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Wee Hur

13-23 Gibbons Street Redfern NSW

JV3 Assessment Report – NCC 2016

20E-18-0323-TRP-6769262-0

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13-23 Gibbons Street Redfern NSW Job Title: JV3 Assessment Report – NCC 2016	
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2 EXECUTIVE SUMMARY

VIPAC has been engaged to review the proposed student accommodation at 13-23 Gibbons Street, Redfern, NSW 2016 against the requirements for the National Construction Code 2016 provisions for energy efficiency under Section J (NCC 2016 Volume 1, Part J).

This report details the outcome of a National Construction Code (NCC) 2016 Section J assessment (JV3) to determine compliance requirements for the proposed development. Energy simulations were undertaken to provide an alternative method of verification (JV3) in relation to NCC Section J in order to allow for glazing and insulation variations within the development.

JV3 requires the comparison of a reference building (Case 1) to two proposed building models, one having the reference building (Case 2) and one having the same services as the proposed services (Case 3).

The following table details the computer simulation results for the simulation cases undertaken in compliance with the JV3 Verification Method. The simulation process is detailed as part of this report.

	CASE 1 Reference Building [DTS Fabric and DTS services]	**CASE 2 Proposed Building [Proposed Fabric and DTS services] ***	**CASE 3 Proposed Building [Proposed Fabric and Proposed services] ***
Annual Energy Consumption (normalised consumption)	287 MJ/m2	274 MJ/m2	274 MJ/m2

** The "proposed services" under the modelling case 3 have been conservatively set at the "DTS services" level. The results of modelling cases 2 and 3 are therefore the same (274 MJ/m2).*

The results show that the total annual energy consumption of the Proposed Building models is less than the annual energy consumption of the Reference Building. The glazing systems utilised within the proposed building are therefore compliant with the performance requirement of JP1 under JV3 method of verification.

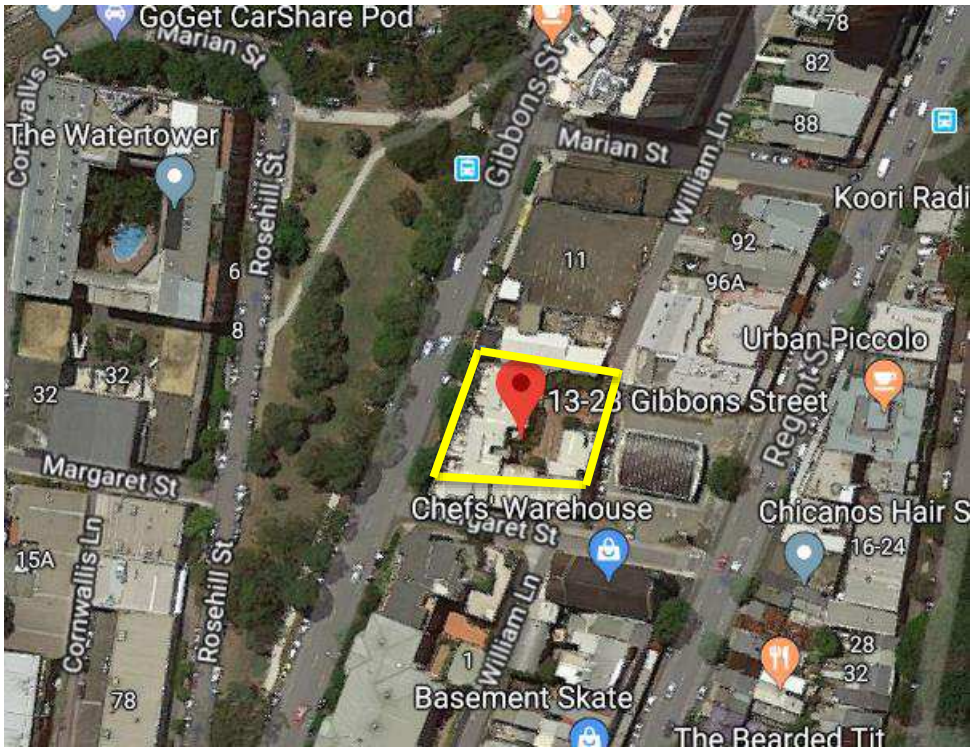
Areas addressed by JV3 assessment

The following table outlines the glazing thermal insulation levels utilised in the Proposed Building simulations. Based on this assessment, systems with performance level of equal or better will achieve NCC Part J compliance under the JV3 method of verification.

Item	**Minimum total insulation and glazing performance requirements**
External walls	Total R-Value: R2.8
Internal walls	Total R-Value: R1.8
Floor	Suspended slabs: Total R-Value: R2.0 Concrete slab on ground: no added thermal insulation.
Ceiling / Roof	Total R-Value: R4.2
Glazing performance (Total system performance values must be lower or equal to the U-Value and SHGC values provided, AFRC)	***Addressed through JV3 assessment (identical glazing performance nominated to ensure consistency)*** Total U-Value ≤ 7 (W/m2K) Total SHGC: ≤ 0.55
Other	Building services: minimum DTS performance or better

A summary of the NCC Section J requirements is provided in section 7 of this report.

Subject to satisfaction of the provisions outlined in this report, this development will comply with the requirements of Section J of NCC 2016.



Location of the development – 13-23 Gibbons Street, Redfern, NSW 2016 – Source: Google Map

3 INTRODUCTION

VIPAC has been engaged to review the proposed development at 13-23 Gibbons Street, Redfern, NSW 2016 against the requirements for the National Construction Code 2016 provisions for energy efficiency under Section J.

Energy simulation was undertaken to provide an alternative method of verification (JV3) in relation to NCC Section J in order to allow for glazing and thermal insulation variations for the heritage walls and windows.

The assessment process under JV3 requires a comparison of simulated annual energy consumption of a reference building to the proposed building utilising the required assumptions and inputs for JV3. The reference building is based on the proposed building with the performance of all features set to the minimum performance in order to achieve DTS compliance with the provisions of Part J1 to J7.

The proposed building in this assessment also utilises DTS compliance performance of the provisions of Part J1 to J8 excluding those of Part J2 in relation to the glazing system performance and those of Part J1 as outlined in section 7 of this report.

On this basis, the outcome of this JV3 assessment demonstrates achievement of compliance for the proposed glazing and thermal insulation variations for the building (outlined in section 7). Compliance with the DTS provisions for all the other parts is therefore required by all the applicable design trades of the development

A summary of the NCC Section J requirements for the development is provided in section 7 of this report.

Compliance with JP1 has been verified in accordance with JV3 requirements and utilising Carrier E20-II energy modelling software package that is ABCB protocol compliant.

The Reference and Proposed Building computer models were generated using an ABCB compliant energy simulation software and strictly in accordance with the following guidelines:

- NCC Section J Part JV3 Verification Using a Reference Building.
- NCC Section J Assessment and Verification of an Alternative Solution Handbook 2010.
- ABCB Protocol for Building Energy Analysis Software Version 2006.1.

4 NATIONAL CONSTRUCTION CODE - SECTION J

The National Construction Code (NCC) 2016 includes mandatory minimum energy performance requirements for buildings (Class 3, Class 5 to 9) in Section J. The objective is to reduce building greenhouse gas emissions by efficiently using operational energy. Section J is focused on establishing minimum acceptable practice in the building industry.

To meet the performance requirements JP1 and JP3 of Section J of the NCC, compliance of the design and function of the building can be demonstrated with the Deemed-To-Satisfy (DTS) provisions of Section J Parts J1 to J8. Alternatively, achievement of the performance requirements can be demonstrated through Verification Method JV3 in lieu of individual provisions for some or all of the provisions under Parts J1 to J8.

- Part J1 Building Fabric relates to the building fabric and minimum thermal performance for constructions according to climate zone for roofs, ceilings, roof lights, walls, and floors.
- Part J2 Glazing relates to the control of heat loss and heat gain within specified limits through vision glazing that forms part of the envelope.
- Part J3 Building Sealing details requirements in order to restrict unwanted infiltration into a building.
- Part J5 Air-Conditioning and Ventilation Systems details requirements to ensure these services are used and use energy in an efficient manner.
- Part J6 Artificial Lighting and Power details requirements for lighting and power to ensure energy is used efficiently by these systems.
- Part J7 Hot Water Supply and Swimming Pool & Spa Pool Plant details requirements for hot water supply design.
- Part J8 Facilities for Energy Monitoring.

4.1 NCC JV3 - VERIFICATION USING A REFERENCE BUILDING

To demonstrate compliance with Verification Method JV3, a thermal calculation method must be used to demonstrate that the annual energy consumption of the proposed building is not more than the annual energy consumption of a reference building where the buildings have been modelled in accordance with the requirements of NCC Section J JV3.

The following section summarises the process of performing the NCC Section J Alternative Solution JV3 used in this study:

Modelling Case 1 (Reference Building): Calculated the theoretical annual energy consumption allowance by modelling a reference building. This was the DTS complying building based on the criteria in JV3 (d)(i) in the following table.

Modelling Case 2: Calculated the theoretical annual energy consumption of the proposed Alternative Solution with the services modelled as if they were the same as those of the reference building [JV3 (a)(ii)].

Modelling Case 3: Calculated the theoretical annual energy consumption of the proposed Alternative Solution (building and services) based on the criteria in JV3 (a)(i).

The theoretical annual energy consumption calculated in cases 2 and 3 was then compared to the annual energy consumption allowance calculated in case 1 to ensure that in both cases, the annual energy consumption of the reference building in case 1 is not exceeded by that in cases 2 and 3.

The following table outlines the NCC requirements for the JV3 method of verification which were considered in all the modelling runs for the building.

(a) For a Class 3 building, compliance with JP1 is verified when it is determined that the *annual energy consumption* of the proposed building with its *services* is not more than the *annual energy consumption* of a *reference building* when—
(i) the proposed building is modelled with the proposed *services*; and
(ii) the proposed building is modelled with the same *services* as the *reference building*.

(b) The *annual energy consumption* of the proposed building in (a) may be reduced by the amount of energy obtained from—
(i) an on-site *renewable energy* source; or
(ii) another process as reclaimed energy.

(c) The *annual energy consumption* calculation method must comply with the ABCB Protocol for Building Energy Analysis Software.

(d) The *annual energy consumption* in (a) must be calculated—
(i) for the *reference building*, using—
(A) the *Deemed-to-Satisfy Provisions* for Parts J1 to J7 but including only the minimum amount of mechanical ventilation *required* by Part F4; and
(B) a solar absorptance of 0.6 for *external walls* and 0.7 for roofs; and
(C) the maximum *illumination power density* without any increase for a control device *illumination power density* adjustment factor; and
(D) *air-conditioning* with the *conditioned space* temperature within the range of 18° CDB to 26° CDB for 98% of the plant operation time; and
(E) the profiles for occupancy, *air-conditioning*, lighting and internal heat gains from people, hot meals, appliances, equipment and hot water supply systems—
(aa) of the actual building—
(AA) if the operating hours per year are not less than 2500; or
(BB) if the daily operating profiles are not listed in Specification JV; or
(bb) of Specification JV; and
(F) infiltration values—
(aa) 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
(bb) for the whole building, when pressurising plant is not operating, 1.5 air change per hour; and
(ii) for both the proposed building and the *reference building* using the same—
(A) *annual energy consumption* calculation method; and
(B) location, being either the location where the building is to be constructed if appropriate climatic data is available, or the nearest location with similar climatic conditions, for which climatic data is available; and
(C) adjacent structures and features; and
(D) environmental conditions such as ground reflectivity, sky and ground form factors, temperature of external bounding surfaces, air velocities across external surfaces and the like; and
(E) orientation; and
(F) building form, including—
(aa) the roof geometry; and
(bb) the floor plan; and
(cc) the number of *storeys*; and
(dd) the ground to lowest floor arrangements; and
(ee) the size and location of *glazing*; and
(G) external doors; and
(H) testing standards including for insulation, *glazing*, water heater and package *air-conditioning* equipment; and
(I) thermal resistance of air films including any adjustment factors, moisture content of materials and the like; and
(J) dimensions of external, internal and separating walls; and
(K) surface density of *envelope* walls over 220 kg/m^2; and
(L) quality of insulation installation; and
(M) assumptions and means of calculating the temperature difference across *air-conditioning* zone boundaries; and
(N) floor coverings and furniture and fittings density; and
(O) internal shading devices, their colour and their criteria for operation; and
(P) number, sizes and floors served by lifts and escalators; and
(Q) range and type of *services* and energy sources other than energy generated on-site from sources that do not emit greenhouse gases such as solar and wind power; and
(R) internal artificial lighting levels; and
(S) internal heat gains including people, lighting, appliances, meals and other electric power loads; and
(T) *air-conditioning* system configuration and zones; and
(U) daily and annual profiles of the—
(aa) building occupancy; and
(bb) operation of *services*; and

(V) range of internal temperatures and plant operating times; and
(W) supply hot water temperature and rate of use; and
(X) infiltration values unless there are specific additional sealing provisions or pressure testing to be undertaken; and
(Y) unit capacity and sequencing for water heaters, refrigeration chillers and heat rejection equipment such as cooling towers; and
(Z) metabolic rate for people; and
(iii) for the proposed building using a solar absorptance for the roof and walls 0.05 higher than that proposed; and

(e) Where the *annual energy consumption* of the hot water supply or the lifts and escalators are the same in the proposed building and the *reference building*, they may be omitted from the calculation of both the proposed building and the *reference building*.

(f) A lift in a building with more than one classification may be proportioned according to the number of *storeys* of the part for which the *annual energy consumption* is being calculated.

(g) The design must include—
(i) the ability to achieve all the criteria used in the *annual energy consumption* calculation method such as having an automatic operation controlling device capable of turning lighting, and *air-conditioning* plant on and off in accordance with the occupancy and operating profiles used; and
(ii) compliance with—
(A) J1.2 for general thermal construction; and
(B) J1.3(c) for compensation for a loss of ceiling insulation; and
(C) J1.6(a)(ii), J1.6(c) and J1.6(d) for floor edge insulation; and
(D) BS 7190 for testing a water heater; and
(E) AS/NZS 3823.1.2 at test condition T1 for testing package *air-conditioning* equipment; and
(F) AHRI 550/590 for testing a refrigeration chiller.

4.2 GENERAL DEFINITIONS

Envelope

In the NCC, this term is not limited to the building's outer shell, but also includes those continuous elements that separate a conditioned space from a non-conditioned space. For example, the floor between a plant room and an office space may be part of the envelope, rather than the outer shell. A non-conditioned space may be included within the envelope under certain circumstances.

Glazing

The glazing definition needs to be read in conjunction with the definition of a window and roof light. It can include a glazed door. For the purposes of Section J, the glazing provides an aperture by which light and energy can flow into or from the conditioned space. Glazing includes the glass and any frame system.

Annual energy consumption

This is the amount of energy calculated to be consumed under certain specific conditions in consideration of operating profiles, internal loads and plant efficiencies. It is used in Verification Method JV3 that compares the calculated energy consumption with that of a complying reference building. It should not be considered a prediction of the actual energy consumption of an actual building as there could be major differences in the conditions such as the internal loads of the building and the hours of operation. It differs from annual energy load because it is affected by the type of heating or cooling appliance used, for example, heating by a reverse cycle air-conditioner uses less than half the energy that a gas fired heater would use to meet the same annual energy load.

Conditioned space

A conditioned space is one likely to be air-conditioned rather than one that is air-conditioned. In some cases, chilled and hot water may be reticulated through duct risers as part of the building design to enable conditioning to be provided as part of a later fitout. A conditioned space may include a ceiling or under-floor space that is open to the conditioned space such as a space separated by only a perforated or grille ceiling or floor where the space is a supply air or return air plenum.

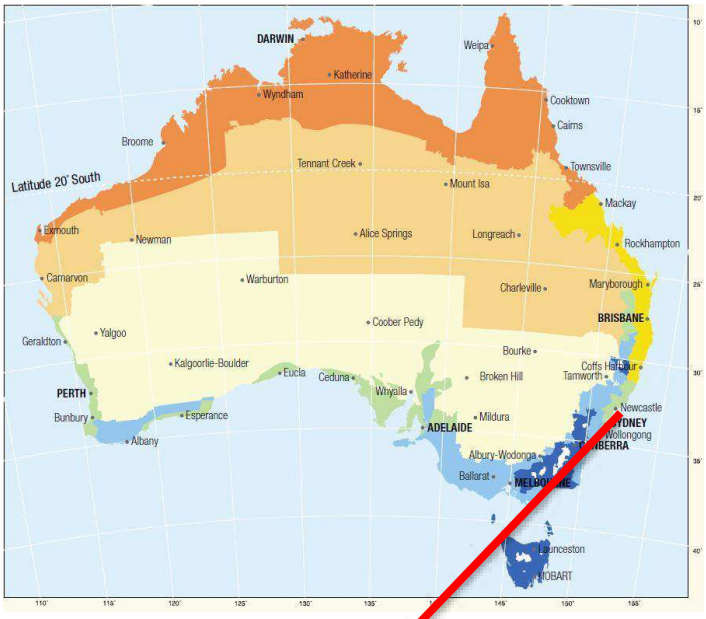
5 BUILDING DESCRIPTION

5.1 NCC CLIMATE ZONE & BUILDING CLASSIFICATION

The climate zone is defined by the NCC as 'an area for specific locations, having energy efficiency provisions based upon a range of similar climatic characteristics'.

The development is located in Redfern, NSW 2016 which is within the NCC climate zone 5 (warm temperate). The main building classification for the development is Class 3.

This report acknowledges that the NCC 2019 has been released and is currently in effect, however, based on the information provided by the Australian Building Construction Board (ABCB), *a 12-month transition period ending 30 April 2020 available in relation to the energy efficiency provisions in Section J. During this time, either the new NCC 2019 provisions or those from NCC 2016 may be used*. On this basis, the transitional BCA 2016 Section J provisions are being utilised for this development. It is required that the client confirms this with the certifier / planning authority prior to the construction since the minimum requirements under NCC 2019 Part J may be different.



ZONE	DESCRIPTION
1	High humid summer, warm winter
2	Warm humid summer, mild winter
3	Hot dry summer, warm winter
4	Hot dry summer, cool winter
5	Warm temperate
6	Mild temperate
7	Cool temperate
8	Alpine

5.2 SCOPE OF ANALYSIS

The scope of this report is based on;

1. Review & interpretation of architectural drawings to determine the Section J envelope and orientation of the building for assessment.
2. Parts J1 and J2 compliance (see sections 5 and 7 of the report)
    - Review and interpretation of façade and glazing dimensions based on the architectural drawings

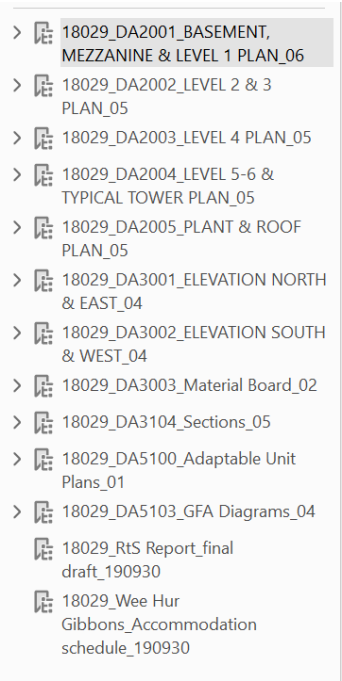
- Establish glazed areas of building envelope to conduct Part J2 DTS analysis.
- Input parameters (façade area, external shading devices and glazing dimensions) into the NCC Glazing Calculator spreadsheet.

3. JV3 compliance (see Section 6)
    - Conduct energy modelling for a reference building using the DTS results of the Parts J1 & J2 assessment and inputs reflecting achievement of minimum performance under the DTS provisions of Parts J3-J8. The energy modelling conducted is based on geometry development from the architectural and facade documentation.
    - Conduct energy modelling runs for the proposed building using glazing system thermal performances to reflect products in alignment with the architectural design intent.
    - Comparison of the annual energy consumption to determine JV3 compliance for the building with proposed level of glazing and wall insulation performance.

5.3 INFORMATION USED

The assessment within the report presents the requirements of Section J Part JV3 with respect to the documented design of the development. The assessment format generally follows the layout of Clauses within NCC Section J, to demonstrate the compliance requirements for Parts J1 & J2.

The assessment is based on the following architectural drawings provided by Allen jack + Cottier.



The computer simulations were conducted using the NCC compliant energy simulation software and according to the following provisions and guidelines:

- NCC Section J Part JV3 Verification Using a Reference Building.
- NCC Section J Assessment and Verification of an Alternative Solution Handbook 2010.
- ABCB Protocol for Building Energy Analysis Software Version 2006.1.

5.4 GENERAL ASSUMPTIONS FOR GLAZING AND JV3 ANALYSIS

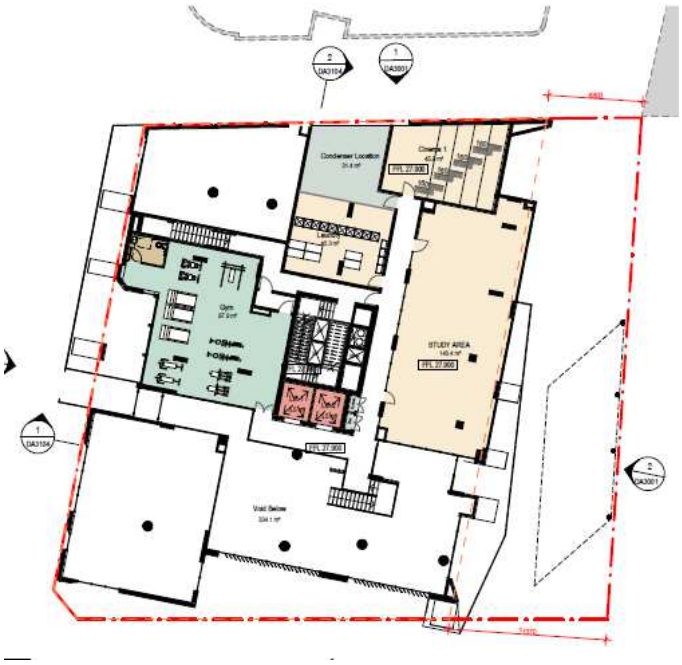
- Glazing areas defined as glazing in the building envelope (as per Section J) include the area of any associated framing.
- The glazing thermal performance properties are inclusive of frame effects (Total system: Glass + Frame).
- Relevant shading must comply with the requirements of J2.5 (a) of the NCC 2016.
- With the exception of Parts J1 and J2 (components outlined in section 7.1 and 7.2 of this report), all other elements of the building design are required to achieve the DTS compliance provisions of NCC 2016 under Section J.

5.5 ARCHITECTURAL DRAWINGS

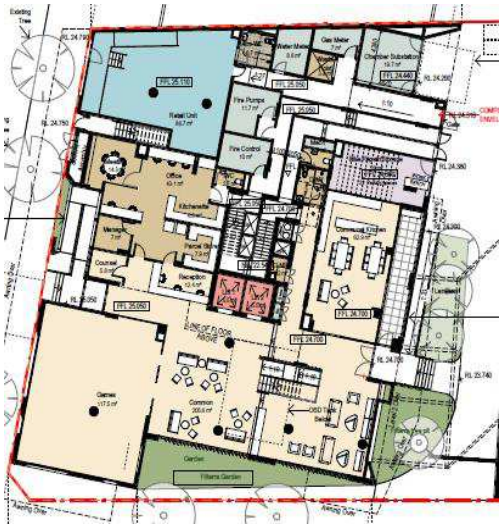
Selected architectural plans and elevations for the proposed development are provided below.

Floor Plans - Basement

Floor Plan – Mezzanine



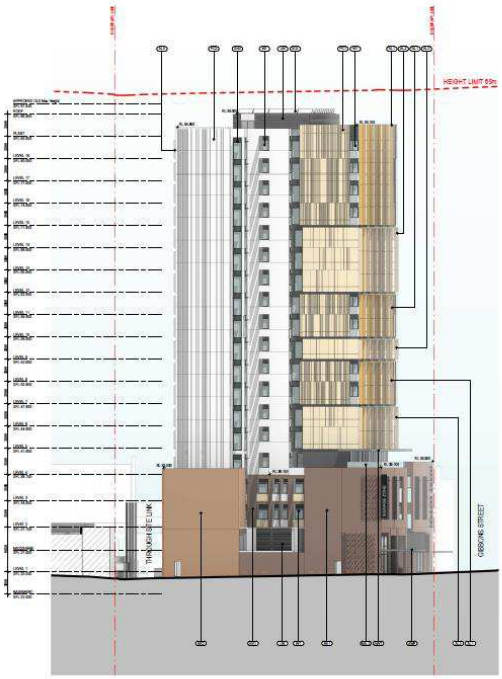
Floor Plans - Level 1 & 2



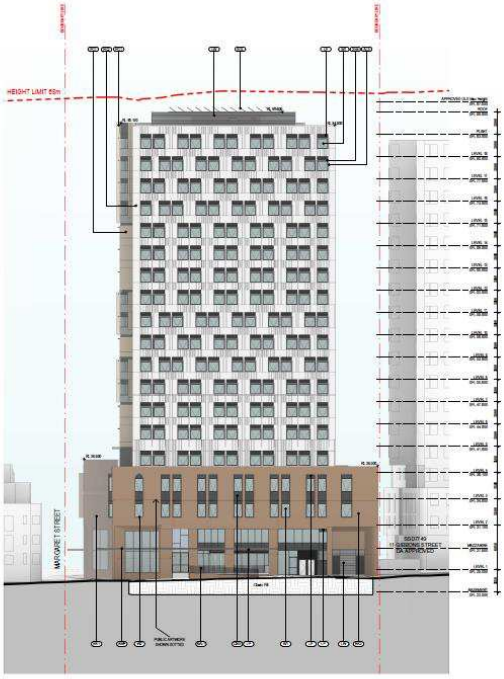
Floor Plans - Level 3 & 4

Floor Plans - Level 5 & 6

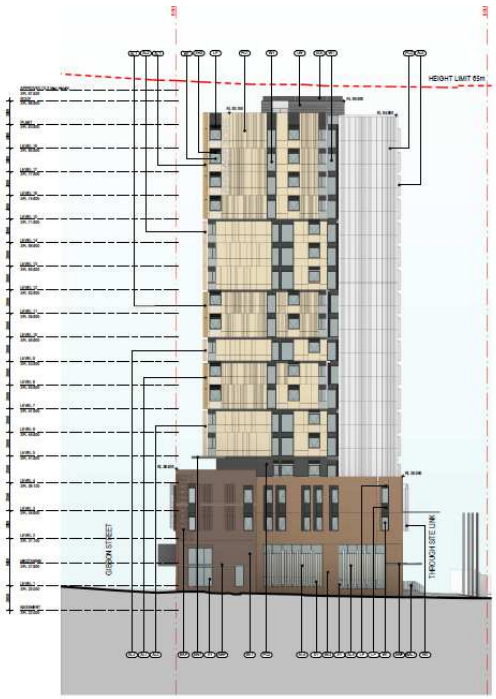
Elevations:



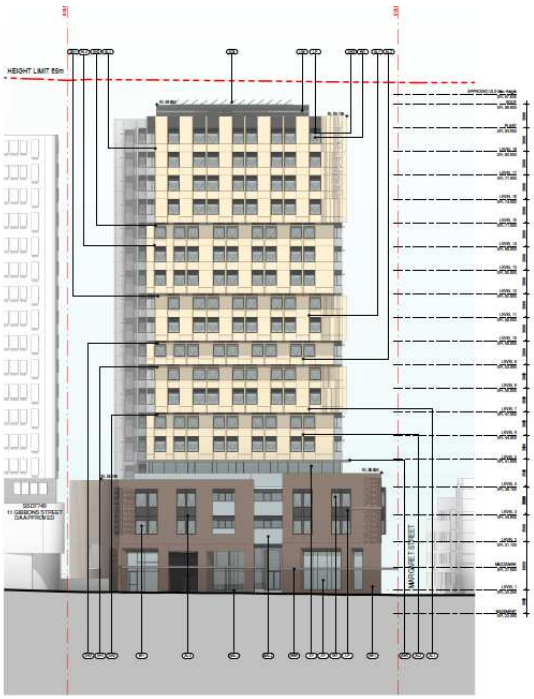
1 North Elevation Detail



2 East Elevation Detail



3 South Elevation Detail



4 West Elevation Detail

6 ENERGY MODELLING

6.1 PROCESS

A Reference Building energy model was generated using the NCC compliant energy simulation software (Carrier E20-II). This model was based on the deemed to satisfy provisions (J1-8) and solar absorbance of 0.6 for external walls and 0.7 for roofs. This reference model provided the annual energy target for JP1 verification. This target was measured in MJ/m².

The following two modelling cases were generated and compared with the reference building:

- The proposed building as modelled with the proposed design services.
- The proposed building as modelled with the same services used in modelling of the Reference Building.

The above process has been detailed in the following sections of the report.

6.1.1 COMPUTER SIMULATION

Computer modelling was performed using the Carrier E-II software to predict the annual mechanical energy consumption requirements for the building. This program uses a dynamic simulation to assess the building envelope response as well as space and surface temperatures, internal loads and energy consumption.

To ensure appropriate results are derived from the software package, ABCB requires that the software conform to appropriate BESTEST validation test or be certified in accordance with ANSI/ASHRAE Standard 140-2001: “Standard Method of Test for Evaluation of Building Energy Analysis Computer Programs”. Carrier E-II satisfies this requirement.

The Carrier E20-II program models the heat exchange between the air-conditioned space and the external environment to the space, hot or cold bodies in the space including people, lighting, and machines, and the air-conditioning system. The external environment includes the external ambient conditions and adjacent spaces.

The heat exchange analysis includes convection to and from surfaces, radiation exchange to and from the external environment, radiation exchange between the space internal surfaces, conduction through surfaces, and changes in humidity.

The software addressed all the main aspects of thermal modelling such as:

- Energy flow through the building’s envelope, including at adiabatic surfaces and also including thermal storage effects;
- Accurately modelling the performance of the air-conditioning and ventilation systems, including plant and equipment using their energy input ratios, coefficients of performance, or efficiency at full and part load;
- Control strategies, sequencing of plant and equipment, controlled settings and types of controls;
- Relative humidity range; and
- Use of different energy types.

The energy consumption outputs from the program were used as inputs to this assessment.

6.2 MODELLING INPUT DATA - GENERAL

In accordance with Verification Method JV3, the following input data were used to calculate the annual energy consumption for the reference building.

6.2.1 WEATHER DATA

Historical hourly local weather data, in the form of twelve months’ data, was used to represent the building external ambient data at the building location and to accurately model the dynamic nature of building thermal response. The weather data contains hourly records of radiation, temperature, humidity, sunshine duration and wind speed and direction for a typical meteorological year.

6.2.2 AREA

The building geometry is based on the latest architectural drawing prepared Allen jack + Cottier.

6.2.3 AIR CONDITIONING, ZONING AND SIMULATION

The HVAC systems used in both the Proposed Building and Reference Building models were predefined in Carrier E20-II HAP, for all air-conditioned spaces, a temperature range of 18°CDB to 26°CDB for 98% of the plant operation time was adopted as required by NCC JV3 for both the “reference” and “proposed” models.

The mechanical systems for both the Proposed Building and Reference Building models were simulated with the input parameters in accordance with the DTS Requirements of NCC Part J5.

Infiltration Rates

The infiltration into the building through the building fabric has been included in both the “reference” and proposed” models as per Table 21 NCC JV3 (d) (i) (F): infiltration rates.

Description	ACH/Hr
For a perimeter zone of depth equal to the floor-to-ceiling height, when pressurising plant is operating	1.0
For the whole building, when pressurising plant is not in operation.	1.5

6.2.4 INTERNAL LOADS & NCC DEFAULT VALUES

Stable Energy Consumption Items and Parameters

In compliance with NCC section J, the annual energy consumption of various items that are not impacted by the glazing system selection or the simulation modelling has not been included within the assessment as these items are the same for all simulation cases. This includes items such as internal lighting, hot water supply/generation, lifts, car park ventilation & lighting, miscellaneous ventilation and small AC systems.

In compliance with NCC Section J requirements, there are parameters that must be the same in all modelling runs (i.e. the reference building as well as the proposed building). This is to avoid using energy efficiency criteria or calculations that could result in a more generous allowance using the reference building and then criteria or calculations that result in lower annual energy consumption values for the proposed building.

In compliance with NCC Section J, the following parameters remained unchanged in all the simulation runs:
The annual energy consumption calculation method itself.
The location;
Adjacent structures and features
The environmental conditions (such as ground reflectivity, sky and ground form factors, temperature of external bounding surfaces, air velocities across external surfaces and the like.)
The building orientation
The building form
The external doors (e.g. numbers, types, etc.)
The testing standards, including for insulation, glazing, water heater and package air-conditioning equipment.
The thermal resistance of air films including any adjustment factors, moisture content of materials and the like.
The dimensions of external, internal and separating walls.
The surface density of envelope walls over 220 kg/m2.
The quality of the insulation installation.
Assumptions and means of calculating the temperature difference across air-conditioning zone boundaries.
The floor coverings and furniture and fittings density.
The internal shading devices, their colour and their criteria for operation.
The number and sizes of lifts and escalators and the floors served.
The range and type of services and energy sources other than energy generated on-site from sources that do not emit greenhouse gases such as solar and wind power.
The internal artificial lighting levels.
The internal heat gains including people, lighting, appliances, meals and other electric power loads.
The air-conditioning system configuration and zones.
The daily and annual profiles of the building occupancy and operation of services.
The range of internal temperatures and plant operating times.

The supply hot water temperature and rate of use.
The infiltration values;
The unit capacity and sequencing for water heaters, refrigeration chillers and heat rejection equipment such as cooling towers.
The metabolic rate for people.

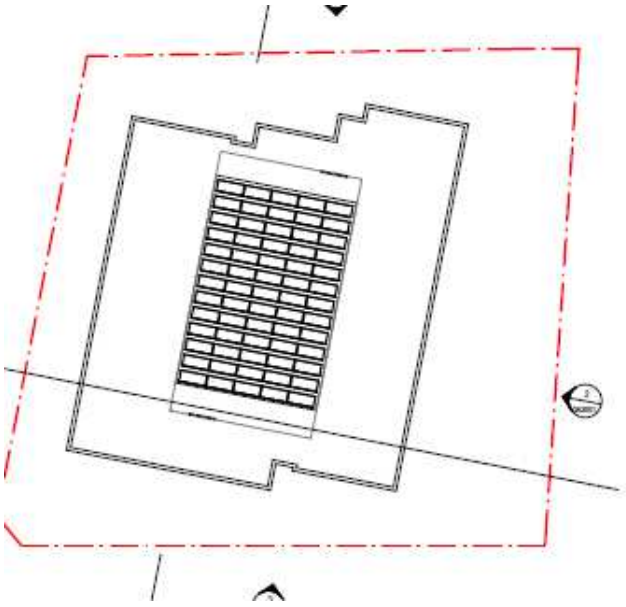
Internal heat loads, lighting loads and occupancy density

The internal heath loads applied to both the “reference” and “proposed” models are provided in the following table. The occupancy, lighting and equipment loads have been uniformly distributed throughout the building.

Item	Details
People Load	75 W sensible heat gain and 55 W latent heat gain
Hourly Profile	The schedule is provided in section 5.2.4 – based on NCC Specification Table 2A
Appliances & Equipment head Load	5 W/m2 averaged for 24 hours per day, 7 days per wek, continious operation. As per Table 2h of the NCC 2016 Section J JV3.
Hot water consumption	50 L / person as per Table 2i Heated Water Supply Consumption Rate

Onsite Energy Generation

JV3 allows the renewable energy generated on-site or the “free” energy derived from another process (e.g. heat from cogeneration) to be deducted from the annual energy consumption of the proposed building. This means that the “annual energy consumption” is the sum of the energy drawn annually from the electrical grid, the gas network or fuel brought in by road transport and not the total of the energy consumed by the services that use energy. Onsite energy generation has been applied to the JV3 analysis, based on the information provided, the design includes a 30 kW Solar PV system on the roof (shown on the roof plan below).



Schedules of Usage

The internal load schedules used in the model are as per the *Specification JV Annual Energy Consumption Criteria* provided in NCC Section J. Details of the schedules used are contained in the following tables;

The annual energy consumption—
(a) for *air-conditioning*, must be calculated on the basis of—
(i) the daily occupancy and operation profiles in Table below; and
(ii) plant serving public areas of a Class 3 being available on thermostatic control 24 hours per day;
(iii) the internal heat gains in a building—
(A) from occupants and hot meals, in accordance with one of the options in Table 2j of Part J; and
(B) from appliances and equipment, in accordance with Table 2h of Part J; and
(C) from artificial lighting, that is calculated in (b); and
(b) for artificial lighting, must be calculated on the basis of the proposed level of artificial lighting in the building with the daily profile in Tables 2a to 2g of Part J; and
(c) for heated water supply, must be calculated on the basis of the consumption rates of Table 2i of Part J.

Occupancy and operation profiles

The following table provides the occupancy and operation profiles used (for the class 3 areas) for modelling runs in accordance with Table 2a of the NCC Section J:

Time period	Occupancy		Artificial lighting	Air-conditioning	
	Monday to Friday	Saturday, Sunday and holidays		Monday to Friday	Saturday, Sunday and holidays
12:00am to 1:00am	85%	85%	5%	On	On
1:00am to 2:00am	85%	85%	5%	On	On
2:00am to 3:00am	85%	85%	5%	On	On
3:00am to 4:00am	85%	85%	5%	On	On
4:00am to 5:00am	85%	85%	5%	On	On
5:00am to 6:00am	85%	85%	25%	On	On
6:00am to 7:00am	85%	85%	80%	On	On
7:00am to 8:00am	80%	85%	80%	On	On
8:00am to 9:00am	50%	50%	50%	On	On
9:00am to 10:00am	10%	50%	20%	Off	On
10:00am to 11:00am	10%	20%	20%	Off	Off
11:00am to 12:00pm	10%	20%	20%	Off	Off
12:00pm to 1:00pm	10%	20%	20%	Off	Off
1:00pm to 2:00pm	10%	20%	20%	Off	Off
2:00pm to 3:00pm	10%	20%	20%	Off	Off
3:00pm to 4:00pm	10%	30%	20%	Off	Off
4:00pm to 5:00pm	50%	50%	20%	On	On
5:00pm to 6:00pm	50%	50%	50%	On	On
6:00pm to 7:00pm	70%	50%	50%	On	On
7:00pm to 8:00pm	70%	70%	50%	On	On
8:00pm to 9:00pm	80%	80%	50%	On	On
9:00pm to 10:00pm	85%	80%	50%	On	On
10:00pm to 11:00pm	85%	85%	50%	On	On
11:00pm to 12:00am	85%	85%	5%	On	On

Note:

1. The occupancy profile is expressed as a percentage of the maximum number of people that can be accommodated in the building. The artificial lighting profile is expressed as a percentage of the maximum *illumination power density* permitted under Part J6.

6.3 MODELLING CASE 1 - REFERENCE BUILDING WITH DTS SERVICES

6.3.1 INPUTS

Building Fabric: The building fabric was modelled based on the minimum Deemed to Satisfy (DTS) provisions outlined in the NCC Part J1 and J2 for building fabric (summarised in the following table).

Building Services: Based on the minimum NCC part J Deemed to Satisfy provisions.

The following table further outlines the DTS building fabric thermal performance and services used within the simulation model 1 (reference case).

Item		Reference Building Case (Model 1)
J1 (DTS)	Roof / Ceiling	Total R-Value: R4.2 (Minimum NCC 2016 DTS)
	Roof lights	N.A
	External Walls	Total R-Value: R2.8 (Minimum NCC 2016 DTS):
	Internal Walls	Total R-Value: R1.8 (Minimum NCC 2016 DTS)
	Floors	Suspended slabs: Total R-Value: R2.0 (Minimum NCC 2016 DTS) Concrete slab on ground: no added thermal insulation.
J2 (DTS)	Glazing	Set at the minimum NCC 2016 DTS requirements. **Process:** As expected, the “proposed” glazing did not meet the NCC part J2 deemed to satisfy calculators. Specification of the DTS external glazing were refined to be as close as possible to 100% to ensure the highest possible energy consumption figure was achieved for the reference building.
J3-8 (DTS)	Building Services	Set at the minimum NCC 2016 DTS requirements.
Other	Solar Absorptance:	Solar absorptance of 0.6 for external walls and 0.7 for roofs, in accordance with JV3.

6.3.2 RESULTS

The outcome for the Reference Building with DTS services was 287 MJ/m² per annum.

6.4 MODELLING CASE 2 - PROPOSED BUILDING WITH DTS SERVICES

6.4.1 INPUTS

Building Fabric: The building was modelled based on the proposed fabric which is the same as the NCC part J deemed to satisfy provisions with the following exceptions:

- J2 – Glazing: modelling is based on the proposed glazing performance specification (provided in the following table and also summarised in section 7.2 of the report);

Building Services: Based on the minimum NCC part J Deemed to Satisfy provisions.

The following table further outlines the performance inputs applied to the simulation model 2 (proposed building with DTS services):

Item		Proposed Building Case (Model 2)
J1 (Proposed)	Roof / Ceiling	Total R-Value: R4.2 (Minimum NCC 2016 DTS)
	Roof lights	N.A
	External Walls	Total R-Value: R2.8 (Minimum NCC 2016 DTS):
	Internal Walls	Total R-Value: R1.8 (Minimum NCC 2016 DTS)
	Floors	Suspended slabs: Total R-Value: R2.0 (Minimum NCC 2016 DTS) Concrete slab on ground: no added thermal insulation.
J2 (Proposed)	Glazing	***Addressed through JV3 assessment (identical glazing performance nominated to ensure consistency)*** Total U-Value ≤ 7 (W/m2K) Total SHGC: ≤ 0.55
J3-8 (DTS)	Building Services	As required by NCC JV3 method: Set at the minimum of NCC 2016 DTS requirements (Similar to Case 1 - Reference Building)

6.4.2 RESULTS

The outcome for the Proposed Building with DTS services was 274 MJ/m² per annum.

6.5 MODELLING CASE 3 - PROPOSED BUILDING WITH PROPOSED SERVICES

6.5.1 INPUTS

Building Fabric: The building was modelled based on the proposed fabric which is the same as the NCC part J deemed to satisfy provisions with the following exceptions:

- J2 – Glazing: modelling is based on the proposed glazing performance specification (provided in the following table and also summarised in section 7.2 of the report);

Building Services: Based on the proposed building services. The "proposed services" under the modelling case 3 have been conservatively set at the "DTS services" level. The results of modelling cases 2 and 3 are therefore identical.

The following table outlines the performance inputs applied to the simulation model 2 (proposed building with proposed services):

Item		Proposed Building Case (Model 2)
J1 (Proposed)	Roof / Ceiling	Total R-Value: R4.2 (Minimum NCC 2016 DTS)
	Roof lights	N.A
	External Walls	Total R-Value: R2.8 (Minimum NCC 2016 DTS):
	Internal Walls	Total R-Value: R1.8 (Minimum NCC 2016 DTS)
	Floors	Suspended slabs: Total R-Value: R2.0 (Minimum NCC 2016 DTS) Concrete slab on ground: no added thermal insulation.
J2 (Proposed)	Glazing	***Addressed through JV3 assessment (identical glazing performance nominated to ensure consistency)*** Total U-Value ≤ 7 (W/m2K) Total SHGC: ≤ 0.55
J3-8 (Proposed)	Building Services	The "proposed services" under the modelling case 3 have been therefore conservatively set at the "DTS services" level. The results of modelling cases 2 and 3 are therefore the same.

6.5.2 RESULTS

The outcome for the Proposed Building with proposed services was 274 MJ/m² per annum.

Note: The "proposed services" under the modelling case 3 have been conservatively set at the "DTS services" level. The results of modelling cases 2 and 3 are therefore the same (274 MJ/m2).

7 SUMMARY OF THE SIMULATION RESULTS AND CONCLUSION

The following table summarises the total annual energy consumption for the simulation cases of the development.

	CASE 1 Reference Building [DTS Fabric and DTS services]	CASE 2 Proposed Building [Proposed Fabric and DTS services] *	CASE 3 Proposed Building [Proposed Fabric and Proposed services] *
Annual Energy Consumption (normalised consumption)	287 MJ/m2	274 MJ/m2	274 MJ/m2

** The "proposed services" under the modelling case 3 have been conservatively set at the "DTS services" level. The results of modelling cases 2 and 3 are therefore the same (274 MJ/m2).*

A reference building was modelled having minimum DTS envelope characteristics as well as minimum DTS services. The annual energy consumption of the reference building and services was estimated to be 287 MJ/m^2.annum.

The annual energy consumption of the proposed building with the DTS services (modelling case 2) is calculated at 274 MJ/m^2.annum. The services under the 3rd modelling case have been conservatively set at the "DTS services" level. The results of modelling cases 2 and 3 are therefore the same (274 MJ/m^2.annum).

The Proposed Building therefore meets the criteria of JV3 (a) (i) & (ii), for Verification Method JV3 as 274 MJ/m^2.annum is less than the 287 MJ/m^2 annum estimated for the Reference Case.

The proposed insulation and glazing system as outlined within the report (see section 7) are therefore compliant with the performance requirement of NCC Section J 2016.

8 SUMMARY OF THE SECTION J REQUIREMENTS

8.1 PART J 1 – BUILDING FABRIC REQUIREMENTS

8.1.1 OVERVIEW

Section J part J1 outlines the minimum requirements of building envelope. The envelope is defined by the NCC as parts of a building's fabric that separate a conditioned space or habitable room from the exterior of the building or a non-conditioned space.

The required thermal insulation requirements are as provided below:

Item	Required minimum total insulation R-Value
Roof lights	N.A
Ceiling / Roof	Total R-Value: R4.2 (Minimum NCC 2016 DTS)
External walls	Total R-Value: R2.8 (Minimum NCC 2016 DTS):
Internal walls	Total R-Value: R1.8 (Minimum NCC 2016 DTS)
Floor	Suspended slabs: Total R-Value: R2.0 (Minimum NCC 2016 DTS) Concrete slab on ground: no added thermal insulation.

8.1.2 PART J1.1 – APPLICATION

The deemed-to-satisfy provisions of Part J1 apply to the building elements forming the envelope of a Class 2 to 9 building. Part J1 is therefore applicable to all works within the building.

8.1.3 J1.2 THERMAL CONSTRUCTION GENERAL

All insulation installed are required to meet J1.2 and AS/NZ 4859.1. Builder is to ensure compliance, during construction.

Care should be taken when installing insulation to ensure a continuous envelope between a conditioned space and either the outside environment or a non-conditioned space.

Insulation is to be fitted tightly to each side of framing members but need not be continuous over the framing member. The total R-value requirements for roof, walls and floors are calculated for parts of the roof, walls or floor that are clear of any framing members.

The installation of insulation should not interfere with the safety or performance of domestic services and fittings such as heating flues, recessed light fittings, transformers for low voltage lighting, gas appliances and general plumbing and electrical components. This includes providing appropriate clearance as detailed in relevant legislation and referenced standards such as for electrical, gas and fuel oil installations. Low voltage lighting transformers should not be covered by insulation and be mounted above the insulation rather than on the ceiling. Expert advice may also be needed on how much bulk insulation can be placed over electrical wiring.

Addition of insulation to other building elements may alter the fire properties of those elements. Re-testing or re-appraisal of these elements may be required.

For reflective insulation to achieve its tested R-value, the airspace adjoining the insulation needs to be a certain width. This width varies depending on the particular type of reflective insulation and the R-value to be achieved.

Where the width of airspace is to be achieved in a wall cavity or the like, care should be taken to ensure compliance with all other applicable NCC provisions. For example, the provisions relating to weatherproofing masonry may require a greater width of cavity.

The R-value of bulk insulation is reduced if it is compressed. The allocated space for bulk insulation is therefore to allow the insulation to be installed so that it maintains its correct thickness unless exempted such as at wall studs. This is particularly relevant to wall and cathedral ceiling framing whose members can only accommodate a limited thickness of insulation. In some instances, larger framing members or thinner insulation material, such as polystyrene boards, may be necessary to ensure that the insulation achieves its required R-value.

Note:

The thermal insulation performance requirements outlined in this report nominate the Section J compliance requirements only. The specified performance values therefore do not consider requirements for any other disciplines such as Acoustics, Fire or Safety compliance. Where required, the development shall comply with any additional requirements related to other disciplines in addition to the Section J compliance requirements detailed in this report.

8.1.4 J1.3 ROOF AND CEILING CONSTRUCTION

Roof and ceiling construction works are required to meet J1.3 requirements. For roof and ceiling constructions that form part of the building envelope of the conditioned space, NCC Section J Compliance shall be achieved with minimum total R4.2 insulation. This is with the conservative assumption that the solar absorbance of the roof and balcony finish, where above conditioned areas, is high, (i.e. SA over 0.6).

8.1.5 J1.4 ROOF LIGHTS (ADDRESSED AS PART OF JV3)

Based on the design drawings, no roof lights aer proposed for the conditioned space. Part J1.4 is therefore not applicable to this development.

Under any other design conditions, the roof light must meet the following criteria (Table J1.4 Roof Lights – Thermal Performance of transparent and translucent elements).

Roof light shaft index (see Note 2)	Constant	Total area of *roof lights* serving the room or space as a percentage of the *floor area* of the room or space			
		Up to 2%	More than 2% to and up to 3%	More than 3% and up to 4%	More than 4% and up to 5%
Less than 0.5	*SHGC*	Not more than 0.83	Not more than 0.57	Not more than 0.43	Not more than 0.34
	Total U-Value	Not more than 8.5	Not more than 5.7	Not more than 4.3	Not more than 3.4
0.5 to less than 1.0	*SHGC*	Not more than 0.83	Not more than 0.72	Not more than 0.54	Not more than 0.43
	Total U-Value	Not more than 8.5	Not more than 5.7	Not more than 4.3	Not more than 3.4
1.0 to less than 2.5	*SHGC*	Not more than 0.83	Not more than 0.83	Not more than 0.69	Not more than 0.55
	Total U-Value	Not more than 8.5	Not more than 5.7	Not more than 4.3	Not more than 3.4
2.5 and more	*SHGC*	Not more than 0.83	Not more than 0.83	Not more than 0.83	Not more than 0.83
	Total U-Value	Not more than 8.5	Not more than 5.7	Not more than 4.3	Not more than 3.4

Notes:

1. The total area of a roof light serving the space as a percentage of the floor area of the space must not exceed 5%.
2. The roof light shaft index is determined by measuring the distance from the centre of the shaft at the roof to the centre of the shaft at the ceiling level and dividing it by the average internal dimension of the shaft opening at the ceiling level in the same units of measurement.
3. The total area of roof lights is the combined area for all roof lights serving the room or space.
4. The area of a roof light is the area of the roof opening that allows light to enter the building.
5. The thermal performance of an imperforate ceiling diffuser may be included in the Total U-Value and SHGC of the roof light.
6. If the roof lights is required for compliance with NCC Part F4, it must

   (i) Have an area not more than 150% of the minimum area required by F4.6; and

   (ii) Have transparent and translucent elements, including any imperforate ceiling diffuser, with a combined performance of not more than: SHGC: 0.29 and U-Value: 2.9

The performance requirements of the total glazing system (glass + frame) must be demonstrated under NFRC100-2001 conditions and based on AFRC requirements and in compliance with the NCC.

8.1.6 J1.5 WALLS

External Wall Construction (addressed through JV3):

All wall construction should be designed to meet J1.5. For external wall constructions that form part of the building envelope (conditioned space) in the proposed development. **NCC compliance shall be achieved with a minimum total thermal insulation of R2.8 for external walls separating the conditioned space from the non-conditioned space.**

Internal Wall Construction

All internal wall constructions that form part of the building envelope which separates conditioned and non-conditioned spaces in this climate zone are required to achieve a minimum thermal resistance of 1.8 m^2 K/W. This is assuming that the mechanical ventilation of the space is more than 1.5 air changes per hour.

NCC compliance shall be achieved with a minimum total thermal insulation of R1.8 for internal walls separating the conditioned space from the non-conditioned space.

8.1.7 J1.6 FLOORS

There are no requirements for floor insulation for the floors which are concrete a slab on ground unless the floors incorporate in-slab heating or cooling system which is not applicable to this development.

NCC compliance shall be achieved with a minimum total thermal insulation of R2 for the suspended concrete floor slabs separating a conditioned space from a non-conditioned space.

8.2 PART J2 GLAZING (ADDRESSED THROUGH JV3)

Part J2 requires established minimum glazing system performance requirements, which vary depending on the climate zone and the orientation and shading of the glazing. The glazing conductance (U-value) and Solar Heat Gain Coefficient (SHGC and shading) are assessed together and calculated for each façade orientation.

The DTS provisions of part J2 do NOT apply to this development since compliance is achieved through the alternative method of verification (JV3) detailed in this report.

The following table outlines the glazing performance proposed for different facade types. Compliance of the following performance specifications was assessed in line with the NCC JV3 alternative assessment requirements.

The performance of each type of glazing system (glass and frame) must be in compliance with NFRC / AFRC requirements and test conditionings.

Glazing Performance Requirements	***Addressed through JV3 assessment (identical glazing performance nominated to ensure consistency)*** Total U-Value ≤ 7 (W/m2K) Total SHGC: ≤ 0.55

The glazing performance requirements outlined in this report nominate the Section J compliance requirements only. The specified performance values therefore do not consider requirements for any other disciplines such as Acoustics, Fire or Safety compliance. Where required, the development shall comply with any additional requirements related to other disciplines in addition to the Section J compliance requirements detailed in this report.

8.3 PART J3 – BUILDING SEALING

Part J3 of the NCC 2016 contains the requirements of the Deemed-to-Satisfy compliance for building sealing. The purpose of this subsection is to ensure that additional heating and cooling loads will not be introduced through building leakage.

Part J3 is applicable to this development.

Clause J3.2 refers to chimneys and flues which are not applicable to this development.

Clause J3.3 refers to roof lights which is applicable to the atrium roof light.

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 AS2047, louvred windows or doors, and fire doors. 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.

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.

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.

Clause J3.7 outlines that if evaporative cooling is used, the system must be fitted with self-closing non-return dampers.

All services consultants and contractors shall design and build to ensure compliance with Part J3 of the NCC Section J and all subsections associated therein.

8.4 PART J4

Part J4 of the NCC 2016 (formerly known as Air Movement) is blank and therefore not applicable to this development.

8.5 PART J5 – AIR CONDITIONING AND VENTILATION SYSTEMS

Part J5 of the NCC outlines the performance requirements for air conditioning and ventilation systems to ensure these services operate in an efficient manner.

All services consultants and contractors shall design the air conditioning and ventilation systems to ensure compliance with Part J5 of the NCC Section J and all subsections associated therein.

8.6 PART J6 – ARTIFICIAL LIGHTING AND POWER

Part J6 of the NCC outlines the performance requirements for illumination power density and the efficient use of lighting power and controls.

All services consultants and contractors shall design the artificial lighting systems to ensure compliance with Part J6 of the NCC Section J and all subsections associated therein with regards to power.

8.7 PART J7 – HOT WATER SUPPLY

Part J7 of the NCC outlines the provisions for the energy efficient use of hot water supply systems.

Clause J7.2 of Part J7 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.

All services consultants and contractors shall design the Hot Water supply systems to ensure compliance with Part J7 of the NCC Section J and all subsections associated therein.

8.8 PART J8 – FACILITIES FOR ENERGY MONITORING

Part J8 of the NCC outlines the provisions of facilities for energy monitoring. Facilities for energy monitoring shall be provided in accordance to Part J8 of the NCC.

A building or sole-occupancy unit with a floor area of more than 500 m2 must have the facility to record the consumption of gas and electricity.

A building with a floor area of more than 2,500m2 must have the facility to record individually the energy consumption of:

i. air-conditioning plant including, where appropriate, heating plant, cooling plant and air handling fans; and
ii. artificial lighting; and
iii. appliance power; and
iv. central hot water supply; and

v. internal transport devices including lifts, escalators and travelators where there is more than one serving the building; and
vi. other ancillary plant.

All services consultants and contractors shall design for access for maintenance and facilities for monitoring to ensure compliance with Part J8 of the NCC Section J and all subsections associated therein.

9 DISCLAIMER

This report is prepared using the information described above and inputs from other consultants. Whilst VIPAC has endeavoured to ensure the information used is accurate, no responsibility or liability to any third party is accepted for any loss or damage arising out of the use of this report by any third party. Any third party wishing to act upon any material contained in this report should first contact VIPAC for detailed advice which will take into account that party's particular requirements.

Computer performance assessment provides an estimate of building performance. This estimate is based on a necessarily simplified and idealised version of the building that does not and cannot fully represent all the intricacies of the building once built. As a result, simulation results only represent an interpretation of the potential performance of the building. No guarantee or warrantee of building performance in practice can be based on simulation results alone. VIPAC and its employees and agents shall not be liable for any loss arising because of, any person using or relying on the Report and whether caused by reason or error, negligent act or omission in the report. The draft assessment has been prepared based on the preliminary building services and architectural design with the view to conduct a detailed assessment once the design is further developed.

Performance of the completed building may be significantly affected by the quality of construction; the quality of commissioning, ongoing management of the building, and the way the building is operated, monitored and maintained. Building fabric inputs require verifiable manufacturer data to confirm thermal properties.

This report is intended as a guide to assist with the application of NCC Section J. It should be read in conjunction with the NCC 2016, specific applications may vary during the design development of the