

Case Study

Example energy efficiency calculation

NCC 2022 Volume One Deemed-to-Satisfy elemental provisions, Class 2, climate zone 6

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This case study provides an example of the calculations required to demonstrate compliance with the Part J Energy Efficiency Performance Requirements J1P2 and J1P3 using the proposed Deemed-to-Satisfy elemental provisions of NCC 2022 Volume One.

The example building is a steel-framed *sole-occupancy unit* on the top floor of a 3-storey apartment complex located in Melbourne, Victoria. The case study shows how to calculate the requirements for the building fabric and equivalent energy usage. Example calculations for building sealing and Class 2 common area *services* are not included as no changes have been proposed to these provisions in NCC 2022.

Construction and site details

Table 1 Site and construction details (Plans in [Attachment A](#))

Building Element	Detail
Building location	Victoria
NCC climate zone	6
NCC building classification	Class 2 <i>sole-occupancy unit</i> (SOU) on top storey of a three storey complex

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Building Element	Detail
Roof & ceiling general arrangements	<ul style="list-style-type: none"> • Flat with flat ceiling • Eaves as shown on plan – roof of balcony area considered as eave • Steel framed • Metal sheet roof – colour – Colourbond ‘Monument’ – Solar Absorptance (SA) 0.73 • Downlights (to 0.5% of plan area of ceiling)
External wall general arrangements	<ul style="list-style-type: none"> • Steel frame, bulk insulation with weather barrier • Lightweight external fibre cement cladding – Colorbond ‘Shale Grey’ – SA 0.43 • Wall height – 2400mm
Floors and subfloor wall general arrangements	<ul style="list-style-type: none"> • Concrete floor • Floor area of building Class 2 SOU – approx. 107m²
Main type of heater	Un-ducted heat pump split system 9kW – 2.5 stars (GEMS 2019)
Main type of cooler	Un-ducted heat pump split system 9kW – 2.5 stars (GEMS 2019)
Type of water heater	Gas instantaneous
Installed capacity of rooftop photovoltaics	0.0kW
Swimming pool	No pool
Spa	No spa

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Building Element	Detail
Windows	<p>Aluminium framed, double glazed – clear glass</p> <p>Black powder coated – SA = 0.96</p> <p>North Glazing = 11.52m², East Glazing = 11.07m²</p> <p>North Wall Area = 29.6m² , East Wall Area = 22.8m²</p>

Calculations

Compliance Pathway: Compliance with the Performance Requirement *J1P2 Building Fabric of sole-occupancy unit of a Class 2 building or a Class 4 part* is achieved in this example as a Deemed-to-Satisfy Solution in accordance with J2D2(2)(b). This requires compliance with the following clauses and sub-clauses:

- J3D3(b) to J3D3(e); and
- J3D7; and
- J3D8 and J3D11 to J3D13 or
- J3D9; and
- J3D10.

Compliance Pathway: Compliance with the Performance Requirement *J1P3 Energy Usage of sole-occupancy unit of a Class 2 building or a Class 4 part* is achieved in this example using the Whole-of-Home standard using the ABCB Whole-of-Home Calculator (Beta) as evidence. This requires compliance with clause J3D14.

Note, clause J3D1 *Elemental provisions for Class 2 building or a Class 4 part* outlines the applicable provisions required for compliance with the Performance Requirements in general. J2D2(2)(b) provides detailed requirements of the relevant provisions for compliance with Performance Requirement J1P2 as summarised above.

Example calculations for compliance with Performance Requirements J1P1 and J1P4 have not been included as part of this example as they are not relevant to Class 2 SOUs and shall be considered separately.

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J1P2 – Building fabric

1. Sub-clause J3D3(b) requires compliance with clause J4D3 for general thermal construction.
 - a. This example calculation assumes that the relevant J4D3 requirements for general thermal construction have been met.
2. Sub-clause J3D3(c) requires compliance with clause J3D5 and J3D6 for thermal breaks.
3. Sub-clause J3D3(d) requires compliance with sub-clauses J4D7(3) and J4D7(4) for floor edge insulation.
 - a. There is no requirement to comply with this clause as the example does not involve a concrete slab on the ground, and there is no in-slab or in-screed heating or cooling system installed.
4. Sub-clause J3D3(e) requires compliance with Part J5 for building sealing.
 - a. This example calculation assumes that the relevant Part J5 requirements have been met through standard construction practice.
5. Clause J3D5 requires:
 - a. A roof thermal break of R0.2 required as all components of the roof are metal with the ceiling lining being directly fixed to the components. As the building is of Type A construction for fire safety purposes, this component is to be non-combustible strip applied over the vapour permeable membrane and framing members.
6. Clause J3D6 requires:
 - a. A wall thermal break of R0.2 is required as the wall lining of the example building is directly fixed to the metal frame and the external cladding is a fibre-cement product. As the building is of Type A construction this component is to be non-combustible strip applied over the vapour permeable membrane and framing members. This requirement is met through the installation of a R1.0 under the requirements of clause J3D7.
7. Clause J3D7 Roofs requires:
 - a. Under (1)(f), the minimum R-Value to be achieved by a building in climate zone 6 is to be R3.5 or, if the roof contains reflective insulation, R3.0.

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- b. There are no conditions applied to the SA of the upper surface of a roof in climate zone 6.
 - c. For this example, it is assumed that reflective insulation has been installed in compliance with sub-clause J3D7(3)(a)-(c) making the nominated R-Value R3.0.
 - d. The loss of insulation associated with exhaust fans, flues or recessed downlights has been compensated by increasing the R-Value of the ceiling insulation to R3.4 in accordance with Table J3D7s.
 - e. To comply with the thermal bridging requirements of sub-clause J3D7(5)(b) Option 2 of Table J3D7w was selected and a thermal break strip of R1.0 is to be installed. This R1.0 thermal break will also meet the requirements of clause J3D6.
8. Clause J3D8 External Walls requires:
- a. Under sub-clause (1)(a)(iii), the ratio of opaque external walls to the floor area is 28% which is $\geq 20\%$ and $< 35\%$, so the Total R-Value of the external walls must be a minimum of R1.83.
 - i. Glazing Area: $4(3.24) + 2.16 + 5.67 + 1.80 = 22.59$
 - ii. Opaque External Wall Area: $[(12.34 \times 2.40) + (9.50 \times 2.4)] - 22.59 = 29.85$
 - iii. Opaque External Wall Area to Floor Ratio: $\frac{29.85}{107.0} \times 100 = 27.89\% \therefore 28\%$
 - b. The 'Build a Wall' feature of the ABCB Façade Calculator tool was used to calculate the external wall Total R-Value for this example. A wall system using a steel frame, plasterboard, bulk insulation, a weather barrier and external cladding was used. The insulation of this system was R2.0. When installed at 600mm centres with a thermal break strip of R0.2, the overall R-Value of the system is R1.85.
 - c. Under sub-clause (3), there is no requirement in climate zone 6 for external walls to achieve a minimum or maximum solar absorptance figure.
9. Clause J3D9 Wall Glazing.
- a. Compliance via the whole-of-façade pathway is not applicable as the minimum requirements for walls (clause J3D8) and windows (clauses J3D11-13) are being met separately.

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10. Clause J3D10 Floors.

- a. There is no requirement for the floor of the building to have insulation installed under this clause as the floor is above the ground and not above a carpark.

11. Clause J3D11 External Winter Glazing – The Beta Glazing Calculator for NCC 2022 (Attachment B) was used to support the calculations that show that the selected glazing would be compliant with this clause.

- a. Table J3D11a provides the maximum SHGC ratio as 8.36 for climate zone 6.
 - i. This ratio has been achieved. (Note: Calculator has rounded 8.36 to 8.4)
- b. Aluminium frame, double glazed, clear glass, dark frame
 - i. Windows - U-Value: 4.20, SHGC: 0.69.
 - ii. Door - U-Value: 4.00, SHGC: 0.68

12. Clause J3D12 External Summer Glazing – The Beta Glazing Calculator for NCC 2022 (Attachment B) was used to support the calculations that show that the selected glazing would be compliant with this clause.

- a. Aluminium frame, double glazed, clear glass, dark frame
 - i. Windows - U-Value: 4.20, SHGC: 0.69
 - ii. Door – U-Value: 4.00, SHGC: 0.68

13. Clause J3D13

- a. The shading from the example building was used in the Beta Glazing Calculator for NCC 2022 (Attachment B). The shading devices identified are in compliance with this clause.
 - i. W1 – No shading: P = 0, H = 2.1
 - ii. W2 – No shading: P = 0, H = 2.1
 - iii. W3 – Balcony Shading: P = 5.1, H = 2.1
 - iv. W4 – Balcony Shading: P = 3.0, H = 2.1
 - v. W5 – Balcony Shading: P = 2.4, H = 2.4
 - vi. W6 – Balcony Shading: P = 7.31, H = 2.1
 - vii. W7 – No Shading: P = 0, H = 2.1

J1P3 – Energy usage of a sole-occupancy unit of a Class 2 or a Class 4 part

1. Clause J3D14 (Attachment C)

- a. When calculated in accordance with sub-clause (a), the net annual energy usage of the dedicated services must not exceed the allowance

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calculated in sub-clause (b). (Note there is no pool, spa or photovoltaic solar installed, so these factors are not considered)

$$\begin{aligned} \text{i. (1)(a): } & (A \times E_E)^1 + EP + ES - ER \\ & = (1.134 \times 2.308) = 2.61 \end{aligned}$$

$$\begin{aligned} \text{ii. (1)(b): } & A \times EF^2 \\ & = 1.134 \times 2.32 = 2.63 \\ & 2.61 < 2.63 \end{aligned}$$

Summary of design requirements

Table 2 Summary of design requirements

Building elements	Minimum requirements	Notes
Roof	R4.4 (Assuming the installation of reflective insulation)	<p>J3D5: Thermal break of R0.2 required as roof components are metal covered in J3D7.</p> <p>J3D7(1)(f): With reflective insulation the minimum R-Value is R3.0.</p> <p>Table J3D7s requires adding R0.4 to compensate for exhaust fans/flues/recessed downlights</p> <p>Table J3D7w requires a thermal break of R1.0 to comply with J3D7(5)(b) and J3D5.</p>

¹ the the floor area factor calculated from Table J3D14a multiplied by the value in the Whole of Home Standard

² the the floor area factor calculated from Table J3D14a multiplied the energy factor taken from Table J3D14b

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Building elements	Minimum requirements	Notes
Walls	R1.83 – The NCC Façade calculator 'Build a Wall' function to achieve R1.85	J3D8(1)(a)(iii): ratio of opaque external walls to floor area is 28%
Floors and subfloor walls.	No requirement.	
Glazing	In accordance with Beta 2022 NCC Glazing Calculator for Class 2 buildings	It is expected that design will be commonly carried out using the glazing calculator, hence example calculations are not included. Screenshots have been provided in Attachment B.
Thermal Construction	In accordance with NCC Volume One J4D3	Assumption is these requirements are met
Ceiling Fans	No requirement	As the building is in climate zone 6 there is no minimum requirement for ceiling fans.
Floor Edge Insulation	No requirement	J4D7(3) and J4D7(4) are not required as the floor is not a concrete slab-on ground and there is no in-slab/in-screed heating or cooling system.

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Building elements	Minimum requirements	Notes
Building Sealing	In accordance with Part J5	It is assumed that the requirements of Part J5 have been met.
Shading Devices	Shading devices in accordance with J3D13.	The Beta Glazing Calculator for NCC 2022 identifies shading requirements.
Equivalent Energy Usage	Net annual energy usage factor must not exceed 2.7.	Calculations from J3D14 were performed using the factors provided and the Whole of Home tables. (Attachment C)

Notes:

Compliance with other NCC provisions (such as fire, waterproofing, condensation, etc.) is not considered. This shall be considered separately when determining required construction arrangements and details.

These requirements are considered general in nature. Specific detailing requirements as required by NCC, relevant codes and standards and supplier product technical requirements are not included (such as fit-up and installation detailing, abutting and fixing of insulation, etc.). This shall be considered during design and construction.

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Attachment A

Design plans

Figure 1 SBA01-28 Apartment Block – Perspective View

SBA01-28 Apartments

Perspective

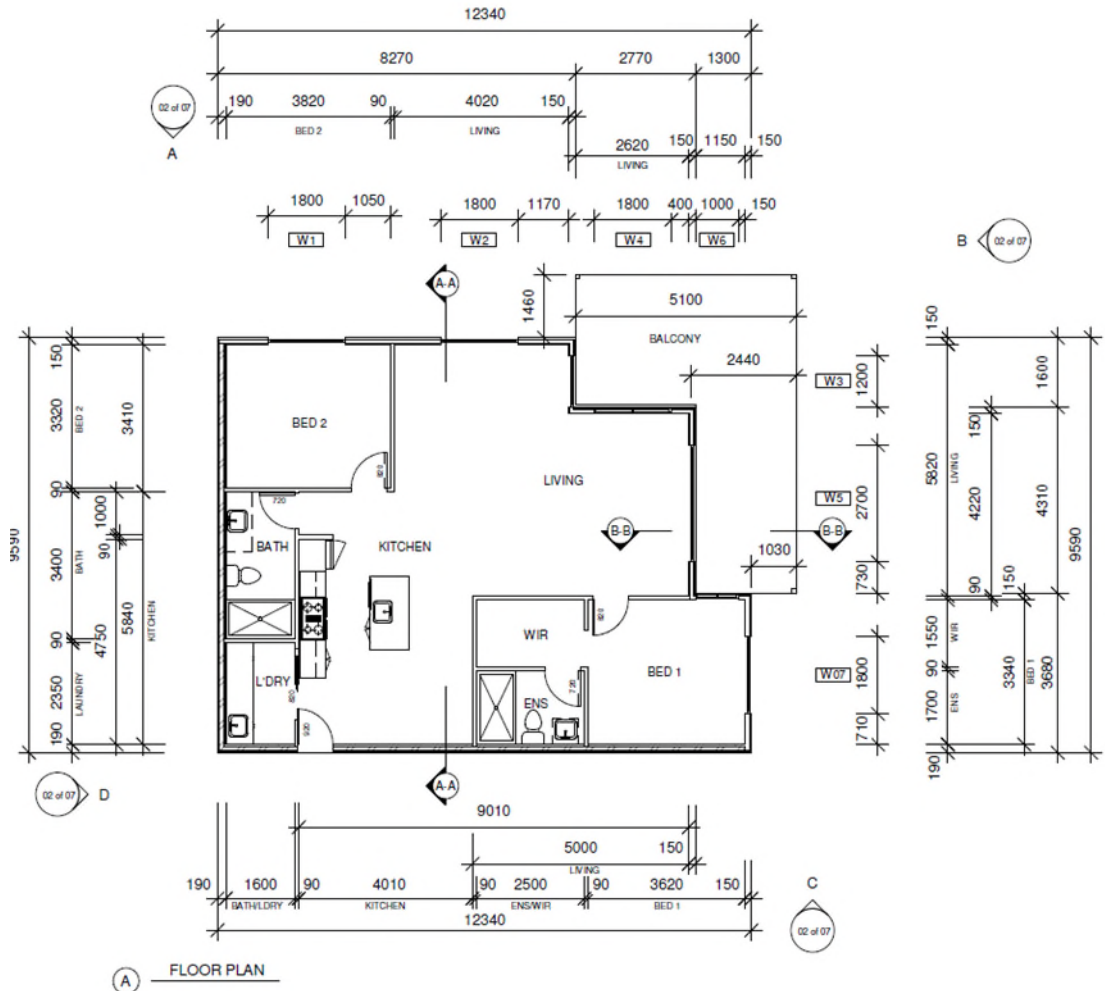


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Figure 2 SBA01-28 Apartment Block – Floor Plan




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Attachment B

External Glazing Calculator



ABC Building Code

Glazing Calculator (Beta 2022) Volume 1 Class 2



National Construction Code

1. Enter building name and description below - identifying the particular part(s) covered by this assessment.

Class 2 SOU Example

Floor Type	Area
Lower Floor	107m ²
Upper Floors	
Area of dwelling	107m ²
Area of glazing	22.6m ² (21% of floor area)

Number of rows for table below: 7 (as currently displayed)

Climate Zone

6

Constants

C_{g1} 8.36

C_{SHGC} 0.3297

Allowances

$C_{g1} / C_{SHGC} \times W$ 8.4

$C_{SHGC} \times A_{area}$ 35.3


Glazing Elements, Orientation Sector, Size and Performance Characteristics										Shading		Calculation Data			Winter Outcomes		Summer Outcomes		
Glazing element	Orientation	Size			Factors affecting impact of glazing performance				Performance	P&H or Device		Exposure		Size	Conduction / Solar Gain - PASSED 57.0%		Solar heat gain - PASSED 73.6%		
Description (optional)	Facing Sector	Height (m)	Width (m)	Area (m ²)	Bedroom / Utility?	Adjacent Floor Covering	Frame Colour	Openability	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	PH	E _w	Area used (m ²)	% of winter heat loss	% of winter heat gain	SHGC x Es x Area	Element Share % of Allowance Used
1	N	1.80	3.24	Bedroom	Carpet	Dark	Awning	4.20	0.69	0.01	2.10	0.00	1.60	3.24	22%	22%	5.3	20% of 74%	
2	N	1.80	3.24	Other	Floating Timber	Dark	Awning	4.20	0.69	0.01	2.10	0.00	3.38	3.24	18%	39%	6.1	23% of 74%	
3	E	1.80	2.16	Other	Floating Timber	Dark	Awning	4.20	0.69	5.10	2.10	0.00	0.42	2.16	10%	3%	1.1	4% of 74%	
4	N	1.80	3.24	Other	Floating Timber	Dark	Awning	4.20	0.69	3.00	2.10	1.43	0.92	3.24	18%	11%	1.3	5% of 74%	
5	E	2.10	5.67	Other	Floating Timber	Dark	Sliding Door	4.00	0.68	2.40	2.40	1.00	0.72	5.67	24%	14%	5.1	20% of 74%	
6	N	1.80	1.80	Bedroom	Carpet	Dark	Awning	4.20	0.69	7.31	2.10	0.00	0.25	1.80	7%	2%	0.5	2% of 74%	
7	E	1.80	3.24	Bedroom	Carpet	Dark	Awning	4.20	0.69	0.10	2.10	0.00	0.87	3.24	10%	10%	6.5	25% of 74%	

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If inputs are valid




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Attachment C

Whole-of-Home Calculator



ABCB

Whole-of-home (Beta)



National Construction Code

Home details	
State/Territory	VIC
Climate zone	6
Floor area (m ²)	107
Building classification	2

Net equivalent energy usage	
Allowance	2.7
Actual	2.6

Equipment details		
Space heating/cooling		
	Type	Star rating
Space heating	Unducted Heat Pump	4.4
Space cooling	Unducted Heat Pump	4.4

Pools and spas	
Pool volume (L)	
Pool pump star rating	
Spa volume (L)	

Water heating	
Water heater type	Gas Instantaneous

Photovoltaics	
Photovoltaic capacity (kW)	

Notes:

- This calculator automates the NCC whole-of-home energy usage requirements (Part 13.6 of NCC Housing Provisions and J3014 of NCC Volume One)
- For the purposes of this calculator, floor area is measured within the inside face of the external walls of the sole-occupancy unit and includes any conditioned attached Class 10a part
- For the purposes of this calculator, appliance star ratings are as rated under the 2012 GEMS determination

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Note: As the Whole-of-Home Calculator uses 2012 GEMS star ratings as its input, this study entered a 4.4 star rating in the tool in order to approximate the 2019 GEMS 2.5 star rating of the selected appliances.