UNIVERSITY OF TECHNOLOGY SYDNEY

UTS ASRS

BCA SECTION-J
ENERGY EFFICIENCY REPORT

STEENSEN VARMING

AUSTRALIA DENMARK IRELAND UK

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TABLE OF CONTENTS

1 EXECUTIVE SUMMARY

The purpose of this report is to review and assess the proposed refurbishment of the UTS ASRS, against the compliance requirements for the Building Code of Australia (BCA) 2010 provisions for Energy Efficiency under Section J. The objective of the BCA Section J is to reduce greenhouse gas emissions by efficiently using energy in buildings. However, it should be noted that the BCA Section-J provides minimum performance guidelines and does not represent best practice benchmark.

This report will specifically focus only on the 'building envelope' and building material components of the ASRS facility. (It is assumed that the relevant members of the team will ensure compliance with the other component parts of section J – J4 to J8 and hence this report does not include details of these particular sub-sections).

1.1 RATIONALE FOR SUGGESTED APPROACH TO BCA COMPLIANCE

In terms of the external building fabric elements reviewed within this report (external walls, roofs, ceilings, roof lights, external glazing and floors), a simplistic compliance approach with the prescribed 'deemed to satisfy' requirements of the BCA is necessary. This is not only to ensure suitable energy performance characteristics for statutory compliance, but also because any departure from a 'deemed to satisfy' approach would bring with it numerous issues to demonstrate compliance with the intent of Section J.

If we move away from a 'deemed to satisfy' approach, then an alternative verification method is required to demonstrate compliance. The alternative method is quite a complex approach. Hence, the simple 'deemed to satisfy' approach to Section J compliance is suggested.

2 BASIS OF ASSESSMENT

This report has been prepared on the basis of the following documents, provided by architects HASSELL:

S.No.	Drawing Numbers	Revision	Date of Issue
1	A220-F – GA PLAN – LEVEL 00-5	F	22.02.2011
2	A260-F – GA SECTION 01- NORTH-SOUTH - ASRS	F	22.02.2011

3 SCOPE AND LIMITATIONS

This report provides guidance on the BCA Section-J performance requirements for Sections J1 to J3. It should be noted that this report does not provide design certification with respect to compliance with BCA Section J.

The requirements stated in this report need to be reflected in the various design documents as performance parameters that the builder/ contractor need to demonstrate compliance.

The construction details and areas which have been considered for this assessment are based on the drawings provided by the architects "HASSELL".

4 BCA ENERGY EFFICIENCY REQUIREMENTS

Within the BCA 2010, it is a requirement for Class 2 to 9 buildings to achieve efficient use of energy. This requirement is defined in Volume 1 of the 2010 BCA under Section J and is titled "Energy Efficiency". There are eight Deemed-to-Satisfy subsections, J1 to J8, which focus on separate aspects of energy efficiency. These are:

- J1 - Building Fabric
- J2 - External Glazing
- J3 - Building Sealing
- J5 - Air Conditioning and Ventilation Systems
- J6 - Artificial Lighting and Power
- J7 - Hot Water Supply
- J8 - Access for Maintenance and Facilities for monitoring

This report will provide advice on subsections J1 to J3 and will identify how compliance with the BCA 2010 can be achieved for these requirements in regards to the UTS ASRS.

It is assumed that the relevant design professionals will ensure compliance with the relevant sections of the code for their own disciplines, as Steensen Varming will ours. Demarcations of responsibilities are taken as follows:

- J1 – HASSELL (with input from Steensen Varming)
- J2 – HASSELL (with input from Steensen Varming)
- J3 – HASSELL (with input from Steensen Varming)
- J5 – Steensen Varming
- J6 – Steensen Varming
- J7 – Warren Smith & Partners
- J8 – All Disciplines

4.1 BUILDING CLASSIFICATION

The purpose of the spaces within the proposed refurbishment attracts the following classifications:

Location	Use	BCA Classification
Level 00 (RL -5.00)	ASRS	Class 7b (storage)
Level 00.5 (RL -2.10)	ASRS and stores	Class 7b (storage)
Level 01 (RL -2.70)	ASRS and stores	Class 7b (storage)
Level 02 (RL 8.50)	ASRS and stores and loading area	Class 7b (storage)

The above classification has been confirmed by the BCA consultants, Advance Building Approvals (via BCA Compliance Assessment Report dated 23.12.2010).

4.2 BCA CLIMATE ZONE

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

According to Table A1.1of the BCA 2010, Sydney is defined as Climate zone 5.

Fig 1: BCA Climate Zones Map

5 PART J1- BUILDING FABRIC REQUIREMENTS

5.1 PART J1.1 – APPLICATION

As stated in the BCA-2010, the deemed-to-satisfy provisions of Part J1 apply to the building elements forming the envelope of a Class 2 to 9 building; other than a Class 7, 8 or 9b building which do not contain conditioned spaces.

The ASRS is classified as 7b, and is designed to be an air-conditioned space. Hence, Part J1 is applicable to the proposed development.

5.2 PART J1.2 – THERMAL CONSTRUCTION GENERAL

5.2.1 BCA REQUIREMENTS

a) Where thermal insulation is to be installed in exterior envelope wall and roof of the ASRS, insulation must comply with AS/NZS 4859.1 and be installed so that it -

   i. abuts or overlaps adjoining insulation; and
   ii. forms a continuous barrier with ceilings, walls, bulkheads, floors or the like that inherently contribute to the thermal barrier; and
   iii. does not affect the safe or effective operation of a *service* or fitting.

b) Where reflective insulation is to be installed in the wall and roof, the reflective insulation should be installed with -

   i. the necessary airspace to achieve the required R-Value between a reflective side of the reflective insulation and a building lining or cladding; and
   ii. the reflective insulation closely fitted against any penetration, door or window opening; and
   iii. the reflective insulation adequately supported by framing members; and
   iv. each adjoining sheet of roll membrane being -
      A. overlapped not less than 50 mm; or
      B. taped together.

c) Where required, bulk insulation must be installed so that -

   i. it maintains its position and thickness, other than where it crosses roof battens, water pipes, electrical cabling or the like; and
   ii. in a ceiling, where there is no bulk insulation or reflective insulation in the wall beneath, it overlaps the wall by not less than 50 mm.

d) Roof, ceiling, wall and floor materials, and associated surfaces are deemed to have the thermal properties listed in Specification J1.2.

5.2.2 PROPOSED CONSTRUCTION

All constructions including walls, ceilings, floors and roof lights developed by HASSELL must meet the criteria laid out in the following sections, so as to meet the standards set by the 2010 BCA Section J, and as highlighted above.

5.3 PART J 1.3 – ROOF AND CEILING CONSTRUCTION

5.3.1 BCA REQUIREMENTS

For Class 7b building, located in Climate zone 5, a roof or ceiling that is part of the *envelope* must achieve the *Total R-Value* specified in Table J1.3 (a) for the direction of heat flow.

From Table J1.3 (a), the criteria that must be applied to the UTS ASRS is as follows;

- R_{min} (Minimum Total R-value) of 3.2 for roofs and ceilings in general
- Direction of heat-flow should be downwards.

Where, for operational or safety reasons associated with exhaust fans, flues or downlights, the area of required ceiling insulation is reduced, the loss of insulation must be compensated for by increasing the R-value of the insulation in the remainder of the ceiling in accordance with the Table J1.3 (b).

Table J1.3 (b) Adjustment of Minimum R-value for loss of ceiling insulation

Percentage of uninsulated ceiling area	Minimum R-value of ceiling insulation required to satisfy J1.3 (a).							
	2.5	**3.0**	**3.5**	**4.0**	**4.5**	**5.0**	**5.5**	**6.0**
	Adjusted minimum R-value of ceiling insulation required to compensate for loss of ceiling insulation.							
0.5% to less than 1%	2.8	3.4	4.0	4.7	5.4	6.2	6.9	
1.0% to less than 1.5%	2.9	3.6	4.4	5.2	6.1	7.0		
1.5% to less than 2%	3.1	3.9	4.8	5.8	6.8			
2.0% to less than 2.5%	3.3	4.2	5.3	6.5				
2.5% to less than 3%	3.6	4.6	5.9					
3.0% to less than 4.0%	4.2	5.7						
4.0% to less than 5.0%	5.0				**NOT PERMITTED**			
5.0% or more								

A roof that –

i. is required to achieve a minimum total R-value; and
ii. has metal sheet roofing fixed to metal purlins, metal rafters or metal battens; and
iii. does not have a ceiling lining or has a ceiling lining fixed directly to those metal purlins, metal rafters or battens,

must have a thermal break, consisting of a material with an R-Value of not less than R0.2, installed between the metal sheet roofing and its supporting metal purlins, rafters or battens.

5.3.2 PROPOSED ROOF & CEILING CONSTRUCTION

Assessment of the proposed ASRS roofing is presented below:

Opaque Construction | Name: roof\ASRS | Description: flat concrete roof U=0.25 W/m2C

Solar Absorptance		Emissivity		Conductance (W/m²·°C)	Time Constant
Ext. Surf.	Int. Surf.	External	Internal		
0.820	0.400	0.910	0.900	0.326	512.722

Layer	M-Code	Width (...	Conduct...	Convect...	Vapour ...	Density ...	Specific...	Description
Inside	am1plast\1	13.0	0.079	0.0	11.000	400.0	837.0	LIGHTWEIGHT PLAST...
2	am1cav\27	1500.0	0.0	0.025	1.000	0.0	0.0	1000MM AIR (DOWN...
3	am1concd\6	300.0	1.13	0.0	34.000	2000.0	1000.0	DENSITY 1 CONCRET...
4	am1soil\3	1250.0	0.52	0.0	999.000	2050.0	1824.0	EARTH COARSE GRA...

* layer ignored in U-Value/R-Value Calculation

U/R Values (ISO 6946) (Homogenous)

Flow Direction	Internal R Value (m²·°C/W)	External R Value (m²·°C/W)
Horizontal	3.277	3.187
Upward	3.196	3.136
Downward	3.406	3.276

Show U Values | Show R Values

As per above calculations, the R-value of proposed construction (with downward flow) = R 3.40

Minimum R-Value required as per BCA 2010 = R 3.20. Hence, compliance would be achieved.

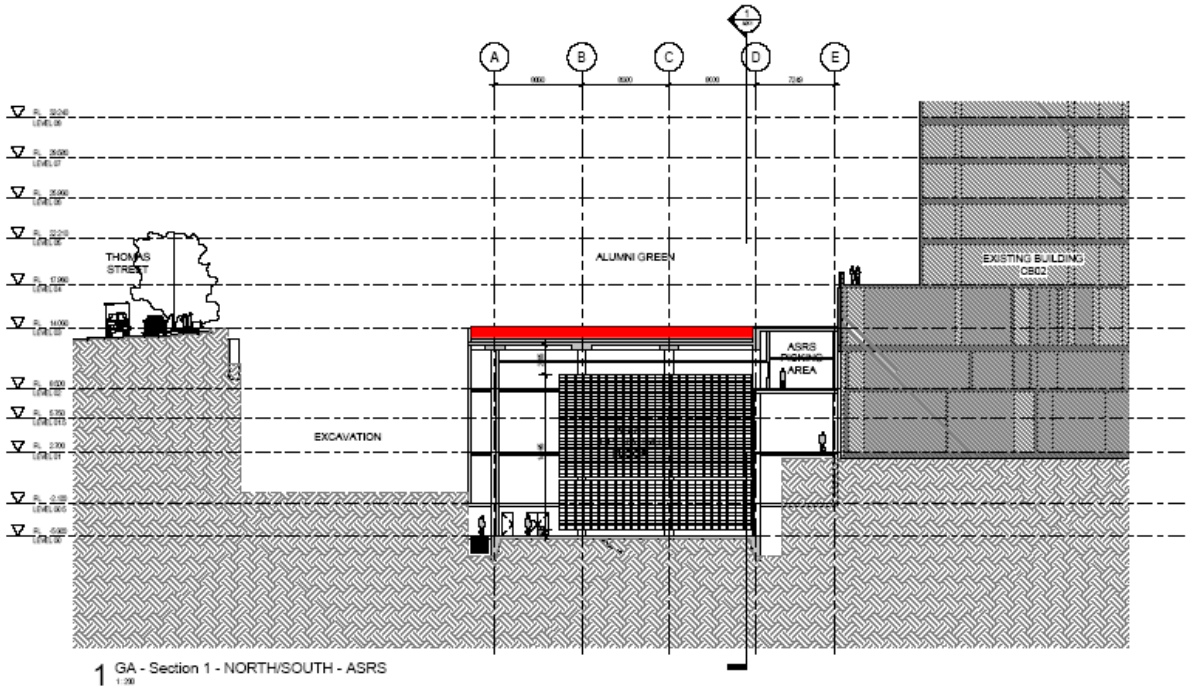

Fig: Highlighted area represents the extent ASRS roof.

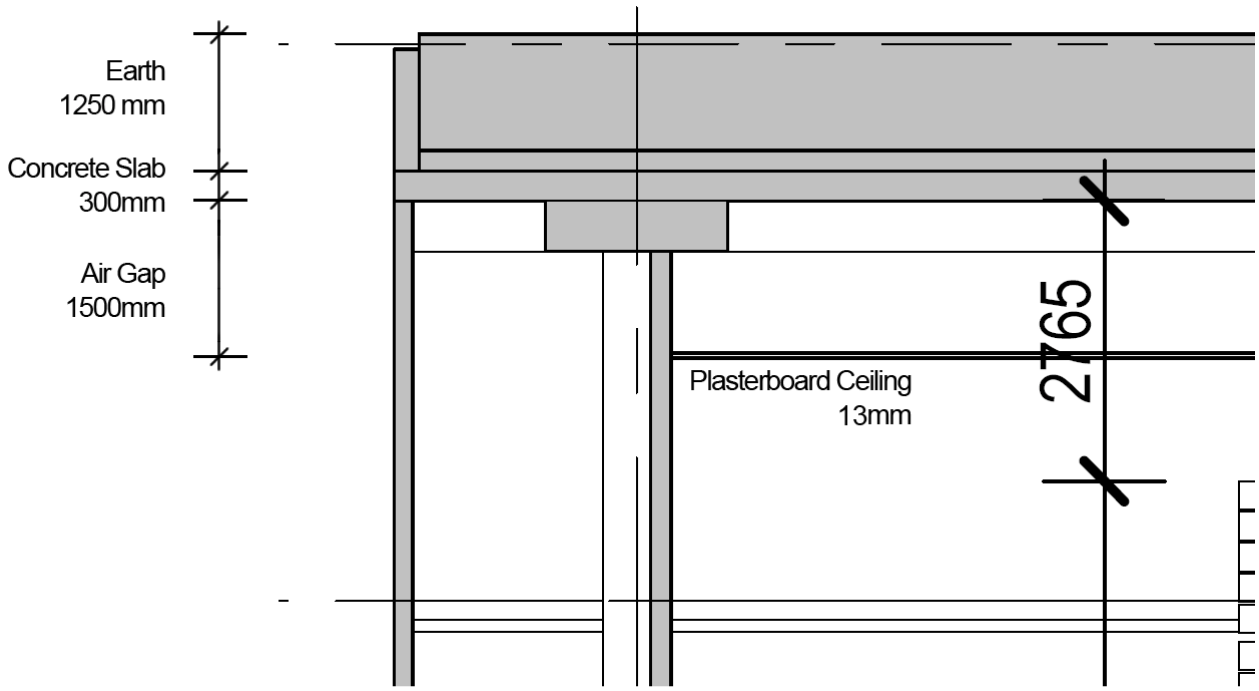

Fig: ASRS roof section

5.4 PART J 1.4 – ROOF LIGHTS

5.4.1 BCA REQUIREMENTS

Roof lights, including any shaft or diffuser, that form part of the envelope of a Class 7b space, must satisfy the following –

a) If the roof-lights are not required for compliance with BCA Part F4, then the roof lights must comply with Table J1.4;

b) Where the roof-lights are required to comply with Part F4, they must –

i. Have an area of not more than 150% of the minimum area required by F4.6; and
ii. Have transparent and translucent elements, including any imperforate ceiling diffuser, with a combined performance of not more than 0.29 SHGC and a Total U-Value of no more than 2.9.

Table J1.4

Table J1.4 ROOF LIGHTS - THERMAL PERFORMANCE OF TRANSPARENT AND TRANSLUCENT ELEMENTS ***Roof light* shaft index (see Note 1)**	**Constant**	**Total area of *roof lights* serving the room or space as a percentage of the *floor area* of the room or space**			
		Up to 2%	**More than 2% to and up to 3%**	**More than 3% and up to 4%**	**More than 4% and up to 5%**
Less than 0.5	*SHGC*	Not more than 0.83	Not more than 0.57	Not more than 0.43	Not more than 0.34
	Total U-Value	Not more than 8.5	Not more than 5.7	Not more than 4.3	Not more than 3.4
0.5 to less than 1.0	*SHGC*	Not more than 0.83	Not more than 0.72	Not more than 0.54	Not more than 0.43
	Total U-Value	Not more than 8.5	Not more than 5.7	Not more than 4.3	Not more than 3.4

1.0 to less than 2.5	*SHGC*	Not more than 0.83	Not more than 0.83	Not more than 0.69	Not more than 0.55
	Total U-Value	Not more than 8.5	Not more than 5.7	Not more than 4.3	Not more than 3.4
2.5 and more	*SHGC*	Not more than 0.83	Not more than 0.83	Not more than 0.83	Not more than 0.83
	Total U-Value	Not more than 8.5	Not more than 5.7	Not more than 4.3	Not more than 3.4

Notes:

1. The *roof light* shaft index is determined by measuring the distance from the centre of the shaft at the roof to the centre of the shaft at the ceiling level and dividing it by the average internal dimension of the shaft opening at the ceiling level (or the diameter for a circular shaft) in the same units of measurement.
2. The total area of *roof lights* is the combined area for all *roof lights* serving the room or space.
3. The area of a *roof light* is the area of the roof opening that allows light to enter the building.
4. The thermal performance of an imperforate ceiling diffuser may be included in the *Total U-Value* and *SHGC* of the *roof light*.
5. The total area of *roof lights* serving the room or space as a percentage of the *floor area* of the room or space must not exceed 5% unless allowed by J1.4(b).

5.4.2 PROPOSED ROOF LIGHT CONSTRUCTION

As no roof lights have been proposed for the ASRS, PART J1.4 is not applicable.

5.5 PART J1.5 – WALLS

5.5.1 BCA REQUIREMENTS

Each part of an external wall that is part of the envelope must satisfy one of the options in Table J1.5a except for—

- opaque non-glazed openings in *external walls* such as doors (including garage doors), vents, penetrations, shutters and the like; and
- *Glazing;* and
- An earth retaining wall or earth-berm, in other than climate zone 8.

5.5.2 PROPOSED WALL CONSTRUCTION

As the external walls of the ASRS are earth retaining walls, PART J1.5 is not applicable.

5.6 PART J1.6 – FLOORS

5.6.1 BCA REQUIREMENTS

a) A floor that is part of the building envelope, including a floor above or below a carpark or a plant room –
   i. Must achieve the Total R-value specified in Table J1.6, and
   ii. With an in-slab heating or cooling system, must be insulated around the vertical edge of its perimeter with insulation having an R-value of not less than 1.0.

b) In *climate zones* 5 (Sydney), the minimum *Total R-Value required* in (a) may be reduced by R0.5 provided R0.75 is added to the *Total R-Value required* for the roof and ceiling construction.

c) A concrete slab-on-ground with an in-slab heating or cooling system must have insulation installed around the vertical edge of its perimeter.

d) The insulation required by (b) must have an R-Value of not less than 1.0, be water-resistant and should be continuous from the adjacent finished ground level to a depth of not less than 300mm; or for the full depth of the vertical edge of the concrete slab-on-ground.

Table J1.6	Location	Climate Zone 5
(a) A slab on ground:	Without an in-slab heating or cooling system	Nil
	With an in-slab heating or cooling system	R 1.25
(b) A suspended floor without an in-slab heating or cooling system where the non-conditioned space is -	Enclosed & Where mechanically ventilated by not more than 1.5 air changes per hour	R 1.00
(c) A suspended floor with an in-slab heating or cooling system where the non-conditioned space is -	Enclosed & Where mechanically ventilated by not more than 1.5 air changes per hour	R 1.25
(d) For other than (a),(b)or (c)		R 2.0

5.6.2 PROPOSED FLOOR CONSTRUCTION

As the ASRS floor is only comprised of a slab on ground with no in-slab heating or cooling, there is a '*Nil'* requirement for Minimum total R-Value.

6 PART J2 – EXTERNAL GLAZING

Part J2 of the 2010 BCA, contains the requirements of the Deemed-to-Satisfy compliance of external glazing. The purpose of this subsection is to ensure that building glazing will provide sufficient thermal insulation, and be appropriately shaded, to minimize heating and cooling loads placed on the building and the associated energy consumption of HVAC systems servicing internal building spaces.

6.1 J2.1 – APPLICATION

As stated by the BCA-2010, Part J2 applies to all classes of buildings, except Class 2, Class 4 parts of buildings and Parts of Class 7, 8 or 9b buildings which do not contain conditioned spaces.

The ASRS being an underground structure does not have any external glazing. Therefore, Part J2 does not apply to ASRS.

6.2 PART J 2.5 – SHADING

Where shading is required to comply with J2.4, it must –

a) Be provided by an external permanent projection, such as a verandah, balcony, fixed canopy, eaves or shading hood, which –
   i. Extends horizontally on both sides of the glazing for the same projection distance P in Figure J2.4; or
   ii. Provides the equivalent shading to (i) with a reveal or the like; or
b) Be provided by an external shading device, such as a shutter, blind, vertical or horizontal building screen with blades, battens or slats, which –
   i. Is capable of restricting at least 80% of the summer solar radiation; and
   ii. If adjustable, is operated automatically in response to the level of solar radiation.

The ASRS project has no proposed external glazing, hence PART J2.5 is not applicable.

7 PART J3 – BUILDING SEALING

Part J3 of the 2010 BCA contains the requirements of the Deemed-to-Satisfy compliance for building sealing. The purpose of this subsection is to ensure that additional heating and cooling loads will not be introduced through building leakage.

7.1 J3.1 - APPLICATION

As stated by the 2010 BCA, Part J3 applies to Class 7b areas in climate zone 5. Therefore, Part J3 applies to the ASRS.

7.1 J3.2 - CHIMNEYS AND FLUES

The chimney or flue of an open burning appliance must be provided with a damper or flap that can be closed to seal the chimney or flue. Steensen Varming will include this requirement within our specification.

7.2 J3.3 - ROOF LIGHTS

The Part J3.3 of the BCA Section J requirements will not apply to the ASRS development, as there would not be any roof lights.

7.3 J3.4 – WINDOWS AND DOORS

The Part J3.4 of the BCA Section J requirements is applicable to the ASRS. The requirements stated below, should be included in the architectural specifications.

Part J3.4 of the 2010 BCA requires that a seal to restrict air infiltration must be fitted to each edge of an external door, openable external window or the like when it is:

- part of the envelope of a conditioned space

The weather seal, which is required for the bottom edge of an external swing door, must be a draft-protection device.

The weather seal may be a foam or rubber compressible strip, fibrous seal or the like. Main entrances to the building, if leading to a conditioned space, must have an airlock, self-closing door, revolving door or the like.

These above requirements do not apply to —

- a window complying with AS 2047; or
- a fire door: or smoke door; or
- a roller shutter door, roller shutter grille or other security door or device installed only for out-of-hours security.

An entrance to the building, if leading to a conditioned space must have an airlock, self-closing door, revolving door or the like, other than –

- where the conditioned space has a floor area of not more than 50m^2.

7.4 J3.5 – EXHAUST FANS

A miscellaneous exhaust fan, such as a bathroom or domestic kitchen exhaust fan, must be fitted with a sealing device such as a self-closing damper or the like when serving a conditioned space or a habitable room in Climate zone 5.

Exhaust fans provided to serve the ASRS development must be fitted with a sealing device such as a self-closing damper or the like, so as to comply with BCA Part J3.5. Steensen Varming will include this requirement within our specification, where applicable.

7.5 J3.6 – CONSTRUCTION OF ROOFS, WALLS AND FLOORS

For all conditioned spaces, the roofs, ceilings, external walls, external floors and any opening such as windows and doors must be constructed to minimise air leakage.

The construction required will be:

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

The above requirements should be included in the architectural specifications.

Part J3.6 does not apply to openings, grilles and the like required for smoke hazard management.

7.6 J3.7 – EVAPORATIVE COOLERS

Evaporative coolers, if provided, must be fitted with a self-closing damper or the like when serving a heated space, or a habitable room or a public area of a building in Climate zone 5.

8 PART J5 - AIR CONDITIONING AND VENTILATIONS SYSTEMS

Steensen Varming will ensure to comply with part J5 of the 2010 BCA and all subsections associated therein.

9 PART J6 – ARTIFICIAL LIGHTING AND POWER

Steensen Varming will provide a design solution compliant to Part J6 of the 2010 BCA and all subsections associated therein with regards to power.

10 PART J7 - HOT WATER SUPPLY

Warren Smith & Partners is engaged to undertake the hydraulic services aspect of this project and it is assumed that they will provide a design solution compliant to Part J7 of the BCA-2010.

11 PART J8 - ACCESS FOR MAINTENANCE & FACILITIES FOR MONITORING

11.1 J8.2ACCESS FOR MAINTENANCE

Access must be provided to all plant, equipment and components that require maintenance in accordance with Part I2.

a) All services and their components, including-

- Time switches and motion detectors
- Room temperature thermostats
- Plant thermostats such as boilers or refrigeration units
- Outside air dampers

- Reflectors, lenses and diffusers of light fittings
- Heat transfer equipment

b) Adjustable or motorised shading devices

11.2 J8.3 FACILITIES FOR ENERGY MONITORING

Facilities for monitoring must be provided, in accordance with the following:

a) A building with a floor area of more than 500m² must have the facility to record the consumption of electricity and gas.
b) A building with a floor area of more than 2,500m² must have the facility to record individually the energy consumption of –

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

11.3 PROPOSED DESIGN FOR ASRS

Steensen Varming will ensure to comply with Part J8 of the 2010 BCA and all subsections associated therein.

It is assumed other consultants will discharge their own responsibilities as appropriate in relation to this section of the BCA.