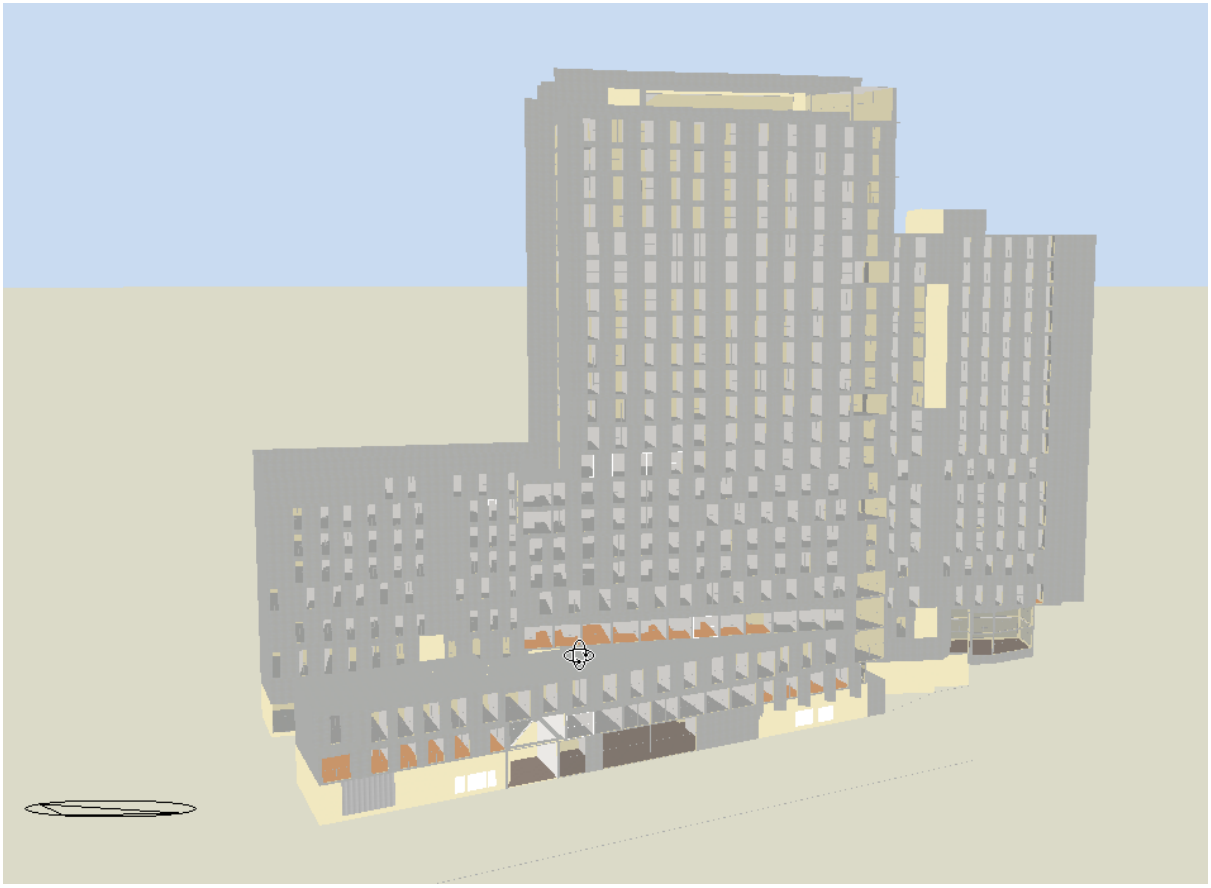
THERMAL ENVIRONMENTAL

WINDTECH CONSULTANTS

83-123 EVELEIGH STREET, REDFERN NSW
'PRECINCT 3 – THE PEMULWUY'

BCA Section J – JV3 Assessment Report



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EXECUTIVE SUMMARY

Thermal Environmental has undertaken review of Section J requirements for the proposed Student Accommodation development at 83-123 Eveleigh Street, Redfern, NSW. The thermal performance required for the glazing and building envelope to satisfy the Section J requirements using the verification method (JV3) are analysed and presented within this report.

To demonstrate compliance with Section J, dynamic thermal simulation is carried out using the clauses of Sections J1 - J2 and the relevant verification method (JV3). Through this, it is demonstrated that annual energy consumption of the proposed building with its services is not more than the annual energy consumption of a reference building or deemed-to-satisfy (DTS) building. The total energy consumption is summarised as below:

Simulation Scenarios	DTS Fabric and Services – Reference Building (Run 1)	Designed Fabric and DTS Services (Run 2)	Design Fabric and Services (Run 3)
Total Annual Energy Consumption (kWh)	1,548,000	1,526,660	N/A

Comparison of the reference building (Run 1) with the designed fabric and DTS services (Run 2) shows reduction in the total energy consumption, which is attributed to an efficient building envelope. Also the proposed building services will be more efficient compared with the DTS services therefore the Run 3 energy consumption will be less than that of Run 2 and Run 1.

The proposed building fabric performance is summarised in the table below:

Building Fabric	Description and Area Serving	Thermal Performance
Roof	External Roof – Metal and Concrete Deck	Total R-value – 3.2 (same as DTS)
Walls	All External Walls	Total R-value – 2.8 (Same than DTS)
	Internal Walls separating conditioned and non-conditioned spaces	Same ad DTS
Floor	Concrete Floor – separating conditioned and non-conditioned spaces	Same ad DTS
Roof Light	None	None

The summary of compliant glazing system (glass and frame) for the proposed design using the verification method (JV3) is summarised in the table below. As the project progress through the schematic and detailed design phase, further investigation on the glazing performance and optimization will be required through additional modelling.

Building Levels	Orientation or Façade	Glazing Description	JV3 Performance (AFRC)[1]
External Glazing - All levels	All facades and Orientations	Double Glazing	U Value – 2.8, SHGC – 0.26 and VLT – 40% (indicative)
Internal Glazing	-	Single Glazing	U Value – 4.5, SHGC – 0.73 and VLT – 80% (indicative)

[1] *The selection to be better or equal to the quoted performance, and the values quoted are AFRC values which takes glass and frame into account. The glazing selection to be verified and checked with the manufacturer that the selected window systems are WERS certified.*

1 INTRODUCTION

The proposed development at 83-123 Eveleigh Street, Redfern NSW, comprises construction of a student accommodation building. The development consists of lower ground, ground, and Level 1 to 21 with roof top plant room. The proposed development has been assessed against the requirements of Section J of the Building Code of Australia (BCA). The assessment method carried out to demonstrate compliance is the verification method (JV3) of Section J of the BCA 2016.

According to the BCA building classification Part A3 the proposed development is classed as Class 3 building. The development consists of student accommodation units, amenities, staff rooms, reception and office area and circulation spaces such as stairs, void and lobbies. The proposed development falls within Sydney City Council which is according to the BCA is Climate Zone 5.

1.1 METHODOLOGY

Methodology employed in this report includes the following steps:

- Review BCA 2016 – Section J requirements in particular fabric and glazing requirements.
- Develop dynamic thermal simulation models to calculate and compare energy consumption; and
- Assess reference building energy consumption and compare with the proposed building design (building fabric and glazing) for section J compliance.

1.2 DOCUMENTATION

The following documentation shown in Figure 1 supplied by Turner Studio was used in the preparation of this report.

DA-110-001_00 Roof (1)	5/06/2017 4:24 AM	PDF Document
DA-110-001_00 Roof	5/06/2017 4:24 AM	PDF Document
DA-110-007_00 Lower Ground (1)	5/06/2017 4:24 AM	PDF Document
DA-110-007_00 Lower Ground	5/06/2017 4:24 AM	PDF Document
DA-110-008_00 Upper Ground (1)	5/06/2017 4:24 AM	PDF Document
DA-110-008_00 Upper Ground	5/06/2017 4:24 AM	PDF Document
DA-110-010_00 Level 01	5/06/2017 4:24 AM	PDF Document
DA-110-020_00 Level 02	5/06/2017 4:24 AM	PDF Document
DA-110-030_00 Level 03 (1)	5/06/2017 4:24 AM	PDF Document
DA-110-030_00 Level 03	5/06/2017 4:24 AM	PDF Document
DA-110-040_00 Levels 04, 05	5/06/2017 4:24 AM	PDF Document
DA-110-050_00 Level 06	5/06/2017 4:24 AM	PDF Document
DA-110-060_00 Level 07	5/06/2017 4:24 AM	PDF Document
DA-110-070_00 Levels 08, 09 (1)	5/06/2017 4:24 AM	PDF Document
DA-110-070_00 Levels 08, 09	5/06/2017 4:24 AM	PDF Document
DA-110-080_00 Level 10	5/06/2017 4:24 AM	PDF Document
DA-110-090_00 Levels 11-14,16	5/06/2017 4:24 AM	PDF Document
DA-110-100_00 Level 15	5/06/2017 4:24 AM	PDF Document
DA-110-110_00 Level 17	5/06/2017 4:24 AM	PDF Document
DA-110-120_00 Levels 18-20	5/06/2017 4:24 AM	PDF Document
DA-110-130_00 Level 21 (1)	5/06/2017 4:24 AM	PDF Document
DA-110-130_00 Level 21	5/06/2017 4:24 AM	PDF Document
DA-110-140_00 Plant (1)	5/06/2017 4:24 AM	PDF Document
DA-110-140_00 Plant	5/06/2017 4:24 AM	PDF Document
DA-250-010_00 Eveleigh Street_North Elevation (1)	5/06/2017 4:24 AM	PDF Document
DA-250-010_00 Eveleigh Street_North Elevation	5/06/2017 4:24 AM	PDF Document
DA-250-020_00 Lawson Street_West Elevation (1)	5/06/2017 4:24 AM	PDF Document
DA-250-020_00 Lawson Street_West Elevation	5/06/2017 4:24 AM	PDF Document
DA-250-030_00 Railway Line_South Elevation (1)	5/06/2017 4:24 AM	PDF Document
DA-250-030_00 Railway Line_South Elevation	5/06/2017 4:24 AM	PDF Document
DA-250-040_00 Terraces_East Elevation	5/06/2017 4:24 AM	PDF Document
DA-350-010_00 Section A-A	5/06/2017 4:24 AM	PDF Document
DA-350-020_00 Section B-B (1)	5/06/2017 4:24 AM	PDF Document
DA-350-020_00 Section B-B	5/06/2017 4:24 AM	PDF Document
DA-350-030_00 Section C-C	5/06/2017 4:24 AM	PDF Document
DA-350-040_00 Section D-D (1)	5/06/2017 4:24 AM	PDF Document
DA-350-040_00 Section D-D	5/06/2017 4:24 AM	PDF Document
DA-400-010_00 Room Layouts (1)	5/06/2017 4:24 AM	PDF Document
DA-400-010_00 Room Layouts	5/06/2017 4:24 AM	PDF Document
DA-400-020_00 5 Bed Cluster Layout (1)	5/06/2017 4:24 AM	PDF Document
DA-400-020_00 5 Bed Cluster Layout	5/06/2017 4:24 AM	PDF Document

Figure 1: Documentation Used

1.3 CLIMATE ZONE

The BCA splits regions of Australia up into eight different climate zones. Energy efficiency provision within the BCA Section J are dependent upon the climate zone a development falls within. The development is located within the Sydney City Council and therefore falls within Climate Zone 5 according to Part A1 of the BCA.

2 SECTION J ENERGY EFFICIENCY REVIEW

Section J of the BCA was developed to ensure that buildings are constructed to reduce greenhouse gas emissions. This requires improved building energy performance and ensures the installed services are operated in an efficient manner. Energy efficiency provisions are outlined for building construction and its services (heating, cooling, power, artificial lighting and hot water supply). In addition to this building's heating services, energy is to be obtained from a low greenhouse gas intensity source or an onsite renewable energy source or through another process as reclaimed energy.

2.1 BCA SECTION J PERFORMANCE REQUIREMENTS

There are three performance requirements of Section J in the BCA as outlined below:

2.1.1 Performance Requirement – JP1

A building, including its services, must have, to the degree necessary, features that facilitate the efficient use of energy appropriate to:

- The function and use of the building and services;
- The internal environment;
- The geographic location of the building;
- The effects of nearby permanent features such as topography, structures and buildings;
- Solar radiation being:
  - utilised for heating; and
  - controlled to minimise energy for cooling;
- The sealing of the building envelope against air leakage;
- The utilisation of air movement to assist heating and cooling;
- The energy source of the services.

2.1.2 Performance Requirement – JP2

A building, including its services, must have, to the degree necessary, features that facilitate the maintenance of systems and components appropriate to the function and use of the building.

2.1.3 Performance Requirement – JP3

Heating such as for a conditioned space must, to the degree necessary, obtain energy from –

- A source that has a greenhouse gas intensity that does not exceed 100 g CO_2-e/MJ of thermal energy load; or
- An on-site renewable energy source; or
- Another process as reclaimed energy.

There are two options to meet the performance requirement of Section J. The design and function of the building must comply with Deemed-to-Satisfy (DTS) provisions (JP1 and JP3) or pass Verification Method. The analysis of this report covers compliance with the Verification Method of Section J.

If the building design and function does not comply with the Deemed-to-Satisfy provisions, the building design and function must undergo Verification Methods JV3 of the Section J. The Section J Verification Method (JV3) has processes outlined to determine the energy efficiency of a building through the use of a dynamic thermal simulation technique. Further discussion on JV3 method is described below.

2.2 VERIFICATION USING REFERENCE BUILDING – JV3

To demonstrate compliance, Verification Method (JV3) states that a thermal simulation method must be used to calculate the annual energy consumption of the proposed building with its services is not more than annual energy consumption of a reference building when the buildings have been modelled in accordance with JV3 (a) to (g) of the BCA Section J.

The building energy models constructed for verification to achieve compliance in accordance to JV3 are:

- Run 1: reference building with DTS fabric and DTS services to establish the annual energy consumption allowance;
- Run 2: proposed building with proposed envelope and DTS services to demonstrate that the proposed envelope design is at least as energy efficient as a DTS complying design; and
- Run 3: proposed building with proposed services to calculate the annual energy consumption of the proposed design.

For compliance with Section J it is required that the annual energy consumption from Run 3 and Run 2 must both be no larger than the allowance obtained from Run 1.

2.3 DEEMED TO SATISFY (DTS) PROVISIONS

The reference building is modelled using Deemed-to-Satisfy provisions as specified by JV3. The DTS provision within Section J of the BCA outlines the following:

- Part J1 Building Fabric – Minimum thermal performance for constructions according to climate zone for roofs, ceilings, roof lights, walls, and floors.
- Part J2 Glazing – Methods outlined to control heat loss and gain in a building through the use of glazed elements within the allowances specified. This applies to both internal and external glazing.
- Part J3 Building Sealing – Provisions to reduce the loss of conditioned air and restrict unwanted infiltration to a building.
- Part J4 Air Movement – No longer relevant. This section has been deleted from the BCA.
- Part J5 Air-Conditioning and Ventilation Systems – Requirements to ensure these services are used in an efficient manner.
- Part J6 Artificial Lighting and Power – Requirements for lighting and power to ensure energy is used efficiently within a building.
- Part J7 Hot Water Supply – Restrictions for hot water supply design except for solar systems within climate zones 1-3.
- Part J8 Access for maintenance.

2.4 BUILDING CLASSIFICATION

According to the BCA building classification Part A3 the proposed development is classed as Class 3 building.

2.5 SECTION J APPLICABLE PARTS REVIEW

Table 1 outlines the Parts of Section J that are applicable to a Class 3 Building. Thermal Environmental has produced a Section J compliance report for the facility considering all the relevant clauses.

Table 1: Applicable Section J Parts

BCA Section J Parts	Class 3 (Student Accommodation)
Part J1 – Building Fabric	Applicable
Part J2 – External Glazing	Applicable
Part J3 – Building Sealing	Applicable
Part J4 – Air Movement	Not relevant
Part J5 – Air Conditioning and Ventilation Systems	Applicable
Part J6 – Artificial Lighting and Power	Applicable
Part J7 – Hot Water Supply	Applicable
Part J8 – Access for Maintenance	Applicable

2.5.1 Part J1 – Building Fabric

Part J1 of Section J outlines the requirements for building fabric covering roof and ceiling construction, walls, floors and roof lights (skylights).

Based on the architectural design and information received, data tables have been compiled below showing the roof, ceiling, wall, floor construction and the requirements for roof-lights of the development. Adjustments and/or inclusions to the construction make-ups where required in order to achieve the requirements have been outlined. Thermal properties of listed materials within data tables are assumed to be equivalent to those listed in *Specification J1.2 Material Properties* of Section J unless indicated otherwise. Insulation thicknesses quoted are nominal and taken from manufacturer's data for typical insulation products as assumed within the calculation tables.

2.5.1.1 Roof and Ceiling Construction

The conditioned spaces of the proposed development must achieve a downwards heat flow (heat gain) minimum total thermal resistance (R-Value) of 3.2 m²K/W for a roof/ceiling generally. The minimum thermal resistance required and the absorptance values are as shown in Table 2.

The lighter coloured roof will have higher heat reflection or lower solar absorptance compared to darker roof. The light coloured roof or low solar absorptance will therefore require less minimum overall insulation compared to the medium and dark coloured roof.

Table 2: Roof and Ceiling Minimum Total Thermal Resistance

Solar Absorptance	Absorptance Value	Minimum Resistance (R-Value)
Upper surface solar absorptance.	≤ 0.4	3.2
	> 0.4 and ≤ 0.6	3.7
	> 0.6	4.2

The roof or ceiling insulation is required for the conditioned spaces separating a conditioned space from a non-conditioned or an exterior of the building. In this case a light coloured roof is used therefore for the reference building the total thermal resistance required is R3.2 (downward).

Any space within the building that does not form the part of a conditioned space or envelope for the Section J assessment, the roof/ceiling insulation requirements does not apply. However the roof/ceiling construction is recommended to have some form of insulation to maintain comfort conditions or provide more habitable space and reduce overall energy consumption.

The various roof types used within the development as a conditioned space envelope are shown in Table 3. The assessment and the insulation requirements for each of the roof types are detailed in this section.

Table 3: Roof Types Used within the Development

Roof/Ceiling	Roof Pitch	Description	Area Serving
Flat Concrete Roof	Flat (< 5°)	Concrete roof with plasterboard lining	-

Table 4 shows the detailed thermal resistance calculation and the compliance requirements for the flat concrete roof construction of the development as outlined within the architectural documentation. Table 6 shows the associated thermal data including the level of insulation required in order to comply with the section J requirements.

Table 4: External Roof/Ceiling Construction – Flat Concrete Roof

Construction Layer	Nominal Thickness	Thermal Conductivity	Thermal Resistance (m² K/W)	
	(mm)	W/m K	Run 2 and 3 (JV3)	Run 1
Outside Air Film (7.0m/s wind assumed)	–	-	0.04	Deemed-to-Satisfy Insulation
Concrete	200	1.44	0.13	

Construction Layer	Nominal Thickness	Thermal Conductivity	Thermal Resistance (m² K/W)	
	(mm)	W/m K	Run 2 and 3 (JV3)	Run 1
Air Cavity (Non-reflective and Unventilated) - Downward heat flow	30	-	0.18	including roof surface absorptance
Plasterboard lining	10	0.17	0.06	
Inside Air Film (still air assumed)	–		0.16	
Total R-Value of the Construction	-	-	0.57	
Additional Insulation Required			2.63	
Total Thermal Resistance (R-Value)			*3.20*	*3.20*

The roof/ceiling construction as shown in Table 6 for the DTS case (Run 1) and also for proposed fabric is 3.2 m^2K/W.

Where for operational or safety reasons associated with exhaust fans, flues or recessed downlights are included, the area of required ceiling insulation is reduced. The loss of insulation must be compensated for by increasing the R-value of the insulation in the remainder of the ceiling in accordance with Table 5.

Table 5: Adjustment of Minimum R-value for Loss of Ceiling Insulation

Percentage of ceiling area uninsulated	Minimum R-value of ceiling insulation required to satisfy loss of ceiling insulation									
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
	Adjusted minimum R-value of ceiling insulation required to compensate for loss of ceiling insulation area.									
0.5% to less than 1.0%	1.0	1.6	2.2	2.8	3.4	4.0	4.7	5.4	6.2	6.9
1.0% to less than 1.5%	1.1	1.7	2.3	2.9	3.6	4.4	5.2	6.1	7.0	N/A
1.5% to less than 2.0%	1.1	1.7	2.4	3.1	3.9	4.8	5.8	6.8	N/A	N/A
2.0% to less than 2.5%	1.1	1.8	2.5	3.3	4.2	5.3	6.5	N/A	N/A	N/A
2.5% to less than 3.0%	1.2	1.9	2.6	3.6	4.6	5.9	N/A	N/A	N/A	N/A
3.0% to less than 4.0%	1.2	2.0	3.0	4.2	5.7	N/A	N/A	N/A	N/A	N/A
4.0% to less than 5.0%	1.3	2.2	3.4	5.0	N/A	N/A	N/A	N/A	N/A	N/A
5.0% or more	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

More than 5% uninsulated ceiling space is not allowed. Interpolation of insulation values is allowed to determine the adjusted minimum R-value of the roof/ceiling insulation.

2.5.1.2 Roof Lights (Sky Lights)

There are no roof lights used within the development.

2.5.1.3 Wall Construction

The external wall constructions of the development forming part of the envelope of conditioned spaces must satisfy one of the following options taken from Table J1.5a for climate zone 6:

a) i) Achieve a minimum Total R-Value of 2.8 m²K/W.

ii) The minimum total R-Value in (i) is reduced

- for a wall with a surface density of not less than 220 kg/m^2, by R-value of 0.5; and
- for a wall that is facing south orientation the total R-Value can be reduced by R-value of 0.5 or shade the external wall of the storey with a verandah, balcony, eaves, overhang, covered car park, carport or the like, which projects at a minimum angle of 30° by R0.5 or if the shading projects a minimum angle of more than 60° the total R-Value can be reduced by R-value of 1.0.

b) For an external wall where the only space for insulation is provided by a furring channel, top hat section, batten or the like –

i) Achieve a minimum Total R-Value of 1.4 m^2K/W; and
ii) Satisfy glazing energy index option B of Table J2.4a (see Section 2.4.2).

The internal wall construction of the development in climate zone 6 that forms the part of the envelope must achieve the following:

a) R-value of 1.0 with the non-conditioned space (for example a common wall between a conditioned and non-conditioned zones) –

i) enclosed with mechanical ventilation of not more than 1.5 air change per hour of outside air; and

ii) glazing not more than the DTS requirements; or

b) R-value of 1.8 for all other conditions than (a).

The wall constructions of the development are shown in Table 6 below. The assessment and the insulation requirements for each of the wall types are calculated in detail in this section.

Table 6: Wall Types Used within the Development

Wall types	Description	External /Internal
Type 1	200 mm Concrete and plasterboard lining	External/Internal

Options (a) (ii) cannot be used to assess compliance for the external walls as all the external walls also do not meet the surface density requirements. The external walls also do not also satisfy the shading requirements throughout the facility.

Option (b) above has been ignored as it requires the use of Energy Index Option B (EIO-B) for the external glazing (see Section 2.4.2). EIO-B puts the emphasis back onto the glazing elements of the building to obtain the required thermal performance, driving up the performance requirement of the glass.

Option (a) (i) has therefore been used to assess compliance for the external walls of the development within this report. The external wall constructions of the development must achieve a minimum Total R-Value of 2.8m^2K/W according to Option (a) (i) above, in order to comply with the Section J.

Internal wall constructions that separate conditioned from non-conditioned spaces that form part of the envelope of the conditioned spaces are required in climate zone 5 to achieve the Total R-value of R1.8m^2k/W listed in Table J1.5b of the BCA for internal walls.

Table 7 and Table 8 describe the external and internal wall construction of the development as outlined within the architectural documentation with their associated thermal data. In order to achieve the Section J DTS requirement (Run 1), it is recommended that all external wall constructions meet a minimum total thermal resistance of R2.8 and all internal wall constructions meet a minimum total thermal resistance of R1.8.

Recommended insulation levels are demonstrated below for both DTS (Run 1) and proposed design (Run 2 and 3) case scenarios.

Table 7: External Wall Types

External Wall Type	Construction Layer	Nominal Thickness	Thermal Conductivity	Thermal Resistance (m^2 K/W)	
		(mm)	W/m K	Run 2 & 3	Run 1
XX	Outside Air Film (7.0m/s wind assumed)	–	-	0.04	Deemed to Satisfy Insulation
	Reinforced Concrete Block Wall	200	1.44	0.13	
	Air Cavity (Non-Reflective and	28	-	0.17	

External Wall Type	Construction Layer	Nominal Thickness	Thermal Conductivity	Thermal Resistance (m² K/W)	
		(mm)	W/m K	Run 2 & 3	Run 1
	Unventilated)				
	Plasterboard lining	10	0.17	0.06	
	Inside Air Film (still air assumed)	–	-	0.12	
	Total Thermal Resistance (R-Value) of the Construction			1.0	
	Recommended Insulation Level				
	Thermal Insulation Required	-	-	*1.5*	
	New Total Thermal Resistance (R-Value)			*2.5*	*2.80*

Table 8: Internal Wall Types

Internal Wall Type	Construction Layer	Nominal Thickness	Thermal Conductivity	Thermal Resistance (m² K/W)	
		(mm)	W/m K	Run 2 & 3	Run 1
XX	Outside Air Film (still air assumed)	–	-	0.12	Deemed to Satisfy Insulation
	Reinforced Concrete Block Wall	180	1.44	0.13	
	Air Cavity (Non Reflective and unventilated)	25	-	0.17	
	Plasterboard Lining	10	0.17	0.06	
	Inside Air Film (still air assumed)	–	-	0.12	
	Total Thermal Resistance (R-Value) of the Construction			0.60	
	Recommended Insulation Level				
	Thermal Insulation Required	-	-	-	
	New Total Thermal Resistance (R-Value)			*0.06*	*1.80*
XX	Outside Air Film (still air assumed)	–	-	0.12	Deemed to Satisfy Insulation
	Plasterboard lining	10	0.17	0.06	
	Air Cavity (Reflective and unventilated)	25	-	0.17	
	Plasterboard Lining	10	0.17	0.06	
	Inside Air Film (still air assumed)	–	-	0.12	
	Total Thermal Resistance (R-Value) of the Construction			0.53	
	Recommended Insulation Level				
	Thermal Insulation Requried	-	-	-	
	New Total Thermal Resistance (R-Value)			*0.53*	*1.80*

2.5.1.4 Floor Construction

The suspended floor or slab on ground is required to comply with floor insulation requirements as per Section J. The requirements of floor insulation is for various floor construction is as shown in Table 9.

Table 9: Floor Construction

Floor Type	Construction Layer	Nominal Thickness (mm)	Thermal Conductivity W/m K	Thermal Resistance (m² K/W) Run 2 & 3	Thermal Resistance (m² K/W) Run 1
Concrete Floor	Outside Air Film (still air assumed)	–	-	0.04	Deemed to Satisfy Insulation
	Concrete Floor	180	1.44	0.13	
	Inside Air Film (still air assumed)	–	-	0.12	
	Total Thermal Resistance (R-Value) of the Construction			0.29	
	Recommended Insulation Level				
	Thermal Insulation Required	-	-	*none*	
	New Total Thermal Resistance (R-Value)			*0.29*	*2.0*

2.5.2 Part J2 –Glazing

The external glazing forming a part of the conditioned space envelope of the development must control the heat loss and gain in accordance with Clause J2.4 of Part J2. Clause J2.4 states the air conditioning energy value assigned to the glazing must not exceed the allowance from Table J2.4a multiplied by the façade area, as outlined in Table 10:

Table 10: Energy Index Option Parameter

Energy Index Option	Air Conditioning Energy Value
A	0.092
B	0.071

Energy Index Option B is included in Part J2 to allow for a lower wall resistance value for wall constructions that have limited space only provided by a furring channel for insulation. However this is not the case for the facility. Therefore for the purposes of a glazing assessment within this report, it has been assumed that the wall construction will contain more space for insulation than that provided by a furring channel. Assessment of the external glazing has been conducted using Energy Index Option A as option B would be more stringent to achieve compliance in-terms of the glazing size and performance requirements.

The section J DTS assessment has been carried out as a means of selecting a DTS Section J compliant glazing system for each façade of the development. The DTS glazing performance is summarised in Appendix A of this report.

Since the DTS glazing performance is stringent and requiring double glazing with high performance an alternative verification method (JV3) is carried out to demonstrate compliance. The summary of compliant glazing (glass and frame window system) for the proposed design using verification method (JV3) is summarised in Table 11.

Table 11: JV3 Glazing Performance Summary

Building Levels	Orientation or Façade	Glazing Description	JV3 Performance (AFRC)[2]
External Glazing - All levels	All facades and Orientations	Double Glazing	U Value – 2.8, SHGC – 0.26 and VLT – 40% (indicative)
Internal Glazing	-	Single Glazing	U Value – 4.5, SHGC – 0.73 and VLT – 80% (indicative)

[2] *The selection to be better or equal to the quoted performance, and the values quoted are AFRC values which takes glass and frame into account. The glazing selection to be verified and checked with the manufacturer that the selected window systems are WERS certified.*

2.5.3 Part J3 – Building Sealing

Part J3 of Section J outlines construction provisions to limit unconditioned air infiltrating into conditioned spaces and also limit conditioned air from escaping.

2.5.3.1 Windows and Doors

Clause J3.4 outlines that a seal to restrict air infiltration must be fitted to each edge of doors, openable windows or the like that separate conditioned spaces from non-conditioned spaces or external areas. This provision is not required for windows complying with Australian Standard AS 2047, roller doors, and fire doors, roller shutter grilles, security doors or device installed out of hours service.

The seal required may be a foam or rubber compressible strip, fibrous seal or the like. The main entrance to the development must have an airlock, self-closing door, revolving door or the like, where the conditioned space has a floor area of more than 50 m^2 or where a café, restaurant, open shop front or the like has a 3 m deep unconditioned zone between the main entrance, including an open front and the conditioned space and at all other entrances to the café, restaurant, open front shop or the like, self-closing doors.

2.5.3.2 Exhaust Fans

Clause J3.5 outlines that any miscellaneous exhaust systems must be fitted with a sealing device such as a self closing damper when serving a conditioned space or habitable room.

2.5.3.3 Construction of Roofs, Walls and Floors

Clause J3.6 outlines for the conditioned areas that the roofs, walls floors and any openings such as for doors and windows must be constructed to minimise air leakage. The construction must enclose conditioned spaces by close fitting internal lining systems at the ceiling, wall and floor junctions or by sealing through caulking, skirting, architraves, cornices or the like. The requirements of this clause do not apply to openings, grilles and the like necessary for smoke hazard management.

2.5.3.4 Evaporative Coolers

Clause J3.7 outlines that if evaporative cooling is used, the system must be fitted with self-closing non-return dampers. This Clause is not applicable as there are no evaporative coolers being used for the proposed development.

It is recommended architects to document the building sealing requirements as to show how Part J3 of the BCA has been satisfied.

2.5.4 Part J5 – Air Conditioning and Ventilation Systems

Part J5 of Section J outlines the provisions that apply to mechanical ventilation and air conditioning systems to ensure these services are used in an efficient manner. Mechanical services design to be produced by in accordance with the requirements of the Section J5.

2.5.4.1 Air-conditioning and Ventilating Systems

The following list outlines the applicable parts of Clause J5.2 to the development:

- The air conditioning system must be capable of being inactivated when the building or part of the building is un-occupied;
- Any motorised outside air or return air dampers must be closed when corresponding systems are switched off;
- The supply and return ductwork must be insulated and sealed in accordance with Specification J5.2, shown in the Appendix B;
- Each air conditioning system must thermostatically control the temperature of each zone, served by that system;
- Each air conditioning system must not use mixed heated and cooled air to control temperature, if the system serves more than one air conditioning zone;

- Each air conditioning system must not utilise more reheat capacity corresponding to a temperature rise of 7.5 K for the design fixed flow rate, if the system serves more than one air conditioning zone;
- Each air conditioning system must not utilise more reheat capacity corresponding to a temperature rise of 7.5 K for the variable flow rate at nominal supply rate, but increased or decreased at the same rate that the supply air rate is respectively decreased or increased when serving more than one air conditioning zone;
- Other than packaged air conditioning unit, the air conditioning system to have a variable speed fan when the supply air quantity is varied;
- Use of direct economy cycle must be used to provide mechanical ventilation for other than process related applications and applications where humidity control is not required. Economy cycle to be installed for air conditioning unit with a capacity is over 35 kWr in climate zones 4, 5, 6, 7 and 8;
- The motor shaft power of all fans within each air conditioning system of the development must be limited to as per Table 12 for the reference building (Run 1 and Run 2) and for the proposed building (Run 3) as per the mechanical services design specification. This requirement is not applicable for un-ducted systems with a supply flow rate less than 1,000L/s, outdoor air preconditioning systems (such as air to air heat exchanges) and for process related components that uses HEPA filters.

Table 12: Maximum Fan Power Limit

Air Conditioning Sensible Heat Load (W/m^2 of the floor area of the Conditioned Space)	Maximum Fan Power (W/m^2 of the Floor Area of the Conditioned Space)		
	For an Air Conditioning System Serving not more than 500 m^2	For an Air Conditioning System Serving more than 500 m^2	Fan Power (kW)
	Reference Building (Run 1 and Run 2)		Proposed Building and its Services(Run 3)
Up to 100	4.1	6.4	As per mechanical services design specification
101 - 150	7.3	10.4	As per mechanical services design specification
151 - 200	10.5	14.1	As per mechanical services design specification
201 - 300	17.1	21.5	As per mechanical services design specification
301 - 400	23.6	28.4	As per mechanical services design specification
For more than 400 W/m^2 sensible heat load – · In a building of not more than 500 m^2 floor area, use 0.07 W of fan power for each Watt of internal load · In a building of more than 500 m^2 floor area use 0.09 W of fan power for each Watt of internal load.			N/A

- Mechanical ventilation systems must be capable of being switched off when the part of the building being served is unoccupied;

- Mechanical ventilation systems serving conditioned spaces must not ventilate greater than 20% more than required by Part F4 of the BCA. This requirement is not applicable when the additional outside air provides free cooling, balances required or process exhaust, or is preconditioned by an energy reclaiming system;
- In other than climate zone 2, where the number of person per m^2 is one or less as specified in D1.13 and the air flow rate is more than 1,000 L/s, have and energy recovery system to precondition outdoor air or have the ability to modulate the mechanical ventilation required by Part F4 in proportion to the number of occupants;
- The mechanical ventilation systems that exceed 1,000 L/s must have a fan motor shaft power to air flow rate ratio of 0.5 W/(L/s) without filters or 0.75 W/(L/s) with filters. For carpark exhaust, when serving a carpark with more than 40 vehicle spaces, be controlled by an atmospheric contaminant monitoring system in accordance with AS 1668.2. The fan motor shaft power to air flow rate ratio must not inhibit the operation of smoke hazard management and operation and essential ventilation such as garbage room, lift motor room, gas meter enclosure or gas regulator enclosure or the like. The requirement is not applicable for energy reclaiming system that preconditions outside air, process related components and miscellaneous exhaust that comply with J5.5.

2.5.4.2 Time switch

Clause J5.3 outlines that the power supply to any air conditioning or heating systems with capacity greater than 10 kW and ventilation systems greater than 1,000 L/s must be controlled by a time switch in accordance with Specification J6 as shown in the Appendix C.

2.5.4.3 Heating and cooling systems

Clause J5.4 outlines the following requirements for systems that provide heating or cooling for air-conditioning systems:

- Any piping, vessels, heat exchangers or tanks containing heated or chilled fluid, other than those with insulation levels covered by the Minimum Energy Performance Standards (MEPS), must be provided with insulation in accordance with Specification J5.4;
- For water flow rates greater than 2 L/s, the total motor shaft power to these systems pumps must not exceed as per Table 13

Table 13: Maximum Pump Power Limit.

Cooling or Heating Load (W/m^2 of the floor area of the conditioned space)	Maximum Pump Power (W/m^2 of the Floor Area of the Conditioned Space)		
	Chilled Water	Condenser Water	Heating Water
Up to 100	1.3	0.9	1.0
101 – 150	1.9	1.2	1.3
151 – 200	2.2	2.2	1.7
201 – 300	4.3	3.0	2.5
301 – 400	5.0	3.6	3.2
More than 400	5.6	5.6	3.6

- Each pump must be capable of varying the shaft speed when the rated capacity is more than 3 kW of pump power, except where the pump is needed to run at full speed for safe or efficient operation;
- For a system containing more than one water heater for heating a building, chiller or coil, must be capable of stopping the flow of water to those that are not operating.

For heating a space via water(i.e. a boiler) that is a part of an air conditioning system, must a minimum thermal efficiency requirements as per Table 5.4b, when tested in accordance with BS 7190.

When gas is available, use reticulated gas at the allotment boundary. The minimum thermal efficiency of a water heater taken from Table 5.4b is shown in Table 14.

Table 14: Minimum Thermal Efficiency for a Water Heater

Fuel Type	Rated Capacity ($kW_{heating}$)	Minimum Gross Thermal Efficiency (%)
Gas	<= 750	80
	> 750	83
Oil	All Capacities	80

For heating a space other than via water, must be –

- A solar water heater; or
- A gas heater or
- An oil heater, but only if reticulated gas in not available at the allotment boundary; or
- Heat pump heater or
- A solid fuel burning heater; or
- A heater or using a reclaimed heat from another process such as reject heat from a refrigeration plant; or
- A combination of all of the above.
- In the case of electric heating only following requirements apply:
  - In climate zone 1 heating capacity must not be more than 10 W/m^2 of the conditioned space floor area.
  - In climate zone 2 heating capacity must not be more than 40 W/m^2 of the conditioned space floor area.
  - In climate zone 3 to 7 the electric heating capacity is as per Table 15 taken from Table J5.4c

Table 15: Minimum Thermal Efficiency for a Water Heater

Floor Area of the Conditioned Space	BCA Climate Zone				
	3	4	5	6	7
	W/m^2 of Floor Area				
Not more than 500 m^2	50	60	55	65	70
More than 500 m^2	40	50	45	55	60

- Any outdoor heating appliances must be controlled to automatically turn off when not needed by an outdoor air temperature sensor, timer, motion detector, or the like.

Table 16 taken from Clause J5.4, Table J5.4d outlines the minimum energy efficiency ratios for packaged air-conditioning equipment with a capacity of not less than 65 kWr, including split units and heat pumps as tested in accordance with AS/NZS 3823.1.2 at test condition T1 for Run 1 and Run 2. The energy efficiency ratio of the air conditioning system used within the facility is as per the design. The designed COPs of the air conditioning system for the facility are as per the mechanical services design specification.

Table 16: Minimum Energy Efficiency Ratio for Packaged Air-conditioning Equipment

Equipment	Minimum Energy Efficiency Ratio (W_r / $W_{input\ power}$)	
	Run 1 and Run 2	Run 3
Air Conditioner – Cooling (Capacity between 65 to 95 kW)	2.70	TBC

Table 17 taken from Clause J5.4, Table J5.4e outlines the minimum energy efficiency ratios for refrigerant chillers up to 350 kWr capacity when determined in accordance with ARI 550/590.

Table 17: Minimum Energy Efficiency Ratio for Refrigerant Chillers

Equipment	Minimum Energy Efficiency Ratio (W_r / $W_{input\ power}$)	
	For Full Load Operation	For Integrated Part Load
Water Cooled Chiller	4.2	5.2
Air Cooled or Evaporatively Cooled Chiller	2.5	3.4

Clause J5.4 outlines the following for heat rejection systems:

- An air cooled condenser fan motor that is part of an air conditioning system except part of packaged air conditioning equipment or part of refrigerant chillers must not use more than 42 W of fan motor power for each kW of heat rejected from the refrigerant when determined in accordance with ARI 460.
- The propeller or axial type of fan of a cooling tower that is part of an air conditioning system must not use more than 310 W of fan motor power for each L/s of cooling water circulated. For centrifugal fan the fan power should not exceed 590 W for each L/s of cooling water circulated.
- The propeller or axial fan of a closed circuit cooler that is part of an air conditioning system must not use more than 500 W of fan power for each L/s of cooled liquid fluid circulated. For centrifugal fan the fan power should not exceed 670 W of fan power for each L/s of cooled fluid circulated.
- The propeller or axial fan of an evaporative condenser that is part of an air conditioning system must not use more than 18 W of fan power for each kW of heat rejected and if the fan is centrifugal the fan power should not exceed 22 W for each kW of heat rejected.
- The spray water pump of a closed circuit cooler or evaporative condenser must not use more than 150 W of pump motor shaft power for each L/s of spray water circulated.

2.5.4.4 Miscellaneous Exhaust Systems

Clause J5.5 outlines that any miscellaneous exhaust system with an air flow greater than 1,000 L/s of the proposed development having a variable demand must be capable of:

- Having the operator reduce energy consumption such as with a variable speed drive;
- Being stopped when not required.

These exhaust systems must be designed to minimise the exhausting of conditioned air. The requirements of Clause J5.5 do not apply to exhaust systems needed to balance required ventilation or where airflow must be maintained for safe operation and within Class 3 building.

Mechanical services design to be produced in accordance with the requirements of the Section J5.

2.5.5 Part J6 – Artificial Lighting and Power

Part J6 outlines provisions that apply to artificial lighting and power to ensure energy is used efficiently. Electrical services design to be produced in accordance with the requirements of the Section J6.

2.5.5.1 Artificial Lighting

Clause J6.2 outlines the requirements for interior artificial lighting design. For the proposed development, the aggregate illumination power load must not exceed the power load allowance that is a function of the lighting areas, lighting levels and controls. Table 18 outlines the maximum illumination power densities for different applications within the proposed development.

Table 18: Lighting Power Density Allowances

Lighting Application	Maximum Illumination Power Density (W/m^2)
Board Room and Conference Room	10

Lighting Application	Maximum Illumination Power Density (W/m^2)
Corridors and Circulation Space	8
Staff Change Room	6
Entry Lobby from Outside the Building	15
Common Room	8
Control Room, Switch Room and the Like	9
Kitchen and Food Preparation Area	8
Lounge Area for Communal use in a Class 9C Building	10
Office (artificially lit to 200 lux or more)	9
Office (artificially lit to less than 200 lux)	7
Plant Room	5
Restaurant, Café and a Space for the Serving and Consumption of food or drinks	18
Retail Space	22
Sole Occupancy Unit of a Class 9C Building	7
Storage with Shelving no Higher than 75% of the height of the aisle lighting	8
Storage with Shelving Higher than 75% of the height of the aisle lighting	10
Service Area, Cleaners Room	5
Toilet, Locker Room, Staff Room, Rest Room and the Like	6

For areas not listed in Table 18, the maximum illumination power density can be calculated from the required illuminance level for the space as follows:

- For an illuminance level of not more than 80 lux, 7.5 W/m^2; and
- For an illuminance level of more than 80 lux and not more than 160 lux, 9 W/m^2; and
- For an illuminance level of more than 160 lux and not more than 240 lux, 10 W/m^2; and
- For an illuminance level of more than 240 lux and not more than 320 lux, 11 W/m^2; and
- For an illuminance level of more than 320 lux and not more than 400 lux, 12 W/m^2; and
- For an illuminance level of more than 400 lux and not more than 480 lux, 13 W/m^2; and
- For an illuminance level of more than 480 lux and not more than 540 lux, 14 W/m^2; and
- For an illuminance level of more than 540 lux and not more than 620 lux, 15 W/m^2;

For an illuminance levels greater than 620 lux the average light source efficacy must not be less than 80 Lumens/W.

The allowable maximum illumination power densities as shown in Table 18 can be increased if control strategies are utilised to use energy more efficiently. The assessment of increases to the illumination power densities should be detailed further as the lighting designs are developed and for detail refer to lighting design engineer's compliance certificate.

2.5.5.2 Interior Artificial Lighting and Power Control

Clause J6.3 outlines methods for the control of interior artificial lighting and power. The applicable parts of this clause are shown in the following list:

- Artificial lighting of a room or space must be individually operated by a switch or other control device.
- An occupant activated device, such as a room security device, a motion detector in accordance with Specification J6 or the like, must be provided in the sole occupancy unit of a Class 5 and 6 building, to cut power to the artificial lighting, air conditioner, local exhaust fans and bathroom heater when the sole occupancy unit is unoccupied.
- An artificial lighting switch must be located in a visible position within the room being switched or adjacent room where the lighting being switched is visible.

The provisions outlined above for artificial lighting are not applicable to emergency lighting systems that are in accordance with Part E4 of the BCA.

2.5.5.3 Interior Decorative and Display Lighting

Clause J6.4 outlines the provisions applicable to interior decorative and display lighting. Within the following list the applicable parts of this Clause are shown:

- Interior decorative and display lighting must be controlled separately from other artificial lighting.
- Each area of interior decorative and display lighting must have a specific manual switch if the areas of display are to operate at separate times.
- A time switch in accordance with Specification J6, outlined in the Appendix C, must control display lighting that exceeds 1 kW.
- Window display lighting must be controlled separately from other display lighting.

2.5.5.4 Artificial Lighting Around the Perimeter of a Building

Clause J6.5 contains provisions for artificial lighting around the perimeter of a building. The following list outlines the applicable parts of this Clause:

- Artificial lighting around the perimeter of a building must be controlled by a daylight sensor or a time switch in accordance with Specification J6, shown in the Appendix C.
- When the artificial lighting around the perimeter of a building exceeds 100W, the average light source efficacy must not be less than 60 Lumens/W or be controlled by a motion detector in accordance with Specification J6, shown in the Appendix C. (Not applicable to emergency lighting).
- Decorative perimeter artificial lighting must be controlled by a time switch in accordance with Specification J6.

2.5.5.5 Boiling Water and Chilled Water Storage Units

Clause J6.6 outlines a provision for power to boiling water and chilled water units, stating each unit must be controlled by a time switch in accordance with Specification J6, shown in the Appendix C.

Electrical services design to be produced in accordance with the requirements of the Section J6.

2.5.6 Part J7 – Hot Water Supply

Part J7 of Section J outlines the provisions for the energy efficient use of hot water supply systems. Hydraulic services design to be produced by Services Engineers in accordance with the requirements of the Section J7.

Clause J7.2 states that a hot water supply system for food preparation or sanitary purposes must be designed and installed in accordance with Section 8 of AS/NZS 3500.4.

2.5.7 Part J8 – Access for Maintenance

Part J8 outlines the provisions applicable to providing sufficient access for maintenance in order to satisfy the performance requirement JP2 as outlined in Section 3.1 of this report.

2.5.7.1 NSW Provisions - Access for Maintenance

Clause J8.2 states that access for maintenance must be provided to:

- adjustable or motorised shading devices; and.
- time switches and motion detectors; and
- room temperature thermostats; and
- plant thermostats such as on boilers or refrigeration units; and
- motorised air dampers and control valves; and
- reflectors, lenses and diffusers of light fittings; and
- heat transfer equipment; and
- plant that receives a concession under JV3(b) for the use of energy obtained from an on-site renewable energy source or another process as reclaimed energy

2.5.7.2 Facilities for Energy Monitoring

Clause J8.3 requires facilities for energy monitoring for a building or sole occupancy unit with a floor area of more than 500 m^2 must have the facility to record the consumption of gas and electricity.

A building with a floor area of more than 2,500 m^2 must have the facility to record individually the energy consumption of followings:

- Air conditioning plant including, where appropriate, heating plant, cooling plant and air handling fans and
- Artificial lighting
- Appliance power; and
- Central hot water supply; and
- Internal transport devices including lifts, escalators and travelators where there is more than one serving the building; and
- other ancillary plant.

3 ENERGY CONSUMPTION ASSESSMENT

The following section demonstrates compliance to BCA Section J by using computer simulation to calculate the annual energy consumption as required by JV3 – Verification by using a reference building.

3.1 ANALYSIS

As the main concept of the performance requirement is to facilitate the efficient use of energy, the basis of the analysis is done through computer simulation techniques to compare the annual energy consumption of a DTS case to that of the proposed solution.

The DesignBuilder and EnergyPlus whole building energy simulation software packages have been utilised for the purpose of predicting energy performance of the development. EnergyPlus is a simulation program designed for modelling buildings with all their associated heating, cooling, lighting, ventilating, and other energy flows. EnergyPlus is a stand-alone simulation engine without a 'user friendly' graphical interface. DesignBuilder release version 3.2.0.070 and EnergyPlus release version 7.2.0.006 has been utilised for the analysis of this report. EnergyPlus simulation software is certified in accordance with ANSI/ASHRAE Standard 140-2001: "Standard Method of Test for Evaluation of Building Energy Analysis Computer Programs".

The International Weather for Energy Calculation (IWEC) hourly data file for Sydney climate data has been used for the analysis. IWEC weather data files are compiled from no less than 18 years of weather records. The IWEC hourly data is considered to be equivalent Test Reference Year (TRY) weather data.

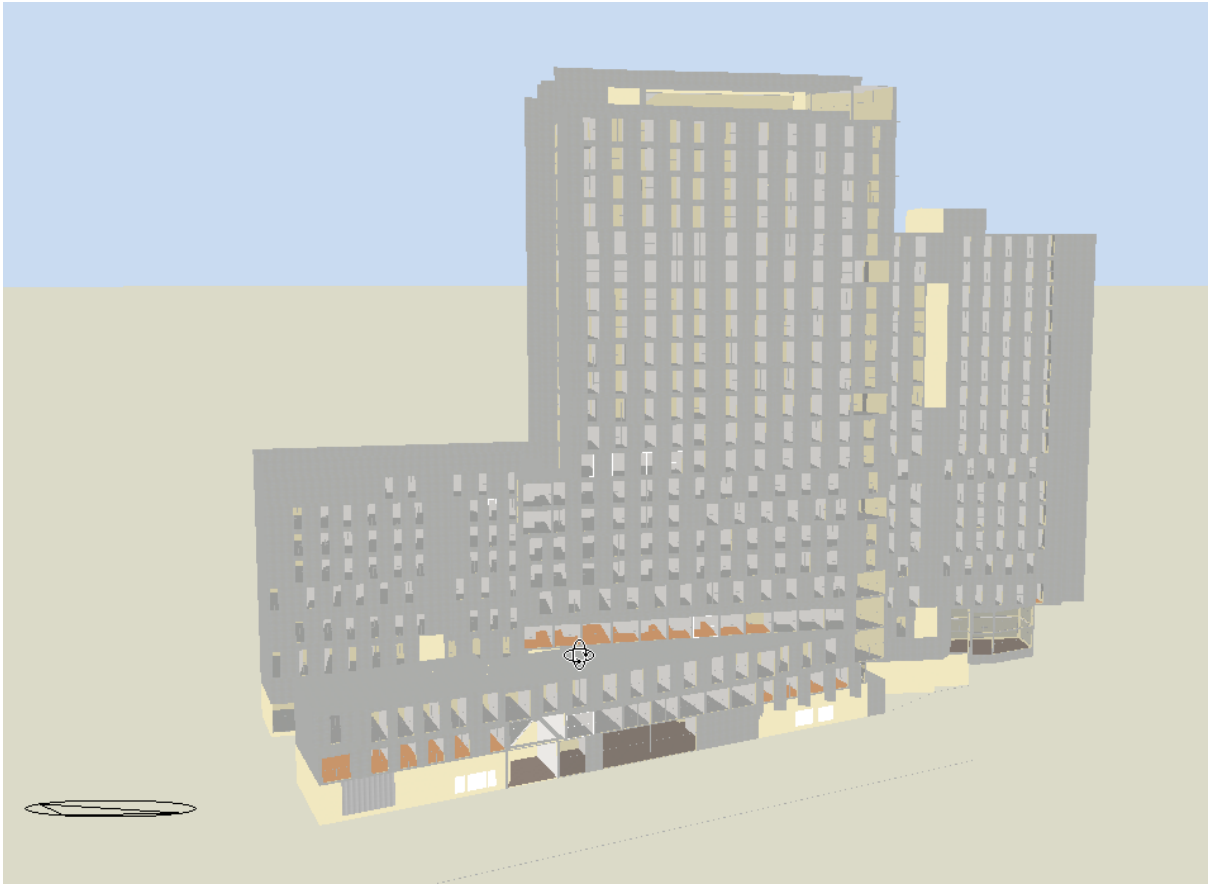

Figure 2: DesignBuilder Dynamic Thermal Simulation Model

The computer model of the Student Accommodation building shown in Figure 2 has been used for the dynamic thermal simulation. The simulation model includes the necessary features such as; shadowing, influence of surrounding buildings and internal conditions in order to analyse thermal performance of all the conditioned spaces of the proposed development and assess its annual energy performance.

3.1.1 Energy Model Inputs

This section of the report summarises the inputs in the dynamic thermal simulation model.

3.1.1.1 Building Fabric

The building fabric for each model is described in Section 2.5.1 of this report

3.1.1.2 External Glazing

The external glazing used within the development is described in Section 2.5.2 of this report.

3.1.1.3 Internal Loads

The internal loads are in accordance with Specification JV – Annual Energy Consumption Criteria for each zone type for the reference building (Run 1) and proposed fabric with DTS services (Run 2).

For all simulation runs:

- Internal heat gains are as follows:
  - From occupants, at an average rate of 75 W per person sensible heat gain and 55 W per person latent heat gain with the number of people calculated in accordance with D1.13; and
  - From hot meals in a dining room, restaurant or café at a rate of 5 W per person sensible heat and 25 W per person latent heat gain with the number of people calculated in accordance with D1.13; and
  - No appliances and equipment internal heat gain.
  - Artificial lighting based on Table 6.2a for Run 1 and Run 2 and for Run 3 the lighting power density is calculated on the basis of proposed design.
- Solar absorptance of 0.6 for external walls and 0.7 for roofs.
- Air conditioning space temperature within the range of 18°C DBT to 26°C DBT for 98% of the plant operation time
- Profiles for occupancy, air conditioning, lighting, appliances and equipment and hot water systems as per Specification JV.

3.1.1.4 Infiltration Values

- For a perimeter zone of depth equal to the floor-to-ceiling height, when pressurising plant is operating, 1.0 air change per hour; and
- For the whole building when pressurising plant is not operating, 1.5 air change per hour

3.1.1.5 Heating and Cooling System

The heating and cooling system for the reference building (Run 1) and the proposed fabric with DTS services (Run 2) is as per 2.5.4. For the proposed building with designed fabric and designed services (Run 3) the efficiencies as per Table 19. The COP inputs used within all simulation scenarios is summarised in Table 19.

Table 19: Heating and Cooling System and its Efficiency

AC Units	DTS (Run 1) and Run 2 COP	Proposed Building (Run 3) COP
All air conditioning units	2.7 (See Section 2.5.4)	TBC

3.1.1.6 Lighting

The lighting for the reference building (Run 1) and proposed fabric with DTS services (Run 2) is as per Section 2.5.5. The proposed building with proposed services lighting power density and the DTS building lighting power density is summarised in Table 20.

Table 20: Summary of Lighting Power Density.

Room Description	Reference Building and DTS Services Lighting Power Density (Run 1 and Run 2)	Proposed Building Lighting Power Density (Run 3)
Various Spaces	As per Section 2.5.5	TBA
		TBA
		TBA
		TBA
		TBA
		TBA
		TBA
		TBA
		TBA
		TBA
		TBA

3.1.1.7 Load Profiles (Occupancy, Lighting, Equipment and HVAC)

The internal loads and profiles for Occupancy, Lighting, Equipment and HVAC System are in accordance with Specification JV. These are used for Run 1, Run 2 and Run 3 (TBC) as per Table 21.

Table 21: Load Profiles for Occupancy, Lighting, Equipment and HVAC (Class 3)

Time Period (Local Standard Time)	Occupancy		Lighting	Equipment	HVAC	
	Weekdays	Weekends and Holidays	Weekdays, Weekends & Holidays	Weekdays, Weekends & Holidays	Weekdays	Weekends & Holidays
0:00 - 1:00	85%	85%	5%	100%	ON	ON
1:00 - 2:00	85%	85%	5%	100%	ON	ON
2:00 - 3:00	85%	85%	5%	100%	ON	ON
3:00 - 4:00	85%	85%	5%	100%	ON	ON
4:00 - 5:00	85%	85%	5%	100%	ON	ON
5:00 - 6:00	85%	85%	25%	100%	ON	ON
6:00 - 7:00	85%	85%	80%	100%	ON	ON
7:00 - 8:00	80%	85%	80%	100%	ON	ON
8:00 - 9:00	50%	50%	50%	100%	ON	ON
9:00 - 10:00	10%	50%	20%	100%	OFF	ON
10:00 - 11:00	10%	20%	20%	100%	OFF	OFF
11:00 - 12:00	10%	20%	20%	100%	OFF	OFF
12:00 - 13:00	10%	20%	20%	100%	OFF	OFF
13:00 - 14:00	10%	20%	20%	100%	OFF	OFF
14:00 - 15:00	10%	20%	20%	100%	OFF	OFF
15:00 - 16:00	10%	30%	20%	100%	OFF	OFF
16:00 - 17:00	50%	50%	20%	100%	ON	ON
17:00 - 18:00	50%	50%	50%	100%	ON	ON
18:00 - 19:00	70%	50%	50%	100%	ON	ON
19:00 - 20:00	70%	70%	50%	100%	ON	ON
20:00 - 21:00	80%	80%	50%	100%	ON	ON
21:00 - 22:00	85%	80%	50%	100%	ON	ON
22:00 - 23:00	85%	85%	50%	100%	ON	ON
23:00 - 24:00	85%	85%	5%	100%	ON	ON

3.2 SIMULATION RESULTS

Table 22 summarises the total annual energy consumption for three simulation scenarios to demonstrate compliance with BCA Section J. These are as follows:

- Run 1: Reference building or the DTS building;
- Run 2: Proposed building fabric with DTS building services; and
- Run 3: Proposed building with proposed building services.

The result of the total annual energy consumption comparison shows that the total annual energy consumption of Run 2 is not more than Run 1. Also the Run 3 (Design case) is less than that of Run 2 and Run 1.

Table 22: Total Annual Energy Consumption for two Simulation Scenarios

Simulation Scenarios	DTS Fabric and Services – Reference Building (Run 1)	Designed Fabric and DTS Services (Run 2)	Design Fabric and Services (Run 3)
Total Annual Energy Consumption (kWh)	1,548,000	1,526,660	N/A

Table 23 shows the breakdown of all the energy consumption for the three simulation scenarios. All these components have the same usage profile and occupant density, lighting and equipment as described in Table 23.

Table 23: Energy End Use Summary for Run 1, Run 2 and Run 3

Energy End Use Category	Annual Consumption (kWh)		
	Run 1	Run 2	Run 3
Cooling	405,028	344,708	TBC
Heating	432,435	471,415	
Internal Lighting	281,879	281,879	
Equipment	428,658	428,658	
Total	1,548,000	1,526,660	

3.3 CONCLUSION

The simulation outcome in Table 23 above shows that the total annual energy consumption of 1,526,660 kWh for Run 2 is less than that of Run 1 (1,548,000 kWh), thus the proposed building with its DTS services is more efficient compared to the reference building. The efficiency gain is mainly attributed to the building envelope.

When Run 3 is assessed with more efficient services than DTS, the energy consumption is further reduced compared to Run 2 and Run 1. Therefore the proposed building with services, fabric and glazing is compliant using the verification method (JV3).

APPENDIX A – DTS GLAZING ASSESSMENT

Lower Ground:

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014) HELP

Building name/description: 73-123 Eveleigh Street, Redfern | Application: Class 3 | Climate zone: 5

Storey: Lower Ground

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A		66.8m²		61.2m²		12.7m²		185m²	
Option B									n/a
Glazing area (A)		*61.9m²*		*5.76m²*		*9.84m²*		*91.2m²*	

Number of rows preferred in table below: 8 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	Family Room	NE		4.85	8.50		4.1	0.13	*6.000*	######	*0.00*	*6.15*	*1.00*	*1.00*	41.23	100% of 100%
2	Kitchen	NE		4.85	2.50		4.1	0.13	device		2.00	0.00	0.00	0.20	12.13	
3	Lounge	NE		4.85	1.77		4.1	0.13	device		2.00	0.00	0.00	0.20	8.58	
4	Gym	SE		3.20	1.80		8.0	1.00				0.00	1.00	1.00	5.76	100% of 76%
5	Gym	SW		4.15	2.37		2.2	0.13	device		2.00	0.00	0.39	0.34	9.84	100% of 100%
6	Lounge	NW		3.20	11.08		2.8	0.21	0.400	3.200	0.13	0.00	0.97	0.90	35.46	43% of 100%
7	?? Xx	NW		3.20	2.90		2.8	0.21	0.400	3.200	0.13	0.00	0.97	0.90	9.28	11% of 100%
8	Gym	NW		4.15	11.20		2.8	0.21	1.200	4.150	0.29	0.00	0.91	0.76	46.48	46% of 100%

IMPORTANT NOTICE AND DISCLAIMER IN RESPECT OF THE GLAZING CALCULATOR

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if inputs are valid

Upper Ground

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: 73-123 Eveleigh Street, Redfern

Application: Class 3

Climate zone: 5

Storey: Upper Ground

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A		6.6m²		194m²		27.8m²		337m²	58m²
Option B									n/a
Glazing area (A)		*6.2m²*		*137m²*		*26.4m²*		*199m²*	*37m²*

Number of rows preferred in table below: 23 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS									SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	Entry Lounge	NE		5.30	1.17		3.4	0.42	device		2.00	0.00	0.00	0.20	6.20	100% of 99%
2	5 Bed Cluster (Type D)	SE		3.25	1.95		1.8	0.12				0.00	1.00	1.00	6.34	5% of 99%
3	5e	SE		3.25	1.40		1.8	0.12				0.00	1.00	1.00	4.55	3% of 99%
4	5 Bed Cluser Type B	SE		2.50	1.95		1.8	0.12	*0.450*	5.400	*0.00*	*2.90*	*1.00*	*1.00*	4.88	4% of 99%
5	Twin Type A	SE		5.50	5.60		1.8	0.12	0.450	5.400	0.08	-0.10	0.96	0.94	30.80	22% of 99%
6	Meeting Rooms	SE		5.50	2.80		1.8	0.12	0.500	2.250	0.22	-3.25	0.89	0.84	15.40	11% of 99%
7	Entry Lounge	SE		5.50	13.56		1.8	0.12				0.00	1.00	1.00	74.58	55% of 99%
8	Entry Lounge	SW		5.50	4.80		1.5	0.12	2.850	5.800	0.49	0.30	0.88	0.82	26.40	100% of 100%
9	Studio Type A	NW		2.25	6.75		3.9	0.18	0.500	2.250	0.22	0.00	0.94	0.82	15.19	7% of 98%
10	Studio Type A	NW		2.25	1.33		3.9	0.18	0.500	2.250	0.22	0.00	0.94	0.82	2.99	1% of 98%
11	Studio Type A	NW		2.25	21.00		3.9	0.18	0.500	2.250	0.22	0.00	0.94	0.82	47.25	22% of 98%
12	Studio Type A	NW		2.85	8.13		3.9	0.18				0.00	1.00	1.00	23.16	14% of 98%
13	5 Bed Cluster (Type D)	NW		2.85	2.70		3.9	0.18				0.00	1.00	1.00	7.70	5% of 98%
14	5 Bed Cluser Type B	NW		3.25	0.90		3.9	0.18				0.00	1.00	1.00	2.93	2% of 98%
15	5 (a-e)	NW		3.25	4.50		3.9	0.18				0.00	1.00	1.00	14.63	9% of 98%
16	Studio Type A	NW		3.25	2.70		3.9	0.18				0.00	1.00	1.00	8.78	5% of 98%
17	Entry Foyer	NW		5.50	1.20		3.9	0.18	2.000	5.500	0.36	0.00	0.87	0.70	6.60	2% of 98%
18	Entry Lounge	NW		5.50	2.90		3.9	0.18	1.000	5.500	0.18	0.00	0.95	0.85	15.95	8% of 98%
19	Entry Lounge	NW		5.50	6.67		3.9	0.18	2.000	5.500	0.36	0.00	0.87	0.70	36.69	14% of 98%
20	Admin	NW		5.50	3.15		3.9	0.18				0.00	1.00	1.00	17.33	11% of 98%
21	Meeting Rooms	internal		2.10	4.99		3.0	0.85			2.00	0.00	0.64	0.54	10.48	28% of 100%
22	Meeting Rooms	internal		2.10	4.10		3.0	0.85			2.00	0.00	0.64	0.54	8.61	23% of 100%
23	Admin	internal		2.10	8.67		3.0	0.85			2.00	0.00	0.64	0.54	18.21	49% of 100%

IMPORTANT NOTICE AND DISCLAIMER IN RESPECT OF THE GLAZING CALCULATOR

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if inputs are valid

Level 1

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: 73-123 Eveleigh Street, Redfern | Application: Class 3 | Climate zone: 5

Storey: Level 1

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A				119m²				335m²	
Option B									n/a
Glazing area (A)				*34.2m²*				*121m²*	

Number of rows preferred in table below: 18 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance			P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)		P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	5(e)	SE		2.52	1.35		4.5	0.27					0.00	1.00	1.00	3.40	10% of 98%
2	5 Bed Cluser Type (D)	SE		2.52	1.95		4.5	0.27					0.00	1.00	1.00	4.91	15% of 98%
3	5 Bed Cluser Type (B)	SE		2.52	1.95		4.5	0.27					0.00	1.00	1.00	4.91	15% of 98%
4	Twin Type A	SE		2.50	5.60		4.5	0.27		0.750	3.000	0.25	0.50	0.95	0.93	14.00	40% of 98%
5	Studio Type A	SE		2.50	2.80		4.5	0.27		0.750	3.000	0.25	0.50	0.95	0.93	7.00	20% of 98%
6	Study	NW		2.60	4.50		4.5	0.27					0.00	1.00	1.00	11.70	11% of 100%
7	Studio Type A	NW		2.60	4.50		4.5	0.27		1.450	3.000	0.48	0.40	0.94	0.76	11.70	8% of 100%
8	Studio Type A	NW		2.90	2.60		4.5	0.27		0.600	3.000	0.20	0.10	0.95	0.84	7.54	6% of 100%
9	Studio Type A	NW		2.60	12.00		4.5	0.27		1.450	3.000	0.48	0.40	0.94	0.76	31.20	21% of 100%
10	Studio Type A	NW		2.90	2.60		4.5	0.27					0.00	1.00	1.00	7.54	7% of 100%
11	Studio Type A	NW		2.60	1.50		4.5	0.27					0.00	1.00	1.00	3.90	4% of 100%
12	5 (a-d)	NW		2.60	6.00		4.5	0.27		0.600	3.000	0.20	0.40	0.99	0.95	15.60	14% of 100%
13	5 Bed Cluster Type D	NW		2.50	0.95		4.5	0.27					0.00	1.00	1.00	2.38	2% of 100%
14	5 Bed Ckuster Type B	NW		2.90	0.90		4.5	0.27					0.00	1.00	1.00	2.61	2% of 100%
15	5 (a-e)	NW		2.90	4.50		4.5	0.27					0.00	1.00	1.00	13.05	12% of 100%
16	Studio Type A	NW		2.90	2.70		4.5	0.27					0.00	1.00	1.00	7.83	7% of 100%
17	Studio Type A	NW		2.90	0.95		4.5	0.27					0.00	1.00	1.00	2.76	3% of 100%
18	Access Studio Type A	NW		2.90	0.95		4.5	0.27					0.00	1.00	1.00	2.76	3% of 100%

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if inputs are valid

Level 2

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: 73-123 Eveleigh Street, Redfern | Application: Class 3 | Climate zone: 5

Storey: Level 2

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A				89.5m²		34.2m²		294m²	
Option B									n/a
Glazing area (A)				*25.9m²*		*19m²*		*176m²*	

Number of rows preferred in table below: 13 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance			P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)		P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	5 Bed Cluser Type (D)	SE		2.52	1.95		4.5	0.27					0.00	1.00	1.00	4.91	19% of 98%
2	Twin Type A	SE		2.50	5.60		4.5	0.27		0.750	3.000	0.25	0.50	0.95	0.93	14.00	54% of 98%
3	Studio Type A	SE		2.50	2.80		4.5	0.27		0.750	3.000	0.25	0.50	0.95	0.93	7.00	27% of 98%
4	5 Bed Cluser Type C	SW		2.50	6.60		1.8	0.30					0.00	1.00	1.00	16.50	87% of 100%
5	5E	SW		2.50	1.00		1.8	0.30					0.00	1.00	1.00	2.50	13% of 100%
6	Study	NW		2.60	4.50		5.0	0.17					0.00	1.00	1.00	11.70	7% of 100%
7	Studio Type A/ 5 (a-3)	NW		2.60	38.30		5.0	0.17		0.650	3.000	0.22	0.40	0.99	0.94	99.58	54% of 100%
8	Studio Type A	NW		2.60	4.50		5.0	0.17					0.00	1.00	1.00	11.70	7% of 100%
9	5 (a-e)	NW		2.60	7.50		5.0	0.17					0.00	1.00	1.00	19.50	12% of 100%
10	5 Bed Cluster Type B	NW		2.60	1.50		5.0	0.17					0.00	1.00	1.00	3.90	2% of 100%
11	5 (a-e)	NW		2.60	7.50		5.0	0.17					0.00	1.00	1.00	19.50	12% of 100%
12	Studio Type A	NW		2.90	2.70		5.0	0.17					0.00	1.00	1.00	7.83	5% of 100%
13	Access Studio Type A	NW		2.90	0.95		5.0	0.17					0.00	1.00	1.00	2.76	2% of 100%

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if inputs are valid

Level 3

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014) — HELP

Building name/description: 73-123 Eveleigh Street, Redfern | Application: Class 3 | Climate zone: 5

Storey: Level 3

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A				89.5m²		34.2m²		298m²	
Option B									n/a
Glazing area (A)				25.9m²		19m²		124m²	

Number of rows preferred in table below: 13 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance			P&H or device		Shading	Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)		P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	5 Bed Cluser Type (D)	SE		2.52	1.95		4.5	0.27					0.00	1.00	1.00	4.91	19% of 98%
2	Twin Type A	SE		2.50	5.60		4.5	0.27		0.750	3.000	0.25	0.50	0.95	0.93	14.00	54% of 98%
3	Studio Type A	SE		2.50	2.80		4.5	0.27		0.750	3.000	0.25	0.50	0.95	0.93	7.00	27% of 98%
4	5 Bed Cluser Type C	SW		2.50	6.60		1.8	0.30					0.00	1.00	1.00	16.50	87% of 100%
5	5E	SW		2.50	1.00		1.8	0.30					0.00	1.00	1.00	2.50	13% of 100%
6	Study	NW		2.60	4.50		5.0	0.22					0.00	1.00	1.00	11.70	10% of 98%
7	Studio Type A/ 5 (a-3)	NW		2.60	18.00		5.0	0.22		0.650	3.000	0.22	0.40	0.99	0.94	46.80	36% of 98%
8	Studio Type A	NW		2.60	4.50		5.0	0.22					0.00	1.00	1.00	11.70	10% of 98%
9	5 (a-e)	NW		2.60	7.50		5.0	0.22					0.00	1.00	1.00	19.50	16% of 98%
10	5 Bed Cluster Type B	NW		2.60	1.50		5.0	0.22					0.00	1.00	1.00	3.90	3% of 98%
11	5 (a-e)	NW		2.60	7.50		5.0	0.22					0.00	1.00	1.00	19.50	16% of 98%
12	Studio Type A	NW		2.90	2.70		5.0	0.22					0.00	1.00	1.00	7.83	7% of 98%
13	Access Studio Type A	NW		2.90	0.95		5.0	0.22					0.00	1.00	1.00	2.76	2% of 98%

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if inputs are valid

Level 4 & 5

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014) — HELP

Building name/description: 73-123 Eveleigh Street, Redfern | Application: Class 3 | Climate zone: 5

Storey: Level 4-5

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A				89.5m²		34.2m²		313m²	
Option B									n/a
Glazing area (A)				25.9m²		19m²		128m²	

Number of rows preferred in table below: 13 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance			P&H or device		Shading	Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)		P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	5 Bed Cluser Type (D)	SE		2.52	1.95		4.5	0.27					0.00	1.00	1.00	4.91	19% of 98%
2	Twin Type A	SE		2.50	5.60		4.5	0.27		0.750	3.000	0.25	0.50	0.95	0.93	14.00	54% of 98%
3	Studio Type A	SE		2.50	2.80		4.5	0.27		0.750	3.000	0.25	0.50	0.95	0.93	7.00	27% of 98%
4	5 Bed Cluser Type C	SW		2.50	6.60		1.8	0.30					0.00	1.00	1.00	16.50	87% of 100%
5	5E	SW		2.50	1.00		1.8	0.30					0.00	1.00	1.00	2.50	13% of 100%
6	Study	NW		2.60	4.50		5.0	0.22					0.00	1.00	1.00	11.70	9% of 96%
7	Studio Type A/ 5 (a-3)	NW		2.60	19.50		5.0	0.22		0.650	3.000	0.22	0.40	0.99	0.94	50.70	38% of 96%
8	Studio Type A	NW		2.60	4.50		5.0	0.22					0.00	1.00	1.00	11.70	9% of 96%
9	5 (a-e)	NW		2.60	7.50		5.0	0.22					0.00	1.00	1.00	19.50	16% of 96%
10	5 Bed Cluster Type B	NW		2.60	1.50		5.0	0.22					0.00	1.00	1.00	3.90	3% of 96%
11	5 (a-e)	NW		2.60	7.50		5.0	0.22					0.00	1.00	1.00	19.50	16% of 96%
12	Studio Type A	NW		2.90	2.70		5.0	0.22					0.00	1.00	1.00	7.83	6% of 96%
13	Access Studio Type A	NW		2.90	0.95		5.0	0.22					0.00	1.00	1.00	2.76	2% of 96%

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if inputs are valid

Level 6

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014)

HELP

Building name/description: 73-123 Eveleigh Street, Redfern

Application: Class 3

Climate zone: 5

Storey: Level 6

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A			4.2m²	89.5m²		34.2m²	12m²	313m²	
Option B									n/a
Glazing area (A)			*2.13m²*	*25.9m²*		*19m²*	*2.13m²*	*142m²*	

Number of rows preferred in table below: 17 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS									SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	Studio Type E	E		2.50	0.85		4.5	0.15				0.00	1.00	1.00	2.13	100% of 95%
2	5 Bed Cluser Type (D)	SE		2.52	1.95		4.5	0.27				0.00	1.00	1.00	4.91	19% of 98%
3	Twin Type A	SE		2.50	5.60		4.5	0.27	0.750	3.000	0.25	0.50	0.95	0.93	14.00	54% of 98%
4	Studio Type A	SE		2.50	2.80		4.5	0.27	0.750	3.000	0.25	0.50	0.95	0.93	7.00	27% of 98%
5	5 Bed Cluser Type C	SW		2.50	6.60		1.8	0.30				0.00	1.00	1.00	16.50	87% of 100%
6	5E	SW		2.50	1.00		1.8	0.30				0.00	1.00	1.00	2.50	13% of 100%
7	Studio Type D	W		2.50	0.85		4.5	0.50				0.00	1.00	1.00	2.13	100% of 100%
8	Study	NW		2.60	4.50		5.0	0.21				0.00	1.00	1.00	11.70	8% of 98%
9	Studio Type A/ 5 (a-3)	NW		2.60	16.50		5.0	0.21	0.650	3.000	0.22	0.40	0.99	0.94	42.90	29% of 98%
10	Studio Type D	NW		2.60	4.20		5.0	0.21				0.00	1.00	1.00	10.92	8% of 98%
11	Studio Type E	NW		2.60	4.20		5.0	0.21				0.00	1.00	1.00	10.92	8% of 98%
12	Studio Type A	NW		2.60	4.50		5.0	0.21				0.00	1.00	1.00	11.70	8% of 98%
13	5 (a-e)	NW		2.60	7.50		5.0	0.21				0.00	1.00	1.00	19.50	14% of 98%
14	5 Bed Cluster Type B	NW		2.60	1.50		5.0	0.21				0.00	1.00	1.00	3.90	3% of 98%
15	5 (a-e)	NW		2.60	7.50		5.0	0.21				0.00	1.00	1.00	19.50	14% of 98%
16	Studio Type A	NW		2.90	2.70		5.0	0.21				0.00	1.00	1.00	7.83	6% of 98%
17	Access Studio Type A	NW		2.90	0.95		5.0	0.21				0.00	1.00	1.00	2.76	2% of 98%

if inputs are valid

IMPORTANT NOTICE AND DISCLAIMER IN RESPECT OF THE GLAZING CALCULATOR

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Level 7

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014) — HELP

Building name/description: 73-123 Eveleigh Street, Redfern | Application: Class 3 | Climate zone: 5

Storey: Level 7

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A				89.5m²		34.2m²	12m²	313m²	
Option B									n/a
Glazing area (A)				25.9m²		19m²	2.13m²	135m²	

Number of rows preferred in table below: 15 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	5 Bed Cluser Type (D)	SE		2.52	1.95		4.5	0.27				0.00	1.00	1.00	4.91	19% of 98%
2	Twin Type A	SE		2.50	5.60		4.5	0.27	0.750	3.000	0.25	0.50	0.95	0.93	14.00	54% of 98%
3	Studio Type A	SE		2.50	2.80		4.5	0.27	0.750	3.000	0.25	0.50	0.95	0.93	7.00	27% of 98%
4	5 Bed Cluser Type C	SW		2.50	6.60		1.8	0.30				0.00	1.00	1.00	16.50	87% of 100%
5	5E	SW		2.50	1.00		1.8	0.30				0.00	1.00	1.00	2.50	13% of 100%
6	Studio Type D	W		2.50	0.85		4.5	0.50				0.00	1.00	1.00	2.13	100% of 100%
7	Study	NW		2.60	4.50		5.0	0.21				0.00	1.00	1.00	11.70	9% of 96%
8	Studio Type A/ 5 (a-3)	NW		2.60	18.00		5.0	0.21	0.650	3.000	0.22	0.40	0.99	0.94	46.80	33% of 96%
9	Studio Type E	NW		2.60	4.20		5.0	0.21				0.00	1.00	1.00	10.92	8% of 96%
10	Studio Type A	NW		2.60	4.50		5.0	0.21				0.00	1.00	1.00	11.70	9% of 96%
11	5 (a-e)	NW		2.60	7.50		5.0	0.21				0.00	1.00	1.00	19.50	15% of 96%
12	5 Bed Cluster Type B	NW		2.60	1.50		5.0	0.21				0.00	1.00	1.00	3.90	3% of 96%
13	5 (a-e)	NW		2.60	7.50		5.0	0.21				0.00	1.00	1.00	19.50	15% of 96%
14	Studio Type A	NW		2.90	2.70		5.0	0.21				0.00	1.00	1.00	7.83	6% of 96%
15	Access Studio Type A	NW		2.90	0.95		5.0	0.21				0.00	1.00	1.00	2.76	2% of 96%

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if inputs are valid

Level 8 & 9

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014) — HELP

Building name/description: 73-123 Eveleigh Street, Redfern | Application: Class 3 | Climate zone: 5

Storey: Level 8-9

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A		49.4m²		47.6m²		25.8m²		195m²	
Option B									n/a
Glazing area (A)		25.3m²		7m²		19m²		68.9m²	

Number of rows preferred in table below: 9 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	Bed Cluser Type A	NE		2.50	1.40		4.8	0.15				0.00	1.00	1.00	3.50	14% of 95%
2	Twin Type B	NE		2.50	8.70		4.8	0.15				0.00	1.00	1.00	21.75	86% of 95%
3	Studio Type A	SE		2.50	2.80		6.2	0.88	0.750	3.000	0.25	0.50	0.95	0.93	7.00	100% of 93%
4	5 Bed Cluser Type C	SW		2.50	6.60		1.8	0.13				0.00	1.00	1.00	16.50	87% of 99%
5	5E	SW		2.50	1.00		1.8	0.13				0.00	1.00	1.00	2.50	13% of 99%
6	Studio Type B and A / 5	NW		2.60	16.50		5.0	0.21	0.650	3.000	0.22	0.40	0.99	0.94	42.90	60% of 77%
7	Studio Type A	NW		2.60	3.00		5.0	0.21				0.00	1.00	1.00	7.80	12% of 77%
8	5 (a-e)	NW		2.60	5.50		5.0	0.21				0.00	1.00	1.00	14.30	22% of 77%
9	5 Bed Cluster Type C	NW		2.60	1.50		5.0	0.21				0.00	1.00	1.00	3.90	6% of 77%

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if inputs are valid

Level 10

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014) — HELP

Building name/description: 73-123 Eveleigh Street, Redfern | Application: Class 3 | Climate zone: 5

Storey: Level 10

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A		49.4m²		47.6m²		25.8m²		195m²	
Option B									n/a
Glazing area (A)		*25.3m²*		*7m²*		*19m²*		*68.9m²*	

Number of rows preferred in table below: 9 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance			P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)		P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	Bed Cluser Type A	NE		2.50	1.40		4.8	0.15					0.00	1.00	1.00	3.50	14% of 95%
2	Twin Type B	NE		2.50	8.70		4.8	0.15					0.00	1.00	1.00	21.75	86% of 95%
3	Studio Type A	SE		2.50	2.80		6.2	0.88		0.750	3.000	0.25	0.50	0.95	0.93	7.00	100% of 93%
4	5 Bed Cluser Type C	SW		2.50	6.60		1.8	0.13					0.00	1.00	1.00	16.50	87% of 99%
5	5E	SW		2.50	1.00		1.8	0.13					0.00	1.00	1.00	2.50	13% of 99%
6	Studio Type B and A / 5	NW		2.60	16.50		5.0	0.21		0.650	3.000	0.22	0.40	0.99	0.94	42.90	60% of 77%
7	Studio Type A	NW		2.60	3.00		5.0	0.21					0.00	1.00	1.00	7.80	12% of 77%
8	5 (a-e)	NW		2.60	5.50		5.0	0.21					0.00	1.00	1.00	14.30	22% of 77%
9	5 Bed Cluster Type C	NW		2.60	1.50		5.0	0.21					0.00	1.00	1.00	3.90	6% of 77%

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if inputs are valid

Level 11-14 & 16

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014) — HELP

Building name/description: 73-123 Eveleigh Street, Redfern | Application: Class 3 | Climate zone: 5

Storey: Level 11-14 16

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A		49.4m²		47.6m²		25.8m²		195m²	
Option B									n/a
Glazing area (A)		*25.3m²*		*7m²*		*19m²*		*68.9m²*	

Number of rows preferred in table below: 9 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance			P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)		P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	Bed Cluser Type A	NE		2.50	1.40		4.8	0.15					0.00	1.00	1.00	3.50	14% of 95%
2	Twin Type B	NE		2.50	8.70		4.8	0.15					0.00	1.00	1.00	21.75	86% of 95%
3	Studio Type A	SE		2.50	2.80		6.2	0.88		0.750	3.000	0.25	0.50	0.95	0.93	7.00	100% of 93%
4	5 Bed Cluser Type C	SW		2.50	6.60		1.8	0.13					0.00	1.00	1.00	16.50	87% of 99%
5	5E	SW		2.50	1.00		1.8	0.13					0.00	1.00	1.00	2.50	13% of 99%
6	Studio Type B and A / 5	NW		2.60	16.50		5.0	0.21		0.650	3.000	0.22	0.40	0.99	0.94	42.90	60% of 77%
7	Studio Type A	NW		2.60	3.00		5.0	0.21					0.00	1.00	1.00	7.80	12% of 77%
8	5 (a-e)	NW		2.60	5.50		5.0	0.21					0.00	1.00	1.00	14.30	22% of 77%
9	5 Bed Cluster Type C	NW		2.60	1.50		5.0	0.21					0.00	1.00	1.00	3.90	6% of 77%

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if inputs are valid

Level 15

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014) — HELP

Building name/description: 73-123 Eveleigh Street, Redfern | Application: Class 3 | Climate zone: 5

Storey: Level 15

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A		49.4m²		47.6m²		25.8m²		195m²	
Option B									n/a
Glazing area (A)		*25.3m²*		*7m²*		*19m²*		*68.9m²*	

Number of rows preferred in table below: 9 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS									SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	Bed Cluser Type A	NE		2.50	1.40		4.8	0.15				0.00	1.00	1.00	3.50	14% of 95%
2	Twin Type B	NE		2.50	8.70		4.8	0.15				0.00	1.00	1.00	21.75	86% of 95%
3	Studio Type A	SE		2.50	2.80		6.2	0.88	0.750	3.000	0.25	0.50	0.95	0.93	7.00	100% of 93%
4	5 Bed Cluser Type C	SW		2.50	6.60		1.8	0.13				0.00	1.00	1.00	16.50	87% of 99%
5	5E	SW		2.50	1.00		1.8	0.13				0.00	1.00	1.00	2.50	13% of 99%
6	Studio Type B and A / 5	NW		2.60	16.50		5.0	0.21	0.650	3.000	0.22	0.40	0.99	0.94	42.90	60% of 77%
7	Studio Type A	NW		2.60	3.00		5.0	0.21				0.00	1.00	1.00	7.80	12% of 77%
8	5 (a-e)	NW		2.60	5.50		5.0	0.21				0.00	1.00	1.00	14.30	22% of 77%
9	5 Bed Cluster Type C	NW		2.60	1.50		5.0	0.21				0.00	1.00	1.00	3.90	6% of 77%

if inputs are valid

Level 17

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014) — HELP

Building name/description: 73-123 Eveleigh Street, Redfern | Application: Class 3 | Climate zone: 5

Storey: Level 17

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A		49.4m²		52.2m²		11.3m²		116m²	
Option B									n/a
Glazing area (A)		*25.3m²*		*10.5m²*		*9.25m²*		*42.9m²*	

Number of rows preferred in table below: 5 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS									SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	Bed Cluser Type A	NE		2.50	1.40		4.8	0.16				0.00	1.00	1.00	3.50	14% of 99%
2	Twin Type B	NE		2.50	8.70		4.8	0.16				0.00	1.00	1.00	21.75	86% of 99%
3	Studio Type A	SE		2.50	4.20		5.8	0.55	0.750	3.000	0.25	0.50	0.95	0.93	10.50	100% of 100%
4	Access Studio Type B	SW		2.50	3.70		1.6	0.14				0.00	1.00	1.00	9.25	100% of 100%
5	Studio Type B and A / 5	NW		2.60	16.50		5.0	0.26	0.650	3.000	0.22	0.40	0.99	0.94	42.90	100% of 100%

if inputs are valid

Level 18-20

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014) — HELP

Building name/description: 73-123 Eveleigh Street, Redfern | Application: Class 3 | Climate zone: 5

Storey: Level 18-20

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A		49.4m²		52.2m²	12.5m²	11.3m²		116m²	8.2m²
Option B									n/a
Glazing area (A)		*25.3m²*		*10.5m²*	*2.5m²*	*9.25m²*		*49.9m²*	*6.6m²*

Number of rows preferred in table below: 8 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS									SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	Bed Cluser Type A	NE		2.50	1.40		4.8	0.16				0.00	1.00	1.00	3.50	14% of 99%
2	Twin Type B	NE		2.50	8.70		4.8	0.16				0.00	1.00	1.00	21.75	86% of 99%
3	Studio Type A	SE		2.50	4.20		5.8	0.55	0.750	3.000	0.25	0.50	0.95	0.93	10.50	100% of 100%
4	Access Studio Type B	SW		2.50	3.70		1.6	0.14				0.00	1.00	1.00	9.25	100% of 100%
5	Study	S		2.50	1.00		6.2	0.63				0.00	1.00	1.00	2.50	100% of 87%
6	Study	NW		2.60	4.20		4.8	0.22				0.00	1.00	1.00	10.92	23% of 99%
7	Studio Type B and A / 5	NW		2.60	15.00		4.8	0.22	0.650	3.000	0.22	0.40	0.99	0.94	39.00	77% of 99%
8	Study	Internal		2.20	3.00		2.6	0.88			2.00	0.00	0.64	0.54	6.60	100% of 98%

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if inputs are valid

Level 21

NCC VOLUME ONE GLAZING CALCULATOR (first issued with NCC 2014) — HELP

Building name/description: 73-123 Eveleigh Street, Redfern | Application: Class 3 | Climate zone: 5

Storey: Level 21

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A	22.4m²	41.6m²		65.1m²		37m²		66m²	20m²
Option B									n/a
Glazing area (A)	*18.4m²*	*29.9m²*		*11.3m²*		*17.6m²*		*18m²*	*6m²*

Number of rows preferred in table below: 8 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS									SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device		Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1	Room ??	N		3.60	5.10		3.6	0.18	1.000	3.600	0.28	0.00	0.92	0.73	18.36	100% of 99%
2	Room ??	NE		3.60	1.70		3.8	0.13	3.500	3.600	0.97	0.00	0.13	0.35	6.12	5% of 100%
3	Twin B	NE		2.70	8.80		3.8	0.13				0.00	1.00	1.00	23.76	95% of 100%
4	Access Studio Type B	SE		2.70	1.40		5.8	0.90	0.750	2.700	0.28	0.00	0.85	0.81	3.78	33% of 99%
5	Studio Type A	SE		2.70	2.80		5.8	0.90	0.750	2.700	0.28	0.00	0.85	0.81	7.56	67% of 99%
6	Access Studio Type B	SW		2.70	6.50		2.8	0.21				0.00	1.00	1.00	17.55	100% of 100%
7	Room ??	NW		3.60	5.00		4.8	0.31				0.00	1.00	1.00	18.00	100% of 100%
8	Room ??	internal		3.00	2.00		5.4	0.90			2.00	0.00	0.64	0.54	6.00	100% of 100%

IMPORTANT NOTICE AND DISCLAIMER IN RESPECT OF THE GLAZING CALCULATOR

The Glazing Calculator has been developed by the ABCB to assist in developing a better understanding of glazing energy efficiency parameters.
While the ABCB believes that the Glazing Calculator, if used correctly, will produce accurate results, it is provided "as is" and without any representation or warranty of any kind, including that it is fit for any purpose or of merchantable quality, or functions as intended or at all.
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if inputs are valid

APPENDIX B - SPECIFICATION J5.2 – DUCTWORK INSULATION AND SEALING

Ductwork Sealing

Heating or cooling ductwork and fittings must be sealed against air loss by:

- Closing all openings in the surface, joints and seams of ductwork with adhesives, mastics, sealants or gaskets in accordance with the duct sealing requirements of AS 4254 for the static pressure in the system.
- Having a draw band encased with adhesive tape for flexible ductwork at an operating pressure of less than 500 Pa.

These requirements do not apply to ductwork and fittings located within the last conditioned space served.

Ductwork Insulation

Ductwork and fittings for heating or cooling, including evaporative cooling must be thermally insulated with insulation complying with AS/NZS 4859.1 to:

- Achieve the Total R-Value specified in Table A24.

Table A24– Ductwork and Fittings – Minimum Total R-Value

Location of Duct Work and Fittings	Minimum *Total R-Value* for Ductwork and fittings in each *climate* zone		
	1, 2, 3 and 5	4, 6 and 7	8
Within a Conditioned Space	1.2	1.2	1.6
Where exposed to direct sunlight	3.0	3.0	3.4
All Other Locations	2.0	2.0	2.4

- For flexible ductwork of no more than 3 m in length to an outlet or from an inlet, achieve a minimum material R-value of 1.0;
- Insulation on ductwork conveying cold air must be protected by a vapour barrier on the outside of the insulation and where the vapour barrier in a membrane, overlapping adjoining sheets of the membrane by 50 mm and bonding or taping the sheets together;
- Ductwork insulation must be protected against the effects of weather and sunlight and abut adjoining insulation to form a continuous barrier and be installed so that it maintains its position and thickness, other than at flanges and supports;
- The required R-Value of the insulation as per Table A24 above do not apply to heating and cooling ductwork and fittings located within the only or last room that is served by the system, air registers, diffusers, outlets, grilles and flexible fan connections;
- The required R-value of the insulation as per Table A24 above do not apply to ductwork outside air and exhaust air associated with a heating or cooling system, floor of an in-situ air handling unit and package air conditioning equipment complying with Minimum Energy Performance Standard (MEPS).

APPENDIX C - SPECIFICATION J6 – LIGHTING AND POWER CONTROL DEVICES

Lighting Timers

A lighting timer must –

- Be located within 2 m of every entry door to the space; and
- Have an indicator light that is illuminated when the artificial lighting is off; and
- Not control more than an area of 100 m^2 with a single push button timer and 95% of the light in spaces of area more than 25 m^2.
- Be capable of maintaining the artificial lighting for not less than 5 minute and not more than 15 minutes unless it is reset and without interruption if the timer is reset.

Time Switch

A time switch must be capable of switching on and off electric power systems;

- At variable pre-programmed times and on variable pre-programmed days.
- To limit the period the system is switched on, to 2 hours beyond the time for which the building is occupied.

A time switch must be capable of being overridden by a manual switch by a period of up to 2 hours, after which the time switch must resume control.

A time switch for external lighting must be capable of limiting the period the system is switched on to between 30 minutes before sunset and 30 minutes after sunrise is determined or detected including any pre-programmed period between these times and being overridden by a manual switch or a security access system for a period of up to 30 minutes after which the time switch must resume control.

A time switch for boiling water and chilled water storage units must be capable of being overridden by a manual switch or a security access system that senses a person's presence, overrides for a period of up to 2 hours, after which if there is no further presence detected, the time switch must resume control.

Motion Detectors

In a Class 3 building, other than within a sole occupancy unit a motion detector must;

- Be capable of sensing movement such as by infra-red, ultrasonic or microwave detection or by a combination of these means.
- Be capable of detecting a person before they have entered 1 m into the space.
- Other than within a sole occupancy unit of a class 5 and 6 building, not control more than an area of 100 m^2 and 95% of the lights in spaces of area more than 25 m^2.
- Be capable of maintaining the artificial lighting when activated for a minimum of 5 minutes and a maximum of 15 minutes unless it is reset.
- Be capable of maintaining the artificial lighting without interruption if the motion detector is reset.

When outside a building, a motion detector must;

- Be capable of sensing movement such as by infra-red, ultrasonic or microwave detection or by a combination of these means.
- Be capable of detecting a person within a distance from the light equal to twice the mounting height or 80% of the ground area covered by the light's beam.
- Not control more than five lights.
- Be operated in series with a photoelectric cell or astronomical time switch so that the light will not operate in daylight hours.
- Be capable of maintaining the lighting for a maximum of 10 minutes unless it is reset.
- Have a manual override which is reset after a maximum period of 4 hours.

Daylight Sensor and Dynamic Lighting Control Device

A daylight sensor and dynamic control device for artificial lighting must for switching ON and OFF

- Be capable of having the switching level set point adjusted between 50 and 100 Lux;
- Have a delay of more than 2 minutes and a differential of more than 100 Lux for a sensor controlling high pressure discharge lighting and 50 Lux for a sensor controlling other than high pressure discharge lighting;
- For dimmed or stepped switching, be capable of reducing the power consumed by the controlled lighting in proportion to the incident daylight on the working plane either continuously down to a power consumption that is less than 50% of full power or in no less than 4 steps down to a power consumption that is less than 50% of full power;
- Where a daylight sensor and dynamic control device has a manual override switch, the manual override switch must not be able to switch the lights permanently on or bypass the lighting controls.