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Project: **Proposed Rosebank College Extension**
1A Harris Road
Five Dock

Report: **Energy Efficiency Evaluation**
Section J of NCC 2019

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SECTION 1 - BASIS OF ASSESSMENT

1.1 THE PROJECT

The proposed development at Rosebank College, 1A Harris Road, Five Dock is a new two level building above a lower level car park.

- The Climate Zone is Climate Zone 5.
- This assessment is based on drawings 19129 DA001-P3, DA002-P3, DA003-P3, DA004-P5, DA005-P6, DA006-P6, DA007-P3, DA008-P3, DA009-P3, DA010-P3, DA011-P2, DA012-P2, DA013-P2, DA014-P2,
- This Report addresses ONLY matters relevant to Section 'J' of Volume 1 of NCC 2019 pertaining to building Class 9b.
- The project is assessed using the Deemed To Satisfy provisions of NCC 2019.

1.2 AUTHOR QUALIFICATION

Michael May is a qualified Electrical Engineer (SAIT – 1980), Certified Energy Manager (CEM)(#92319), Sydney University Training in NCC/BCA - Section 'J' (2007), Member Association of Building Sustainability Assessors, Member Australian Institute of Energy.

1.3 COMPLIANCE

This assessment demonstrates that the project, as specified in the plans and in the recommendations in Section 2 of this report, complies with Section J of the NCC 2019.

Michael May
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SECTION 2 - SUMMARY OF PROVISIONS TO COMPLY

In addition to the information provided in the drawings, the following measures are required to comply with Section J of the NCC 2019. The detailed report includes all supporting information.

PARTS J1-J3 compliance requirements apply to the Conditioned spaces as defined in Appendix 5. The car park and play areas are unconditioned spaces and are exempt from compliance requirements of these sections.

PART J4 is not included in the current BCA.

PARTS J5-J8 compliance requirements apply to the whole development.

2.1 PART J1 – BUILDING FABRIC - conditioned spaces only

Compliance can be met by:

New light coloured metal roof

- *Installing 55mm R1.3 reflective insulating blanket and R1.5 ceiling batt or equivalent in the ceiling cavity, giving a **total 'R-value' of R4.34(downwards)**, which exceeds the required minimum of R3.70.* *OR*
- *Installing R2.5 Ceiling batts & reflective sarking under the roof, giving a **total 'R-value' of R4.04 (downwards),** which exceeds the minimum required of R3.70*

New external brick or block veneer wall

- *Adding R2.50 wall batts in a steel frame to the brick or block veneer wall system, providing an added R-value of R0.65, giving a **total 'R-value' of R1.21.***

New external cladding walls

- *adding R2.50 wall batts in a steel frame and R0.20 thermal break to the cladding wall system, giving a **total 'R-value' of R1.10.***

New suspended floor above the car park areas

- *Adding a R1.5 insulation batt to the concrete slab, giving a **total 'R-value' of R2.31,** which exceeds the required minimum of R2.0.* *OR*
- *Adding a 25mm R1.2 polystyrene product or equivalent to the concrete slab, giving a **total 'R-value' of R2.01,** which exceeds the required minimum of R2.0.*

New External Glazing:

- *Installing all the new windows and glazed doors on both levels with a characteristic equal to or less than a **U-value of 4.9 and a SHGC-value of 0.64,** which can be achieved with clear or neutral low-e type glazing.*

2.2 PART J3 - BUILDING SEALING - conditioned spaces only

Compliance can be met by the following:

- *The new external entry doors to the GLAs must be self-closing.*
- *Any new exhaust fans to have self-closing dampers, including "miscellaneous exhaust fans".*

2.3 PART J5 - A/C & VENTILATION SYSTEMS

Compliance can be met by:

- *Certification by a mechanical engineer if any new air-conditioner is greater than 65kWr.*
- *Ensure any new A/C System has the ability to be inactive when the area is not occupied.*
- *Ensure any new A/C System greater than 2kWr has a 7 day time switch installed.*
- *Ensure any new Mechanical Ventilation system has the ability to be inactive when the area is not occupied.*
- *Ensure any new Mechanical Ventilation system greater than 1000L/s is controlled by a time switch.*

2.4 PART J6 - ARTIFICIAL LIGHTING & POWER

Compliance can be met by:

- *Not exceeding the "Max. Lighting Wattage" for any new lighting in each of the areas in the lighting calculations table in* ***Appendix 2****.*
- *The maximum internal lighting wattage for the car park level must not exceed* ***7,609 watts.***
- *The maximum internal lighting wattage for the mid level must not exceed* ***5,731 watts.***
- *The maximum internal lighting wattage for the upper level must not exceed* ***4,641 watts.***
- *Time switch(s) or motion detector(s) or security card reader(s) must be installed to control at least* ***95%*** *of the lighting in the building.*
- *Decorative or display lighting must be controlled separately from general lighting manually and by a time switch in accordance with specification J6 if the lighting exceeds 1kW*
- *External perimeter lighting including the outdoor gaming lounges must be controlled by either a daylight sensor or a time switch in accordance with specification J6, and have a light source efficiency of not less than 60 lumens/watt if the lighting exceeds 100watts.*

2.5 PART J8 - FACILITIES FOR ENERGY MONITORING

Compliance can be met by:

- *The building must have energy meters for recording time-of-use electricity and gas (if applicable) consumption for the whole building.*

SECTION 3 - DETAILED REPORT OF PROVISIONS TO COMPLY

3.1 PART J1 - BUILDING FABRIC - conditioned spaces only

J1.1 Application - All new parts of the new building envelope need to comply.

Building Envelope

The building envelope for the purpose of Section J is bound by the new external walls, floor and roof of the proposed new two storey building. As shown in Appendix 5

J1.2 Thermal Construction General - Builder is to ensure compliance, during construction.

- Insulation must comply with AS/NZS 4859.1.
- Insulation must abut or overlap adjoining insulation other than at supporting members such as studs, noggings, joists, furring channels where the insulation must be against the member.
- Insulation must form a continuous barrier with ceilings, walls, bulkheads, floors or the like that contribute to the thermal barrier.
- Insulation must not affect the safe or effective operation of a service or fitting.
- Reflective insulation must be installed with the necessary airspace between the reflective side of the insulation and the lining or cladding.
- Reflective insulation must be installed closely against any penetration, door or window opening.
- Each adjoining sheet of roll membrane being overlapped not less than 50mm or taped together.
- Bulk insulation must be installed so that it maintains its position and thickness, other than when it is compressed between cladding and supporting members, water pipes, electrical cabling or the like.
- When selecting insulation caution should be taken to clearly identify the total R-value of the installed roofing and ceiling system or wall system.

J1.3 Roof & Ceiling Construction

(a) In this Climate Zone, the minimum total R-value is R3.70 (downward direction of heat flow).

(b) In this Climate zone the solar absorptance of the upper surface of a roof must be no more than 0.45 (light coloured roof)

The roof & ceiling system is a light coloured metal roof with plasterboard ceiling which requires additional insulation to achieve a minimum total R-value of R3.7(downwards).

Roof & Ceiling Element	R- Value Unventilated- Down
Outside air film	0.04
Metal roof	0.00
Additional insulation	*2.16 minimum*
Reflective Airspace	1.28
Plasterboard	0.06
Internal air film	0.16
Total R-value	**3.70 minimum**

Compliance can be met by:

- *Installing 55mm R1.3 reflective insulating blanket and R1.5 ceiling batt or equivalent in the ceiling cavity, giving a* ***total 'R-value' of R4.34(downwards)****, which exceeds the required minimum of R3.70.*

  OR

- *Installing R2.5 Ceiling batts & reflective sarking under the roof, giving a* ***total 'R-value' of R4.04 (downwards),*** *which exceeds the minimum required of R3.70*

The following table is provided by "Colorbond" to describe their range of roof colours according to the Section J requires. It is reproduced here as a guide.

Colour	Solar Absorptance	BCA Classification	BASIX Classificatio
Classic Cream™	0.32	L	L
Surfmist®	0.32	L	L
Paperbark®	0.42	M	L
Evening Haze®	0.43	M	L
Shale Grey™	0.43	M	L
Sandbank®	0.46	M	L
Dune®	0.47	M	L
Windspray®	0.58	M	M
Pale Eucalypt®	0.60	M	M
Bushland®	0.62	D	M
Headland®	0.63	D	M
Wilderness®	0.65	D	M
Jasper®	0.68	D	M
Manor Red®	0.69	D	M
Woodland Grey®	0.71	D	D
Loft®	0.71	D	D
Monument®	0.73	D	D
Ironstone®	0.74	D	D
Cottage Green®	0.75	D	D
Deep Ocean®	0.75	D	D

J1.4 Roof lights – not applicable

J1.5 Walls-glazing construction

(a) The total system U-value for the Wall-glazing construction must not be greater than U-value 2.0

(b) The total system U-value for display glazing must not be greater than U-value 5.8.

(c) The total system U-value for wall-glazing construction must be calculated in accordance with Specification J1.5a.

(d) Wall components must achieve a minimum total R-value of R1.0 where the wall area is less than 80% of the total wall-glazing area, and in accordance with Table J1.5a where the wall area is 80% or more of the total wall-glazing area.

(e) The solar admittance of externally facing wall-glazing construction must not be greater than that specified in Table J1.5b, namely 0.13 for this climate zone.

(f) The solar admittance of a wall-glazing construction must be calculated in accordance with Specification J1.5a.

(g) The total system SHGC of Display glazing must not be greater than 0.81 divided by the shading multiplier specified in Specification J1.5a.

In this project the new walls have to achieve a minimum R-value of R1.0

Brick or block veneer walls.

Wall Element	R- Value
Outside air film	0.04
Brick or block	0.17
Air gap	0.17
R2.5 wall batts in steel frame	0.65
Plasterboard	0.06
Internal air film	0.12
Total R-value	**1.21**

Compliance can be met by:

- *Adding R2.50 wall batts in a steel frame to the brick or block veneer wall system, providing an added R-value of R0.65, giving a* ***total 'R-value' of R1.21.***

Cladding walls with thermal break and internal plasterboard.

Wall Element	R- Value
Outside air film	0.04
Cladding	0.03
Thermal break	0.20
R2.5 Wall batts with metal frame	0.65
Plasterboard	0.06
Internal air film	0.12
Total R-value	**1.10**

Compliance can be met by:

- *adding R2.50 wall batts in a steel frame and R0.20 thermal break to the cladding wall system, giving a* ***total 'R-value' of R1.10.***

Glazing – method 2 – refer appendix 1

Compliance can be met by:

- *Installing all the new windows and glazed doors on both levels with a characteristic equal to or less than a* ***U-value of 4.9 and a SHGC-value of 0.64,*** *which can be achieved with clear or neutral low-e type glazing.*

J1.6 Floors

(a) A floor must achieve a Total R-Value of R2.0

The concrete suspended slab of the mid level conditioned spaces requires additional insulation to achieve a minimum total R-value of R2.0.

The insulation value of an enclosed subfloor for a floor area to perimeter ration of 5.5 is R0.55 (refer Table 2a below)

Floor Element	R- Value
Indoor air film	0.16
150mm Concrete Slab	0.10
Additional insulation	*1.19 minimum*
Enclosed subfloor insulation	0.55
Total R-value	**2.0 minimum**

Compliance can therefore be met by the following:

- *Adding a R1.5 insulation batt to the concrete slab, giving a **total 'R-value' of R2.31,** which exceeds the required minimum of R2.0.*

  OR

- *Adding a 25mm R1.2 polystyrene product or equivalent to the concrete slab, giving a **total 'R-value' of R2.01,** which exceeds the required minimum of R2.0.*

Table 2a R-Value of sub-floor spaces

Ratio of *floor area* to floor perimeter (m)	Sub-floor space *R-Value*
1.0	0.10
1.5	0.15
2.0	0.20
2.5	0.25
3.0	0.30
3.5	0.35
4.0	0.40
4.5	0.45
5.0	0.50
5.5	0.55
6.0	0.60
6.5	0.65
7.0	0.70

Table 2b R-Value of soil in contact with a floor

Ratio of *floor area* to floor perimeter (m)	Wall thickness of 50 mm	Wall thickness of 100 mm	Wall thickness of 150 mm	Wall thickness of 200 mm	Wall thickness of 250 mm	Wall thickness of 300 mm
1.0	0.4	0.5	0.5	0.6	0.7	0.8
1.5	0.6	0.7	0.7	0.8	0.9	1.0
2.0	0.7	0.8	0.9	1.0	1.1	1.3
2.5	0.9	1.0	1.1	1.2	1.3	1.5
3.0	1.0	1.2	1.3	1.4	1.5	1.7
3.5	1.2	1.3	1.5	1.6	1.7	1.9
4.0	1.3	1.5	1.6	1.7	1.9	2.2
4.5	1.5	1.7	1.8	1.9	2.1	2.4
5.0	1.6	1.8	2.0	2.1	2.3	2.6
5.5	1.8	2.0	2.1	2.2	2.4	2.8
6.0	1.9	2.1	2.3	2.4	2.6	2.9
6.5	2.0	2.3	2.4	2.6	2.8	3.1

3.2 PART J2 - GLAZING

The glazing provisions from NCC 2016 are now included in Part J1.

3.3 PART J3 - BUILDING SEALING - conditioned spaces only

J3.1 Application

Applies to elements forming the envelope of a Class 2 to 9 building other than:

(a) A building in climate zones 1, 2, 3 and 5 where the only means of air-conditioning is by using an evaporative cooler.

(b) A permanent building opening, in a space where a gas appliance is located, that is necessary for the safe operation of a gas appliance.

(c) A building or space where the mechanical ventilation required provides sufficient pressurisation to prevent infiltration.

J3.2 Chimneys and Flues – not applicable

J3.3 Roof Lights – not applicable

J3.4 Windows and doors

All external doors and windows must either have seals to restrict air infiltration or the windows must comply with AS 2047. (fire and smoke doors, roller shutter door or grills are exempt)

A seal for the bottom edge of a swing door must be a draft protection device and for other edges of an external door and openable windows may be a foam or rubber compression strip fibrous seal or the like.

An entrance to a building must have an airlock, self-closing door, revolving door or the like, where the conditioned space has a floor area greater than 50m^2.

Compliance can be met by the following:

- *The new external entry doors to the GLAs must be self-closing.*

J3.5 Exhaust fans

All exhaust fans fitted in a conditioned space must have a sealing device such as a self-closing damper or the like.

Compliance can be met by:

- *Any new exhaust fans to have self-closing dampers, including "miscellaneous exhaust fans".*

J3.6 Construction of roofs, walls and floors

Roofs, walls and floors and any opening such as a window or door must be constructed to minimise air leakage by:

- Enclosed or internal lining systems that are close fitting at ceiling, wall and floor *junctions* or
- Sealed by caulking, skirting, architraves, cornices or the like.

3.4 PART J4 - AIR MOVEMENT- Is not included in the current NCC

3.5 PART J5 - A/C & VENTILATION SYSTEMS

Any new air-conditioning system requires certification by a Mechanical Engineer, where the size of the air-conditioner is greater than 65kWr. For smaller package or split systems the motor efficiency performance is controlled under the Australian Governments Minimum Energy Performance Scheme (MEPS).

Compliance can be met by:

- *Certification by a mechanical engineer if any new air-conditioner is greater than 65kWr.*

A mechanical ventilation system will require certification by a Mechanical Engineer.

General provisions include:

J5.2 Air-conditioning system control

(a) An air-conditioning system –

i. must be capable of being deactivated when the building or part of a building served by that system is not occupied; and
ii. when serving more than one air-conditioning zone or area with different heating or cooling needs, must—
    (A) thermostatically control the temperature of each zone of area; and
    (B) not control the temperature by mixing actively heated air and actively cooled air; and
    (C) limit reheating to not more than—
        (aa) for a fixed supply air rate, a 7.5 K rise in temperature; and
        (bb) for a variable supply air rate, a 7.5 K rise in temperature at the nominal supply air rate but increased or decreased at the same rate that the supply air rate is respectively decreased or increased; and
iii. which provides the required mechanical ventilation, other than in climate zone 1 or where dehumidification control is needed, must have an outdoor air economy cycle, if the total air flow rate of any airside component of an air-conditioning system capacity is greater than or equal to 2000 l/s; and
iv. which contains more than one water heater, chiller or coil, must be capable of stopping the flow of water to those not operating; and
v. with an airflow of more than 1000L/s, must have a variable speed fan when its supply air quantity is capable of being varied; and
vi. when serving a sole-occupancy unit in a Class 3 building, must not operate when any external door of the sole-occupancy unit that opens to a balcony or the like, is open for more than one minute; and
vii. must have the ability to use direct signals from the control components responsible for the delivery of comfort conditions in the building to regulate the operation of central plant; and
viii. must have a control dead band of no less than 2^{o}C, except where a smaller range is required for specialised applications; and
ix. must be provided with balancing dampers and balancing values that ensure the maximum design air or fluid flow is achieved but not exceeded by more than 15% above design at each component or group of components

x. must ensure that each independently operating space of more than 1000m^2 and every separate floor of the building has provision to terminate airflow independently of the remainder of the system sufficient to allow for different operating times; and
xi. when deactivated, must close any motorised outdoor air or return air damper that is not otherwise being actively controlled.

(b) When two or more air-conditioning systems serve the same space they must use control sequences that prevent the systems from operating in opposing heating and cooling modes.

(c) Time switches –
- (i) A time switch must be provided to control –
  - (A) an air-conditioning system of more than 2 kWr; and
  - (B) a heater of more than 1 $kW_{heating}$ used for air-conditioning.
- (ii) The time switch must be capable of switching electric power on and off at variable pre-programmed times and on variable pre-programmed days
- (iii) The requirements of (i) and (ii) do not apply to –
  - (A) an air-conditioning system that serves—
    - (aa) only one sole-occupancy unit in a Class 2 or 3 building; or
    - (bb) a Class 4 part of a building; or
    - (cc) only one sole-occupancy unit in a Class 9c building; or
  - (B) a building where air-conditioning is needed for 24 hour occupancy.

Compliance can be met by:
- *Ensure any new A/C System has the ability to be inactive when the area is not occupied.*
- *Ensure any new A/C System greater than 2kWr has a 7 day time switch installed.*

J5.3 Mechanical ventilation systems control

(a) A mechanical ventilation system, including one that is part of an air-conditioning system, except where the mechanical system serves only one sole-occupancy unit in a Class 2 building or serves only a Class 4 part of a building, must—
- (i) be capable of being deactivated when the building or part of the building served by that system is not occupied; and
- (ii) when serving a conditioned space
  - (A) where in the outdoor air flow is greater than 500 L/s, have
    - (aa) an energy reclaiming system that preconditions outdoor air at a minimum sensible heat transfer effectiveness of 60%; or
    - (bb) demand control ventilation in accordance with AS 1668.2 if appropriate to the application; and
  - (B) not exceed the minimum outdoor air quantity required by Part F4 by more than 20%, except where –
    - (aa) additional unconditioned outdoor air is supplied for free cooling; or
    - (bb) additional mechanical ventilation is needed to balance the required exhaust; or
    - (cc) an energy reclaiming system preconditions all the outside air.
- (iii) For an airflow of more than 1000L/s, have a variable speed fan unless the downstream airflow is required by Part F4 to be constant.

(b) Exhaust Systems – An exhaust system with an air flow rate of more than 1000L/s must be capable of stopping the motor when the system is not needed, except for an exhaust system in a sole-occupancy unit in a Class2,3 or 9c building.

(c) Carpark exhaust systems – Carpark exhaust systems must have a control system in accordance with 4.11.2 or 4.11.3 of AS 1668.2

(d) Time switches –

(i) A time switch must be provided to a mechanical ventilation system with an air flow rate of more than 1000 L/s

(ii) The time switch must be capable of switching electric power on and off at variable pre-programmed times and on variable pre-programmed days

(iii) The requirements of (i) and (ii) do not apply to –

(C) A mechanical ventilation system that serves—

(aa) only one sole-occupancy unit in a Class 2, 3 or 9c building; or

(bb) a Class 4 part of a building; or

(D) a building where air-conditioning is needed for 24 hour occupancy.

Compliance can be met by:

- *Ensure any new Mechanical Ventilation system has the ability to be inactive when the area is not occupied.*
- *Ensure any new Mechanical Ventilation system greater than 1000L/s is controlled by a time switch.*

J5.4 Fan systems

(a) Fans, ductwork and duct components that form part of an air-conditioning system or mechanical ventilation system must separately comply with (b), (c), (d) and (e) or achieve a lower fan motor input power per flowrate than when combining (b), (c), (d) and (e).

Clauses J5.4 (b), (c), (d) and (e) are included in appendix 6

J5.5 Ductwork insulation

(i) Ductwork and fitting in an air-conditioning system must be provided with insulation.

i. Complying with AS/NZS 4859.a, and

ii. Have an insulation R-value greater than or equal to

- R1.0 flexible ductwork
- The same as connecting duct work for cushion boxes
- R1.20 within a conditioned space
- R3.0 where exposed to direct sunlight
- R2.0 all other locations

(ii) Insulation must

i. Be protected against the effects of weather and sunlight, and

ii. Be installed so that it abuts joining insulation to form a continuos barrier and maintains it position and thickness

iii. When conveying cooled air be protected by a vapour barrier on the outside of the insulation.

(iii) These requirements do not apply to:

- Ductwork or fittings located in the last room served, or
- Return air ductwork passing in a conditioned space, or
- Ductwork for outside or exhaust air, or
- The floor of an in-situ air-handling unit, or
- Packaged air-conditioning equipment complying with MEPS, or
- Flexible fan connectors

J5.6 Ductwork sealing

Ductwork in an air-conditioning system with a capacity of 3000 L/s or greater, not located within the only or last room served by the system, must be sealed against air loss in accordance with the duct sealing requirements of AS 4254.1 and AS 4254.2 for the static pressure of the system

J5.7 Pump systems

(a) Pumps and pipe work that form part of an air-conditioning system must separately comply with (b), (c) and (d) or achieve a lower pump motor input power per flowrate than when combining (b), (c) and (d).

Clauses J5.7 (b), (c) and (d) are included in appendix 6

J5.8 Pipework insulation

(a) Piping, vessels, heat exchangers and tanks containing heating or cooling fluid, where the fluid is held at a heated or cooled temperature, that are part of an air-conditioning system, other than in appliances covered by MEPS, must be provided with insulation.
  (i) Complying with AS/NZS 4859.1, and
  (ii) Have an insulation in accordance with Table J5.8a and J5.8b below

Table J5.8a - Piping

Fluid temp range	Min R-value Nom Pipe <40mm	Min R-value Nom Pipe 40-80 mm	Min R-value Nom Pipe 80-150mm	Min R-value Nom Pipe >150mm
Low Temp Chilled <2^{o}C	1.3	1.7	2.0	2.7
Chilled 2^{o}C - 20^{o}C	1.0	1.5	2.0	2.0
Heated 30^{o}C - 85^{o}C	1.7	1.7	1.7	1.7
High Temp heated >85^{o}C	2.7	2.7	2.7	2.7

The minimum R-value may be halved for piping penetrating a structural member

Table J5.8b – Vessels, heat exchangers and tanks

Fluid temp range	Min R-value Nom Pipe <40mm
Low Temp Chilled <2^{o}C	2.7
Chilled 2^{o}C - 20^{o}C	1.8
Heated 30^{o}C - 85^{o}C	3.0
High Temp heated >85^{o}C	3.0

(b) Insulation must-
  (i) Be protected against the effects of weather and sunlight, and
  (ii) Be able to withstand the temperatures within the piping, vessel, heat exchanger or tank.

(c) These requirements do not apply to piping, vessels or heat exchangers
- located in the last room served and downstream of the control device for the regulation of heating or cooling service to that room, or
- encased within a concrete slab or panel which is part of the heating or cooling system, or
- supplied as an integral part of a chiller, boiler or unitary air-conditioner, or
- inside an air- handling unit, fan-coil unit, or the like.

J5.9 Space Heating

(d) A Heater used for air-conditioning or as part of an air-conditioning system must be-
  (i) A solar heater; or
  (ii) A gas heater; or
  (iii) A heat pump heater; or
  (iv) A heater using reclaimed heats from another process such as reject heat from a refrigeration plant; or
  (v) An electric heater if_
    (A) The heater capacity is not more than-
      (aa) 10 W/m^2 of the floor area of the conditioned space in climate zone 1; or
      (bb) 40 W/m2 of the floor area of the conditioned space in climate zone 2; or
      (cc) In this climate zone <500m2 – 65W/m2 or >500m2 – 55W/m2; or
    (B) The annual energy consumption of the heating is not more than 15 kWh/m2 of the floor area of the conditioned space in climate zones 1,2,3,4 and 5; or
    (C) The in-duct heater complies with J5.2(a)(ii)(C); or
  (vi) Any combination of (i) to (v).

(e) An electric heater may be used for heating a bathroom in a class 2,3,9a or 9c building if the heating capacity is not more than 1.2 kW and the heater has a timer.

(f) A fixed heating or cooling appliance that moderates the temperature of an outdoor space must be configured to automatically shut down when-
  (i) There are no occupants in the space served; or
  (ii) A period of one hour has elapsed since the last activation of the heater; or
  (iii) The space served has reached a design temperature.

(g) A gas water heater, that is used as part of an air-conditioning system, must-
  (i) If rated to consume 500MJ/hour of gas or less, achieve a minimum gross thermal efficiency of 86%; or
  (ii) If rated to consume more than 500MJ/hour of gas or less, achieve a minimum gross thermal efficiency of 90.

J5.10 Refrigerant chillers

Refer appendix 6.

J5.11 Unitary air-conditioning equipment

Refer appendix 6.

J5.12 Heat rejection equipment

Refer appendix 6.

3.6 PART J6 - ARTIFICIAL LIGHTING & POWER

J6.1 Application

Parts J6.2, J6.3 and J6.5 (a)(ii) do not apply to a Class 8 electricity network substation.

J6.2 Interior artificial lighting

(b) All artificial lighting for the whole building must not exceed the aggregated maximum Illumination Power Density (IPD) specified in Table J6.2a.(refer Appendix 3).

Compliance can be met by:

- *Not exceeding the "Max. Lighting Wattage" for any new lighting in each of the areas in the lighting calculations table in Appendix 2.*
- *The maximum internal lighting wattage for the car park level must not exceed **7,609 watts.***
- *The maximum internal lighting wattage for the mid level must not exceed **5,731 watts.***
- *The maximum internal lighting wattage for the upper level must not exceed **4,641 watts.***

(c) The lighting limits do not apply to the following:

- Emergency Lighting
- Signage and display lighting
- A heater where it emits light
- Lighting for a specialised process nature
- Lighting for performances such as theatrical or sporting
- Lighting of permanent displays in museums or galleries
- Lighting installed solely to provide Photosynthetically active radiation for plant growth

J6.3 Interior artificial lighting and power control

(a) Artificial lighting of a room or space must be individually operated by a switch or other control device.

(c) An artificial lighting switch must:

(i) Be located in a visible position in the room being switched or in an adjacent room or space from where 90% of the lighting being switched is visible,

(ii) for other than a single function space such as an auditorium, theatre or sporting stadium, not operate lighting for an area greater than 250m^2 if in a Class 5 or Class 8 building, or.

(ii) not operate lighting for an area greater than 250m^2 for a space up to 2000m^2 or up to 1000m^2 for a space greater than 2000m^2

(d) 95% of artificial lighting in a building or storey of a building, other than a Class 2 or 3 building or a Class 4 part, of more than 250m^2 must be controlled by:

(i) A time switch in accordance with Specification J6; or

(ii) An occupant sensing device such as a security key card reader or a motion detector in accordance with Specification J6.

Compliance can be met by:

- *Time switch(s) or motion detector(s) or security card reader(s) must be installed to control at least 95% of the lighting in the building.*

(i) These lighting requirements do not apply to Emergency lighting requirements or where lighting is required for 24 hours occupancy situations.

(j) The requirements of (d) do not apply to the following:

(i) Artificial lighting in a space where the sudden loss of artificial lighting would cause an unsafe situation such as in a patient care area in a Class 9a building or in a Class 9c aged care building.

(ii) A heater where the heater also emits light, such as in bathrooms.

J6.4 Interior decorative and display lighting

(a) Interior decorative and display lighting, such as for a foyer mural or art display, must be controlled:
  (i) Separately from other artificial lighting; and
  (ii) By a manual switch for each area other than when the operating times of the displays are the same in a number of areas such as in a museum, art gallery or the like, in which case they may be combined; and
  (iii) By a time switch in accordance with Specification J6 where display lighting exceeds 1 kW.

(b) Window display lighting must be controlled separately from other display lighting.

Compliance can be met by:
- *Decorative or display lighting must be controlled separately from general lighting manually and by a time switch in accordance with specification J6 if the lighting exceeds 1kW*

J6.5 External artificial lighting

(a) External artificial lighting attached to or directed at the façade of a building, must:
  (i) Be controlled by either a daylight sensor or a time switch that is capable of switching on and off electric power to the system at variable pre-programmed times and on variable pre-programmed days; and
  (ii) When the total perimeter lighting load exceeds 100W, use LED luminaires for 90% of the total lighting load, or be controlled by a motion detector in accordance with Specification J6, or when used for decorative purposes, such as façade lighting or signage lighting, have a separate time switch in accordance with Specification J6.

(b) The requirements of (a)(ii) do not apply to the following:
  (i) Emergency lighting in accordance with Part E4.
  (ii) Lighting around a detention centre.

Compliance can be met by:
- *External perimeter lighting must be controlled by either a daylight sensor or a time switch in accordance with specification J6, and have a light source efficiency of not less than 60 lumens/watt if the lighting exceeds 100 watts.*

NOTE:
- That for smaller rooms a greater Illumination Power Density can be achieved by using a Motion Detector.
- All areas have had the Room Aspect Ration applied.
- For stairwells and corridors the provisions of Part E4 override this Section.

J6.6 Boiling water & chilled water storage units

Power supply to a boiling water or chilled water storage unit must be controlled by a time switch in accordance with Specification J6.

J6.7 Lifts – not applicable

J6.8 Escalators and moving walkways – not applicable

Specification J6

This section contains the requirements for lighting control devices should they be used in the building.

Spec J6.3 Time switch

(a) A time switch must be capable of switching on and off electric power at variable pre-programmed times and on variable pre-programmed days

(b) A time switch for internal lighting must be capable of being overridden by
- a means of turning the lights on
  - by a manual switch or occupant sensing device for a period of 2 hours after which the time switch must resume control or
  - an occupant sensing device that overrides the time switch upon a person's entry and returns control to the time switch on the person's exit (eg security card reader), and
- a manual "off" switch

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

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

Spec J6.4 Motion Detectors

(b) In a Class 5, 6, 7, 8, 9a or 9b building, a motion detector must:
- (i) Be capable of sensing movement such as by infra-red, ultrasonic or microwave detection or by a combination of these means; and
- (ii) Be capable of detecting a person before they have entered 1 m into the space, and movement of 500mm within the useable part of the space; and
- (iii) Not control more than, in other than a car park, an area of 500m^2 with a single sensor or group of parallel sensors and 75% of the lights in spaces using high intensity discharge; and
- (iv) Be capable of maintaining the artificial lighting when activated for a maximum of 30 minutes unless it is reset, and without interruption if the motion detector is reset by movement; and
- (v) Not be overridden by a manual switch to permanently leave the lights on.

(c) When outside a building, a motion detector must:

(i) Be capable of sensing movement such as by infra-red, ultrasonic or microwave detection or by a combination of these means; and

(ii) Be capable of detecting a person within a distance of twice the mounting height or 80% of the ground area covered by the lights beam, and

(iii) Not control more than 5 lights and

(iv) Be operated in series with a photoelectric cell or astronomical time switch so that the lights will not operate in daylight hours, and

(v) Be capable of maintaining the artificial lighting when the switch is turned on for a maximum of 10 minutes unless it is reset, and

(vi) Have a manual override switch which is reset after a maximum period of 4 hours.

Spec J6.5 Daylight sensor and dynamic lighting control device

(a) A daylight sensor and dynamic lighting control device for artificial lighting must:

For switching on and off, be capable of having the switching level set point adjusted between 50 and 10000 lux; and have a delay of more than 2 minutes or a differential of more than 50 lux, and

For dimming or stepped switching, be capable of reducing the power consumed by the controlled lighting in proportion to the incident daylight on the working plane either continuously down or in no less than 4 steps down to a power consumption that is less than 50% of full power.

(b) Where a daylight sensor and dynamic control device has a manual override switch, the manual override switch must not be able to switch the lights permanently on or bypass the lighting controls.

3.7 PART J7 – HEATED WATER SUPPLY, SWIMMING POOL, SPA POOL

J7.2 Heated Water Supply

A heated water supply for food preparation and sanitary purposes must be designed and installed in accordance with Part B2 of the NCC Volume Three – Plumbing Code of Australia.

3.8 PART J8 - FACILITIES FOR ENERGY MONITORING

J8.1 Application

The provisions of this part apply to all buildings except:

- the sole-occupancy of a Class 2 building,
- a Class 4 part of a building or
- a Class 8 electricity network substation.

J8.2 Not included in current NCC

J8.3 Facilities for Energy Monitoring

(a) A building with a floor area greater than 500m^2 must have an energy meter to record time-of-use consumption of gas and electricity.
(b) A building with a floor area greater than 2500m^2 must have energy meters to record time-of-use energy consumption of air-conditioning plant, artificial lighting, appliance power, central hot water supply, internal transport devices, and other ancillary plant.
(c) 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.
(d) the provision of (b) do not apply to a Class 2 Building with a floor of more than 2500m^2 where the total area of common areas is less the 500m^2

Compliance can be met by:

- *The building must have energy meters for recording time-of-use electricity and gas (if applicable) consumption for the whole building.*

SECTION 4 - APPENDICES

APPENDIX 1 – WALL-GLAZING CONSTRUCTION

NCC 2019 Glazing calculator

Project Name	Rosebank College					
Building Class	9b		Class 2,3,5,6,7,8,9a, 9c, ward			
Climate Zone	5		Storey	both levels		
Wall+glazing U-value max limit	2.0					
	N	E	S	W		
Solar Admittance max limit	0.13	0.13	0.13	0.13		
Proposed wall R-value	1.10	1.10	1.10	1.10		
	Method 1				Method 2	
	N	E	S	W	Combined	
Wall+glazing area	330.2	166.4	359.5	166.4	1022.5	
Glazing area	128.2	28.1	112.0	6.4	274.7	
percentage	39%	17%	31%	4%	27%	
Proposed Wall U-value	0.91	0.91	0.91	0.91	0.91	
Proposed Wall+Glazing U-value	2.46	1.58	2.15	1.06		1.98
Proposed Wall+Glazing Solar Admit	0.097	0.038	0.199	0.009		
	Reference combined SHGC Energy Value					144.60
	Proposed combined SHGC Energy Value					144.55

Element	Facing	Height	Width	Area	U-value	SHGC	P	H
GLA south	s	2.00	28.00	56.0	4.90	0.64		
GLA north	n	2.70	28.80	77.8	4.90	0.64	3.1	2.7
office	n	2.70	3.00	8.1	4.90	0.64	levice	
gla doors	e	2.70	5.60	15.1	4.90	0.64	levice	
gla doors	w	3.20	2.00	6.4	4.90	0.64	levice	
GLA south	s	2.00	28.00	56.0	4.90	0.64		
GLA north	n	2.30	14.40	33.1	4.90	0.64	3.1	2.6
gla doors	n	2.30	4.00	9.2	4.90	0.64	4.1	2.6
gla doors	e	2.70	2.10	5.7	4.90	0.64	levice	
office door	e	2.70	2.70	7.3	4.90	0.64	levice	

APPENDIX 2 - LIGHTING CALCULATIONS TABLES

AREA DESCRIPTION	FLOOR DIMENSIONS		AREA (m2)	LIGHT ALLOW	MAX. LIGHTING WATTAGE
	L	B		(W/m²)	(W)
Lower Level					
Car park south	17.2	44.1	757.7	2	**1515**
Car park east	17.2	40.4	695.2	2	**1390**
store	8.7	3.4	29.2	1.5	**68**
Car park ramp	17.2	23.4	403.1	11.5	**4636**
Total Sum					**7609**

AREA DESCRIPTION	FLOOR DIMENSIONS		AREA (m2)	LIGHT ALLOW	MAX. LIGHTING WATTAGE
	L	B		(W/m²)	(W)
Mid Level					
Foyer	13.4	7.8	104.1	9	**1252**
office	5	4.0	20.1	4.5	**148**
circulation	6.5	4.0	25.8	5	**207**
GLA	9.4	7.5	70.3	4.5	**445**
GLA	9.4	7.4	70.0	4.5	**444**
GLA	9.7	7.3	70.6	4.5	**447**
GLA	9.7	7.3	70.6	4.5	**447**
GLA	7.6	10.9	82.6	4.5	**512**
GLA	7.4	9.4	69.7	4.5	**442**
GLA	28.4	9.2	262.5	4.5	**1386**
Total Sum					**5731**

AREA DESCRIPTION	FLOOR DIMENSIONS		AREA (m2)	LIGHT ALLOW	MAX. LIGHTING WATTAGE
	L	B		(W/m^2)	(W)
Upper Level					
Circulation	4.7	7.2	33.8	5	**263**
office	3.2	6.4	20.4	4.5	**151**
toilet	4.1	3.1	12.9	3	**66**
toilet	4.1	2.5	10.2	3	**53**
toilet	4.1	3.2	13	3	**66**
GLA	9.4	7.5	70.2	4.5	**445**
GLA	9.4	7.4	70.0	4.5	**444**
GLA	9.7	7.4	71.3	4.5	**451**
GLA	9.7	7.4	71.3	4.5	**451**
GLA	7.6	10.9	82.6	4.5	**512**
GLA	9.4	7.5	70.9	4.5	**449**
GLA	21.2	10.1	214.9	4.5	**1143**
office	4.8	4.2	20.3	4.5	**149**
Total Sum					**4641**

APPENDIX 3 - TABLE OF MAXIMUM ILLUMINATION POWER DENSITY

Space	Maximum illumination power density ($W/m^{2)}$
Auditorium, church and public hall	8
Board room and conference room	5
Car park - general	2
Car park - entry zone (first 20 m of travel)	11.5
Common rooms spaces and corridors	4.5
Control room, switch room, and the like	3
Corridors	5
Courtroom	4.5
Entry lobby	9
Health-care - Children's ward	4
Health-care - examination room	4.5
Health-care - patient ward	2.5
Health-care - all patient care	2.5
Kitchen and food preparation area	4
Laboratory	6
Library - stack and shelving	2.5
Library - reading room	4.5
Museum and gallery - circulation, cleaning and service lighting	2.5
Office - artificially lit to an ambient level of 200 lux or more	4.5
Office - artificially lit to an ambient level of less than 200 lux	2.5
Plant room	4
Restaurant, café, bar, hotel lounge and a space for the serving and consumption of food or drinks	14
Retail space including a museum and gallery whose purpose is the sale of objects	14
School - general purpose learning area	4.5
Storage with shelving no higher than 75% of the height of the aisle lighting	1.5
Service area, locker room, staff room, cleaner's room, rest room and the like	1.5
Toilet, locker room, staff room, rest room and the like	3
Wholesale storage and display area	4

Notes:

1. In areas not listed above, the maximum *illumination power density* is:
   a) For an illuminance of less than 80 Lux, 2 W/m^2
   b) For an illuminance of less than 80 to 160 Lux, 2.5 W/m^2
   c) For an illuminance of less than 160 to 240 Lux, 3 W/m^2
   d) For an illuminance of less than 240 to 320 Lux, 4.5 W/m^2
   e) For an illuminance of less than 320 to 400 Lux, 6 W/m^2
   f) For an illuminance of less than 400 to 600 Lux, 10 W/m^2
   g) For an illuminance of less than 600 to 800 Lux, 11.5 W/m^2

APPENDIX 4 - EVIDENCE OF COMPLIANCE CHECKLIST

The purpose of this checklist is to itemise the evidence that should be collected during the construction phase of the project that will demonstrate how the final building complies with the Energy Efficiency requirements of Section J of the NCC that were identified during the design phase. Generally, evidence should take the form of delivery receipts, photographs, or signed and dated statements from installers. This following check list is a generic list and some elements may not be applicable to a particular project.

PART J1 - BUILDING FABRIC

Element	Applicable (Y or N)	Evidence
Roof & ceiling insulation		Delivery receipts for roof/ceiling insulation type and rating and/or pictures of insulation installation and the R rating of the insulation.
Wall insulation		Delivery receipts for wall insulation type and rating and/or pictures of insulation installation and the R rating of the insulation.
Floor		Delivery receipts for floor insulation type and rating and/or pictures of insulation installation and the R rating of the insulation.

Or a signed and dated statement from the builder/contractor that the Building Fabric insulation was installed as per the authorised plans and the Energy Efficiency Report.

PART J2 - GLAZING

Element	Applicable (Y or N)	Evidence
Glazing		Delivery receipts for the glazing installed on site including the thermal characteristics of the glazing (U-value and SHGC- value).

Or a signed and dated statement from the builder/contractor that the Glazing was installed with the thermal characteristics as per the authorised plans and the Energy Efficiency Report.

PART J3 - BUILDING SEALING

Element	Applicable (Y or N)	Evidence
Infiltration prevention		Delivery receipts for the number of self closing doors installed.
Exhaust fans		Delivery receipts for the self closing dampers on exhaust fans or pictures showing their installation.

Or a signed and dated statement from the builder/contractor that the self closing doors and/or A/C outlet next to the open shop front was installed as per the authorised plans, specifications and the Energy Efficiency Report.

PART J5 - A/C & VENTILATION SYSTEMS

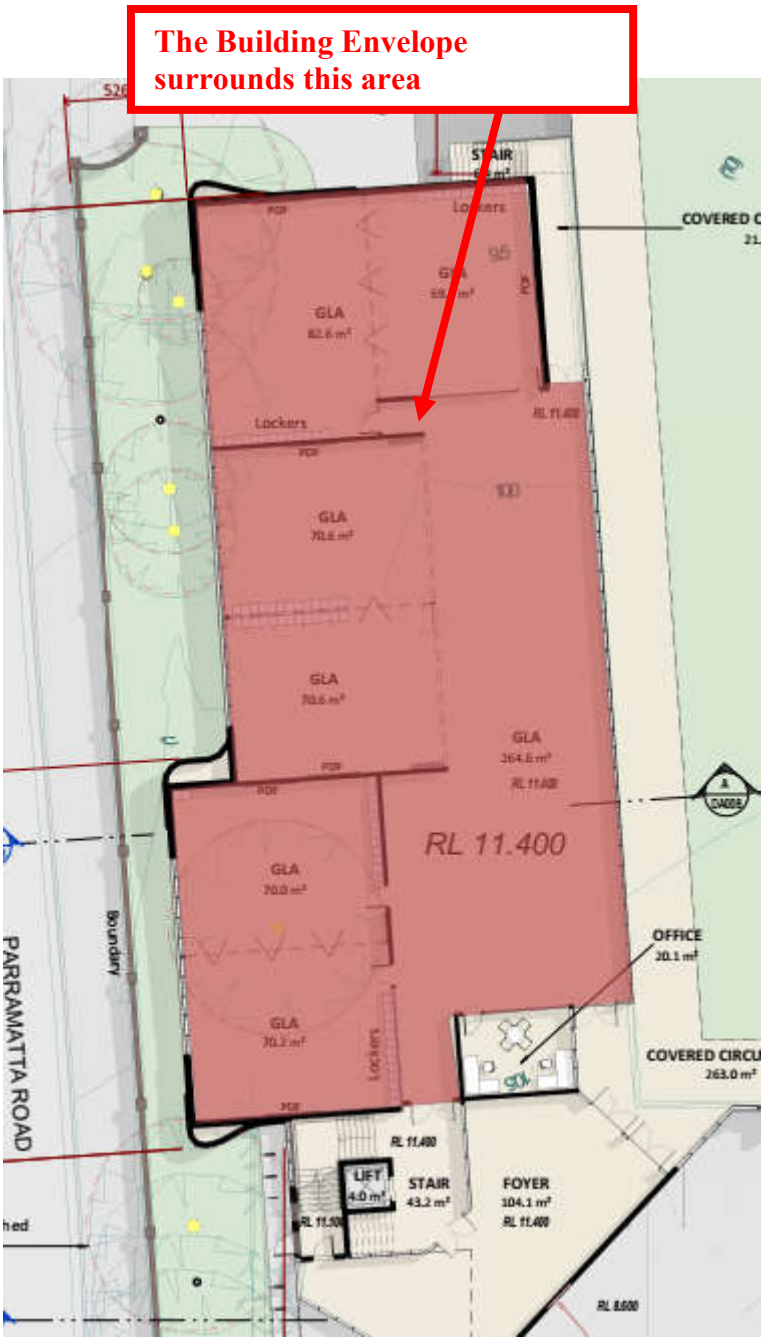
A signed and dated statement from the A/C installer that the A/C system complies with MEPS and complies with all the requirements of Section J of the NCC 2019.

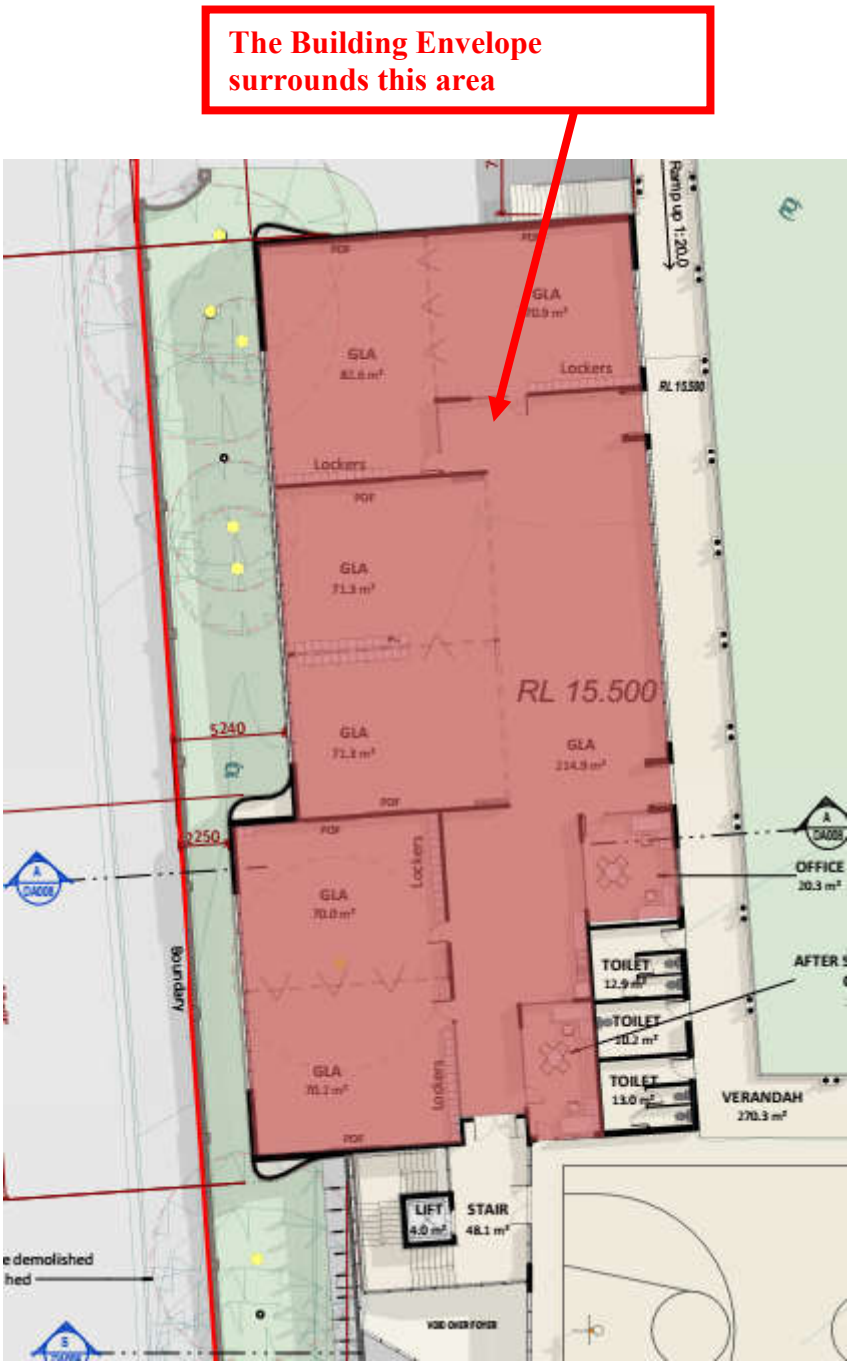
PART J6 - ARTIFICIAL LIGHTING AND POWER

Element	Applicable (Y or N)	Evidence
Internal Lighting		Delivery receipts for the number and wattage of all the internal lights installed.
External lighting		Delivery receipts for the number and wattage of all the external lights installed.

Or a signed and dated statement from the lighting installer that the lighting was installed as per the authorised plans, specifications and the Energy Efficiency Report.

APPENDIX 5 – BUILDING ENVELOPE




The Building Envelope surrounds this area
Ramp up 1:20.0
GLA
Lockers
RL 15.500
GLA
Lockers
GLA
RL 15.500
5240
GLA
GLA
2250
GLA
Lockers
OFFICE
TOILET
TOILET
TOILET
VERANDAH
Boundary
LIFT
STAIR
demolished

APPENDIX 6 – NCC 2019 ADDITIONAL CLAUSES

J5.4 Fan systems

(a) Fans, ductwork and duct components that form part of an *air-conditioning* system or mechanical ventilation system must—

(i) separately comply with (b), (c), (d) and (e); or

(ii) achieve a fan motor input power per unit of flowrate lower than the fan motor input power per unit of flowrate achieved when applying (b), (c), (d) and (e) together.

(b) **Fans—**

(i) Fans in systems that have a static pressure of not more than 200 Pa must have an efficiency at the full load operating point not less than the efficiency calculated with the following formula:

$\eta_{min} = 13 \times \ln(p) - 30$

where—

η_{min} = the minimum *required* system static efficiency for installation type A or C or the minimum *required* system total efficiency for installation type B or D; and

p = the static pressure of the system (Pa).

(ii) Fans in systems that have a static pressure above 200 Pa must have an efficiency at the full load operating point not less than the efficiency calculated with the following formula:

$\eta_{min} = 0.85 \times (a \times \ln(P) - b + N) \ / \ 100$

where—

η_{min} = the minimum *required* system static efficiency for installation type A or C or the minimum *required* system total efficiency for installation type B or D; and

P = the motor input power of the fan (kW); and

N = the minimum performance grade obtained from Table J5.4a; and

a = regression coefficient a, obtained from Table J5.4b; and

b = regression coefficient b, obtained from Table J5.4c; and

ln = natural logarithm.

(iii) The requirements of (i) and (ii) do not apply to fans that need to be explosion proof.

Table J5.4a Minimum fan performance grade

Fan type	Installation type A or C	Installation type B or D
Axial — as a component of an air handling unit or fan coil unit	46.0	51.5
Axial — other	42.0	61.0
Mixed flow — as a component of an air handling unit or fan coil unit	46.0	51.5
Mixed flow – other	52.5	65.0
Centrifugal forward-curved	46.0	51.5
Centrifugal radial bladed	46.0	51.5
Centrifugal backward-curved	64.0	64.0

Notes to Table J5.4a:

1. **Installation type A** means an arrangement where the fan is installed with free inlet and outlet conditions.
2. **Installation type B** means an arrangement where the fan is installed with a free inlet and a duct at its outlet.
3. **Installation type C** means an arrangement where the fan is installed with a duct fitted to its inlet and with free outlet conditions.
4. **Installation type D** means an arrangement where the fan is installed with a duct fitted to its inlet and outlet.

Table J5.4b Fan regression coefficient a

Fan type	Fan motor input power < 10 kW	Fan motor input power ≥ 10 kW
Axial	2.74	0.78
Mixed flow	4.56	1.1
Centrifugal forward-curved	2.74	0.78
Centrifugal radial bladed	2.74	0.78
Centrifugal backward-curved	4.56	1.1

Table J5.4c Fan regression coefficient b

Fan type	Fan motor input power < 10 kW	Fan motor input power ≥ 10 kW
Axial	6.33	1.88
Mixed flow	10.5	2.6
Centrifugal forward-curved	6.33	1.88
Centrifugal radial bladed	6.33	1.88
Centrifugal backward-curved	10.5	2.6

(c) **Ductwork—**

(i) The pressure drop in the index run across all straight sections of rigid ductwork and all sections of flexible ductwork must not exceed 1 Pa/m when averaged over the entire length of straight rigid duct and flexible duct. The pressure drop of flexible ductwork sections may be calculated as if the flexible ductwork is laid straight.

(ii) Flexible ductwork must not account for more than 6 m in length in any duct run.

(iii) The upstream connection to ductwork bends, elbows and tees in the index run must have an equivalent diameter to the connected duct.

(iv) Turning vanes must be included in all rigid ductwork elbows of 90° or more acute than 90° in the index run except where—

(A) the inclusion of turning vanes presents a fouling risk; or

(B) a long radius bend in accordance with AS 4254.2 is used.

(d) **Ductwork components in the index run—**

(i) The pressure drop across a coil must not exceed the value specified in Table J5.4d.

Table J5.4d Maximum coil pressure drop

Number of rows	Maximum pressure drop (Pa)
1	30
2	50
4	90
6	130
8	175
10	220

(ii) A high efficiency particulate arrestance (HEPA) air filter must not exceed the higher of—

(A) a pressure drop of 200 Pa when clean; or

(B) the filter design pressure drop when clean at an air velocity of 1.5 m/s.

(iii) Any other air filter must not exceed—

(A) the pressure drop specified in Table J5.4e when clean; or

(B) the filter design pressure drop when clean at an air velocity of 2.5 m/s.

Table J5.4e Maximum clean filter pressure drop

Filter minimum efficiency reporting value	Maximum pressure drop (Pa)
9	55
11	65
13	95
14	110

(iv) The pressure drop across intake louvres must not exceed the higher of—

(A) for single stage louvres, 30 Pa; and

(B) for two stage louvres, 60 Pa; and

(C) for acoustic louvres, 50 Pa; and

(D) for other non-weatherproof louvres, 30 Pa.

(v) The pressure drop across a variable air volume box, with the damper in the fully open position, must not exceed—

(A) for units with electric reheat, 100 Pa; and

(B) for other units, 25 Pa not including coil pressure losses.

(vi) Rooftop cowls must not exceed a pressure drop of 30 Pa.

(vii) Attenuators must not exceed a pressure drop of 40 Pa.

(viii) Fire dampers must not exceed a pressure drop of 15 Pa when open.

(ix) Balancing and control dampers in the index run must not exceed a pressure drop of 25 Pa when in the fully open position.

(x) Supply air diffusers and grilles must not exceed a pressure drop of 40 Pa.

(xi) Exhaust grilles must not exceed a pressure drop of 30 Pa.

(xii) Transfer ducts must not exceed a pressure drop of 12 Pa.

(xiii) Door grilles must not exceed a pressure drop of 12 Pa.

(xiv) Active chilled beams must not exceed a pressure drop of 150 Pa.

(e) The requirements of (a), (b), (c) and (d) do not apply to—

(i) fans in unducted *air-conditioning* systems with a supply air capacity of less than 1000 L/s; and

(ii) smoke spill fans, except where also used for *air-conditioning* or ventilation; and

(iii) the power for process-related components; and

(iv) kitchen exhaust systems.

J5.7 Pump systems

(a) **General —** Pumps and pipework that form part of an *air-conditioning* system must either—

(i) separately comply with (b), (c) and (d); or

(ii) achieve a pump motor power per unit of flowrate lower than the pump motor power per unit of flowrate achieved when applying (b), (c) and (d) together.

(b) **Circulator pumps —** A glandless impeller pump, with a rated hydraulic power output of less than 2.5 kW and that is used in closed loop systems must have an energy efficiency index (EEI) not more than 0.27 calculated in accordance with European Union Commission Regulation No. 622/2012.

(c) **Other pumps —** Pumps that are in accordance with Articles 1 and 2 of European Union Commission Regulation No. 547/2012 must have a minimum efficiency index (MEI) of 0.4 or more when calculated in accordance with European Union Commission Regulation No. 547/2012.

(d) **Pipework —** Straight segments of pipework along the index run, forming part of an *air-conditioning* system—

(i) in pipework systems that do not have branches and have the same flow rate throughout the entire pipe network, must achieve an average pressure drop of not more than—

(A) for constant speed systems, the values nominated in Table J5.7a; or

(B) for variable speed systems, the values nominated in Table J5.7b; or

(ii) in any other pipework system, must achieve an average pressure drop of not more than—

(A) for constant speed systems, the values nominated in Table J5.7c; or

(B) for variable speed systems, the values nominated in Table J5.7d.

(e) the requirements of (d) do not apply—

(i) to valves and fittings; or

(ii) where the smallest pipe size compliant with (d) results in a velocity of 0.7 m/s or less at design flow.

Table J5.7a Maximum pipework pressure drop - Non-distributive constant speed systems

Nominal pipe diameter (mm)	Maximum pressure drop in systems operating 5000 hours/annum or less (Pa/m)	Maximum pressure drop in systems operating more than 5000 hours/annum (Pa/m)
Not more than 20	400	400
25	400	400
32	400	400
40	400	400
50	400	350
65	400	350
80	400	350
100	400	200
125	400	200
150 or more	400	200

Table J5.7b Maximum pipework pressure drop - Non-distributive variable speed systems

Nominal pipe diameter (mm)	Maximum pressure drop in systems operating 5000 hours/annum or less (Pa/m)	Maximum pressure drop in systems operating more than 5000 hours/annum (Pa/m)
Not more than 20	400	400
25	400	400
32	400	400
40	400	400
50	400	400
65	400	400
80	400	400
100	400	300
125	400	300
150 or more	400	300

Table J5.7c Maximum pipework pressure drop - Distributive constant speed systems

Nominal pipe diameter (mm)	Maximum pressure drop in systems operating 2000 hours/annum or less (Pa/m)	Maximum pressure drop in systems operating between 2000 hours/annum and 5000 hours/annum (Pa/m)	Maximum pressure drop in systems operating more than 5000 hours/annum (Pa/m)
Not more than 20	400	300	150
25	400	220	100
32	400	220	100
40	400	220	100
50	400	220	100
65	400	400	170
80	400	400	170
100	400	400	170
125	400	400	170
150 or more	400	400	170

Table J5.7d Maximum pipework pressure drop - Distributive variable speed systems

Nominal pipe diameter (mm)	Maximum pressure drop in systems operating 5000 hours/annum or less (Pa/m)	Maximum pressure drop in systems operating more than 5000 hours/annum (Pa/m)
Not more than 20	400	250
25	400	180
32	400	180
40	400	180
50	400	180
65	400	300
80	400	300
100	400	300
125	400	300
150 or more	400	300

J5.10 Refrigerant chillers

An *air-conditioning* system refrigerant chiller must comply with *MEPS* and the full load operation energy efficiency ratio and integrated part load energy efficiency ratio in Table J5.10a or Table J5.10b when determined in accordance with AHRI 551/591.

Table J5.10a Minimum energy efficiency ratio for refrigerant chillers — Option 1

Chiller type	Full load operation (W_r / $W_{input\ power}$)	Integrated part load (W_r / $W_{input\ power}$)
Air-cooled chiller with a capacity ≤ 528 kWr	2.985	4.048
Air-cooled chiller with a capacity > 528 kWr	2.985	4.137
Water-cooled positive displacement chiller with a capacity ≤ 264 kWr	4.694	5.867
Water-cooled positive displacement chiller with a capacity > 264 kWr but ≤ 528 kWr	4.889	6.286
Water-cooled positive displacement chiller with a capacity > 528 kWr but ≤ 1055 kWr	5.334	6.519
Water-cooled positive displacement chiller with a capacity > 1055 kWr but ≤ 2110 kWr	5.800	6.770
Water-cooled positive displacement chiller with a capacity > 2110 kWr	6.286	7.041
Water-cooled centrifugal chiller with a capacity ≤ 528 kWr	5.771	6.401
Water-cooled centrifugal chiller with a capacity > 528 kWr but ≤ 1055 kWr	5.771	6.519
Water-cooled centrifugal chiller with a capacity > 1055 kWr but ≤ 1407 kWr	6.286	6.770
Water-cooled centrifugal chiller with a capacity > 1407 kWr	6.286	7.041

Table J5.10b Minimum energy efficiency ratio for refrigerant chillers — Option 2

Chiller type	Full load operation (W_r / $W_{input\ power}$)	Integrated part load (W_r / $W_{input\ power}$)
Air-cooled chiller with a capacity ≤ 528 kWr	2.866	4.669
Air-cooled chiller with a capacity > 528 kWr	2.866	4.758
Water-cooled positive displacement chiller with a capacity ≤ 264 kWr	4.513	7.041
Water-cooled positive displacement chiller with a capacity > 264 kWr but ≤ 528 kWr	4.694	7.184
Water-cooled positive displacement chiller with a capacity > 528 kWr but ≤ 1055 kWr	5.177	8.001
Water-cooled positive displacement chiller with a capacity > 1055 kWr but ≤ 2110 kWr	5.633	8.586
Water-cooled positive displacement chiller with a capacity > 2110 kWr	6.018	9.264
Water-cooled centrifugal chiller with a capacity ≤ 528 kWr	5.065	8.001
Water-cooled centrifugal chiller with a capacity > 528 kWr but ≤ 1055 kWr	5.544	8.001
Water-cooled centrifugal chiller with a capacity > 1055 kWr but ≤ 1407 kWr	5.917	9.027
Water-cooled centrifugal chiller with a capacity > 1407 kWr	6.018	9.264

J5.11 Unitary air-conditioning equipment

Unitary *air-conditioning* equipment including packaged air-conditioners, split systems, and variable refrigerant flow systems must comply with *MEPS* and for a capacity greater than or equal to 65 kWr—

(a) where water cooled, have a minimum energy efficiency ratio of 4.0 W_r / $W_{input\ power}$ for cooling when tested in accordance with AS/NZS 3823.1.2 at test condition T1, where input power includes both compressor and fan input power; or

(b) where air cooled, have a minimum energy efficiency ratio of 2.9 W_r / $W_{input\ power}$ for cooling when tested in accordance with AS/NZS 3823.1.2 at test condition T1, where input power includes both compressor and fan input power.

J5.12 Heat rejection equipment

(a) The motor rated power of a fan in a cooling tower, closed circuit cooler or evaporative condenser must not exceed the allowances in Table J5.12.

(b) The fan in an air-cooled condenser must have a motor rated power of not more than 42 W for each kW of heat rejected from the refrigerant, when determined in accordance with AHRI 460 except for—

(i) a refrigerant chiller in an *air-conditioning* system that complies with the energy efficiency ratios in J5.10; or

(ii) packaged air-conditioners, split systems, and variable refrigerant flow *air-conditioning* equipment that complies with the energy efficiency ratios in J5.11.

Table J5.12 Maximum fan motor power — Cooling towers, closed circuit coolers and evaporative condensers

Type	Cooling tower maximum fan motor input power (W/kW_{rej})	Closed circuit cooler maximum fan motor input power (W/kW_{rej})	Evaporative condenser maximum fan motor input power (W/kW_{rej})
Induced draft	10.4	16.9	11.0
Forced draft	19.5	Note	11.0

Note to Table J5.12: A closed circuit, forced draft cooling tower must not be used.