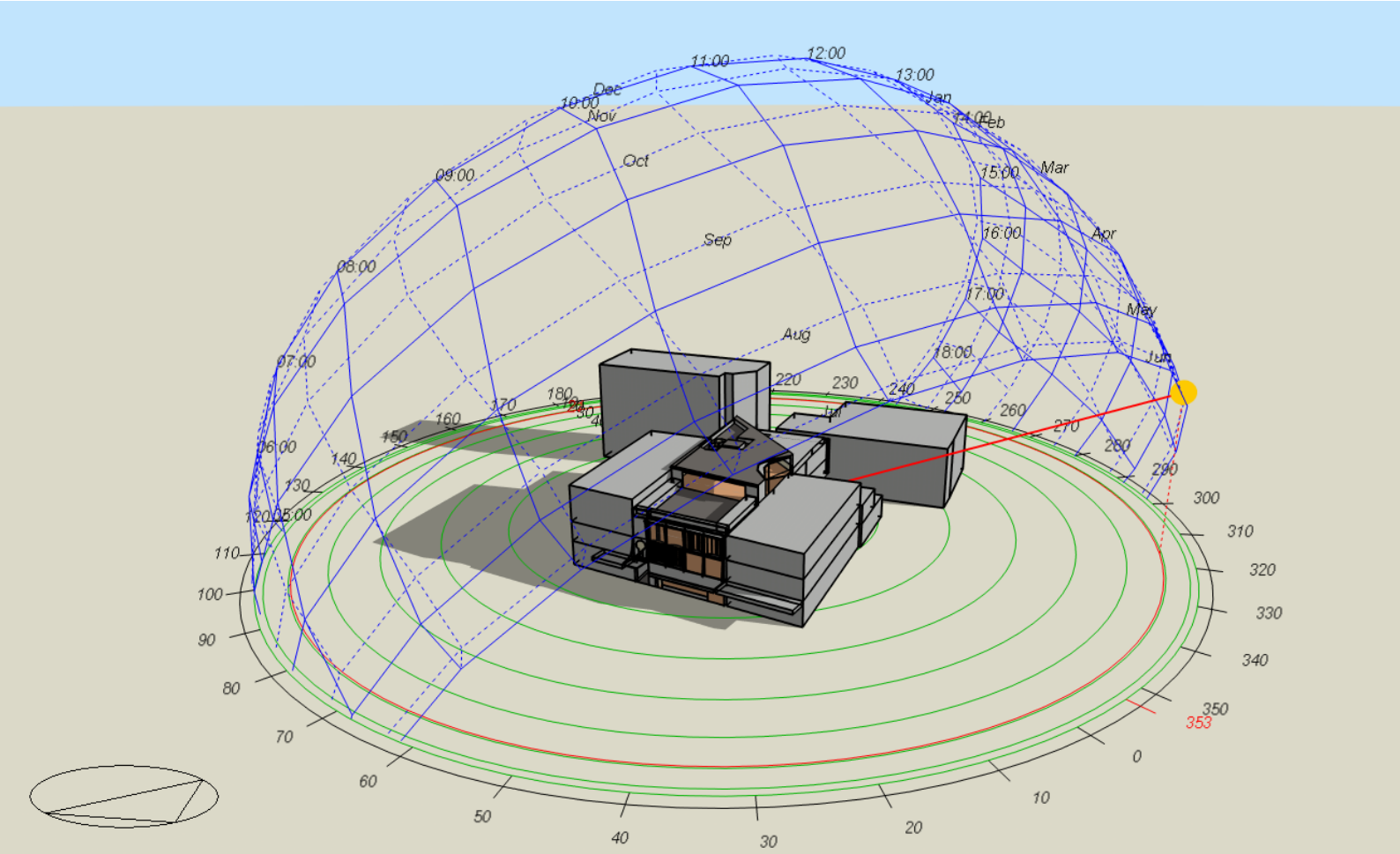
IGS INTEGRATED GROUP SERVICES



34-35 South Steyne, Manly NSW

Energy Efficiency Assessment Report – S4.55-01
NCC Section J – J1V3 Assessment

2 May 2024

192-200 Euston Rd,
Alexandria NSW 2015
Phone: +61 2 8488 4600
Fax: +61 2 9475 4588
Email: admin@igs.com.au
Web: www.igs.com.au
linkedin.com/company/3213174
ABN: 68 163 019 029

Document Control

Revision	Date	Author	
Rev2 - S4.55 - 01	2 May 2024	B.Shojaei	BS

CONTENTS

1 Executive Summary

IGS has been engaged to review the proposed development at 34-35 South Steyne, Manly NSW against the requirements for the National Construction Code 2022 provisions for energy efficiency under Section J (NCC 2022 Volume 1, Part J1).

This report details the outcome of a National Construction Code (NCC) 2022 Section J assessment (J1V3) to determine compliance requirements for the proposed building. Energy simulations were undertaken to provide an alternative method of verification (J1V3) in relation to NCC Section J in order to allow for glazing and insulation variations within the development.

J1V3 requires the comparison of a reference building (Case 1) to two proposed building models, one having the reference building services (Case 2) and one having the same services as the proposed services (Case 3). The comparison is based on the forecasted annual greenhouse gas emissions. Furthermore, in the proposed building (case 3), a thermal comfort level of between a Predicted Mean Vote of -1 to +1 is required across not less than 95% of the floor area of all occupied zones for not less than 98% of the annual hours of operation of the building.

Table 1 details the computer simulation results for the simulation cases undertaken in compliance with the J1V3 Verification Method. The simulation process is detailed as part of this report.

Table 1. Result Summary.

	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] *	Compliance Achieved
Annual greenhouse gas emissions	135,322 kg p.a.	134,463 kg p.a.	134,463 kg p.a.	YES

** 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 (134,463 kg/annum).*

The results show that the total annual Greenhouse Gas emission of the Proposed Building models is less than the annual Greenhouse Gas of the Reference Building. The glazing and insulation systems utilised within the proposed building are therefore compliant with the performance requirement of J1P1 under J1V3 method of verification.

Building Fabric Compliance Options

Table 2 outlines the glazing and 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 J1 compliance under the J1V3 method of verification.

Table 2. Minimum Building Fabric Requirements.

Envelope (separating conditioned and un-conditioned zones)	Minimum Insulation & Glazing Requirements
Roof / Ceiling	Minimum total thermal insulation: R3.7 The solar absorptance of the upper surface of a roof must be not more than 0.45.
Walls	External Walls: minimum total R1.5 thermal insulation. Internal Walls: minimum total R1.0 thermal insulation.

Glazing	Large/Sliding Doors, Double glazed, clear low-e coating: • Total system U-value ≤3.2; • Total system SHGC ≤0.35. Curved glass with straight glass to match, Double glazed, no low-e coating: • Total system U-value ≤4.2; • Total system SHGC ≤0.75. Curved glass, Double glazed, no low-e coating: • Total system U-value ≤4.2; • Total system SHGC ≤0.75. Doors, Single glazed, clear low-e coating: • Total system U-value ≤5.5; • Total system SHGC ≤0.55. Windows, Double glazed, clear low-e coating: • Total system U-value ≤3.2; • Total system SHGC ≤0.35. Curtain Wall glass, Double glazed, low-e coating: • Total system U-value ≤2.8; • Total system SHGC ≤0.35.
Floors	• Suspended Floors (where any): total R-Value: R2.0 (Except were indicated by the project architect) • Concrete Slab on Ground: no added insulation required.
Other	• Building services: minimum DTS performance or better. • Minimum Solar PV capacity of 15 kW (Energy to be used on site)

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 2022.

2 Introduction

IGS has been engaged to review the proposed development at 34-35 South Steyne, Manly NSW against the requirements for the National Construction Code 2022 provisions for energy efficiency under Section J.

The minimum required deemed- to-satisfy (DTS) provisions for Section-J, has been established as per Volume One of NCC 2022. Energy simulation was undertaken to provide an alternative method of verification (J1V3) in relation to NCC Section J in order to allow for glazing and thermal insulation variations within the development.

The assessment process under J1V3 requires a comparison of simulated annual energy consumption of a reference building to the proposed building utilising the required assumptions and inputs for J1V3. 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 J3 to J8.

The proposed building in this assessment also utilises DTS compliance performance of the provisions of Part J3 to J9 excluding those of Part J4 in relation to the glazing and insulation system performance as outlined in section 7 of this report.

On this basis, the outcome of this J1V3 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 J1P1 has been verified in accordance with J1V3 requirements and utilising Design Builder energy modelling software package that is ABCB protocol compliant and strictly in accordance with the following guideline:

- NCC Section J Part J1V3 Verification Using a Reference Building.

The location of the development is shown in Figure 1.

Figure 1. Location of the development - 34-35 South Steyne, Manly NSW– Source: Google Map.

3 National Construction Code - Section J

The National Construction Code (NCC) 2022 includes mandatory minimum energy performance requirements for buildings (Class 2 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 J1P1 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 J3 to J9. Alternatively, achievement of the performance requirements can be demonstrated through Verification Method J1V3.

- Part J3 Elemental provisions for a sole-occupancy unit of a Class 2 building or a Class 4 part of a building
- Part J4 Building Fabric relates to the building fabric and minimum thermal performance for constructions according to climate zone for roofs, ceilings, roof lights, walls, glazing and floors.
- Part J5 Building Sealing details requirements in order to restrict unwanted infiltration into a building.
- Part J6 Air-Conditioning and Ventilation Systems details requirements to ensure these services are used and use energy in an efficient manner.
- Part J7 Artificial Lighting and Power details requirements for lighting and power to ensure energy is used efficiently by these systems.
- Part J8 Heated Water Supply and Swimming Pool & Spa Pool Plant details requirements for hot water supply design.
- Part J9 Facilities for Energy Monitoring and on-site distributed energy resources

3.1 NCC J1V3 - Verification using a reference building

Compliance with J1P1 is verified when:

a. it is determined that the annual greenhouse gas emissions of the proposed building are not more than the annual greenhouse gas emissions of a reference building when—

- the proposed building is modelled with the proposed services; and
- the proposed building is modelled with the same services as the reference building; and

b. in the proposed building, a thermal comfort level of between a Predicted Mean Vote of -1 to +1 is achieved across not less than 95% of the floor area of all occupied zones for not less than 98% of the annual hours of operation of the building; and

c. the building complies with the additional requirements in Specification 33.

i. renewable energy generated and used on site; and
ii. another process such as reclaimed energy, used on site.

The annual greenhouse gas emissions of the proposed building may be offset by—

The calculation method used for (a) and (b) must comply with—

i. ANSI/ASHRAE Standard 140; and
ii. Specification 34.

The following section summarises the process of performing the NCC Section J Performance Solution J1V3 used in this study:

Modelling Case 1 (Reference Building): Calculated the theoretical annual greenhouse gas emissions by modelling a reference building. This was the DTS complying building based on the J1V3 criteria provided in the following pages.

Modelling Case 2: Calculated the theoretical annual greenhouse gas emissions of the proposed Alternative Solution with the services modelled as if they were the same as those of the reference building.

Modelling Case 3: Calculated the theoretical annual greenhouse gas emissions of the proposed Alternative Solution (building and services).

The theoretical greenhouse gas emissions calculated in cases 2 and 3 were then compared to the annual greenhouse gas emissions calculated in case 1 to ensure that in both cases, the annual emissions of the reference building in case 1 is not exceeded by that in cases 2 and 3.

The following tables outline the NCC requirements for the J1V3 method of verification which were considered in all the modelling runs for the Reference Building.

(a) The reference building must— (i) comply with Deemed-to-Satisfy Provisions in Parts J3 to J8; and (ii) have the minimum amount of mechanical ventilation required by Part F6.
(b) The external walls must have a solar absorptance of 0.6.
(c) The air-conditioning must— (i) for 98% of the annual hours of operation, achieve temperatures between— (A) 18°CDB to 25°CDB for conditioned spaces with transitory occupancy; and (B) subject to (ii), 21°CDB to 24°CDB in all other conditioned spaces; and (ii) if the proposed building has no mechanically provided cooling or has mixed mode cooling, have the same method of control and control set points for non-mechanical cooling as the proposed building.
(d) The infiltration rate in each zone must be— (i) 0.7 air changes per hour throughout all zones when there is no mechanically supplied outdoor air; and (ii) 0.35 air changes per hour at all other times.
(e) The artificial lighting must achieve the required maximum Illumination power density in Part J7 without applying the control device adjustment factors.
(f) Minimum Energy Performance Standards must be applied to services not covered by Parts J6 to J8.

3.2 Provisions to Comply with J1V3 – Thermal Comfort Level

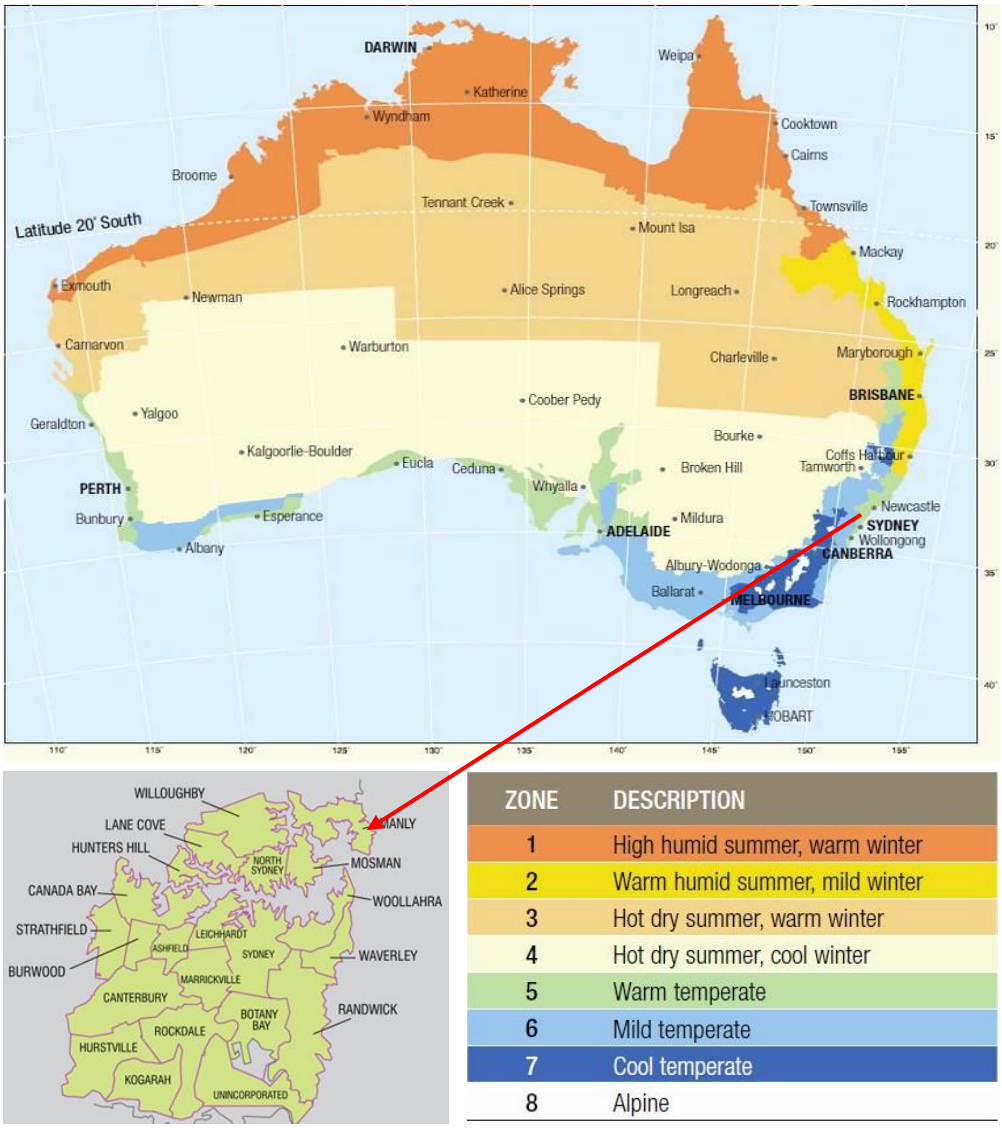
Based on the assessment undertaken as summarised in the following sections of the report, it is demonstrated that the thermal comfort requirements of J1V3 are met and the proposed building achieves the minimum PMV levels between -1.0 and 1.0 for areas not less than 95% of the occupied zones for 98% of the year.

4 Building Description

4.1 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 Manly NSW which is within the NCC climate zone 5 (Warm temperate). The climate zone map of the development is depicted in Figure 2.



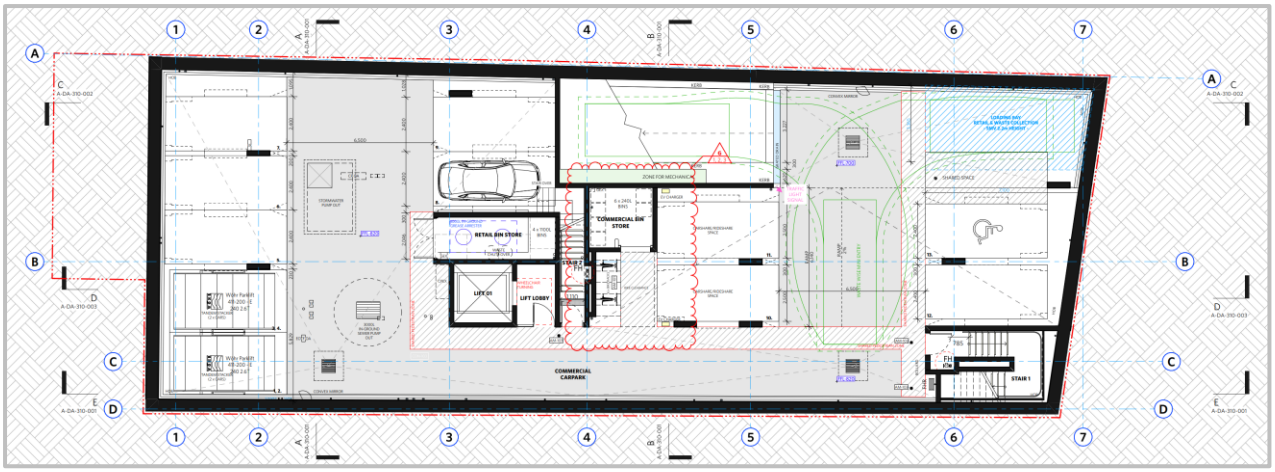
ZONE	DESCRIPTION
1	High humid summer, warm winter
2	Warm humid summer, mild winter
3	Hot dry summer, warm winter
4	Hot dry summer, cool winter
5	Warm temperate
6	Mild temperate
7	Cool temperate
8	Alpine

Figure 2. Climate Zone Map.

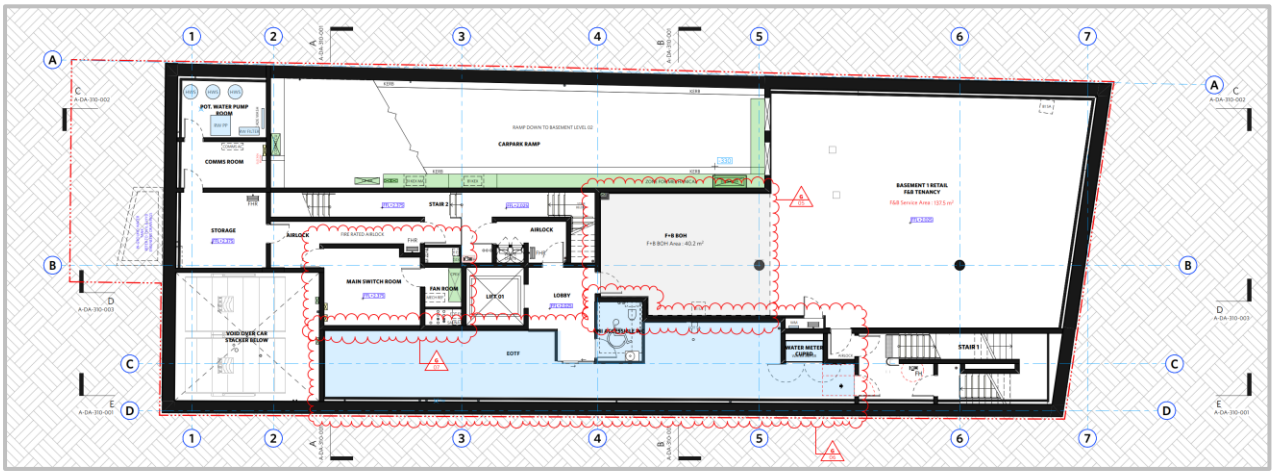
4.2 Architectural Drawings

Selected S4.55 -01 architectural plans and elevations for the proposed development are provided below.

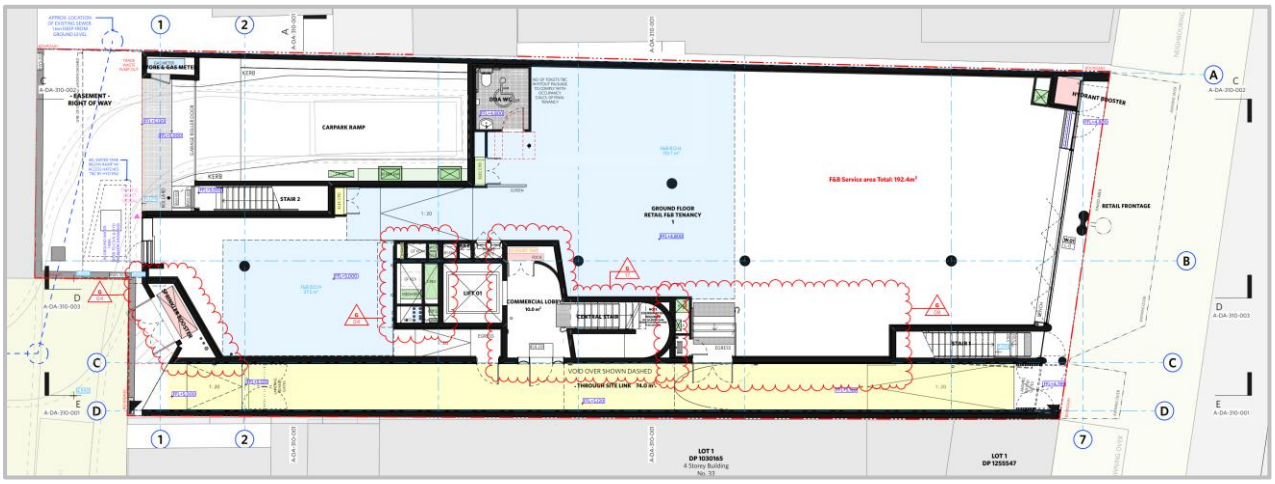
Basement 2 – Floor Plan



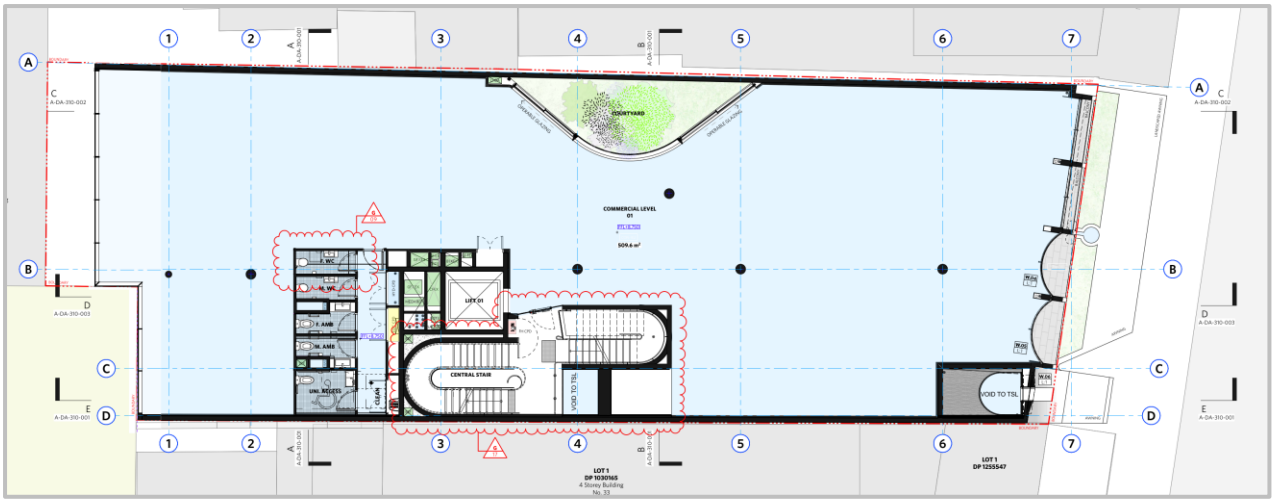
Basement 1 – Floor Plan



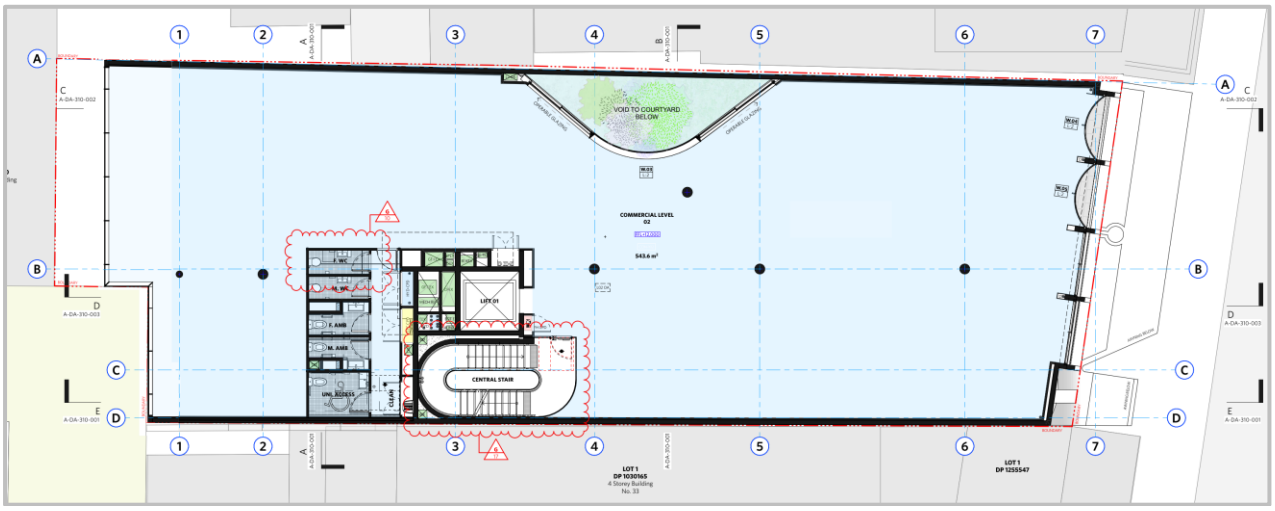
Ground Floor – Floor Plan



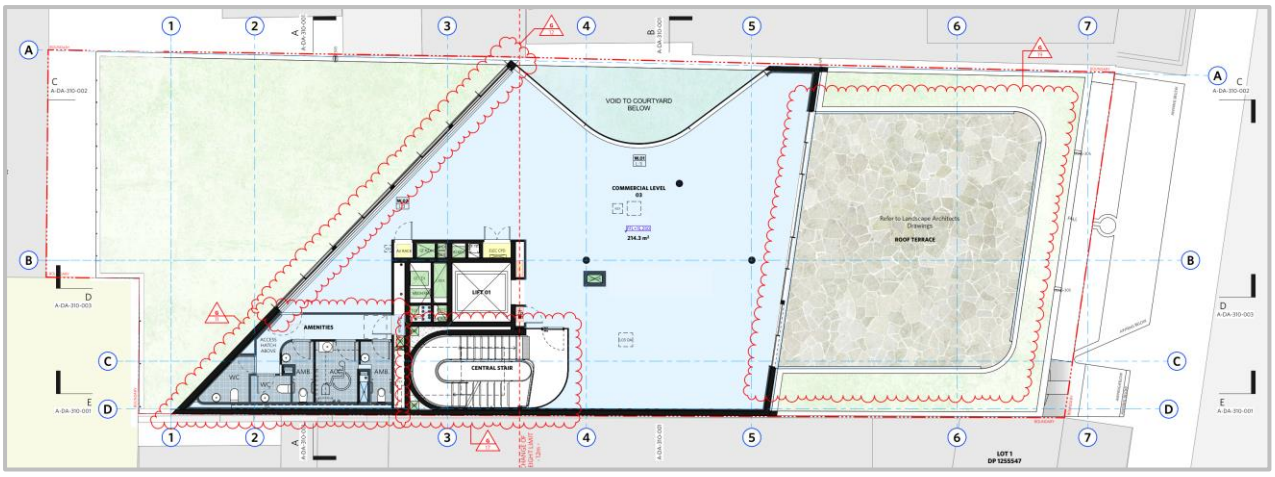
Level 1 – Floor Plan



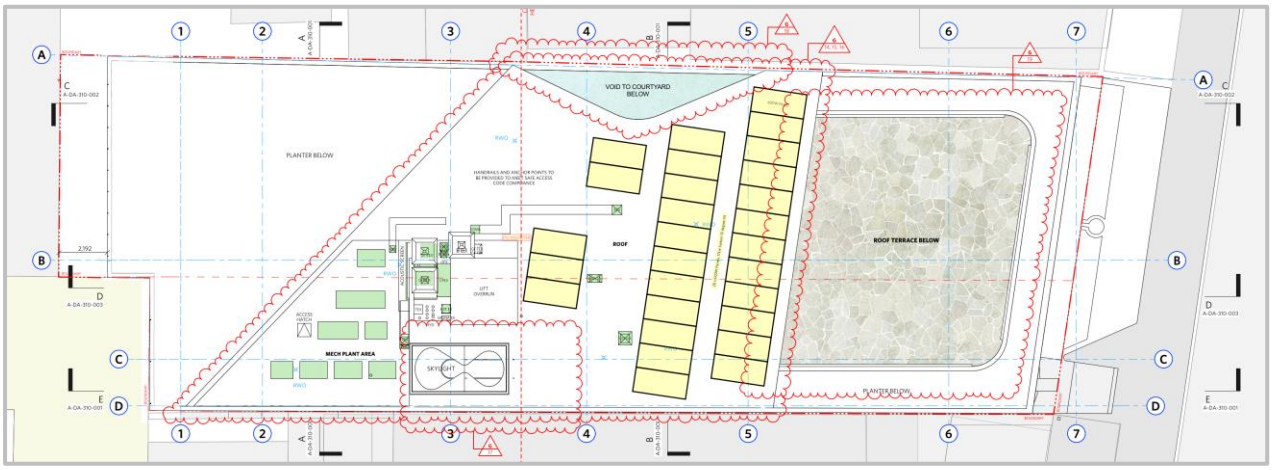
Level 2 – Floor Plan



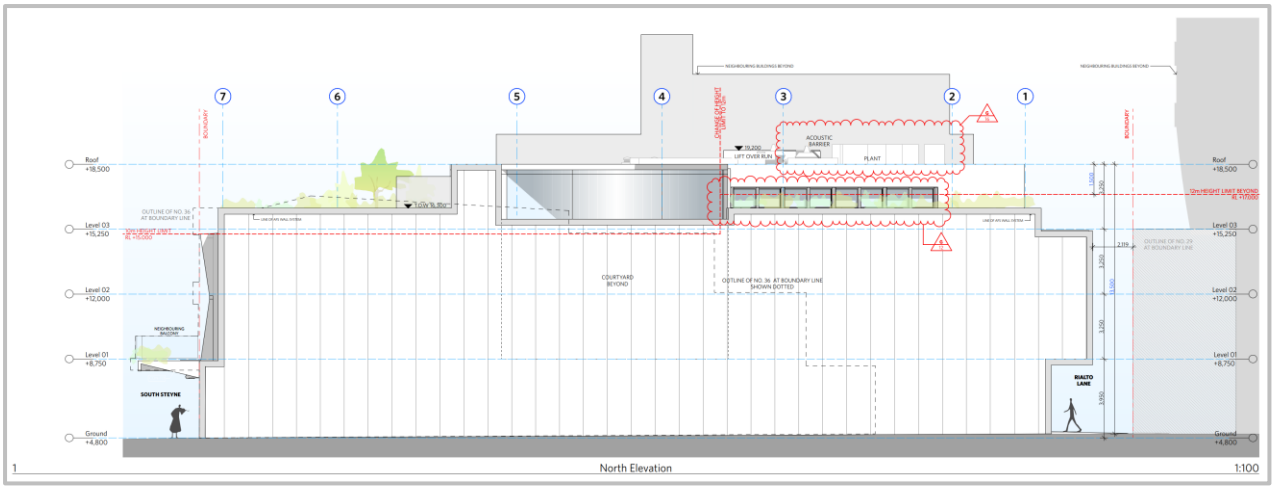
Level 3 – Floor Plan



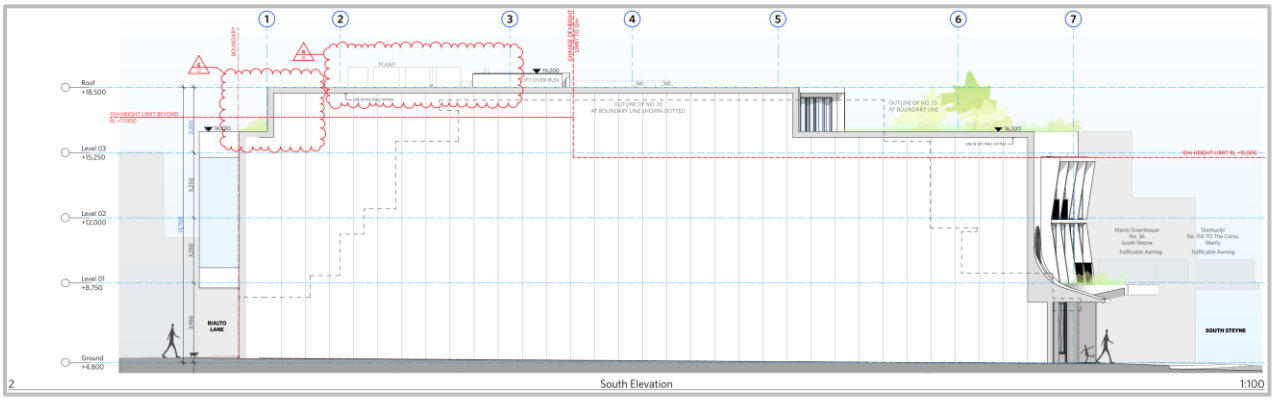
Roof Plan



North Elevation

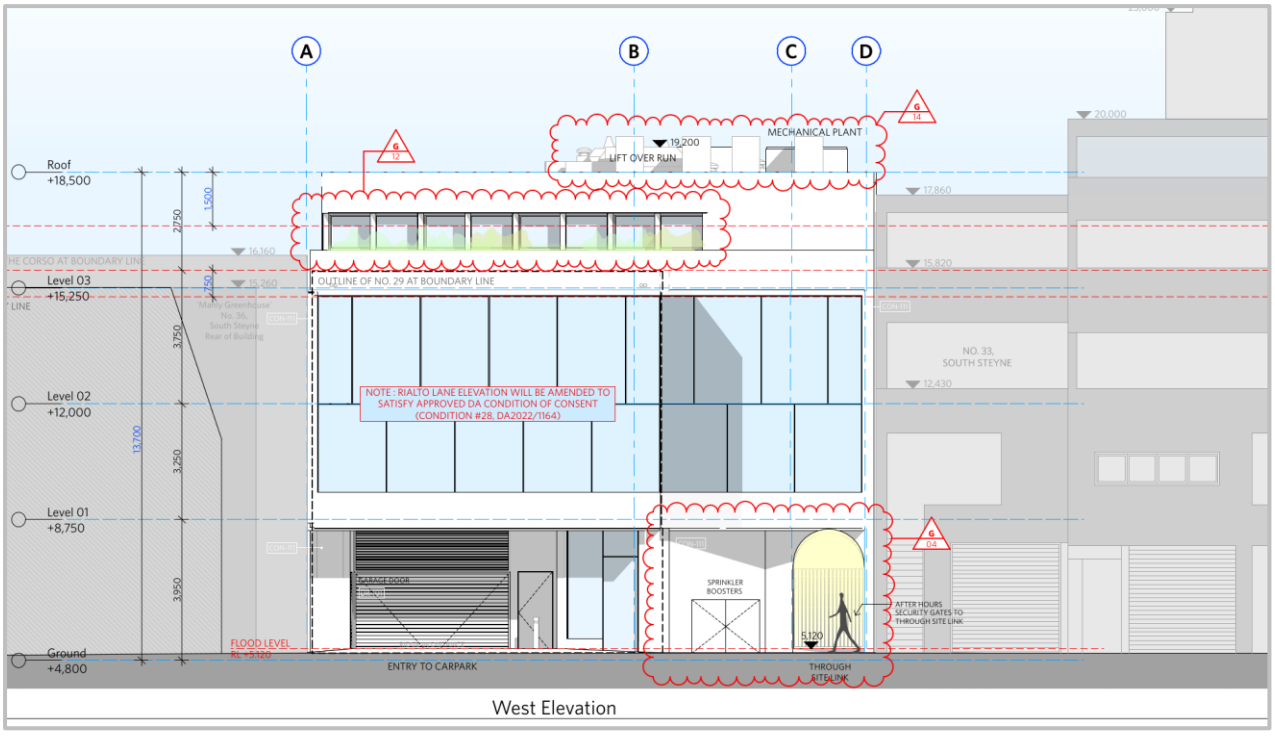


South Elevation



East Elevation

West Elevation



4.3 Scope of Analysis

The scope of this report is based on;

1. Review & interpretation of the architectural drawings to determine the Section J envelope and orientation of the building for assessment.
2. Parts J4 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 J4 DTS analysis (wall-glazing).
    - Input parameters (façade area, external shading devices and glazing dimensions) into the NCC- J1 Calculator (Facade) which is currently available in Beta version only.
3. J1V3 compliance (see Section 6)
    - Conduct energy modelling for a reference building using the DTS results of the Parts J4 assessment and inputs reflecting achievement of minimum performance under the DTS provisions of Parts J5-J9. 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 J1V3 compliance for the building with proposed level of glazing and wall insulation performance.

4.4 Information Used

The assessment within the report presents the requirements of Section J Part J1V3 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 Part J4.

The assessment is based on the following documentation provided.

- A4.55 - 01 Architectural drawings by Durbach block jaggers listed in Table 3.

Table 3. Drawing List.

Drawing Title	Drawing Number
GA – Basement 02	A-DA-110-000
A-DA-110-001	AR-100101
GA – Ground Level	A-DA-110-003
GA – Level 01	A-DA-110-004
GA – Level 02	A-DA-110-005
GA – Level 03	A-DA-110-006
GA – Roof	A-DA-110-007
East + West Elevations	A-DA-210-001
North & South Elevation	A-DA-210-001
Section AA, BB & EE	A-DA-310-001
Section CC	A-DA-310-002
Section DD	A-DA-310-003
GFA & NLA Diagrams, GFA Diagrams Sheet 1	A-DA-710-001

- 3D model (IFC file).
- Glazing Markup provided by Fortis, February 2024.
- NCC 2022 Volume One - Section J.
- Sydney Observatory Hill Typical Meteorological Year (TMY) recorded Weather Data.

4.5 General Modelling Parameters

The parameters presented in Table 4 were applied for both the Reference and the Proposed building models developed for this project.

Table 4. General modelling parameters.

Items	Reference Building	Proposed Building
Climate zone	NCC climate zone 5	Same as Reference Building
Weather data (location and data format)	Sydney Observatory Hill NSW (TMY)	Same as Reference Building
Building Orientation	As per Architectural Drawings	Same as Reference Building
Heating fuel(s)	Electricity	Same as Reference Building
Cooling fuel(s)	Electricity	Same as Reference Building
Infiltration	• 0.7 air changes per hour throughout all zones when there is no mechanically supplied outdoor air; • 0.35 air changes per hour at all other times.	Same as Reference Building

4.6 Space Summary

Modelling parameters for each of the space types included in the building simulation models are described in Table 5.

Table 5. Space summary.

SPACE TYPE	Class 5 Office Areas
Occupancy Profiles	Class 5 profile
Temperature Control Range	21°C to 24°C
Occupant Density m^2/person	10
SPACE TYPE	**Class 6 Areas**
Occupancy Profiles	Class 6 profile
Temperature Control Range	21°C to 24°C
Occupant Density m^2/person	1
SPACE TYPE	**Conditioned Common Areas**
Temperature Control Range	18°C to 25°C
SPACE TYPE	**Unconditioned Common Areas**
Temperature Control Range	-
Occupant Density m^2/person	-

4.7 General Assumptions for Glazing and J1V3 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 the NCC 2022.
- With the exception of Part J4 (outlined in section 7.1 of this report), all other elements of the building design are required to achieve the DTS compliance provisions of NCC 2022 under Section J

4.8 Building Geometry

The proposed development at 34-35 South Steyne, Manly NSW depicted in Figure 3.

Figure 3. Artist Impression of the Building - Credit: Architectural drawings by Durbach block jaggers

The building was modelled as per architectural plans and elevations. Figure 4 provides a representation of various elevations as constructed in the energy simulation model.

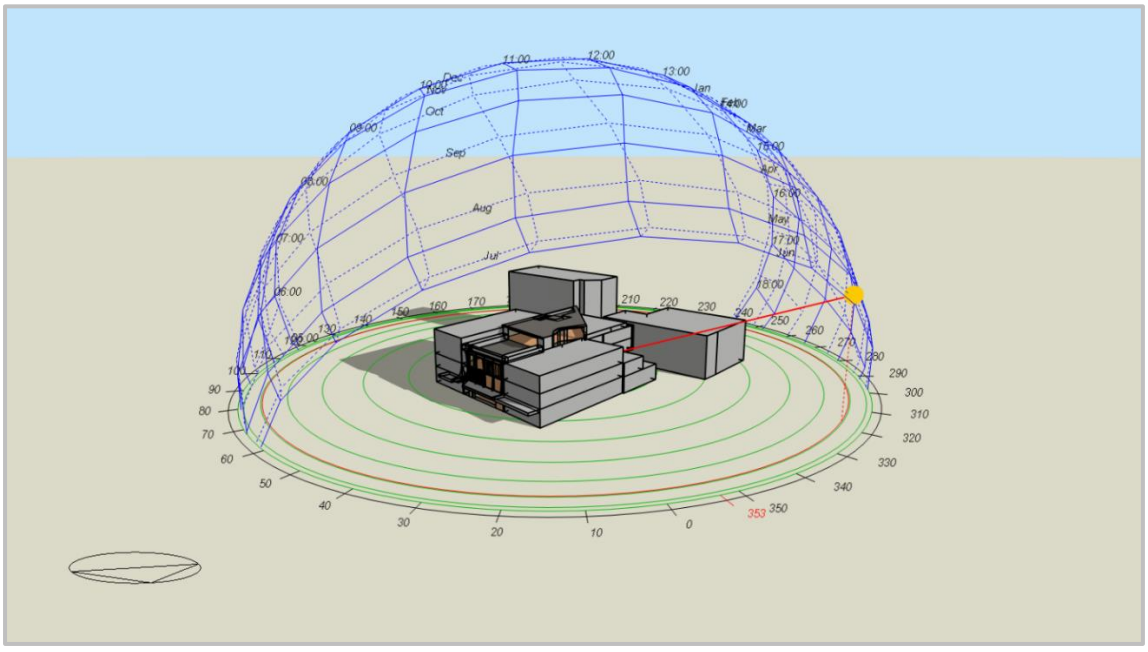


Figure 4. Design Builder Model Geometry – Overall View 1.

5 Energy Modelling

5.1 Process

A Reference Building energy model was generated using the NCC compliant energy simulation software (Design Builder). This model was based on the deemed to satisfy provisions (J3-9) and solar absorbance of 0.6 for external walls. This reference model provided the annual greenhouse gas emissions target for J1P1 verification. This target was measured in kg/annum.
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.

5.2 Computer Simulation

Computer modelling was performed using the Design Builder 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”. Design Builder satisfies this requirement

The Design Builder 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.

This Energy Simulation analysis has been carried out using the Energy Plus energy simulation developed by the USDOE. Energy Plus development is continually tested using industry standard methods as major builds are completed. Three major types of tests are currently conducted:

(a) Analytical tests:

- HVAC tests, based on ASHRAE Research Project 865
- Building fabric tests, based on ASHRAE Research Project 1052

(b) Comparative tests:

- ANSI/ASHRAE Standard 140-2011
- International Energy Agency Solar Heating and Cooling Programme (IEA SHC) BESTEST (Building Energy Simulation Test) methods not yet in Standard 140
- Energy Plus HVAC Component Comparative tests
- Energy Plus Global Heat Balance tests

(c) Release and executable tests

The BESTEST suites compare the results of multiple simulation programs for a series of load-related attributes.

Therefore, the Design Builder simulation suite complies with the ABCB software protocol. The Design Builder graphic user interface (GUI) has been used to develop the complex building geometry with external shading and to access the power of Energy Plus. The energy simulation analysis software description is summarized in Table 6.

Table 6. Energy simulation analysis software description.

Software name and version	Design Builder v7.0.0.082
Software developer	Design Builder Software Ltd / USDOE
Software validation standard	BESTEST

5.3 Modelling Input Data

In accordance with Verification Method J1V3, the following input data were used to calculate the annual energy consumption for the reference and proposed buildings.

5.3.1 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.

Based on the location of the development, the weather data from the closest weather station was used for the simulation of all models (Sydney Observatory Hill NSW, approx. 10.3km from the site). The weather station distance from site is illustrated in Figure 5. Table 7 outlines details of the simulation weather file. The Typical Meteorological Year (TMY) weather file represents a year without unusual extremes in temperature or typical average conditions, suitable for energy simulation modelling.

Table 7. Simulation weather file details.

Weather File Property	**Value**
Location	Sydney Observatory Hill NSW
Weather File Type	The Typical Meteorological Year (TMY)

Figure 5. Weather Station distance from site.

5.3.2 NCC Default Values

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:
(a) General— (i) annual greenhouse gas emissions calculation method; and (ii) greenhouse gas emissions factors (based on Table S34C3); or (iii) location, being either— (A) the location where the building is to be constructed if appropriate climatic data is available; or (B) the nearest location with similar climatic conditions, for which climatic data is available; and (iv) adjacent structures and features; and (v) orientation; and (vi) building form, including— (A) the roof geometry; and (B) the floor plan; and

(C) the number of storeys; and (D) the ground to lowest floor arrangements; and

(E) the size and location of glazing; and

(F) external doors; and

(vii) testing standards including for insulation, glazing, water heater and unitary air-conditioning equipment; and

(b) Fabric and glazing—

(i) quality of insulation installation; and

(ii) thermal resistance of air films including any adjustment factors, moisture content of materials and the like; and

(iii) dimensions of external, internal and separating walls; and

(iv) internal shading devices, their colour and their criteria for operation; and

(c) Services—

(i) range and type of services and energy sources, other than renewable energy generated on site; and

(ii) assumptions and means of calculating the temperature difference across air-conditioning zone boundaries; and

(iii) floor coverings and furniture and fittings density; and

(iv) internal artificial lighting illumination levels; and

(v) internal heat gains including people, lighting, appliances, meals and other electric power loads; and

(vi) air-conditioning system configuration and zones; and

(vii) profiles for occupancy, air-conditioning, lighting and internal heat gains from people, hot meals, appliances, equipment and heated water supply systems based on—

(A) Specification 35; or

(B) NABERS Energy simulation requirements; or

(C) Green Star simulation requirements; or

(D) the actual building if—

(aa) the operating hours per year are not less than 2,500; or

(bb) the daily operating profiles are not listed in Specification 35; and

(viii) supply heated water temperature and rate of use; and

(ix) infiltration values, unless the following have been specified—

(A) additional sealing provisions to those required by Part J5; and

(B) an intended building leakage of less than 10 m^3 /hr.m^2 at 50Pa; and

(C) pressure testing to verify achievement of the intended building leakage,

in which case the intended building leakage at 50Pa may be converted into a whole building infiltration value for the proposed building infiltration using Tables 4.16 to 4.24 of CIBSE Guide A; and

(x) sequencing for water heaters, refrigeration chillers and heat rejection equipment such as cooling towers; and

(xi) representation of clothing and metabolic rate of the occupants; and

(xii) control of air-conditioning except—

(A) the reference building must have variable temperature control for chilled and heated water that modulates the chilled water and heated water temperatures as required to maximise the efficiency of the chiller or boiler operation during periods of low load; and

(B) if the controls for the proposed building are not adequately specified or cannot be simulated, the sample control specifications in Appendix B of AIRAH-DA28 must be used; and

(xiii) 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

(xiv) number, sizes, floors and traffic served by lifts and escalators.

For the modelling of services for the purposes of calculating annual greenhouse gas emissions, for both proposed and reference building:

(a) system demand and response for all items of plant must be calculated on a not less frequent than hourly basis; and

(b) energy usage of all items of plant must be calculated with allowances for—

(i) part load performance; and

(ii) staging to meet system demand; and

(c) energy usage of cooling plant must be calculated with allowances for—

(i) the impact of chilled water temperature on chiller efficiency; and

(ii) the impact of condenser water temperature on water-cooled plant efficiency; and

(iii) the impact of ambient temperature on air-cooled plant efficiency; and

(iv) the energy use of primary pumps serving individual chillers; and

(v) the energy use of auxiliary equipment, including controls and oil heating for chillers; and

(vi) thermal losses in the chilled water system; and

(vii) the impact of chilled water temperature on thermal losses in the chilled water system; and

(d) energy usage of water heating systems for space heating must be calculated with allowances for—

(i) the impact of water temperature on water heater efficiency; and

(ii) the energy use of primary or feedwater pumps serving individual water heaters; and

(iii) thermal losses in water heating systems; and

(iv) the thermal mass of water heating systems, accounting for thermal losses during periods when the system is not operating; and

(e) energy usage of fan and pump systems must be calculated with allowances for—

(i) the method of capacity regulation; and

(ii) the use of either fixed or variable pressure control; and

(f) energy usage of pump systems must be calculated with allowances for the system fixed static pressure head; and

(g) energy usage of auxiliary equipment associated with co-generation and tri-generation systems, including pumps, cooling towers and jacket heaters, must be calculated; and

(h) where the energy usage of the heated water supply for food preparation and sanitary purposes or the energy usage of lifts and escalators is 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; and

(i) energy use of a lift in a building with more than one classification may be apportioned according to the number of storeys of the part for which the annual greenhouse gas emissions and thermal comfort level are being calculated.

5.3.3 Internal heat loads and occupancy density

The internal heat loads applied to both the “reference” and “proposed” models are provided in the Table 8. The occupancy, lighting and equipment loads have been uniformly distributed throughout the building.

Table 8. Load Details.

Item	Details
People Load	• For Dining room, restaurant or café: 80 W sensible heat gain and 80 W latent heat gain. An average adjusted metabolic rate from Table 45 of AIRAH-DA09. A heat emission rate from Table 6.3 of CIBSE Guide A. • For other applications: 75 W sensible heat gain and 55 W latent heat gain. An average adjusted metabolic rate from Table 45 of AIRAH-DA09. A heat emission rate from Table 6.3 of CIBSE Guide A.
Hourly Profile	The schedule is provided in section 5.3.8– based on NCC Specification Table S35C2c, S35C2d and S35C2f.
Internal heat gains for appliances and equipment	Based on NCC Specification Table S35C2l.

5.3.4 Infiltration Rates

The infiltration rates have been included in both the Reference and Proposed models in compliance with Specification 34 of the NCC.

5.3.5 Shading

All external shading has been incorporated in the model based on the provided architectural drawings.

5.3.6 Internal Lighting System

The Reference and proposed buildings have been modelled with Illumination power density in accordance to Table J7D3a of NCC 2022 and listed in Table 9.

Table 9. Internal lighting system.

Space	Illumination Power Density (W/m^2)	
	Reference Building	**Proposed Building**
NCC Class 6	14	Same as Reference Building
NCC Class 5	4.5	Same as Reference Building
Car Park	2.0	Same as Reference Building
WC, EOT	3.0	Same as Reference Building
Corridor	5.0	Same as Reference Building
Lobby	4.5	Same as Reference Building
Plant	4.0	Same as Reference Building
Stairway	2.0	Same as Reference Building
Store	1.5	Same as Reference Building

5.3.7 Ancillary Mechanical Ventilation Fans

The Ancillary Mechanical Ventilation Fans for both Reference and proposed Building models were simulated with the input parameters in accordance with the DTS Requirements of NCC Part J6 and MEPS standard.

The annual energy consumption of ancillary mechanical ventilation fans is summarized in Table 10.

Table 10. Ancillary mechanical ventilation fans.

	Annual energy consumption (kWh)	
	Reference Building	**Proposed Building**
Outdoor Air & Exhaust Fans	6,404	6,404

5.3.8 Schedules of Usage

The internal load schedules used in the model are as per the Specification 35 Modelling profiles provided in NCC Section J. Details of the schedules used are contained in the following tables.

(a) The air-conditioning, must be modelled on the basis of—

(i) the daily occupancy and operation profiles in Tables S35C2a to S35C2k (see the schedules provided in the following table); and

(ii) the internal heat gains in a building—

(A) from occupants and hot meals, in accordance with one of the options in Table S35C2n; and

(B) from appliances and equipment, in accordance with Table S35C2l; and

(C) from artificial lighting, determined in accordance with (b).

(b) The artificial lighting must be modelled on the basis of the proposed level of artificial lighting in the building with the daily profile in Tables S35C2a to S35C2k.

(c) The heated water supply, must be modelled on the basis of the consumption rates of Table S35C2m.

Occupancy and operation profiles

The following table provides the occupancy and operation profiles used for modelling runs in accordance with NCC Section J - Table S35C2c: Weekday occupancy and operation profiles of a Class 5 areas.

Time period	Occupancy	Artificial lighting	Appliances and equipment	Air-conditioning
	(Monday to Friday)	(Monday to Friday)	(Monday to Friday)	(Monday to Friday)
12:00am to 1:00am	0%	15%	25%	Off
1:00am to 2:00am	0%	15%	25%	Off
2:00am to 3:00am	0%	15%	25%	Off
3:00am to 4:00am	0%	15%	25%	Off
4:00am to 5:00am	0%	15%	25%	Off
5:00am to 6:00am	0%	15%	25%	Off
6:00am to 7:00am	0%	15%	25%	Off
7:00am to 8:00am	10%	40%	65%	On
8:00am to 9:00am	20%	90%	80%	On
9:00am to 10:00am	70%	100%	100%	On
10:00am to 11:00am	70%	100%	100%	On
11:00am to 12:00pm	70%	100%	100%	On
12:00pm to 1:00pm	70%	100%	100%	On
1:00pm to 2:00pm	70%	100%	100%	On
2:00pm to 3:00pm	70%	100%	100%	On
3:00pm to 4:00pm	70%	100%	100%	On
4:00pm to 5:00pm	70%	100%	100%	On
5:00pm to 6:00pm	35%	80%	80%	On
6:00pm to 7:00pm	10%	60%	65%	Off
7:00pm to 8:00pm	5%	60%	55%	Off
8:00pm to 9:00pm	5%	50%	25%	Off
9:00pm to 10:00pm	0%	15%	25%	Off
10:00pm to 11:00pm	0%	15%	25%	Off
11:00pm to 12:00am	0%	15%	25%	Off

Note:

1. The occupancy profile is expressed as a percentage of the maximum number of people that can be accommodated in the building.
2. The artificial lighting profile is expressed as a percentage of the maximum illumination power density permitted under NCC Part J7.
3. The appliances and equipment profile are expressed as a percentage of the maximum internal heat gain in NCC Section - Table S35C2l.
4. The air-conditioning profile is expressed as the plant status.

The following table provides the occupancy and operation profiles used for modelling runs in accordance with NCC Section J - Table S35C2d: Weekend occupancy and operation profiles of a Class 5 areas.

Time period	Occupancy (Saturday, Sunday and holidays)	Artificial lighting (Saturday, Sunday and holidays)	Appliances and equipment (Saturday, Sunday and holidays)	Air-conditioning (Saturday, Sunday and holidays)
12:00am to 1:00am	0%	15%	25%	Off
1:00am to 2:00am	0%	15%	25%	Off
2:00am to 3:00am	0%	15%	25%	Off
3:00am to 4:00am	0%	15%	25%	Off
4:00am to 5:00am	0%	15%	25%	Off
5:00am to 6:00am	0%	15%	25%	Off
6:00am to 7:00am	0%	15%	25%	Off
7:00am to 8:00am	0%	15%	25%	Off
8:00am to 9:00am	5%	25%	25%	Off
9:00am to 10:00am	5%	25%	25%	Off
10:00am to 11:00am	5%	25%	25%	Off
11:00am to 12:00pm	5%	25%	25%	Off
12:00pm to 1:00pm	5%	25%	25%	Off
1:00pm to 2:00pm	5%	25%	25%	Off
2:00pm to 3:00pm	5%	25%	25%	Off
3:00pm to 4:00pm	5%	25%	25%	Off
4:00pm to 5:00pm	5%	25%	25%	Off
5:00pm to 6:00pm	0%	15%	25%	Off
6:00pm to 7:00pm	0%	15%	25%	Off
7:00pm to 8:00pm	0%	15%	25%	Off
8:00pm to 9:00pm	0%	15%	25%	Off
9:00pm to 10:00pm	0%	15%	25%	Off
10:00pm to 11:00pm	0%	15%	25%	Off
11:00pm to 12:00am	0%	15%	25%	Off

Note:

1. The occupancy profile is expressed as a percentage of the maximum number of people that can be accommodated in the building.
2. The artificial lighting profile is expressed as a percentage of the maximum illumination power density permitted under Part J7.
3. The appliances and equipment profile are expressed as a percentage of the maximum internal heat gain in Table S35C2l. The air-conditioning profile is expressed as the plant status.

The following table provides the occupancy and operation profiles used for modelling runs in accordance with Table S35C2f Occupancy and operation profiles of Class 6 restaurant or café.

Time period	Occupancy (Monday to Saturday)	Artificial lighting (Monday to Saturday)	Appliances and equipment (Monday to Saturday)	Air-conditioning (Monday to Saturday)
12:00am to 1:00am	0%	5%	15%	Off
1:00am to 2:00am	0%	5%	15%	Off
2:00am to 3:00am	0%	5%	15%	Off
3:00am to 4:00am	0%	5%	15%	Off
4:00am to 5:00am	0%	5%	15%	Off
5:00am to 6:00am	0%	5%	15%	Off
6:00am to 7:00am	5%	40%	40%	Off
7:00am to 8:00am	5%	40%	40%	On
8:00am to 9:00am	5%	60%	60%	On
9:00am to 10:00am	5%	60%	60%	On
10:00am to 11:00am	20%	90%	90%	On
11:00am to 12:00pm	50%	90%	90%	On
12:00pm to 1:00pm	80%	90%	90%	On
1:00pm to 2:00pm	70%	90%	90%	On
2:00pm to 3:00pm	40%	90%	90%	On
3:00pm to 4:00pm	20%	90%	90%	On
4:00pm to 5:00pm	25%	90%	90%	On
5:00pm to 6:00pm	50%	90%	90%	On
6:00pm to 7:00pm	80%	90%	90%	On
7:00pm to 8:00pm	80%	90%	90%	On
8:00pm to 9:00pm	80%	90%	90%	On
9:00pm to 10:00pm	50%	90%	90%	On
10:00pm to 11:00pm	35%	50%	50%	On
11:00pm to 12:00am	20%	30%	30%	On

Note:

1. The occupancy profile is expressed as a percentage of the maximum number of people that can be accommodated in the building.
2. The artificial lighting profile is expressed as a percentage of the maximum illumination power density permitted under Part J7.
3. The appliances and equipment profile are expressed as a percentage of the maximum internal heat gain in Table S35C2I. The air-conditioning profile is expressed as the plant status.
4. Sunday profile is 5% continuous artificial lighting and 5% continuous appliances and equipment. There is no occupancy and the air-conditioning is “off”.

5.4 Air Conditioning Simulation

The HVAC systems for both the Proposed Building and Reference Building models were simulated in Design Builder software package. In compliance with NCC J1V3, the following temperature bands were adopted for 98% of the plant operation time.

- 18°CDB to 25°CDB for conditioned spaces with transitory occupancy; and
- 21°CDB to 24°CDB in all other conditioned spaces

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 J6. The design heating and cooling COPs is set at 2.9 for Proposed Building HVAC system. Figure 6 and Figure 7 demonstrate the HVAC detail applied to the models.

The HVAC systems were simulated based on a selected set of monthly design day temperatures and coincident wet bulb temperatures. The part load performance curves adjust the efficiency of the system based on the capacity, as well as the supply air and environmental conditions.

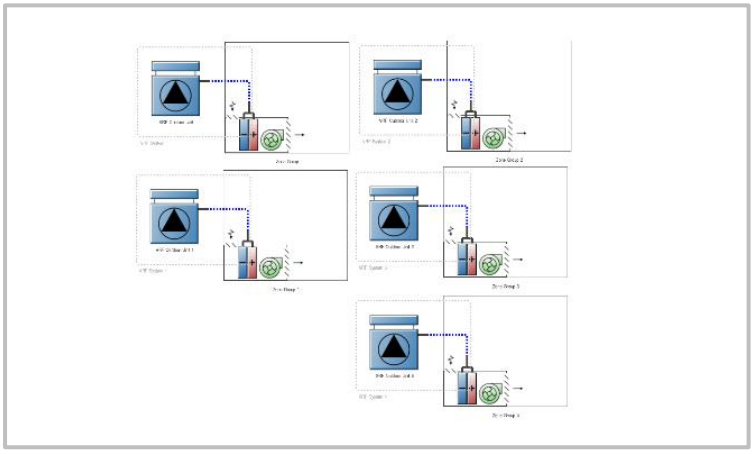


Figure 6. Detailed HVAC system modelled.

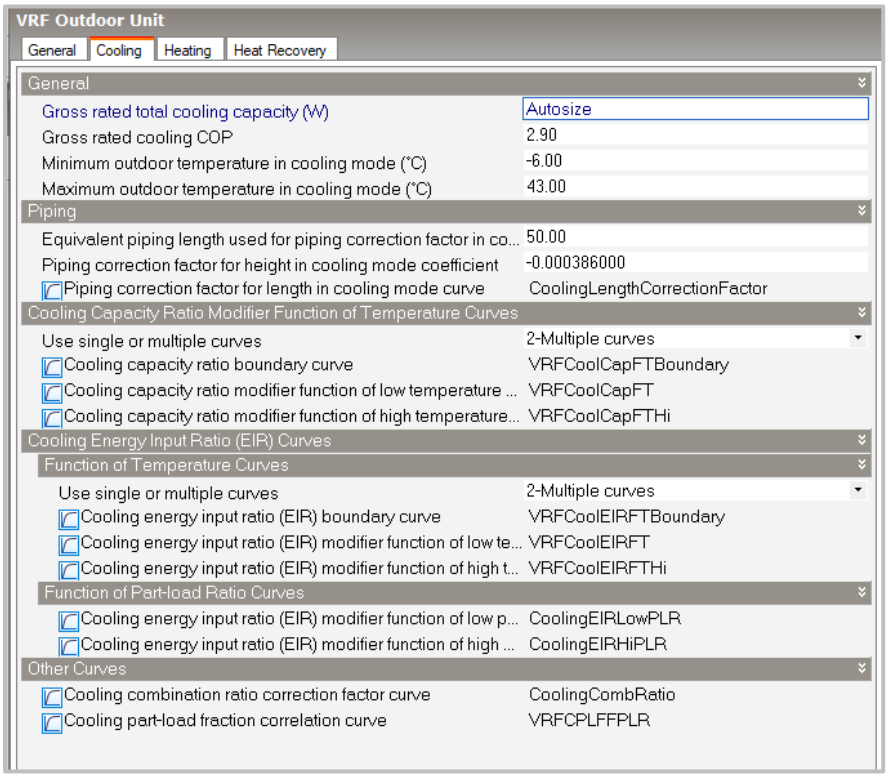


Figure 7. Sample of input data for detailed HVAC modelling – outdoor units - Sample.

5.5 Greenhouse gas emissions factors

The annual greenhouse gas emissions for the proposed building and the reference building have been calculated using the greenhouse gas emissions factors (kg CO_2-e/GJ) listed in Table 11.

Table 11. Greenhouse gas emissions factors.

Energy Source	GHG emissions factors ($kgCO_2$-e/GJ)
Electricity	236

5.6 Onsite Energy Generation

J1V3 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.

5.6.1 Solar PV

The Photovoltaic (PV) system may consist of the following main components or of equal capacity detailed in Table 12.

Total nominal power: 15 kW

Approx. roof space requirements: 94 m^2

Table 12. Main components of photovoltaic (PV) system.

Components	Brand, Model & Quantity
Sample PV Inverter	Sungrow 15 kW - Quantity: 1
Sample PV Panels	Trina Vertex 600 W - TSM-DEG20C.20 Quantity: 25
PV mounting frame and system balance	Quantity: depending on the requirements and final design

The exact sizing, configuration and final design will be completed during the final design stage.

5.6.1.1 Solar PV – Projected Energy Generation for a 15-kW System

Grid system presizing

Geographical Site	**Sydney Intl Airport**		Country	**Australia**
Situation	Latitude	-33.95° S	Longitude	151.18° E
Time defined as	Legal Time	Time zone UT+10	Altitude	3 m
Collector Plane Orientation	Tilt	10°	Azimuth	0°

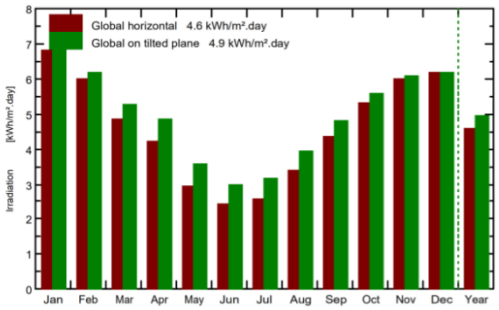
PV-field installation main features

Module type	Standard
Technology	Monocrystalline cells
Mounting method	Facade or tilt roof
Back ventilation properties	Ventilated

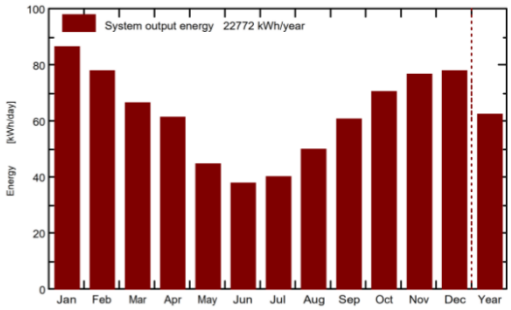
System characteristics and pre-sizing evaluation

PV-field nominal power (STC)	Pnom	15.0 kWp
Collector area	Acoll	94 m²

Meteo and incident energy



System output



	Gl. horiz. kWh/m².day	Coll. Plane kWh/m².day	System output kWh/day	System output kWh
Jan.	6.84	6.87	86.54	2683
Feb.	5.98	6.18	77.94	2182
Mar.	4.87	5.26	66.26	2054
Apr.	4.22	4.85	61.15	1835
May	2.93	3.56	44.88	1391
June	2.41	3.00	37.76	1133
July	2.58	3.18	40.07	1242
Aug.	3.40	3.95	49.82	1544
Sep.	4.37	4.81	60.61	1818
Oct.	5.32	5.58	70.37	2182
Nov.	5.99	6.07	76.54	2296
Dec.	6.20	6.17	77.79	2412
Year	4.58	4.95	62.39	22772

5.7 Modelling for Compliance

5.7.1 Compliance Modelling Case 1 – Reference Building with DTS Services

5.7.1.1 Inputs

Building Fabric: The building fabric was modelled based on the minimum Deemed to Satisfy (DTS) provisions outlined in the NCC Part J4 for building fabric summarised in Table 13.

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

Table 13 further outlines the DTS building fabric thermal performance and services used within the simulation model 1 (reference case).

Table 13. Modelling Case 1 - Reference Building with DTS Services.

Items (Where separating conditioned and non-conditioned zones)		**Reference Building Case (Model 1)**
J4 (DTS)	**Roof / Ceiling**	Total thermal insulation: R3.7 The solar absorptance of the upper surface of a roof must be not more than 0.45.

	Walls &Glazing	• Total System U-Value of wall-glazing construction ≤ U2.0;
		• Total System R-Value of wall components of the wall-glazing construction:
		  ○ Where the wall is less than 80% of the area of the wall-glazing construction ≥R1.0;
		  ○ Where the wall is 80% or more of the area of the wall-glazing construction ≥R1.4.
		• Maximum wall-glazing construction solar admittance: 0.13,
		Process:
		As expected, the "Proposed" glazing and insulation did not meet the NCC part J4 'deemed to satisfy' calculators. Specification of the DTS external glazing and insulation were refined to be as close as possible to 100% to ensure the highest possible energy consumption figure was achieved for the reference building.

	Floors	Minimum total insulation R-Value: R2.0
J5-9 (DTS)	**Building Services**	Set at the minimum NCC 2022 DTS requirements.
Other	**Solar Absorptance:**	Solar absorptance of 0.6 for external walls, in accordance with J1V3.

5.7.1.2 Results

The estimated emission for the Reference Building with DTS services is 135,322 kg p.a.

5.7.2 Compliance Modelling Case 2 – Proposed Building with DTS Services

5.7.2.1 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:

- J4 – Building Fabric: modelling is based on the proposed glazing and insulation performance specification provided in Table 14 and summarised in section 7.1 of the report);

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

Table 14 outlines the performance inputs applied to the simulation model 2 (proposed building with DTS services).

Table 14. Modelling Case 2 - Proposed Building with DTS Services.

Items (Where separating conditioned and non-conditioned zones)		**Proposed Building Case (Model 2)**
J4 (Proposed)	**Roof / Ceiling**	Total thermal insulation: R3.7 The solar absorptance of the upper surface of a roof must be not more than 0.45.
	Walls	External Walls: minimum total R1.5 thermal insulation. Internal Walls: minimum total R1.0 thermal insulation.
	Glazing (addressed through J1V3)	Large/Sliding Doors, Double glazed, clear low-e coating: • Total system U-value ≤3.2; • Total system SHGC ≤0.35. Curved glass with straight glass to match, Double glazed, no low-e coating: • Total system U-value ≤4.2; • Total system SHGC ≤0.75. Curved glass, Double glazed, no low-e coating: • Total system U-value ≤4.2; • Total system SHGC ≤0.75. Doors, Single glazed, clear low-e coating: • Total system U-value ≤5.5; • Total system SHGC ≤0.55. Windows, Double glazed, clear low-e coating: • Total system U-value ≤3.2; • Total system SHGC ≤0.35. Curtain Wall glass, Double glazed, low-e coating: • Total system U-value ≤2.8; • Total system SHGC ≤0.35.
	Floors	Suspended Floors (where any): total R-Value: R2.0 Concrete Slab on Ground: no added insulation required.
J5-9 (DTS)	**Building Services**	As required by NCC J1V3 method: Set at the minimum of NCC 2022 DTS requirements (Similar to Case 1-Reference Building)
Other requirements	• Building services: minimum DTS performance or better • Thermal comfort level of between a Predicted Mean Vote of -1 to +1 across not less than 95% of the floor area of all occupied zones for not less than 98% of the annual hours of operation of the building. • Minimum Solar PV capacity of 15 kW (Energy to be used on site)	

5.7.2.2 Results

The estimated emission for the Proposed Building with DTS services is 134,463 kg p.a.

5.7.3 Compliance Modelling Case 3 – Proposed Building with Proposed Services

5.7.3.1 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:

- J4 – Building Fabric: modelling is based on the proposed glazing and insulation performance specification provided in Table 15 and summarised in section 7.1 of the report);

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.

Table 15 outlines the performance inputs applied to the simulation model 3 (proposed building with proposed services).

Table 15. Modelling Case 3 - Proposed Building with Proposed Services.

Items (Where separating conditioned and non-conditioned zones)		**Proposed Building Case (Model 3)**
J4 (Proposed)	**Roof / Ceiling**	Total thermal insulation: R3.7 The solar absorptance of the upper surface of a roof must be not more than 0.45.
	Walls	External Walls: minimum total R1.5 thermal insulation. Internal Walls: minimum total R1.0 thermal insulation.
	Glazing (addressed through J1V3)	Large/Sliding Doors, Double glazed, clear low-e coating: • Total system U-value ≤3.2; • Total system SHGC ≤0.35. Curved glass with straight glass to match, Double glazed, no low-e coating: • Total system U-value ≤4.2; • Total system SHGC ≤0.75. Curved glass, Double glazed, no low-e coating: • Total system U-value ≤4.2; • Total system SHGC ≤0.75. Doors, Single glazed, clear low-e coating: • Total system U-value ≤5.5; • Total system SHGC ≤0.55. Windows, Double glazed, clear low-e coating: • Total system U-value ≤3.2; • Total system SHGC ≤0.35. Curtain Wall glass, Double glazed, low-e coating: • Total system U-value ≤2.8; • Total system SHGC ≤0.35.
	Floors	• Suspended Floors (where any): total R-Value: R2.0 • Concrete Slab on Ground: no added insulation required.
J5-9 (DTS)	**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 the same.
Other requirements	• Building services: minimum DTS performance or better • Thermal comfort level of between a Predicted Mean Vote of -1 to +1 across not less than 95% of the floor area of all occupied zones for not less than 98% of the annual hours of operation of the building. • Minimum Solar PV capacity of 15 kW (Energy to be used on site)	

5.7.3.2 Results

The estimated emission for the Proposed Building with Proposed services is 134,463 kg p.a.

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 (134,463 kg/annum).

6 Summary of the Simulation Results and Conclusion

Table 16 summarises the total annual energy consumption for the simulation cases of the development.

Table 16. Result Summary.

	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] *	Compliance Achieved
Annual greenhouse gas emissions	135,322 kg p.a.	134,463 kg p.a.	134,463 kg p.a.	YES

***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 (134,463 kg/annum).*

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 135,322 kg/annum.

The annual energy consumption of the proposed building with the DTS services (modelling case 2) is calculated at 134,463 kg/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 (134,463 kg/annum).

The Proposed Building therefore meets the criteria of J1V3 (a) (i) & (ii), for Verification Method J1V3 as 134,463 kg/annum is less than the 135,322 kg/annum estimated for the Reference Case.

The proposed insulation and glazing system for compliance are therefore compliant with the performance requirement of NCC 2022 Section J.

7 Summary of the Section J Requirements

7.1 Part J 4 – Building Fabric Requirements

7.1.1 Overview

Section J part J4 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 in Table 17.

Table 17. The required thermal insulation requirements.

Envelope (separating conditioned and un-conditioned zones)	**Minimum Insulation & Glazing Requirements**
Roof / Ceiling	Total thermal insulation: R3.7 The solar absorptance of the upper surface of a roof must be not more than 0.45.
Walls	External Walls: minimum total R1.5 thermal insulation. Internal Walls: minimum total R1.0 thermal insulation.
Glazing (addressed through J1V3)	Large/Sliding Doors, Double glazed, clear low-e coating: • Total system U-value ≤3.2; • Total system SHGC ≤0.35. Curved glass with straight glass to match, Double glazed, no low-e coating: • Total system U-value ≤4.2; • Total system SHGC ≤0.75. Curved glass, Double glazed, no low-e coating: • Total system U-value ≤4.2; • Total system SHGC ≤0.75. Doors, Single glazed, clear low-e coating: • Total system U-value ≤5.5; • Total system SHGC ≤0.55. Windows, Double glazed, clear low-e coating: • Total system U-value ≤3.2; • Total system SHGC ≤0.35. Curtain Wall glass, Double glazed, low-e coating: • Total system U-value ≤2.8; • Total system SHGC ≤0.35.
Floors	Suspended Floors (where any): total R-Value: R2.0 Concrete Slab on Ground: no added insulation required.

7.1.2 Part J4D2 – Application

The Deemed-to-Satisfy Provisions of this Part apply to building elements forming the envelope of a Class 2 to 9 building other than J4D3(5), J4D4, J4D5, J4D6 and J4D7 which do not apply to a Class 2 sole-occupancy unit or a Class 4 part of a building. Part J4 is therefore applicable to the upgrade works.

7.1.3 J4D3 Thermal Construction - General

(1) Where required, insulation must comply with AS/NZS 4859.1 and be installed so that it—

(a) abuts or overlaps adjoining insulation other than at supporting members such as studs, noggings, joists, furring channels and the like where the insulation must be against the member; and

(b) forms a continuous barrier with ceilings, walls, bulkheads, floors or the like that inherently

contribute to the thermal barrier; and

(c) does not affect the safe or effective operation of a service or fitting.

(2) Where required, reflective insulation must be installed with—

(a) the necessary airspace to achieve the required R-Value between a reflective side of the reflective insulation and a building lining or cladding; and

(b) the reflective insulation closely fitted against any penetration, door or window opening; and

(c) the reflective insulation adequately supported by framing members; and

(d) each adjoining sheet of roll membrane being—

(i) overlapped not less than 50 mm; or

(ii) taped together.

(3) Where required, bulk insulation must be installed so that—

(a) it maintains its position and thickness, other than where it is compressed between the cladding and supporting members, water pipes, electrical cabling or the like; and

(b) in a ceiling, where there is no bulk insulation or reflective insulation in the wall beneath, it overlaps the wall by not less than 50 mm.

(4) Roof, ceiling, wall and floor materials, and associated surfaces are deemed to have the thermal properties listed in Specification 36.

(5) The required Total R-Value and Total System U-Value, including allowance for thermal bridging, must be:

(a) calculated in accordance with AS/NZS 4859.2 for a roof or floor; or

(b) determined in accordance with Specification 37 for wall-glazing construction; or

(c) determined in accordance with Specification 39 or Section 3.5 of CIBSE Guide A for soil or sub-floor spaces.

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. All works need to comply with the minimum Section J Part J4 requirements, Thermal bridging must be accounted for in accordance with J4D3 (5) and is the responsibility of the builder or the architect to obtain a construction build-up calculation from their insulation supplier.

7.1.4 J4D4 Roof and Ceiling Construction

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 R3.7 thermal insulation.

The solar absorptance of the upper surface of a roof must be not more than 0.45.

7.1.5 J4D5 Roof Lights

Based on the architectural drawings roof lights are not proposed for the development conditioned areas, Part J4D5 is therefore not applicable to this development.

Under any other design conditions, the roof light must meet the criteria detailed in Table J4D5 of NCC presented in

Table 18

Table 18. Roof Lights – Thermal Performance of transparent and translucent elements

Roof light shaft index	Total area of roof lights up to 3.5% of the floor area of the room or space	Total area of roof lights more than 3.5% and up to 5% of the floor area of the room or space
< 1.0	≤ 0.45	≤ 0.29
≥ 1.0 to < 2.5	≤ 0.51	≤ 0.33
≥ 2.5	≤ 0.76	≤ 0.49

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) Roof lights must have—
  (a) a total area of not more than 5% of the floor area of the room or space served; and
  (b) transparent and translucent elements, including any imperforate ceiling diffuser, with a combined performance of—
    (i). for Total system SHGC, in accordance with Table J4D5; and
    (ii). for Total system U-Value, not more than U3.9.
(3) 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 (or the diameter for a circular shaft) in the same units of measurement.
(4) The area of a roof light is the area of the roof opening that allows light to enter the building.
(5) The total area of roof lights is the combined area for all roof lights serving the room or space.
(6) 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.

7.1.6 J4D6 Walls and Glazing (addressed through J1V3)

For wall and glazing constructions that form part of the building envelope of the conditioned space, NCC Section J Compliance shall be achieved as follows: J4D6 Walls and Glazing. The requirements of walls and glazing thermal properties are listed in Table 19.

Table 19. Walls and Glazing.

Walls	External Walls: minimum total R1.5 thermal insulation. Internal Walls: minimum total R1.0 thermal insulation.
Glazing	Large/Sliding Doors, Double glazed, clear low-e coating: • Total system U-value ≤3.2; • Total system SHGC ≤0.35. Curved glass with straight glass to match, Double glazed, no low-e coating: • Total system U-value ≤4.2; • Total system SHGC ≤0.75. Curved glass, Double glazed, no low-e coating: • Total system U-value ≤4.2; • Total system SHGC ≤0.75. Doors, Single glazed, clear low-e coating: • Total system U-value ≤5.5; • Total system SHGC ≤0.55. Windows, Double glazed, clear low-e coating: • Total system U-value ≤3.2; • Total system SHGC ≤0.35. Curtain Wall glass, Double glazed, low-e coating:

	• Total system U-value ≤2.8; • Total system SHGC ≤0.35.

7.1.7 J4D7 Floors

For floors without in-slab heating or cooling system:

- There are no requirements for floor insulation for the floors which are concrete slab on ground (assuming the wall thickness is 250mm or higher).
- NCC compliance shall be achieved with a minimum total thermal insulation of R2.0 for any suspended floors separating a conditioned space from a non-conditioned space.

7.2 Part J5 – Building Sealing

Part J5 of the NCC 2022 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 J5 is applicable to the development.

Clause J5D3 refers to chimneys and flues. The chimney or flue of an open solid-fuel burning appliance must be provided with a damper or flap that can be closed to seal the chimney or flue.

Clause J5D4 refers to roof lights.

Clause J5D5 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, a fire door or smoke door; or a roller shutter door, roller shutter grille or other security door or device installed only for out-of-hours security.

A seal to restrict air infiltration—

(a) for the bottom edge of a door, must be a draft protection device; and

(b) for the other edges of a door or the edges of an openable window or other such opening, may be a foam or rubber compression strip, fibrous seal or the like.

An entrance to a building, if leading to a conditioned space must have an airlock, self-closing door, rapid roller door,

revolving door or the like, other than—

(a) where the conditioned space has a floor area of not more than 50 m^2; or

(b) where a café, restaurant, open front shop or the like has—

(i) a 3 m deep un-conditioned zone between the main entrance, including an open front, and the conditioned space; and

(ii) at all other entrances to the café, restaurant, open front shop, or the like, self-closing doors.

A loading dock entrance, if leading to a conditioned space, must be fitted with a rapid roller door or the like.

Clause J5D6 is related to exhaust fans. An exhaust fan must be fitted with a sealing device such as a self-closing damper or the like when serving—

(a) a conditioned space; or

(b) a habitable room in climate zones 4, 5, 6, 7 or 8.

Clause J5D7 is related to construction of ceilings, walls, and floors.

(1) Ceilings, walls, floors, and any opening such as a window frame, door frame, roof light frame or the like must be constructed to minimise air leakage in accordance with (2) when forming part of—

(a) the envelope; or

(b) in climate zones 4, 5, 6, 7 or 8.

(2) Construction required by (1) must be—

(a) enclosed by internal lining systems that are close fitting at ceiling, wall, and floor junctions; or

(b) sealed at junctions and penetrations with—

(i) close fitting architrave, skirting or cornice; or

(ii) expanding foam, rubber compressible strip, caulking or the like.

(3) The requirements of (1) do not apply to openings, grilles or the like required for smoke hazard management.

Clause J5D8 is related to evaporative coolers. An evaporative cooler must be fitted with a self-closing damper or the like—

(a) when serving a heated space; or

(b) in climate zones 4, 5, 6, 7 or 8.

Note:

We understand that louvre windows, bifold doors or other building elements causing infiltration may be installed in the development. It is essential that the zones served by such elements comply with the minimum Part J5 requirements through installation of reed switch technology, appropriate AC control mechanisms, and/or other methods to comply with Part J5 requirements.

7.3 Part J6 – Air Conditioning and Ventilation Systems

Part J6 of the NCC outlines the performance requirements for air conditioning and ventilation systems to ensure these services operate in an efficient manner.

Furthermore, in compliance with the J1V3 method, the proposed building is required to achieve a thermal comfort level of between a Predicted Mean Vote of -1 to +1 across not less than 95% of the floor area of all occupied zones for not less than 98% of the annual hours of operation of the building.

All services consultants and contractors shall design the air conditioning and ventilation systems to ensure compliance with the PMV requirements noted above, Part J6 of the NCC Section J and all subsections associated therein.

7.4 Part J7 – Artificial Lighting and Power

Part J7 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 J7 of the NCC Section J and all subsections associated therein with regard to power.

7.5 Part J8 – Hot Water Supply

Part J8 of the NCC outlines the provisions for the energy efficient use of hot water supply systems.

Clause J8D2 of Part J8 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 J8 of the NCC Section J and all subsections associated therein.

7.6 Part J9 – Facilities for Energy Monitoring and on-site distributed energy resources

Part J9 is applicable to this development.

7.6.1 J9D3 Facilities for energy monitoring

Part J9D3 of the NCC outlines the provisions of facilities for energy monitoring. Facilities for energy monitoring shall be provided in accordance with Part J9D3 of the NCC.

(1) A building or sole-occupancy unit with a floor area of more than 500 m^2 must have the facility to record the time-of-use consumption of gas and electricity.

(2) A building with a floor area of more than 2,500 m^2 must have energy meters configured to enable individual time-of-use energy data recording, in accordance with (3), of—
  (a) air-conditioning plant including, where appropriate, heating plant, cooling plant and air handling fans; and
  (b) artificial lighting; and
  (c) appliance power; and
  (d) central hot water supply; and
  (e) internal transport devices including lifts, escalators, and travelators where there is more than one serving the building; and
  (f) on-site renewable energy equipment; and
  (g) on-site electric vehicle charging equipment; and
  (h) on-site battery systems; and
  (i) other ancillary plant.

(3) Energy meters required by (2) must be interlinked by a communication system that collates the time-of-use energy data to a single interface monitoring system where it can be stored, analysed, and reviewed.

(4) The provisions of (2) do not apply to energy meters serving—
  (a) a Class 2 building where the total floor area of the common areas is less than 500 m^2; or
  (b) individual sole-occupancy units with a floor area of less than 2,500 m^2.

All services consultants and contractors shall design for access for maintenance and facilities for monitoring to ensure compliance with Part J9 of the NCC Section J and all subsections associated therein.

7.6.2 J9D4 Facilities for electric vehicle charging equipment

Part J9D4 of the NCC outlines the provisions of Facilities for electric vehicle charging equipment. Facilities for electric vehicle charging shall be provided in accordance to Part J9 of the NCC.

(1) Subject to (2), a carpark associated with a Class 2, 3, 5, 6, 7b, 8 or 9 building must be provided with electrical distribution boards dedicated to electric vehicle charging—
  (a) in accordance with Table J9D4 (Table 20 of this report) in each storey of the carpark; and
  (b) labelled to indicate use for electric vehicle charging equipment.

Table 20. Electric vehicle distribution board requirement for each storey of a carpark.

Carpark spaces per storey for electric vehicles	Electrical distribution boards for electric vehicle charging per storey
0-9	0
10-24	1
25-48	2
49-72	3
73-96	4
97-120	5
121-144	6
145-168	7

(1) Electrical distribution boards dedicated to serving electric vehicle charging in a carpark must—

(a) be fitted with a charging control system with the ability to manage and schedule charging of electric vehicles in response to total building demand; and

(b) when associated with a Class 2 building, have capacity for each circuit to support an electric vehicle charger able to deliver a minimum of 12 kWh from 11:00 pm to 7:00 am daily; and

(c) when associated with a Class 5 to 9 building, have capacity for each circuit to support an electric vehicle charger able to deliver a minimum of 12 kWh from 9:00 am to 5:00 pm daily; and

(d) when associated with a Class 3 building, have capacity for each circuit to support an electric vehicle charger able to deliver a minimum of 48 kWh from 11:00 pm to 7:00 am daily; and

(e) be sized to support the future installation of a 7 kW (32 A) type 2 electric vehicle charger in—

(i) 100% of the car parking spaces associated with a Class 2 building; or

(ii) 10% of car parking spaces associated with a Class 5 or 6 building; or

(iii) 20% of car parking spaces associated with a Class 3, 7b, 8 or 9 building; and

(f) contain space of at least 36 mm width of DIN rail per outgoing circuit for individual sub-circuit electricity metering to record electricity use of electric vehicle charging equipment; and

(g) be labelled to indicate the use of the space required by (f) is for the future installation of metering equipment.

Limitations

J9D4 does not apply to a stand-alone Class 7a building.

7.6.3 J9D5 Facilities for solar photovoltaic and battery systems

Part J9D5 of the NCC outlines the provisions of Facilities for solar photovoltaic and battery systems. Facilities for solar photovoltaic and battery shall be provided in accordance with Part J9D5 of the NCC.

(1) The main electrical switchboard of a building must—

(a) contain at least two empty three-phase circuit breaker slots and four DIN rail spaces labelled to indicate the use of each space for—

(i) a solar photovoltaic system; and

(ii) a battery system; and

(b) be sized to accommodate the installation of solar photovoltaic panels producing their maximum electrical output on at least 20% of the building roof area.

(2) At least 20% of the roof area of a building must be left clear for the installation of solar photovoltaic panels, except for buildings—

(a) with installed solar photovoltaic panels on—

(i) at least 20% of the roof area; or

(ii) an equivalent generation capacity elsewhere on-site; or

(b) where 100% of the roof area is shaded for more than 70% of daylight hours; or

(c) with a roof area of not more than 55 m^2; or

(d) where more than 50% of the roof area is used as a terrace, carpark, roof garden, roof light or the like.

Limitations

(1) The requirements of J9D5 (1)(a)(i) and (b) do not apply to a building with solar photovoltaic panels installed on at least 20% of the roof area.

(2) The requirements of J9D5 (1)(a)(ii) and (b) do not apply to a building with battery systems installed.

All services consultants and contractors shall design their systems to ensure compliance with Part J9 of the NCC Section J and all subsections associated therein with regards to facilities for energy monitoring and on-site distributed energy resources.

8 Disclaimer

This report is prepared using the information described above and inputs from other consultants. Whilst IGS 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 IGS 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. IGS 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 2022, specific applications may vary during the design development of the project.

The J1V3 Verification Methodology is for NCC Section J compliance purposes only and compares the proposed hypothetical building design to a DTS reference building with the same geometry using defined occupancy and operational control schedules. The annual energy output calculated in the software is used only to demonstrate whether the proposed building envelope has a higher (fail) or lower (pass) value than the DTS reference building.

The modelling therefore does not estimate the actual energy consumption of the building and the outputs must not be used for this purpose.

Glossary

Air-conditioning, for the purposes of Section J of Volume One, means a service that actively cools or heats the air within a space, but does not include a service that directly

(a) cools or heats cold or hot rooms; or

(b) maintains specialised conditions for equipment or processes, where this is the main purpose of the service.

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 J1V3 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.

Annual greenhouse gas emissions mean the theoretical amount of greenhouse gas emissions attributable to the energy used annually by a building's services, excluding kitchen exhaust and the like.

Assessment Method means a method that can be used for determining that a Performance Solution or Deemed-to-Satisfy Solution complies with the Performance Requirements.

Boiler means a vessel or an arrangement of vessels and interconnecting parts, wherein steam or other vapour is generated, or water or other liquid is heated at a pressure above that of the atmosphere, by the application of fire, the products of combustion, electrical power, or similar high temperature means, and—

(a) includes superheaters, reheaters, economisers, boiler piping, supports, mountings, valves, gauges, fittings, controls, the boiler settings and directly associated equipment; but

(b) excludes a fully flooded or pressurised system where water or other liquid is heated to a temperature lower than the normal atmospheric boiling temperature of the liquid.

Carpark means a building that is used for the parking of motor vehicles but is neither a private garage nor used for the servicing of vehicles, other than washing, cleaning or polishing.

Climate zone means an area defined in Figure 2 and in Table 2 for specific locations, having energy efficiency provisions based on a range of similar climatic characteristics.

Conditioned space, means a space that is likely (i.e., expected) to be air-conditioned and is not limited to the space where an air-conditioning system is installed. 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 fit out. 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.

Cooling load means the calculated amount of energy removed from the cooled spaces of the building annually by artificial means to maintain the desired temperatures in those spaces.

Deemed-to-Satisfy Provisions means provisions which are deemed to satisfy the Performance Requirements.

Deemed-to-Satisfy Solution means a method of satisfying the Deemed-to-Satisfy Provisions.

Display glazing means glazing used to display retail goods in a shop or showroom directly adjacent to a walkway or footpath, but not including that used in a café or restaurant.

Domestic services mean the basic engineering systems that use energy or control the use of energy; and—

(a) includes—

(i) heating, air-conditioning, mechanical ventilation and artificial lighting; and

(ii) pumps and heaters for swimming pools and spa pools; and

(iii) heated water systems; but

(b) excludes cooking facilities and portable appliances.

Envelope, for the purposes of Section J in Volume One, means the parts of a building's fabric that separate a conditioned space or habitable room from—

(a) the exterior of the building; or

(b) a non-conditioned space including—

(i) the floor of a rooftop plant room, lift-machine room or the like; and

(ii) the floor above a carpark or warehouse; and

(iii) the common wall with a carpark, warehouse or the like.

External wall, for the purposes of Volume One, means an outer wall of a building which is not a common wall.

Fabric means the basic building structural elements and components of a building including the roof, ceilings, walls, glazing and floors.

Floor area, for the purposes of Volume One, means—

(a) in relation to a building — the total area of all storeys; and

(b) in relation to a storey — the area of all floors of that storey measured over the enclosing walls, and includes—

(i) the area of a mezzanine within the storey, measured within the finished surfaces of any external walls; and

(ii) the area occupied by any internal wall or partitions, any cupboard, or other built-in furniture, fixture or fitting; and

(iii) if there is no enclosing wall, an area which has a use that—

(A) contributes to the fire load; or

(B) impacts on the safety, health or amenity of the occupants in relation to the provisions of the BCA; and

(c) in relation to a room — the area of the room measured within the finished surfaces of the walls, and includes the area occupied by any cupboard or other built-in furniture, fixture or fitting; and

(d) in relation to a fire compartment — the total area of all floors within the fire compartment measured within the finished surfaces of the bounding construction, and if there is no bounding construction, includes an area which has a use which contributes to the fire load; and

(e) in relation to an atrium — the total area of all floors within the atrium measured within the finished surfaces of the bounding construction and if no bounding construction, within the external walls.

Glazing, for the purposes of Section J in Volume One, means a transparent or translucent element and its supporting frame located in the envelope, and includes a window other than a roof light. For the purposes of Section J, the glazing provides an aperture by which light and energy can flow into or from the conditioned space.

Heated water means water that has been intentionally heated. It is normally referred to as hot water or warm water

Heating load means the calculated amount of energy delivered to the heated spaces of the building annually by artificial means to maintain the desired temperatures in those spaces.

Hours of operation means the number of hours when the occupancy of the building is greater than 20% of the peak occupancy.

Illuminance means the luminous flux falling onto a unit area of surface.

Illumination power density (W/m^2) means the total of the power that will be consumed by the lights in a space, including any lamps, ballasts, current regulators and control devices other than those that are plugged into socket outlets for intermittent use such as floor standing lamps, desk lamps or work station lamps, divided by the area of the space.

Internal wall, for the purposes of Volume One, excludes a common wall or a party wall.

Latent heat gain means the heat gained by the vaporising of liquid without change of temperature.

Minimum Energy Performance Standards (MEPS) means the Minimum Energy Performance Standards for equipment and appliances established through the Greenhouse and Energy Minimum Standards Act 2012.

Mezzanine means an intermediate floor within a room.

NABERS Energy for Offices means the National Australia Built Environment Rating Systems for office energy efficiency, which is managed by the New South Wales Government.

Outdoor air means air outside the building.

Performance Requirement means a requirement which states the level of performance which a Performance Solution or Deemed-to-Satisfy Solution must meet.

Performance Solution means a method of complying with the Performance Requirements other than by a Deemed-to-Satisfy Solution.

Predicted Mean Vote (PMV) means the Predicted Mean Vote of the thermal perception of building occupants determined in accordance with ANSI/ASHRAE Standard 55.

R-Value (m^2.K/W) means the thermal resistance of a component calculated by dividing its thickness by its thermal conductivity.

Reference building, for the purposes of Volume One, means a hypothetical building that is used to calculate the maximum allowable annual greenhouse gas emissions and determine the Thermal comfort level for the proposed building.

Reflective insulation means a building membrane with a reflective surface such as a reflective foil laminate, reflective barrier, foil batt or the like capable of reducing radiant heat flow.

Renewable energy means energy that is derived from sources that are regenerated, replenished, or for all practical purposes cannot be depleted and the energy sources include, but are not limited to, solar, wind, hydroelectric, wave action and geothermal.

Residential care building means a Class 3, 9a or 9c building which is a place of residence where 10% or more of persons who reside there need physical assistance in conducting their daily

activities and to evacuate the building during an emergency (including any aged care building or residential aged care building) but does not include a hospital.

Sensible heat gain means the heat gained which causes a change in temperature

Service, for the purposes of Section J in Volume One, means a mechanical or electrical system that uses energy to provide air-conditioning, mechanical ventilation, heated water supply, artificial lighting, vertical transport and the like within a building, but which does not include—

(a) systems used solely for emergency purposes; and

(b) cooking facilities; and

(c) portable appliances.

Site means the part of the allotment of land on which a building stands or is to be erected

Solar admittance means the fraction of incident irradiance on a wall-glazing construction that adds heat to a building's space.

Sole-occupancy unit means a room or other part of a building for occupation by one or joint owner, lessee, tenant, or other occupier to the exclusion of any other owner, lessee, tenant, or other occupier and includes—

(a) a dwelling; or

(b) a room or suite of rooms in a Class 3 building which includes sleeping facilities; or

(c) a room or suite of associated rooms in a Class 5, 6, 7, 8 or 9 building; or

(d) a room or suite of associated rooms in a Class 9c building, which includes sleeping facilities and any area for the exclusive use of a resident.

Thermal comfort level means the level of thermal comfort in a building expressed as a PMV sensation scale.

Total R-Value (m^2.K/W), for the purposes of Volume One, means the sum of the R-Values of the individual component layers in a composite element including any building material, insulating material, airspace, thermal bridging and associated surface resistances.

Total System Solar Heat Gain Coefficient (SHGC), for the purposes of Volume One, means the fraction of incident irradiance on a wall-glazing construction or a roof light that adds heat to a building's space.

Total System U-Value (W/m^2. K), for the purposes of Volume One, means the thermal transmittance of the composite element allowing for the effect of any airspaces, thermal bridging and associated surface resistances.

Ventilation opening means an opening in the external wall, floor or roof of a building designed to allow air movement into or out of the building by natural means including a permanent opening, an openable part of a window, a door or other device which can be held open.

Verification Method means a test, inspection, calculation or other method that determines whether a Performance Solution complies with the relevant Performance Requirements.

Wall-glazing construction, for the purposes of Section J in Volume One, means the combination of wall and glazing components comprising the envelope of a building, excluding—

(a) display glazing; and

(b) opaque non-glazed openings such as doors, vents, penetrations and shutters.

Ward area means that part of a patient care area for resident patients and may contain areas for accommodation, sleeping, associated living and nursing facilities.

Window includes a roof light, glass panel, glass block or brick, glass louvre, glazed sash, glazed door, or other device which transmits natural light directly from outside a building to the room concerned when in the closed position.