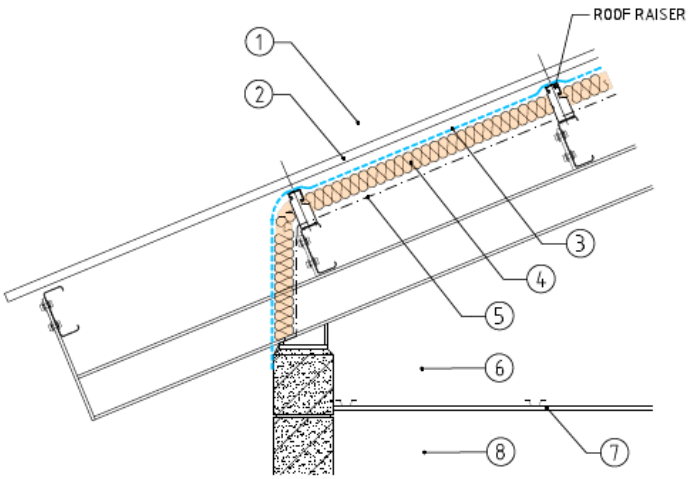
Section 3 - Roof Overall R-Values

Note:

- The use of thin foam or bubble products instead of bulk insulation blankets does not comply.
- Compliance with DIPL Vapour Barrier specifications and standard drawings is also required[5].
- Ceiling insulation is only to be used to meet Sustainability requirements with approval of the Superintendent due to the risk it will be displaced over the life of a building.
- Insulation spacing ('roof raiser')[6] systems are to be used when insulation thickness > 80mm.

Examples of roof constructions with overall R Values > 3.7:

3.1 Preferred - Pitched roof with perforated foil under R2.5 blanket (installed with insulation spacing system) and plasterboard



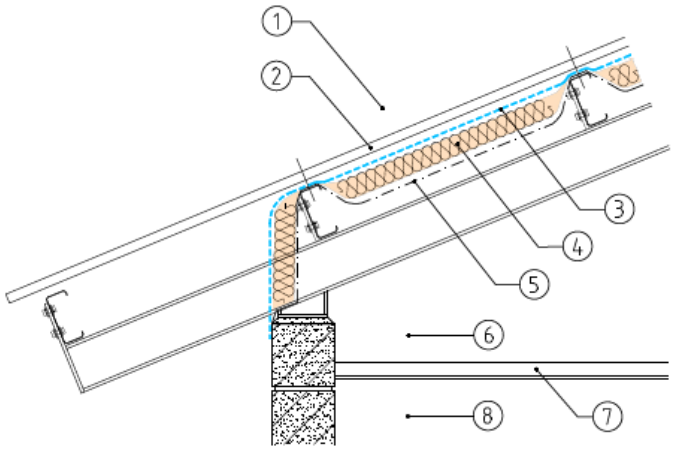
Item	Item description	R-Value
1.	Outdoor air film	0.04
2.	Steel cladding	0.00
3.	AS4200.1 heavy duty Class 1 vapour and water barrier	0.00
4.	R2.5 blanket (with insulation spacing system)	2.47
5.	Perforated foil	0.00[7]
6.	Reflective airspace (*5-10° roof pitch)*	1.28[8]
7.	10mm plasterboard	0.06[9]
8.	Indoor air film	0.16
Total R-Value		4.01

[5] https://dipl.nt.gov.au/industry/technical-standards-guidelines-and-specifications/technical-specifications/buildings.
[6] For example Fletcher Roof Razor system or Bradford Ashgrid Roof Spacer system
[7] The requirements of items 4 and 5 may be met by a single product with bonded perforated foil.
[8] This value becomes R0.28 if the air space is not reflective (perforated foil is not used under the blanket).
Alternative reflective airspace R values:

- > 10° pitch with flat ceiling: R1.12
- Cathedral ceiling – roof pitch:
  - 15-25°: R0.96
  - 25-35°: R0.86
  - 35-45°: R0.66

[9] This value becomes R0.07 for 13mm plasterboard and ~R0.80 for plaster acoustic ceiling tiles

3.2 Pitched roof with perforated foil under R1.8 blanket and insulated plasterboard



Item	Item description	R-Value
1.	Outdoor air film	0.04
2.	Steel cladding	0.00
3.	AS4200.1 heavy duty Class 1 vapour and water barrier	0.00
4.	R1.8 blanket	1.54[10]
5.	Perforated foil	0.00[11]
6.	Reflective airspace (*5-10° roof pitch)*	1.28[12]
7.	25mm acoustic ceiling tiles[13] or 35mm insulated plasterboard[14]	0.76 - 1.4
8.	Indoor air film	0.16
Total R-Value		3.78 - 4.42

[10] R-value reduced due to compression of insulation
[11] The requirements of items 4 and 5 may be met by a single product with bonded perforated foil.
[12] This value becomes R0.28 if the air space is not reflective (perforated foil is not used under the blanket).
Alternative reflective airspace R values:

- > 10° pitch with flat ceiling: R1.12
- Cathedral ceiling – roof pitch:
  - 15-25°: R0.96
  - 25-35°: R0.86
  - 35-45°: R0.66

[13] Check proposed product R-Value
[14] For example, Kingspan K17 Kooltherm insulated plasterboard.

Section 4 – External Walls

4.1 Fire Resistance Considerations

The examples of wall construction types provided here SHOULD NOT BE CONDISERED AS DEEMED TO COMPLY SOLUTIONS. Designers and certifiers need to consider the combustibility, smoke-developed and spread-of-flame indexes of different insulation products and their application to construction types according to NCC Section C.

4.2 Solar Absorptance (SA) of Wall Colours

In the absence of information from paint suppliers, light and medium colours shall be considered to be colours equivalent to (but not necessarily the same as) Colorbond colours[15] where:

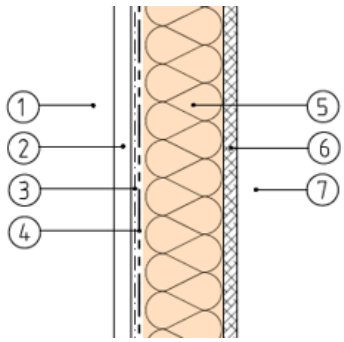
Light: Solar Absorptance (SA) up to 0.43 (inclusive)

Medium: SA 0.44 – 0.60 (inclusive)

4.3 Steel Frame Wall Construction

Example of steel frame wall construction with R0.2 thermal breaks and R-Value > 1.0:

4.3.1 75mm steel framing with R0.2 thermal break strips and R2 batts



Item	Item description	R-Value
1.	Outdoor air film	0.04
2.	Steel cladding	0.00
3.	AS4200.1 heavy duty Class 1 vapour and water barrier	0.00
4.	R0.2 thermal break strips attached to all steel frame members and R2 batts	0.97
6.	13mm plasterboard or Fiberock	>/= 0.087
7.	Indoor air film	0.12
Total R-Value		>/=1.2

15 http://steel.com.au/products/coated-steel/colorbond-steel/basix-and-bca-classification

4.4 Blockwork Wall Construction

Use of an AS 4200.1 heavy duty Class 1 external vapour and water barrier (eg. Bradford Thermofoil 753HD or Fletcher Metal Roof HD 453) is required for buildings that are air conditioned 24 hours/day.

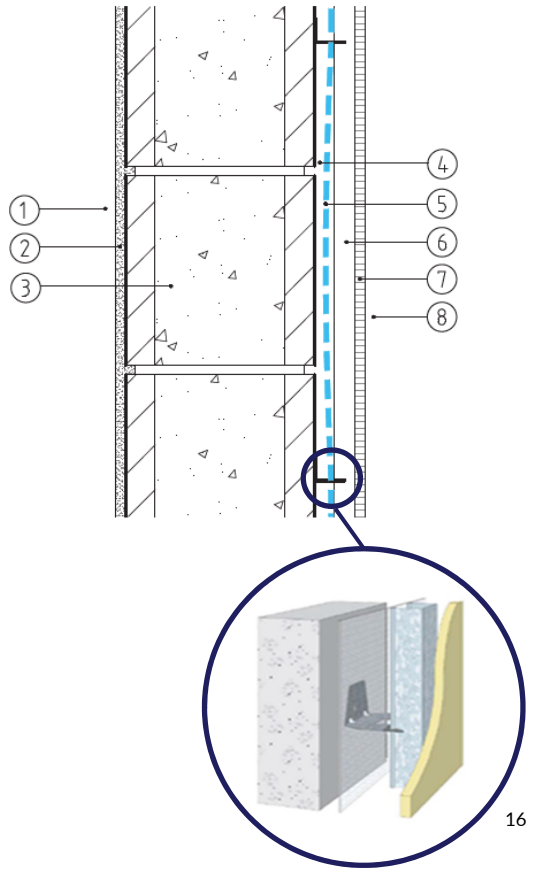
Complete paint systems are vapour retarders rather than full vapour barriers but are accepted by DIPL as sufficient vapour and weather protection for business hours operational blockwork buildings with internal insulation.

Designers are to select option/s to meet project durability, fire resistance, structural, cost and other needs.

Examples of blockwork wall constructions with R Values > 1.0:

Options are depicted in approximate increasing order of cost. Listed options/products are not the only possible solutions.

4.4.1 –Two Reflective Air Gaps inside Plasterboard



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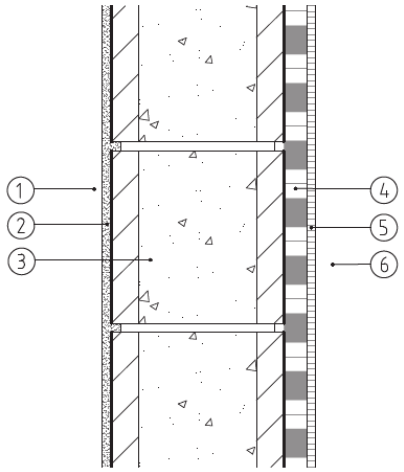
Item	Item description	R-Value
1.	Outdoor air film	0.04
2.	10mm render	0.02
3.	Dense weight 190 mm hollow concrete block (every third core filled)	0.16[17]
4.	~20mm reflective air space (created by spacer clips or biscuits[18] and battens)	Combined with Item 6
5.	~7mm foil bonded R0.2 foam[19]	0.20
6.	~20mm reflective air space (created by spacer clips or biscuits and battens)	0.95[20] Combined with Item 4
7.	13mm plasterboard or Fiberock	>/= 0.07
8.	Indoor air film	0.12
Total R-Value		>/= 1.56

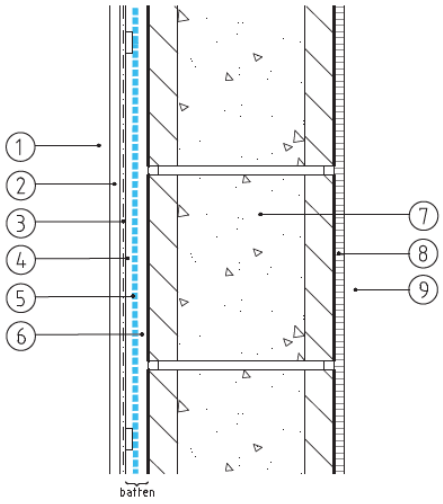
[16] Image source: architectureanddesign.com.au
[17] This reduces to R 0.13 if every core filled.
[18] For example Rondo 282 or BG05K clips or Kingspan Spacer Biscuits.
[19] For example Kingspan Permishield or Fletcher Foam Cell Multipurpose.
[20] As per NCC 2019 Specification J1.2 2(c) (i)(C).

4.4.2 –Direct Stick Insulation Board and Plasterboard



Item	Item description	R-Value
1.	Outdoor air film	0.04
2.	10mm render	0.02
3.	Dense weight 190 mm hollow concrete block (every third core filled)	0.16[21]
4.	>/= R1 insulation board (direct fixed) [22,23]	>/= 1.00
5.	>/= 13mm plasterboard (direct fixed)	>/= 0.07
6.	Indoor air film	0.12
Total R-Value		>/= 1.41

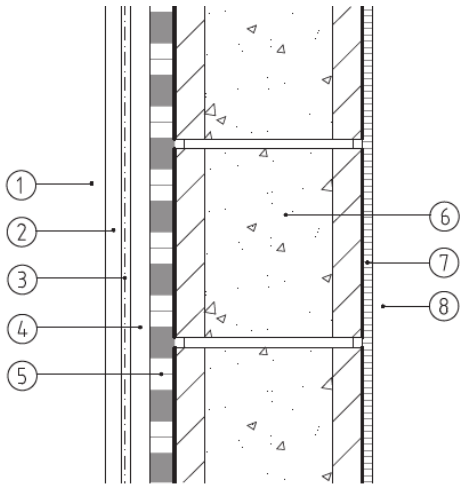
4.4.3 Clad Blockwork with Foil-Bonded Foam and Two Reflective Air Gaps



Item	Item description	R-Value
1.	Outdoor air film	0.04
2.	Metal cladding	0.00
3.	AS4200.1 heavy duty Class 1 vapour and water barrier	0.00
4.	~20mm reflective air space (created by foil bonded foam and spacer biscuits[24])	Combined with Item 6
5.	~7mm R0.2 foil bonded foam[25]	0.20[26]
6.	~20mm reflective air space (created by 40 mm battens minus spacer effect)	0.95[27] Combined with Item 4
7.	Dense weight 190 mm hollow concrete block (every third core filled)	0.16[28]
8.	13mm plasterboard (direct stick)	0.07
9.	Indoor air film	0.12
Total R-Value		1.54

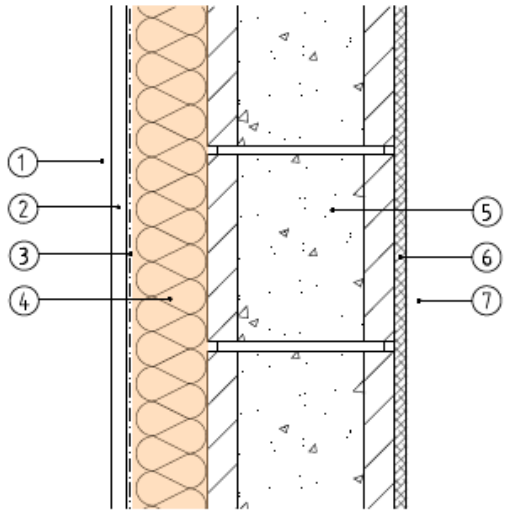
[21] This reduces to R 0.13 if every core filled.
[22] For example Bradford Xtroliner or an insulation bonded plasterboard Kingspan Kooltherm product.
[23] Hygrothermal modelling commissioned by DIPL found a very low risk of moisture and mould in walls of this construction type in Northern Territory climates.
[24] For example, Kingspan Spacer Biscuits.
[25] For example, Kingspan Permishield or Fletcher Foam Cell Multipurpose.
[26] The requirements of items 3 and 5 may be met by a single product such as Fletcher's Sisalation Foam Cell Multipurpose however not all foam products on the market meet all of DIPL's vapour barrier requirements.
[27] As per NCC 2019 Specification J1.2 2(c) (i)(C).
[28] This reduces to R 0.13 if every core filled.

4.4.4 Clad Blockwork with Rigid Insulation Board and One Reflective Air Gap



Item	Item description	R-Value
1.	Outdoor air film	0.04
2.	Metal cladding	0.00
3.	AS4200.1 heavy duty Class 1 vapour and water barrier	0.00
4.	>20mm reflective air gap created by battens on top of insulation board	0.33
5.	>/= R1 insulation board[29]	>/= 1.00
6.	Dense weight 190 mm hollow concrete block (every third core filled)	0.16[30]
7.	13mm plasterboard (direct fixed)	0.07
8.	Indoor air film	0.12
Total R-Value		>/= 1.72

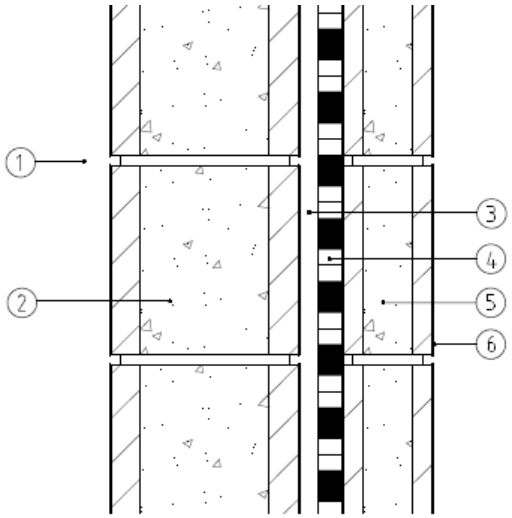
4.4.5 Clad Blockwork with External Steel Framing and Bulk Insulation



Item	Item description	R-Value
1.	Outdoor air film	0.04
2.	Metal cladding	0.00
3.	AS4200.1 heavy duty Class 1 vapour and water barrier	0.00
4.	R1.5 insulation batts within 75mm steel framing	0.96
5.	Dense weight 190 mm hollow concrete block	0.17
6.	13mm plasterboard (direct stick) or Fiberock	>/= 0.07
7.	Indoor air film	0.12
Total R-Value		1.36

[29] For example Bradford Xtroliner or Kooltherm framing board
[30] This reduces to R 0.13 if every core filled.

4.4.6 Double-Skin Blockwork with Insulated Cavity



Item	Item description	R-Value
1.	Outdoor air film	0.04
2.	Dense weight 190 mm hollow concrete block (every third core filled)	0.16[31]
3.	20mm unvented reflective air gap	0.48
4.	>/= R1 insulation board[32]	>/= 1.00
5.	Dense weight 110 mm hollow concrete block	0.12
6.	Indoor air film	0.12
Total R-Value		>/= 1.92

[31] This reduces to R 0.13 if every core filled.
[32] For example Bradford Xtroliner or Kooltherm framing board

Section 5 – Façade, Glazing and Shading Requirements

5.1 Meeting NCC 2019 Section J1.5 requirements

If more design freedom is required than allowed by the deemed to satisfy style DIPL Sustainability MDS requirements, evidence can be submitted that a design meets the NCC 2019 Section J1.5 requirements.

Method 2 of these requirements is recommended as it allows trade-offs between glazing performance on different facades/orientations.

Prior to design finalisation, a completed facade calculator should be submitted by the designer and approved by DIPL. One calculator is available at:

https://www.abcb.gov.au/Resources/Tools-Calculators/facade-calculator-ncc-2019-volume-one[33]

Alternative, private sector, façade calculators can also be used to check compliance with the NCC 2019 Section J1.5.

5.2 Glazing U-Values and Solar Heat Gain Coefficients (SHGCs).

Glazing only U-Values (available on some supplier websites) should not be confused with the whole-of-window (including frame) U-Values used in NCC Section J compliance calculations.

Measure	Relates to	Unit[34]	Where to Find Product Data	Notes
U-Value of glazing *"Thermal transmittance"*	Heat transfer via conduction: Transmission of heat through the window glass	W/(m^2.K)	Australian Glass and Windows Association WERS Certified Products Hub[35]	The lower the number the better the insulation qualities. R-Value is the inverse of U-Value.
Solar Heat Gain Coefficient (SHGC)	Heat transfer via radiation: The fraction of solar thermal radiation that falls on a window that is admitted through that window	Dimensionless	Australian Glass and Windows Association WERS Certified Products Hub	The lower the number the more radiant heat is prevented from entered the building

[33] Note that duplication of a wall reference name will result in errors in ABCB façade calculator results.

[34] Where: W = Watts
m^2 = m^2 surface area
K = The difference in temperature between inside and outside in degrees Kelvin (will be the same as the temperature difference in degrees Celsius)

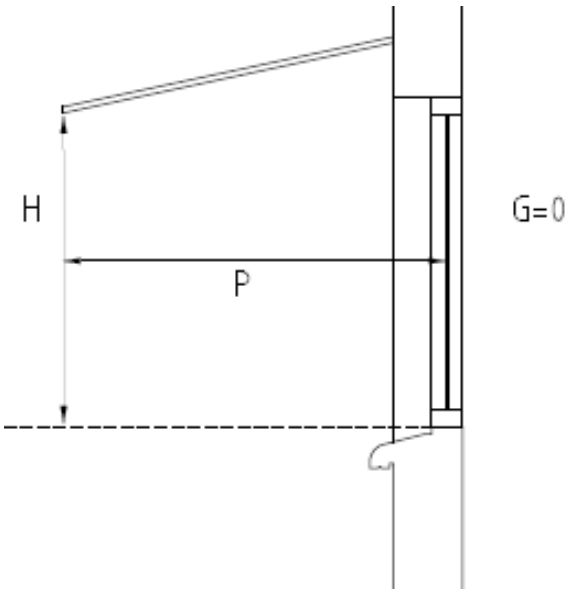
[35] https://awa.associationonline.com.au/werscontent/certified-products-hub

5.3 Window Shading Interpretation for NCC Calculators

Interpretation of the shading parameters P, H and G is provided in NCC 2019 Specification J1.5a Figure 7.

Where sun path modelling is used to prove that no direct radiation enters through glazing at 9am and 3pm on 21 January, 30 April (south of the Tropic of Capricorn) and 21 June (north of the Tropic of Capricorn); 'device' can be entered into the 2019 Façade Calculator.

DIPL will also accept this interpretation of shading parameters in glazing and façade calculators[36]:



[36] If P/H > 1, and it does not meet the requirements to be classified as a 'device', assume it = 1 if the calculator prevents input of higher values.