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NCC 2019 Energy Efficiency

JV3 Section J Compliance Report

Star of the Sea – Star Centre

80 Martin Street, Brighton VIC 3186

Prepared for: Star of the Sea College

Project No.: VC220395

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Revisions

Revision	Description	Date	Prepared by	Approved by
A	For Information	03.05.2023	Jean Chuah	Justin Ireson

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1 List of Abbreviations, Definitions and Units of Measurements

- **Conditioned Space** means a space within a building, including a ceiling or under-floor supply air plenum or return air plenum, where the environment is likely, by the intended use if the space, to have its temperature controlled by air-conditioning
- **DTS** means Deemed-to-Satisfy in regard to provisions as specified in the National Construction Code
- **Envelope** means the parts of a building's fabric that separates 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** means an outer wall of a building which is not a common wall
- **Glazing** means a transparent or translucent element and its supporting frame located in the envelope, and includes a window other than a roof light
- **NCC** - National Construction Code, Building Code of Australia 2019
- **PBA** - Performance Based Assessment
- **Performance Requirement** means a requirement which states the level of performance which a Performance Solution or Deemed-to-Satisfy Solution must be met.
- **Performance Solution** means a method of complying with the Performance Requirements other than by a Deemed-to-Satisfy Solution
- **PMV** – The Predicted Mean Vote of the thermal perception of building occupants determined in accordance with ANSI/ASHRAE Standard 55
- **R-Value** (m^2K/W) means the thermal resistance of a component calculated by dividing its thickness by its thermal conductivity
- **Total R-Value** (m^2K/W) 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)** 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^2K) means the thermal transmittance of the composite element allowing for the effect of any airspaces, thermal bridging, and associated surface resistances.
- **VLT** means Visual Light Transmission and is the proportion of visible light that passes through a window.

2 Disclaimer

Changes to the system configuration described in the report may result in changes to thermal performance. This calculation only assesses and provides a system thermal performance. Other factors which are not considered should be independently assessed, include but are not limited to:

- Condensation risk,
- Water proofing,
- Fire and bushfire performance,
- Structural adequacy,
- Requirements for cyclonic regions.

The systems in this report are generic in nature and suitability of proposed products require to be verified by other parties, such as the specifiers, builders, contractors, installers etc. Where deviations occur, it is the responsibility of these parties to ensure the intent of this report is met.

Where there are deviations, the specifier is to prove that the corresponding specifications in this report are met.

3 Introduction

ACOR Consultants have performed a Performance Based Assessment (PBA) in relation to the proposed extension of the Star of the Sea College – Star Centre in Brighton.

The proposed buildings works have been assessed for compliance against the National Construction Code (NCC) 2019 - Amendment 1, Energy Efficiency Section J requirements using the verification method JV3 Verification using a reference building.

In order for the development to meet the results of the assessment and the mandatory requirements relating to energy efficiency imposed by Section J of the NCC, the building fabric will need to comply with results of the PBA.

A summary of proposed building element requirements is provided in Table 1. Total system values for the DTS reference and proposed buildings are detailed in Section 7 of this report.

Table 1 Summary of Requirements for Proposed Building Project

Fabric Element	Proposed Building
Glazing	Total U-Value (in frame) = 2.5 W/m²K and SHGC (in frame) = 0.30
External Walls	Metal Cladding, Airgap, R2.5 Insulation, Internal Lining Brickwork, Airgap, R2.5 Insulation, Internal Lining
Internal Walls	Plasterboard, R2.5 Insulation, Airgap, Plasterboard
Roof/Ceiling	Metal Cladding (Solar Absorptance < 0.45), Airgap, R3.5 Insulation, Internal Lining
Slab On Ground	R2.0 Insulation, Concrete Slab on Ground, Floor Lining
Suspended Slab (Ground & First Floor)	R2.0 Insulation, Suspended Slab, Floor lining
Slab On Ground (With In-Slab heating)	R3.0 Insulation, Concrete Slab on Ground, Floor Lining
Suspended Slab (With In-Slab heating)	R3.0 Insulation, Suspended Slab, Floor lining

To achieve compliance, the above listed items and all sub-clauses as detailed in this report must be incorporated into the building design and noted on the specifications.

All services equipment is to meet or exceed the Deemed to Satisfy requirements as per NCC Section J Energy Efficiency provisions.

3.1 Sources of Information

The following sources of information used to generate the report were based on architectural drawings provided by PMDL McGlashan Everist, Issued for Town Planning, dated 22/03/2023.

- Proposed Ground Floor Plan — Drawing Number: TP132
- Proposed First Floor Plan — Drawing Number: TP133
- Proposed Second Floor Plan — Drawing Number: TP134
- Proposed Plant Floor Plan — Drawing Number: TP135
- Proposed Roof Plan — Drawing Number: TP136
- Proposed Elevations — Drawing Number: TP200-TP203

- Proposed Sections Drawing Number: TP300-TP301

3.2 Town Planning Requirements

The Built Environment Sustainability Scorecard (BESS) is a tool to assess sustainability design in the Planning permit stage. In the energy section, BESS aims to reduce energy needed to achieve thermal comfort in summer and winter - improving comfort, reducing greenhouse gas emissions, energy consumption, and maintenance costs. Exposed floors and ceilings (forming part of the envelope) must demonstrate a minimum 10% improvement in required NCC2019 insulation levels.

4 Limitations

Computer building simulation and other calculations provided in this report give an estimate of building performance only. This estimate is based on a necessarily simplified and idealised version of the building that does not and cannot fully represent all of 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 warranty of building performance in practice can be based on simulation and calculation results alone.

The Total R-value or Total System U-value (where applicable) for a wall, roof and floor, including allowance for thermal bridging, are theoretical thermal calculation in accordance with AS/NZ 4859.2.2018 and may not be representative of actual in-situ performance.

5 NCC Section J Overview

5.1 Compliance Overview

This report outlines the compliance of the building works with NCC 2019 – Amendment 1, Section J Energy Efficiency provisions.

As per NCC 2019 Part A6 this project is considered to be a Class 9b. The building is located in Climate Zone 6 and will be assessed with the following parts of Section J:

- J1 – Building Fabric
- J3 – Building Sealing
- J5 – Air-Conditioning & Ventilation Systems
- J6 – Artificial Lighting & Power
- J7 – Heated Water Supply
- J8 – Access for Maintenance & Facilities for Monitoring

5.2 JV3 Verification Method Compliance Pathways

For a Class 3, 5, 6, 7, 8 or 9 building or common area of a Class 2 building, compliance with JP1 is verified when it is determined that the annual modelled greenhouse gas emissions of the proposed building is not more than the annual modelled 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
- 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
- the building complies with the additional requirements in Specification JVa

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

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

The calculation method used must comply with—

- (i) ANSI/ASHRAE Standard 140; and
- (ii) Specification JVb.

Figure 1 is a flowchart that indicates various pathways how JV3 may be used to demonstrate compliance.

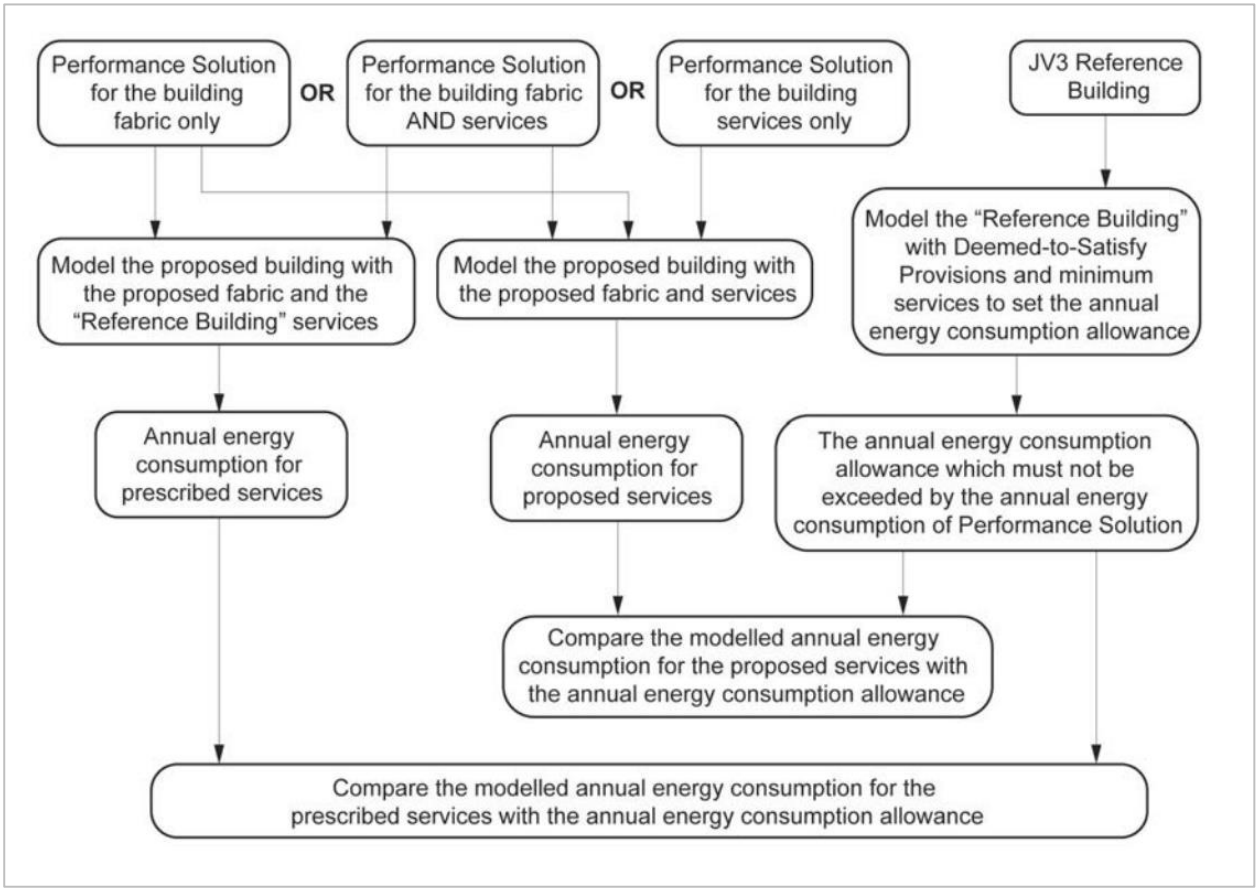


Figure 1 JV3 Performance Solution Pathways

5.3 Project Compliance Pathway – Building Fabric Only

For this project is it expected that the services will meet or exceed minimum DTS requirements and as such, it is not necessary in this report to determine the annual modelled energy use for the Proposed Fabric with Proposed Services. The modelling will therefore focus on the passive aspects of the design by only comparing the annual energy consumption use of Proposed Fabric using DTS Reference Services with the annual modelled energy allowance for the DTS Reference Fabric and DTS Reference Services as highlighted in Figure 2.

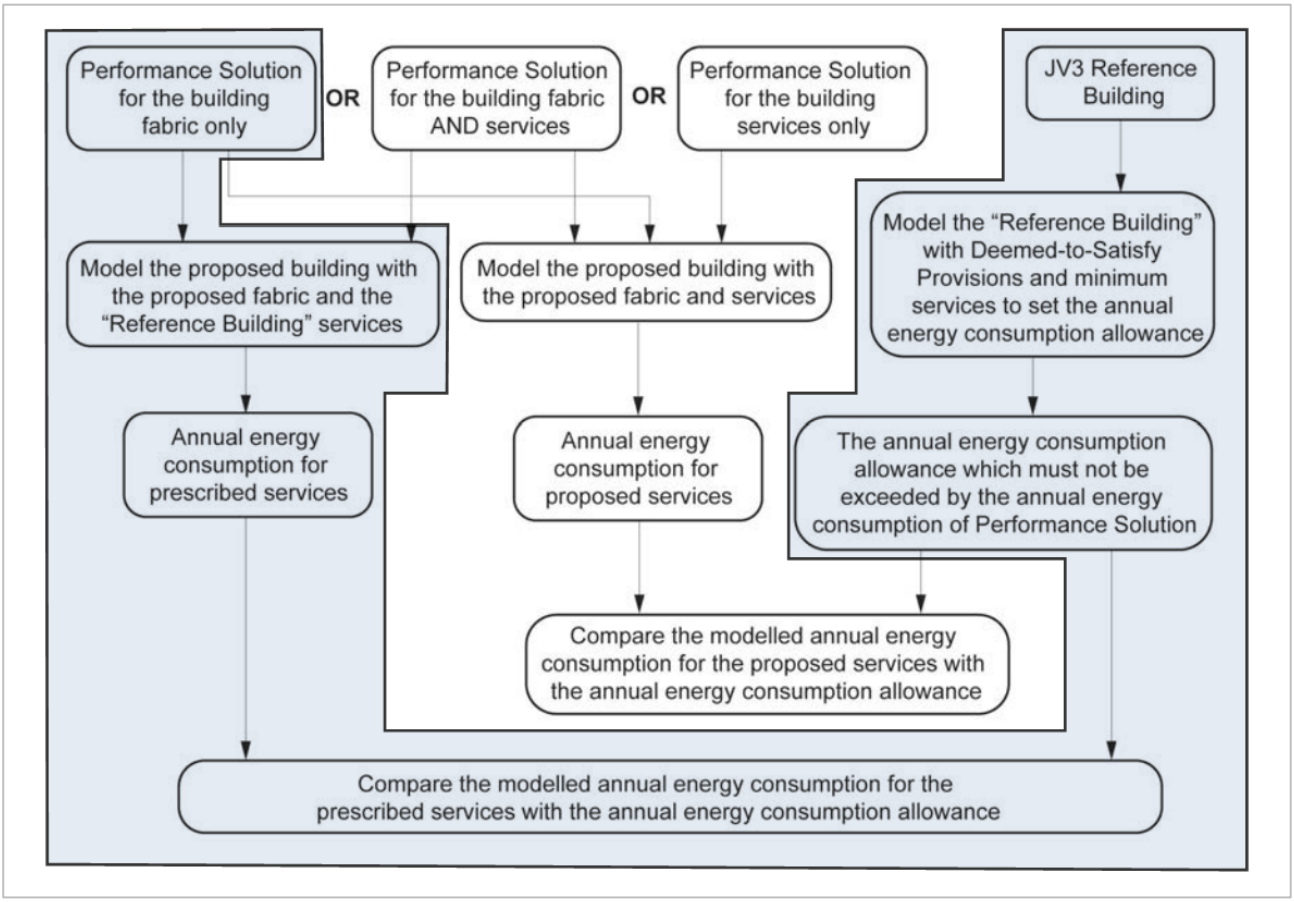


Figure 2 Selected JV3 Pathway Building Fabric Only

5.4 Specification JVa – Additional Requirements

In addition to the modelling requirements for JV3, a building must comply with –

- For the general thermal construction, J1.2; and
- For floor edge insulation, J1.6(b); and J1.6(c); and
- For building sealing, JV4 or J3.

5.5 Thermal Comfort Requirements

In addition to the proposed building's annual modelled greenhouse gas emissions not exceeding the annual modelled greenhouse gas emissions of the Reference building, the proposed building is to achieve thermal comfort requirements to ensure, that in the endeavour to achieve energy efficiency, occupant comfort is not compromised.

The proposed building is therefore to achieve a thermal comfort level represented by a Predicted Mean Vote (PMV) 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.

Thermal comfort is defined as "that condition of mind which expresses satisfaction with the thermal environment" in ASHRAE 55-2013 for assessing indoor environments.

The Predicted Mean Vote (PMV) is an index that aims to predict the mean value of votes of a group of occupants on a seven-point thermal sensation scale as shown in Figure 3.

-3 cold	-2 cool	-1 slightly cool	0 neutral	+1 slightly warm	+2 warm	+3 hot

Figure 3 Thermal Sensation Scale

6 Methodology

6.1 Purpose

The purpose of this assessment is to focus specifically on the building fabric of the proposed building when compared to a reference building based on DTS building fabric provisions using DTS Reference services. Model inputs for the reference and proposed buildings are provided in Section 7 and Appendix A of this report.

6.2 Verification Method Using A Reference Building

6.2.1 Reference building

The annual greenhouse gas emissions of the reference building have been calculated using:

- The DTS provisions as per Part J1 to J7 and the minimum amount of mechanical ventilation required by Part F4.
- Solar absorptance of 0.6 for the external walls
- Air conditioning for 98% of the plant operation time to achieve temperatures between:
  - 18°CDB to 25°CDB for conditioned spaces with transitory occupancy; and
  - 21°CDB to 24°CDB in all other conditioned spaces; and
    - where 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
- The infiltration rate in each zone must be:
  - 0.7 air changes per hour throughout all zones when there is no mechanically supplied outdoor air; and
  - 0.35 air changes per hour at all other times.
- The maximum illumination power density without an increase for adjustment factors
- Minimum Energy Performance Standards applied to services not covered by Parts J5 to J7

6.2.2 Proposed building and reference building

The annual greenhouse gas emissions of the reference building and the proposed building has been calculated using the same:

- Annual greenhouse gas emissions calculation method
- Location
- Adjacent structures and features
- Environmental conditions such as ground reflectivity, sky and ground form factors, temperature of external bounding surfaces, air velocities across external surfaces and the like
- Orientation
- Building form
- Size and location of glazing
- External doors
- Testing standards
- Thermal resistance of air films

- Dimensions of all walls
- Quality of insulation
- Assumptions and calculations relating to A/C zone boundaries
- Floor coverings
- Shading devices
- Range and type of services
- Internal artificial lighting
- Internal heat gains
- A/C system configuration
- Daily and annual occupancy and service profiles
  - Hot water system
  - Infiltration values
  - Representation of clothing and metabolic rate of the occupants
  - If applicable, sequencing for water heaters, refrigeration chillers and heat rejection equipment towers;
    - Control of air-conditioning except—
    - 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
    - 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
- Number, sizes, floors and traffic served by lifts and escalators.
- Services – proposed and reference building
- The profiles for occupancy, air-conditioning, lighting, internal heat gains from people, appliances and equipment and hot water systems as per Specification JVc Modelling Profiles (Refer Appendix A).

6.3 Thermal Comfort Modelling

According to ASHRAE 55-2013, six primary variables are to be considered in the analysis of thermal comfort which include:

- Air temperature: The air temperature surrounding the occupant
- Radiant temperature: The weighted average of all temperatures from surrounding surfaces
- Relative humidity: The percentage of water vapor in the air in relation to saturation
- Air velocity: The rate at which air moves around given distance over time
- Metabolic rate (met): The amount of energy generated from the human body
- Clothing insulation (clo): The amount of insulating materials used to retain or remove body heat

Model inputs and result outputs are provided in Section 4 and Appendix A of this report.

6.4 Simulation Software

DesignBuilder (DB) is an analysis tools for the design and retrofit of buildings and meets the requirements of the ABCB protocol for Commercial Building energy rating software.

7 Building Parameters

7.1 General Information

Table 2 General Information

Item	Description
Building Class	Class 9b
Verification Method Used	JV3 (Covering Parts J1 & J3)
Climate Location Used	Melbourne
Climate Zone	6
Software Used	DesignBuilder v7.0.1.004

7.2 Weather Data

The software used is driven by hourly weather data on temperature, solar radiation, cloud cover, wind speed, and wind direction The weather file used is based on long-term weather data provided by the Australian Bureau of Meteorology. It is the most comprehensive and latest weather data used to represent general Climate Zone 6 data in Victoria. The weather file used for the simulation is selected to be the closest weather data available to the site location.

7.3 Building Fabric Requirements

The following tables provide the minimum DTS building fabric inputs for the DTS reference building model as well as the proposed building fabric inputs for the proposed building model. The following additional information is provided in the following appendices:

- Appendix B – Thermal Envelope

7.3.1 J1.3 Roof and Ceiling Construction

The minimum DTS thermal resistance value for each part of the roof/ceiling construction that is part of the building envelop is R3.2, for a downward direction of heat flow. In addition, the upper surface solar absorptance of the roof surface of the DTS reference building is to be less than or equal to 0.45. The proposed roof construction also meets Town Planning requirements of a 10% improvement over DTS values.

Table 3 Roof/Ceiling Construction

Roof		DTS Reference	Proposed Building
Upper Surface Solar Absorptance		0.45	0.45
No.	Roof/Ceiling Construction	R -Value (m² K/W)	R -Value (m² K/W)
1	Outside Air Film (7 m/s)		0.03
2	Metal Cladding		0.00
3	Thermal Break Material*		0.20
4	Air Gap (Reflective, unventilated) R3.5 Ceiling Insulation**		4.03
5	Ceiling Lining		0.06
6	Inside Air Film (still air)		0.16
Total R-Value		**3.20**	**4.48**

*Note: Where metal sheeting on steel frame is used on construction, NCC J0.4 Roof thermal breaks is to be met.

**Note: The insulation R-value is reduced to incorporate loses to ceiling construction and framing where metal cladding and/or steel frames are used. Calculations assume a default 5% framing area.

J1.5 Walls and Glazing

In the DTS reference building, wall-glazing constructions that form part of the building envelope, both externally and internally, are to achieve the following requirements as provided in Table 4, taking into account thermal bridging. Note that solar admittance only applies to external wall-glazing construction areas.

Table 4 Wall-Glazing Construction Requirements – Class 9b

Wall-Glazing Element - Building Class 9b, Climate Zone 6	Value
Wall-glazing Construction Total System U-Value	≤ U2.0
Wall-glazing Construction External Facade Solar Admittance (All aspects)	≤ 0.13
Wall < 80% of the area of the Wall-glazing Construction Total R-Value	≥ R1.0
Wall ≥ 80% or more of the area of the Wall-glazing Construction Total R-Value	≥ R1.4

There two calculation methods that may be used to determine compliance with Total System U-Value and solar admittance requirements for external wall-glazing construction which include:

- **Method 1 (Single Aspect)** – involves assessing wall-glazing construction facing a single aspect or direction for each façade (i.e. North, South, East & West)
- **Method 2 (Multiple Aspects)** – involves assessing together the wall-glazing construction facing multiple aspects

DTS compliance is achieved when it can be demonstrated that the wall-glazing construction achieves a pass using either Method 1 or Method 2 as detailed in NCC 2019 Specification J1.5a Calculation of U-Value and solar admittance based on requirements specified under NCC J1.5 Walls and glazing. The DTS reference wall-glazing results are provided in Appendix B.

The following tables provide details of wall-glazing construction materials used in the DTS reference and Proposed models.

7.3.1.1 External Walls - Wall < 80% of the area of the Wall-glazing Construction Total R-Value

Table 5 External Wall Construction – Metal Cladding

Metal Cladding		**DTS Reference**	**Proposed Building**
No.	Wall Construction < 80% or more of the area of the Wall-glazing Construction	R -Value (m^2 K/W)	R -Value (m^2 K/W)
1	Outside Air Film (7m/s)		0.04
2	Metal Cladding		0.00
3	Airgap (non-reflective, unventilated)		0.17
4	Insulation*		1.24 (R2.5 unbridged)
5	Internal Lining		0.06
6	Inside Air Film (still air)		0.12
Total R-Value		**1.00**	**1.63**

*Note: R-value of insulation reduced to incorporate loses to wall construction and framing where metal cladding and/or steel frames are used. Calculations assume default 10% framing area. Where lightweight external cladding on steel frame is used on construction, NCC J0.5 Wall thermal breaks is to be met

Table 6 External Wall Thermal Performance – Brickwork

Brickwork		**DTS Reference**	**Proposed Building**
No.	Wall Construction < 80% or more of the area of the Wall-glazing Construction	R -Value (m^2 K/W)	R -Value (m^2 K/W)
1	Outside Air Film (7m/s)		0.04
2	Brickwork		0.09
3	Airgap (non-reflective, unventilated)		0.17
4	Insulation*		1.24 (R2.5 unbridged)
5	Internal Lining		0.06
6	Inside Air Film (still air)		0.12
Total R-Value		**1.00**	**1.72**

*Note: R-value of insulation reduced to incorporate loses to wall construction and framing where metal cladding and/or steel frames are used. Calculations assume default 10% framing area.

7.3.1.2 External Walls - Wall ≥ 80% of the area of the Wall-glazing Construction Total R-Value

Table 7 External Wall Construction – Metal Cladding

Metal Cladding		**DTS Reference**	**Proposed Building**
No.	Wall Construction ≥ 80% or more of the area of the Wall-glazing Construction	R -Value (m² K/W)	R -Value (m² K/W)
1	Outside Air Film (7m/s)		0.04
2	Metal Cladding		0.00
3	Airgap (non-reflective, unventilated)		0.17
4	Insulation*		1.24 (R2.5 unbridged)
5	Internal Lining		0.06
6	Inside Air Film (still air)		0.12
Total R-Value		**1.40**	**1.63**

*Note: R-value of insulation reduced to incorporate loses to wall construction and framing where metal cladding and/or steel frames are used. Calculations assume default 10% framing area. Where lightweight external cladding on steel frame is used on construction, NCC J0.5 Wall thermal breaks is to be met.

Table 8 External Wall Thermal Performance – Brickwork

Brickwork		**DTS Reference**	**Proposed Building**
No.	Wall Construction ≥ 80% or more of the area of the Wall-glazing Construction	R -Value (m² K/W)	R -Value (m² K/W)
1	Outside Air Film (7m/s)		0.04
2	Brickwork		0.09
3	Airgap (non-reflective, unventilated)		0.17
4	Insulation*		1.24 (R2.5 unbridged)
5	Internal Lining		0.06
6	Inside Air Film (still air)		0.12
Total R-Value		**1.40**	**1.72**

*Note: R-value of insulation reduced to incorporate loses to wall construction and framing where metal cladding and/or steel frames are used. Calculations assume default 10% framing area.

7.3.1.3 Internal Walls - Wall ≥ 80% of the area of the Wall-glazing Construction Total R-Value

Table 9 Internal Wall Construction – Internal

Internal		**DTS Reference**	**Proposed Building**
No.	Wall Construction ≥ 80% or more of the area of the Wall-glazing Construction	R -Value (m^2 K/W)	R -Value (m^2 K/W)
1	Internal Surface Resistance (Still air)		0.14
2	Internal Lining		0.06
3	Airgap (non-reflective, unventilated)		0.17
4	Insulation*		1.24 (R2.5 unbridged)
5	Internal Lining		0.06
6	Inside Air Film (still air)		0.12
Total R-Value		**1.40**	**1.79**

*Note: R-value of insulation reduced to incorporate loses to wall construction and framing where metal cladding and/or steel frames are used. Calculations assume default 10% framing area.

7.3.1.4 Glazing

Table 10 External DTS Glazing Systems

DTS Glazing		**DTS Reference Building**		
Item	Location	Total U-Value W/m2K (in frame)	SHGC (in frame)	Visual Light Transmission
All Facades	All glazing	≤ 2.4	≤ 0.17	N/A

Table 11 Proposed External Glazing Systems

Proposed Glazing		**Proposed Building**		
Item	Location	Total U-Value W/m2K (in frame)	SHGC (in frame)	Visual Light Transmission
All Facades	All glazing	2.5	0.30	N/A

7.3.2 J1.6 Floors

A floor of a building envelope, without an in-slab heating or cooling system, must achieve a minimum thermal resistance on R2.0 (downwards) as specified in NCC 2019 Table J1.6 Floors. The tables below detail the construction elements with their respective R-Values that demonstrates a compliant floor system, and also meets Town Planning requirements of a 10% improvement over DTS values.

Table 12 Ground Floor Construction

Ground Floor - Slab		**DTS Reference**	**Proposed Building**
No.		R -Value (m² K/W)	R -Value (m² K/W)
1	Inside Air Film (still air)		0.16
2	Concrete Slab on Ground		0.10
3	Insulation		2.00
4	Ground Thermal Resistance*		1.00
Total R-Value		**2.00**	**2.76**

*Ground thermal resistance R-Value calculated as per Specification J1.6.2(b) based on Ratio of floor area to floor perimeter of 3.3 (based on floor area of conditioned spaces) and a wall thickness of 100mm.

Table 13 Suspended Floor Construction

Exposed Floor		**DTS Reference**	**Proposed Building**
No.		R -Value (m² K/W)	R -Value (m² K/W)
1	Inside Air Film (still air)		0.16
2	Suspended Concrete Slab		0.10
3	Insulation		2.00
4	Outdoor Air Film (7 m/s)		0.04
Total R-Value		**2.00**	**2.30**

Table 14 Ground Floor Construction – In slab heating

Ground Floor - Slab		**DTS Reference**	**Proposed Building**
No.		R -Value (m² K/W)	R -Value (m² K/W)
1	Inside Air Film (still air)		0.16
2	Concrete Slab on Ground		0.10
3	Insulation		3.00
4	Ground Thermal Resistance*		1.00
Total R-Value		**3.25**	**4.26**

*Ground thermal resistance R-Value calculated as per Specification J1.6.2(b) based on Ratio of floor area to floor perimeter of 3.3 (based on floor area of conditioned spaces) and a wall thickness of 100mm.

Table 15 Suspended Floor Construction – In slab heating

Exposed Floor		DTS Reference	Proposed Building
No.		R -Value (m² K/W)	R -Value (m² K/W)
1	Inside Air Film (still air)		0.16
2	Suspended Concrete Slab		0.10
3	Insulation		3.00
4	Outdoor Air Film (7 m/s)		0.04
Total R-Value		**3.25**	**3.60**

7.4 External Shade

Shading has been included in the model as per the architectural drawings where is affects wall-glazing constructions. The Brise Solei shading to the North and South facades has been modelled with a maximum transmittance factor of 0.6.

7.5 Mechanical System

For the purpose of this JV3 assessment, the mechanical system has been designed to comply or exceed the minimum deemed to satisfy (DTS) requirements of the NCC Section J5. DTS compliance to be provided by the relevant mechanical engineer or contractor.

7.6 Electrical System

For the purpose of this JV3 assessment, the lighting system has been designed in accordance with the minimum DTS requirements of the NCC Section J6. DTS compliance to be provided by the relevant electrical engineer or contractor.

7.7 Heated Water Supply

For the purpose of this JV3 assessment, the heated water system has been designed to comply with the minimum NCC Section J7 criteria. NCC compliance to be provided by the relevant hydraulic engineer or contractor.

7.8 Facilities for Energy Monitoring

This building has a floor area of greater than 2500m^2 and therefore, must have the facilities to record the consumption of:

- Air-conditioning plant including, where appropriate, heating plant, cooling plant and air handling fans
- Artificial lighting
- Appliance power
- Central hot water supply
- Internal transport devices including lifts, escalators and travelators.
- Other ancillary plant

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

7.9 Thermal Comfort Parameters

7.9.1 Hours of Occupancy

The number of hours when the occupancy of the building is greater than 20% of the peak in relation to the respective occupancy profile for the building classification.

7.9.2 Thermal Comfort Variables

- **Air temperature**: 21°CDB to 24°CDB for conditioned spaces of functional spaces and occupied areas.
- **Radiant temperature:** Calculated through simulation for each functional and occupied space
- **Relative humidity:** Climatic data for the site
- **Air velocity:** Average speeds $\leq$ 0.2 m/s
- **Metabolic rate (met):** 1.0 Met equivalent to Office Activities Reading, Seated & Writing as defined in ASHRAE Standard 55-2013 Table 5.2.1.2 Metabolic Rates for Typical Task
- **Clothing insulation (clo):** Average summer clo 0.5 and winter clo 1.0.

7.9.3 Thermal Zones

Thermal modelling zoning and result outputs are based on the following parameters:

- Perimeter zones to maximum depth of 4m
- Zoning to match the air conditioning zones, where possible except for perimeter zones
- Each perimeter reported independently (i.e. North, South, East and West)
- Perimeter zones reported independently of interior zones
- Comfort predictions taken as an average across the zone

7.10 Building Form

The building form has been modelled as per the architectural drawings, representing zones, floors, facades, roofs, windows and shading devices, all with their respective design properties. The model is shown in Figure 4 below.

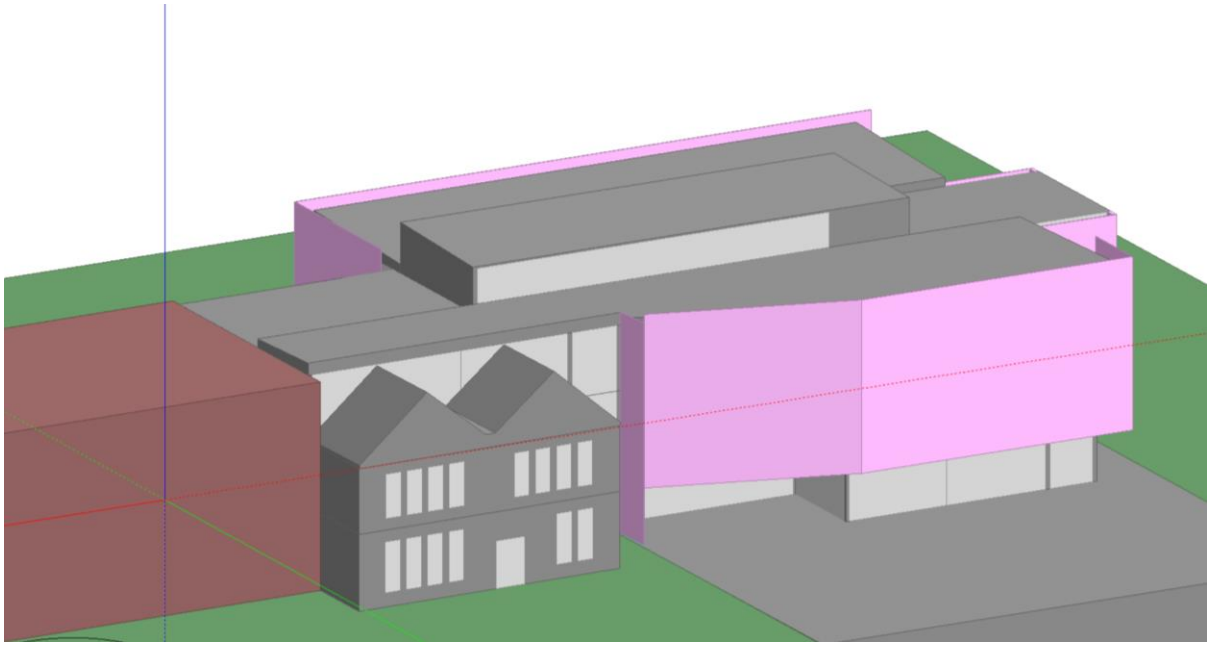


Figure 4 Building Energy Model

8 Results & Conclusion

8.1 Annual Greenhouse Gas Emissions Results

The annual greenhouse gas emissions simulation results for the DTS Reference Building with DTS Services and Proposed Building with DTS Services in the table below.

Table 16 Building Annual Energy Consumption Results

	DTS Reference Building & DTS Services Energy	Proposed Building & DTS Services Energy
Total Greenhouse gas emission ($kgCO_2$)	97,506 $kgCO_2$	82,891 $kgCO_2$

Lift energy has not been included as they are the same in both the DTS Reference and Proposed building models.

8.2 Thermal Comfort Results

This project passes thermal comfort whereby greater than 95% of the floor area achieves a PMV of -1 to 1 for greater than 98% of operation hours, with space temperatures in the range of 21°C to 24°C.

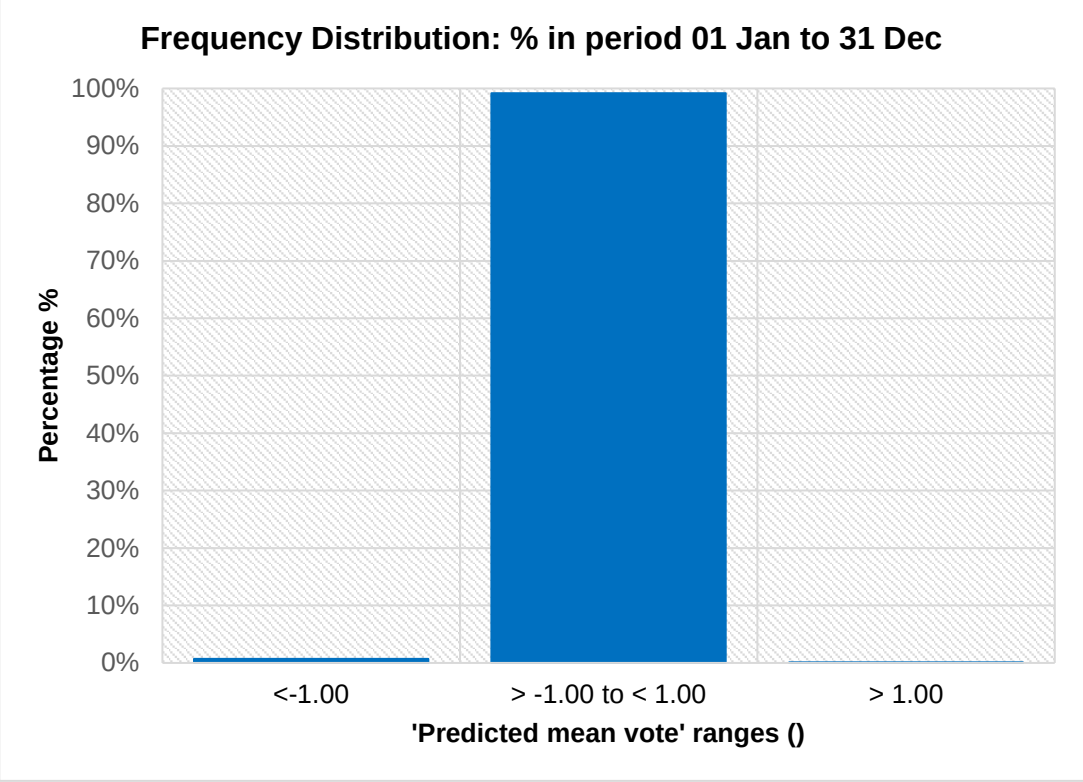


Figure 5 Thermal Comfort Distribution Chart

8.3 Conclusion

Compliance is achieved when the annual modelled greenhouse gas emissions of the proposed building is not more than the annual modelled energy use of a reference building as indicated in the above results.

Therefore, the proposed development complies with J1 and J3 of the NCC 2019 Section J Energy Efficiency requirements including thermal comfort using the JV3 verification method.

Appendix A Building Services & Modelling Inputs

Table 17 Analysis Inputs

Item	Reference Building with DTS Services	Proposed Building with DTS Services
Lighting Levels	As per NCC PartJ6 Table J6.2a Class 9b school spaces - 4.5 W/m^2 Amenities – 3 W/m^2 Stairways – 2 W/m^2 Storage, Service areas – 1.5 W/m^2	As per Reference Building
Lighting Schedule	Class 9b - NCC Specification JVc Table 2j	As per Reference Building
Internal Loads	As per NCC Specification JVc Table 2j Class 9b school spaces – 5 W/m^2	As per Reference Building
Internal Load Schedule	Class 9b - NCC Specification JVc Table 2j	As per Reference Building
Hydraulic		
Domestic Hot Water System	Electric Storage – Efficiency 85%	As per Reference Building
Domestic Hot Water Use	As per NCC Specification JVc Table 2m School – 7 L/person/day at 60^{o}C Other Application – 4 L/person/day at 60^{o}C	As per Reference Building
Cold water average entering temperature	12°C	As per Reference Building
Vertical Transportation		
Lifts	Omitted same energy as proposed	As per Reference Building
Escalators, Travelators	None	None
Mechanical		
HVAC System Type	As per NCC Section J5 DTS Requirements	As per Reference Building
Toilet exhaust fan power	As per NCC Section J5 DTS Requirements	As per Reference Building
Occupancy level	As per NCC Table D1.13	As per Reference Building
Occupant heat gain per person	75W Sensible 55W Latent	As per Reference Building
Occupancy Schedule	Class 9b - NCC Specification JVc Table 2j	As per Reference Building
HVAC Operating Schedule	Class 9b - NCC Specification JVc Table 2j	As per Reference Building
Infiltration	0.35 AC/h for whole building when plant is on and 0.70 AC/h at all other times, in accordance with NCC	As per Reference Building
Space temperature range for 98% of operating time	18°CDB to 25°CDB for conditioned spaces with transitory occupancy 21°CDB to 24°CDB in all other conditioned spaces	As per Reference Building

Item	Reference Building with DTS Services	Proposed Building with DTS Services
Mechanical Ventilation	As per NCC F4 Ventilation rates: 12 l/s-person	As per Reference Building
HVAC Zoning	The HVAC zoning has been modelled as proposed for the mechanical services and thermal comfort	As per Reference Building

Appendix B Thermal Envelope Markups

B.1 Roof Insulation

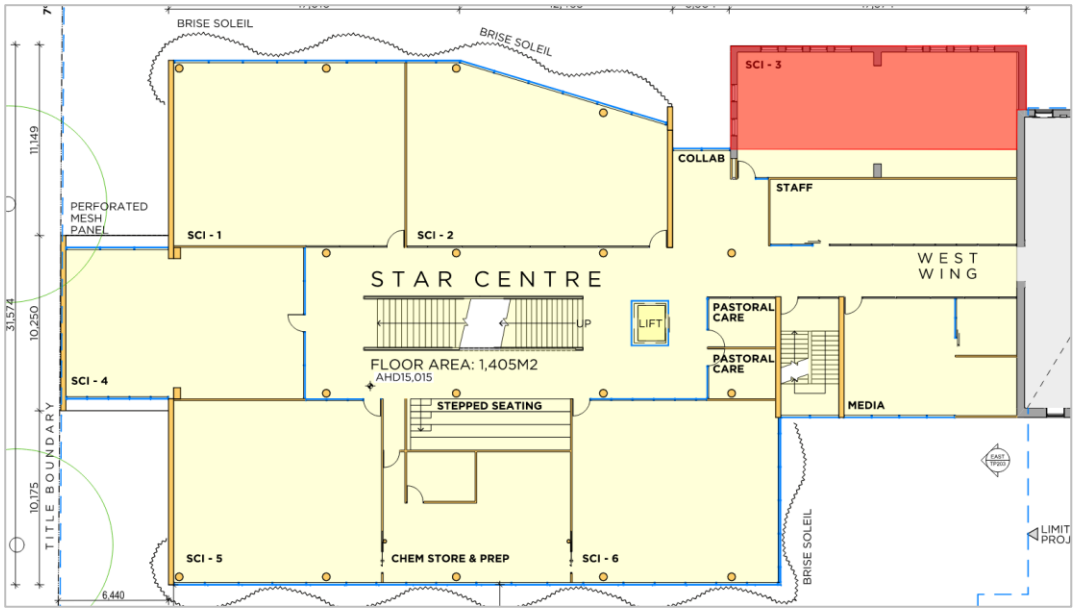


Figure 6 Level 1 Roof Insulation

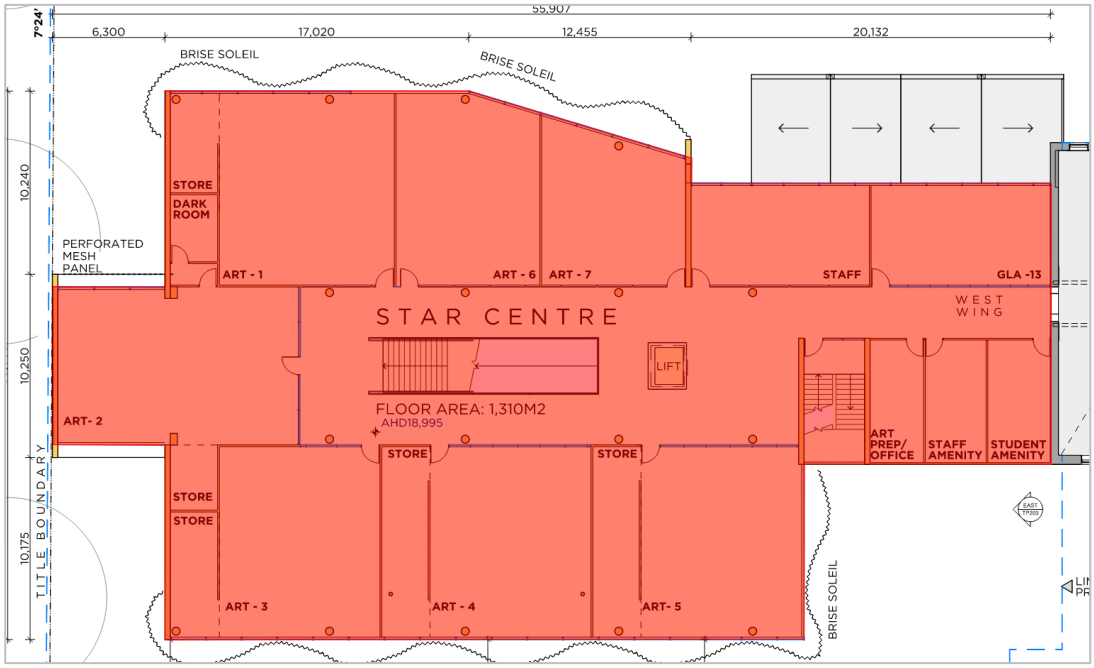


Figure 7 Level 2 Roof Insulation

B.2 Wall Insulation

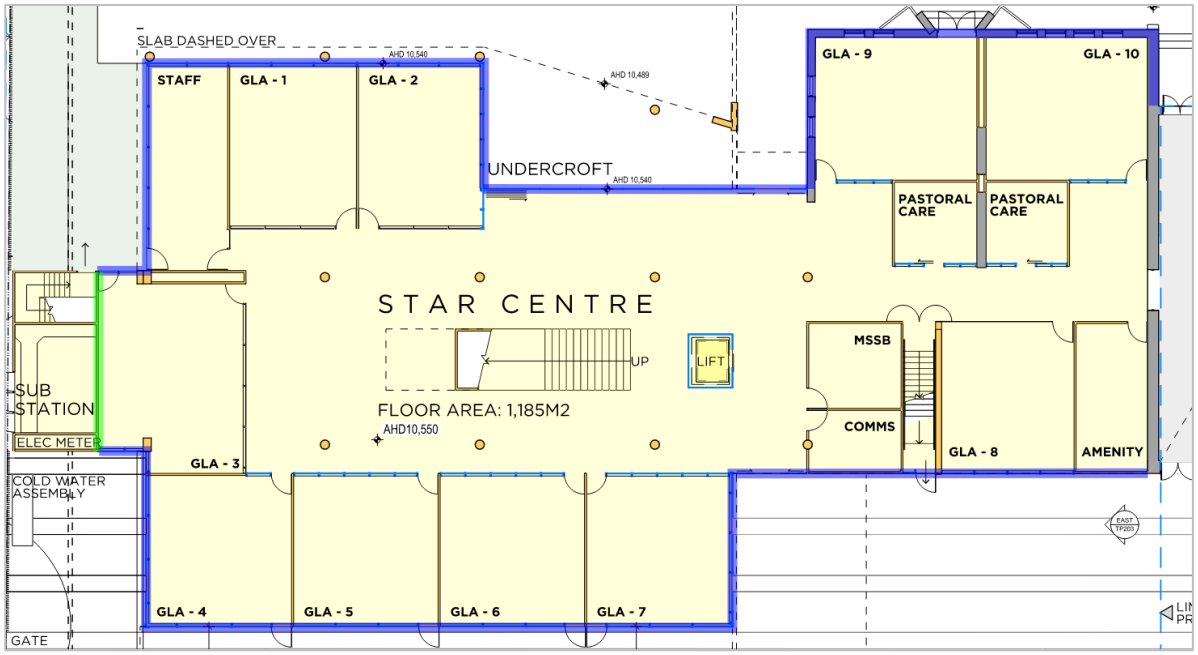


Figure 8 Ground Level Wall Envelope

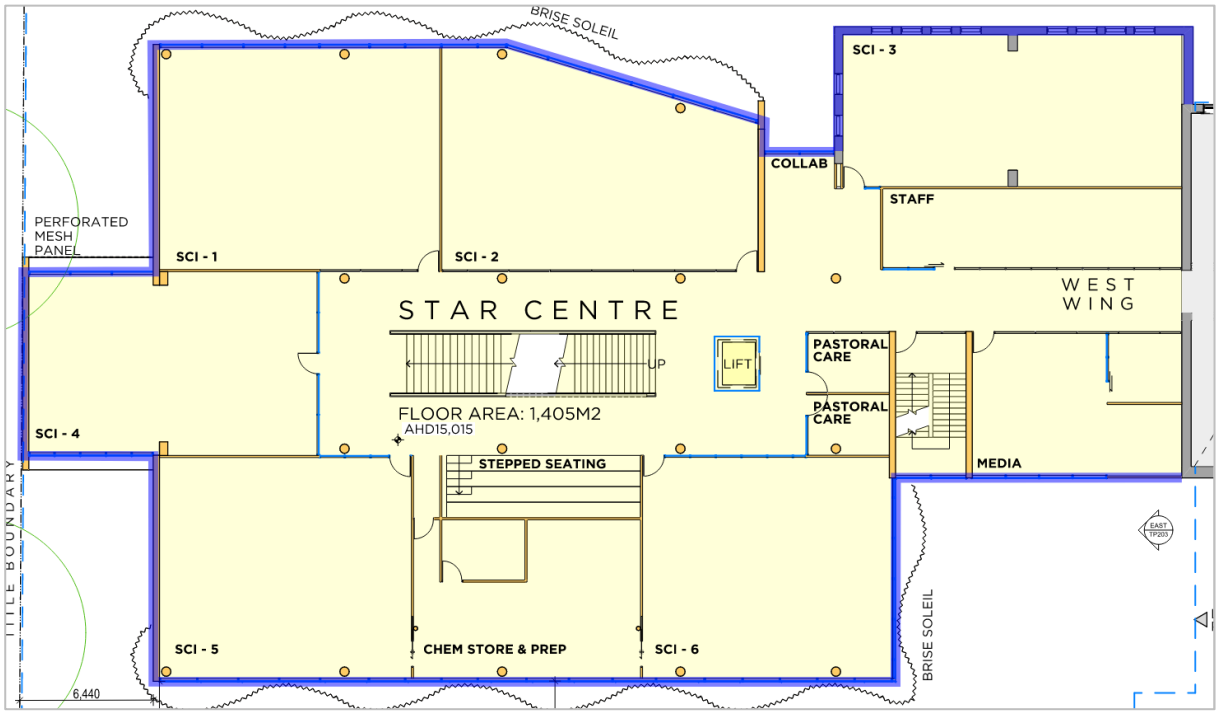


Figure 9 Level 1 Wall Envelope

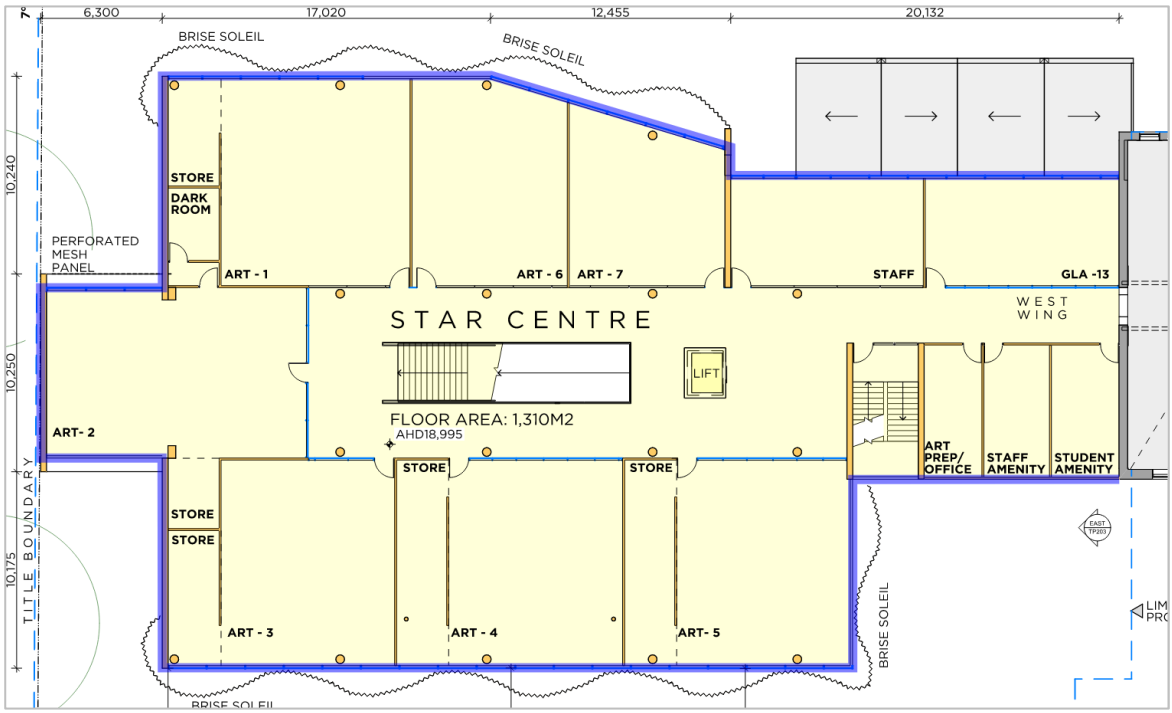


Figure 10 Level 2 Wall Envelope

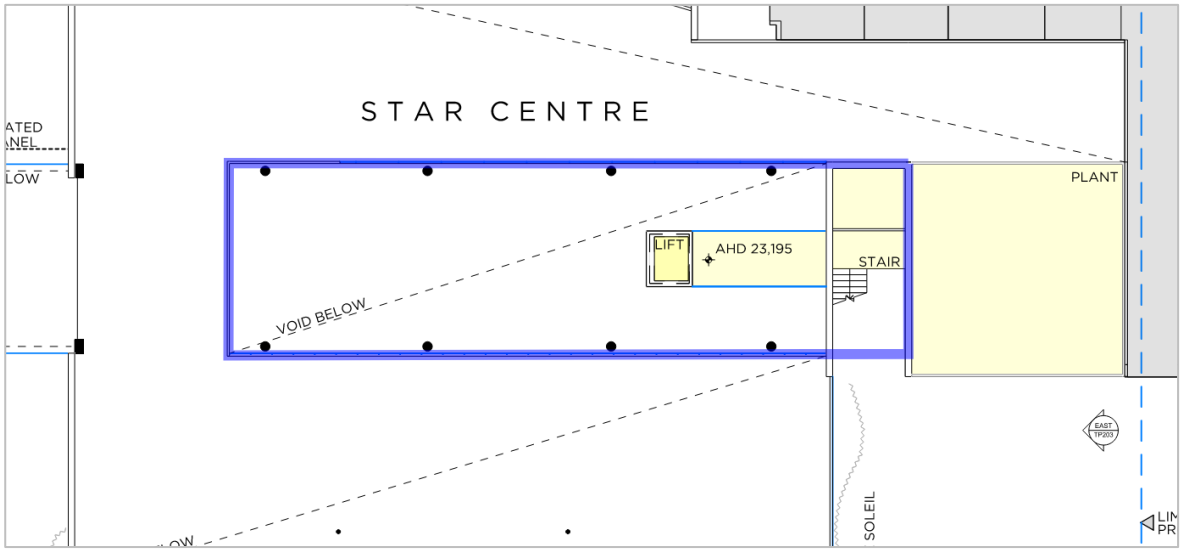


Figure 11 Plant Level Wall Envelope

B.3 Floor Insulation

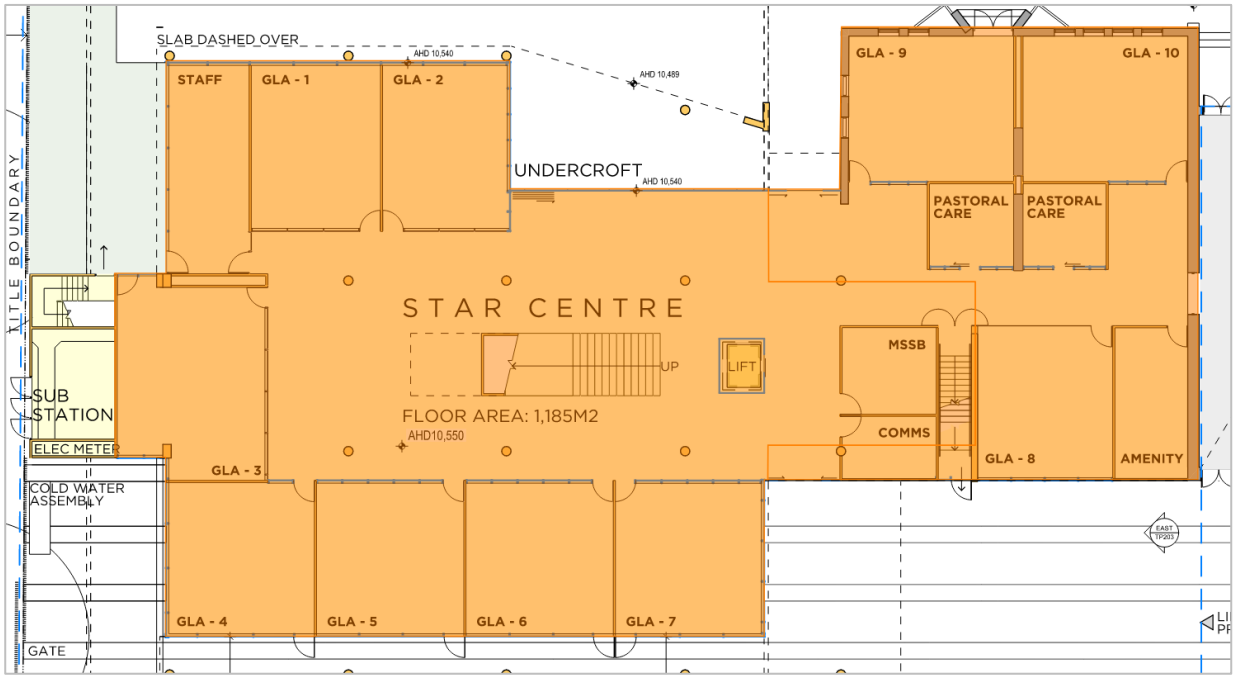


Figure 12 Ground Level Floor Insulation

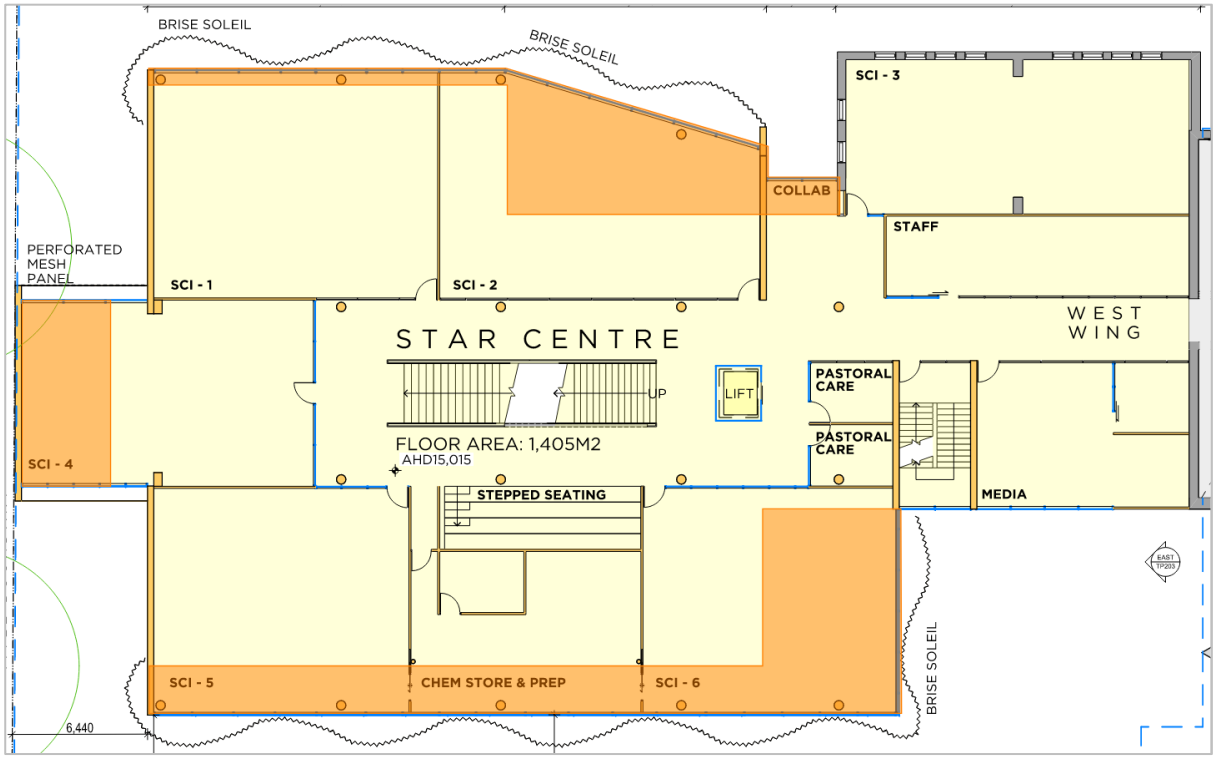


Figure 13 Level 1 Floor Insulation

Appendix C Reference Building DTS Calculations

Glazing Systems

	Glazing Reference	System Type	Glass Type	Frame Type	Glass U-Value (W/m².K)	Glass SHGC	Total System U-Value (W/m².K)	Total System SHGC
1	GL_G						2.40	0.17
2	GL_N1						2.40	0.17
3	GL_N2						2.40	0.17
4	GL_N3						2.40	0.17
5	GL_L1 &L2						2.40	0.17
6	GL_Stair						2.40	0.17
7	GL_L3						2.40	0.17
8	GL_N11						2.40	0.17
9	GL_EXT						2.40	0.17
10	GL_E1						2.40	0.17
11	GL_E2						2.40	0.17
12	GL_E3						2.40	0.17
13	GL_S2						2.40	0.17
14	GL_S3						2.40	0.17
15	GL_W1						2.40	0.17

Wall Glazing Area

North	Glazing Reference	Height (m)	Width (m)	Glazing Area (m²)	Shading Reference	Wall Reference	Wall Area (m²)	Total Area (m²)	Internal
1	GL_G	4.07	2.37	9.6459		R1.0	109.5121	119.16	
2	GL_N1	4.07	16.55	67.3585	SH1			67.36	
3	GL_N2	4.07	12.44	50.6308	SH2			50.63	
4	GL_N3	4.07	3.46	14.0822	SH3			14.08	
5	GL_L1 &L2	8.07	35.67	287.8569				287.86	
6	GL_Stair			106.1687				106.17	
7	GL_L3	2.2	22.78	50.116				50.12	
8	GL_EXT			40.18				40.18	
9	GL_N11	2.9	1.92	5.568	SH4			5.57	
10									
11									
12									
13									
14									
15									
16									

	Result	Target				
Wall-glazing U-Value (W/m².K)	2.19	2.00	Glazing Area (m²)	631.607	Average Glazing U-Value (W/m².K)	2.40
Solar Admittance	0.133	0.130	Wall Area (m²)	109.5121	Average Glazing SHGC	0.17
			Glazing to Façade Ratio	85%	Average Wall R-Value (m².K/W)	1.00

East	Glazing Reference	Height (m)	Width (m)	Glazing Area (m²)	Shading Reference	Wall Reference	Wall Area (m²)	Total Area (m²)	Internal
1	GL_E1	4.01	3.41	13.6741	SH5	R1.0	67.8877	81.56	
2	GL_E2	4.01	2.82	11.3082	SH6			11.31	
3	GL_E3	4.01	7.52	30.1552	SH7			30.16	
4	GL_L1 &L2	8.36	9.8	81.928				81.93	
5									
6									

	Result	Target				
Wall-glazing U-Value (W/m².K)	1.94	2.00	Glazing Area (m²)	137.0655	Average Glazing U-Value (W/m².K)	2.40
Solar Admittance	0.084	0.130	Wall Area (m²)	67.8877	Average Glazing SHGC	0.17
			Glazing to Façade Ratio	67%	Average Wall R-Value (m².K/W)	1.00

South	Glazing Reference	Height (m)	Width (m)	Glazing Area (m²)	Shading Reference	Wall Reference	Wall Area (m²)	Total Area (m²)	Internal
1	GL_G	4.07	10.76	43.7932		R1.0	81.2131	125.01	
2	GL_S2	4.07	28.81	117.2567	SH8			117.26	
3	GL_S3	4.07	3.65	14.8555	SH9			14.86	
4	GL_L1 &L2	8.08	41.49	335.2392				335.24	
5	GL_Stair			84.089				84.09	
6	GL_L3	2.56	27.96	71.5776				71.58	

	Result	Target				
Wall-glazing U-Value (W/m².K)	2.25	2.00	Glazing Area (m²)	666.8112	Average Glazing U-Value (W/m².K)	2.40
Solar Admittance	0.143	0.130	Wall Area (m²)	81.2131	Average Glazing SHGC	0.17
			Glazing to Façade Ratio	89%	Average Wall R-Value (m².K/W)	1.00

West	Glazing Reference	Height (m)	Width (m)	Glazing Area (m²)	Shading Reference	Wall Reference	Wall Area (m²)	Total Area (m²)	Internal
1	GL_W1	3.85	10.31	39.6935	SH10	R1.4	317.9844	357.68	
2	GL_G	3.85	8.56	32.956				32.96	
3	GL_EXT	5.38	2	10.76				10.76	
4						R1.4 (Internal)	37.4479	37.45	☑
5									
6									

	Result	Target				
Wall-glazing U-Value (W/m².K)	1.03	2.00	Glazing Area (m²)	83.4095	Average Glazing U-Value (W/m².K)	2.40
Solar Admittance	0.030	0.130	Wall Area (m²)	355.4323	Average Glazing SHGC	0.17
			Glazing to Façade Ratio	19%	Average Wall R-Value (m².K/W)	1.40

Project Summary

Date
11/04/2023

Name
Star of the Sea-Star Centre

Company
ACOR

Position
ESD Engineer

Building Name / Address
Star Centre
80 Martin St, Brighton VIC 3186

Building State
VIC

Climate Zone
Climate Zone 6 - Mild temperate

Building Classification
Class 9b - schools

Storeys Above Ground
3

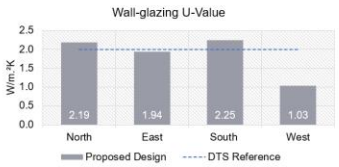
Tool Version
1.2 (June 2020)

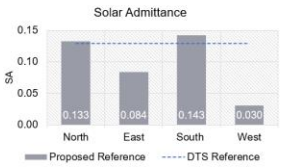
The summary below provides an overview of where compliance has been achieved for Specification J1.5a - Calculation of U-Value and solar admittance - Method 1 (Single Aspect) and Method 2 (Multiple Apects).

Compliant Solution =
Non-Compliant Solution =

	Method 1				Method 2
	North	East	South	West	All
Wall-glazing U-Value (W/m².K)	2.19	1.94	2.25	1.03	1.95
Solar Admittance	0.13	0.08	0.14	0.03	
AC Energy Value					343

Method 1





Method 2