SYDNEY ADVENTIST HOSPITAL
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Sydney Adventist Hospital

ESD Concept Design Report

Report No S.SAN0102-R01
Date 12 July 2010

engineering sustainable environments

REPORT AUTHORISATION

PROJECT: **SYDNEY ADVENTIST HOSPITAL**
ESD CONCEPT DESIGN REPORT

REPORT NO: **S.SAN0102-R01**

Date	Rev	Comment	Prepared by	Checked by	Authorised by
02-06-10	P1	Preliminary issue	MGY	PAS	AMM
16-06-10	A	EA Issue	MGY	PAS	AMM
08-07-10	B	Revised with Architect comments	MGY	PAS	AMM
12-07-10	C	Revised with PM comments	MGY	PAS	AMM

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EXECUTIVE SUMMARY

This report documents the ecologically sustainable design (ESD) initiatives relevant to the proposed redevelopment of Sydney Adventist Hospital. In accordance with NSW Health regulatory guidelines (TS11), sustainable building design initiatives must be incorporated into the project. Generally, the guidelines require consideration be given to passive design principles, indoor environment quality, energy and water conservation and environmentally-friendly material selection.

Green Star:

The development will be able to achieve a minimum 4-star Green Star rating against the appropriate tool for each building. A base-case 'business-as-usual' assessment was carried out using the Green Star Healthcare version 1 tool, to identify the Green Star credits relevant to the project.

The assessment has shown that 27 points can be achieved with little or no additional impact on the project. An additional 32 "points to be confirmed" have been identified as potentially achievable. These points could not be confirmed at this early stage, as they require detailed modelling and studies in order to confirm them.

Sustainability Initiatives:

A number of ESD features have been identified as viable initiatives for the project. These features have been highlighted as they are considered to have a high relevance to the sustainable outcome of the project. Most are not specifically credited in the Green Star rating tool, but are nonetheless indirectly rewarded through the energy reduction criteria.

The sustainability features identified range from passive design features aimed at reducing energy consumption, water efficiency and conservation and advanced automation and controls.

The extensive east and west façades were analysed using solar performance analysis modelling. The impact of single and double glazing, as well as shadings systems, were analysed to determine the approximate savings on HVAC heat loads and, consequently, energy consumption. Results confirm that high performance glazing significantly reduces the load transmitted through the façade.

BCA Section J:

Section J of the BCA sets regulations for energy efficiency that must be met by the design. To assist in building design, a deemed-to-satisfy (DTS) assessment of the building fabric and glazing requirements was undertaken.

The assessment revealed that bulk insulation materials were needed to achieve compliance for each of the building elements, and low 'e' double glazing in the façade. The conditions and specifications of the assessment are all outlined in the body of the report.

CONTENTS

1 GENERAL

1.1 INTRODUCTION

The purpose of this report is to provide an outline of the ecologically sustainable design (ESD) initiatives for the proposed redevelopment of the Sydney Adventist Hospital (SAH).

1.2 EXISTING BUILDING DESCRIPTION

The Sydney Adventist Hospital is located at 185 Fox Valley Road, Wahroonga NSW, in the Upper North Shore.

The hospital was originally opened in 1903 and was originally called The Sanitarium (the 'San'). The Hospital was rebuilt in 1973 and became an acute care institution. Today the hospital is licensed by the New South Wales Department of Health for 342 beds - making it one of the largest private hospitals in Australia. It was the first private hospital in NSW to be accredited by the Australian Council on Healthcare Standards.

Figure 1 *Sydney Adventist Hospital satellite image*

1.3 PROJECT OUTLINE

In summary, the Master Plan of the development involves the followings works and stages:

New CSB Expansion – Stage 1A – Surgical Precinct

- New building of approximately 11 storeys as an extension to the existing Clinical Services Building (CSB);
- Minor upgrade of existing Clinical Services Building (CSB) at the interfacing with the new building; and
- New car parking deck structure.

New CSB Expansion – Stage 1B – Cancer Precinct

- New building of approximately 6 storeys as an extension to the above Surgical Precinct of the Clinical Services Building.

Education Centre – Stage 2

- New three to four level building accommodating the Education Centre, The Australian Research Institute and other educational support facilities;
- New access roads and infrastructure to meet the new demands of the facility;
- New open walkway between the existing CSB and San Clinic 1 Building; and
- Refurbishment of selected floors in the existing hospital following the relocation of the Faculty of Nursing to the new Education Centre.

New Shannon Wing – Stage 3

- New building of approximately 11 storeys encompassing the New Shannon Wing;
- Refurbishment of selected floors in the existing hospital following the relocation of the Staff, Nurses and Doctors Lounge to Level 5 of the new Shannon Wing; and
- Relocate the Bethel House and memorial Fountain to create the Merritt Kellogg Museum.

1.4 REPORT LIMITATIONS & CONSIDERATIONS

Due care and skill has been exercised in the preparation of this report.

The review of the existing engineering services installation involved visual inspection of the installed plant and distribution system(s).

The investigation required for the preparation of this report did not include:

- An exhaustive examination of all aspects of the existing installation, analysis of design calculations, specifications and as-installed records;
- Possible defects contained in inaccessible sections of the existing installation;
- Physical verification of plant and system capacities and operation;
- Assessment of presence of asbestos or other hazardous building materials;
- Measurement of air and water flow rates and temperatures, electrical loadings, switchboard temperatures etc. unless otherwise noted herein.

In addition, Section 4 which refers to BCA section J is intended as a guide to assist with the application of the BCA Section J. It should be read in conjunction with the BCA 2010 and specific applications may vary during the design development of the project.

The building modelling undertaken for the building provides an estimate of the building's performance. 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 and its operation. As a result, modelling results only represent an interpretation of the potential performance of the building. No guarantee or warrantee of building performance in practice can be based on energy modelling results alone.

Cost estimates included in this report are an opinion of the probable cost of the building services and associated works based on preliminary design concepts and as such could vary within ± 15% of the actual tender price. In addition, the estimates are subject to change due to market fluctuations. Estimates are for building services costs only and do not include for builder's work associated with the building services, design consultants or project management fees.

No responsibility or liability to any third party is accepted for any loss or damage arising out of the use of this report by any third party. Any third party wishing to act upon any material contained in this report should first contact Umow Lai for detailed advice which will take into account that party's particular requirements.

1.5 NSW HEALTH GUIDELINES

The NSW Health facility document, *Technical Series TS11- Engineering Services and Sustainable Development Guidelines* (refer Appendix A), was updated in January 2008 to include additional provisions for sustainable building design.

Generally these provision require consideration be given to passive design, indoor environment quality, energy conservation, water conservation and environmentally sound materials. However, three clauses require specific work to be undertaken for the SAH redevelopment:

Table 1 *Specific work required by TS11*

	TS11 Specific Action Clauses	***Impact on the SAH Project Design***
1.	The development shall be designed to improve upon the minimum requirement of Section J of the Building Code of Australia. It is a requirement of NSW Health that energy modelling be undertaken for all projects larger than $10m. The energy modelling shall be undertaken in accordance with either verification method JV2 or JV3 from the BCA. The facility shall be designed such that the designed energy performance achieves a minimum of 10% improvement when compared with either the "stated value" or the deemed to satisfy reference building.	As part of the changes of the 2010 version of the BCA, the JV2 verification method has been made obsolete. Therefore, energy modelling of the proposed facility will need to be carried out in accordance with the JV3 verification method of the BCA. A 10% improvement on the deemed-to-satisfy (DTS) reference building will need to be achieved by the design. Accordingly, the DTS figures used as a baseline in this early concept design stage incorporated a 10% improvement. (refer Section 4)
2.	For all projects greater than $10m an independent commissioning agent shall be engaged such as to ensure that all mechanical services and automated control systems are commissioned to meet the required function and for minimum energy use. The process shall follow the proforma identified in Greenstar, with appropriate adjustment to suit healthcare.	An Independent Commissioning Agent (IGA) will need to be engaged by the building owner to provide commissioning advice to the design team. The Green Star – Healthcare v1 rating tool outlines the exact provisions of the appointment of the IGA, which must be carried out at the beginning of schematic design. Accordingly, an IGA will need to be engaged as soon as possible. The entire requirements of the IGA are provided in Appendix B.
3.	For all projects greater than $10m the project shall undergo the Greenstar rating process, using the Greenstar Pilot Healthcare Tool, such as to achieve a minimum 4 star rating.	The TS11 guidelines reference the pilot tool, which has been made obsolete by the introduction of version 1 of the Healthcare tool. Thus, the project is required to design a 4-star Green Star building and undertake formal certification by the GBCA

2 GREEN STAR

2.1 OVERVIEW

The Green Star rating system is a comprehensive tool for assessing environmental performance of Australian buildings. The TS11 guidelines require 4-star Green Star certification using the Healthcare v1 tool.

Two types of ratings are available for each project; a 'Design' rating and an 'As-Built' rating. The project design team has been proactive in seeking confirmation from NSW Health as to which of the two ratings is required by the Guidelines.

The Green Star framework establishes nine categories of ESD principles. Points are awarded across each category for credits that are incorporated into the project. The nine environmental categories are listed below:

- Management;
- Indoor Environment Quality;
- Energy;
- Water ;
- Transport;
- Materials;
- Emissions;
- Land Use and Ecology; and
- Innovation.

A comprehensive documentation process that requires input from all parties, is part-and-parcel of the Green Star certification process. The documentation is then verified through two rounds of independent assessments by the Green Building Council of Australia (GBCA).

2.2 GREEN STAR APPLICABILITY

The development will be able to achieve a minimum 4-star Green Star rating against the appropriate tool for each building. Based on the nature of the proposed buildings, the following tools will be used for the assessment of the relevant stages:

- Stage 1: Green Star Healthcare v1;
- Stage 2: Green Star Education v1; and
- Stage 3: Green Star Healthcare v1.

2.3 BUSINESS-AS-USUAL ASSESSMENT

A business-as-usual assessment was undertaken against the current Green Star Healthcare v1 tool, to assess the pertinent credits for the project. The graphs below present the results of the assessment, indicating that 4-stars can be achieved by the project.

The assessment has shown that 27 points can be achieved with little or no additional impact on the project. An additional 32 “points to be confirmed”, shown in grey in the below graphs, have been identified as potentially achievable. These points could not be confirmed at this early stage, as they require detailed modelling and studies in order to confirm them.

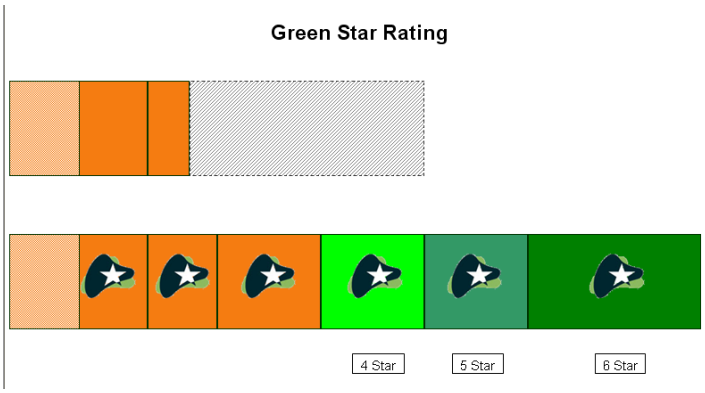


Figure 2 *The easily achievable points and TBC points (grey) against the Green Star scale of 4-stars.*

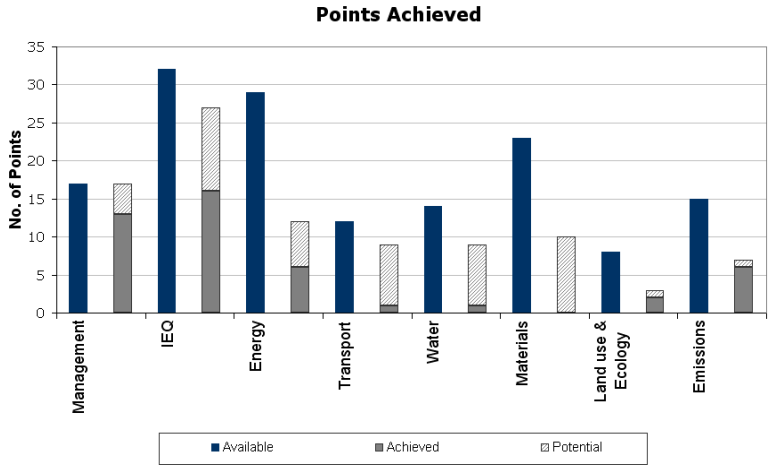


Figure 3 *The projected points by category.*

2.4 CREDIT SUMMARY

The following schedule summarises the available credit points in the Healthcare tool, outlining the generally achievable points and points to be confirmed:

Green Star - Healthcare v1 Credit Summary				
Title	**Credit No.**	**Points Available**	**Points Achieved**	**Points to be Confirmed**
Management				
Green Star Accredited Professional	Man-1	2	2	0
Commissioning Clauses	Man-2	2	2	0
Building Tuning	Man-3	1	1	0
Independent Commissioning Agent	Man-4	1	1	0
Building Guides	Man-5	1	1	0
Environmental Management	Man-6	2	2	0
Waste Management	Man-7	2	2	0
Building Management Systems	Man-9	1	1	0
Maintainability	Man-11	1	1	0
Construction Indoor Air Quality Plan	Man-12	3	0	3
Sustainable Procurement Guide	Man-13	1	1	0
	TOTAL	**17**	**14**	**3**
Indoor Environment Quality				
Ventilation Rates	IEQ-1	4	2	0
Air Change Effectiveness	IEQ-2	2	0	2
CO2 Monitoring & Control and VOC Monitoring	IEQ-3	1	0	1
Daylight	IEQ-4	3	1	1
Thermal Comfort	IEQ-5	2	0	2
Hazardous Materials	IEQ-6	1	NA	0
Internal Noise Levels	IEQ-7	1	1	0
Volatile Organic Compounds	IEQ-8	5	4	1
Formaldehyde Minimisation	IEQ-9	1	1	0
Mould Prevention	IEQ-10	1	0	0
Daylight Glare Control	IEQ-11	1	0	1
High Frequency Ballasts	IEQ-12	1	1	0
Electric Lighting Levels	IEQ-13	1	1	0
External Views	IEQ-14	2	1	0
Individual Thermal Comfort Control	IEQ-15	2	0	2
Exhaust Riser	IEQ-16	1	1	0
Air Distribution System	IEQ-17	1	1	0
Outdoor Pollutant Control	IEQ-18	1	1	0
Places of Respite	IEQ-19	1	1	0
	TOTAL	**32**	**16**	**10**
Energy				

Green Star - Healthcare v1 Credit Summary

Title	Credit No.	Points Available	Points Achieved	Points to be Confirmed
Conditional Requirement	Ene-Con	Conditional Requirement	Yes	/
Greenhouse Gas Emissions	Ene-1	20	0	4
Energy Sub-metering	Ene-2	1	1	0
Peak Energy Demand Reduction	Ene-3	2	0	2
Lighting Zoning	Ene-4	2	1	0
Car Park Ventilation	Ene-6	3	3	0
Efficient External Lighting	Ene-9	1	1	0
	TOTAL	**29**	**6**	**6**
Transport				
Provision of Car Parking	Tra-1	2	0	0
Fuel-Efficient Transport	Tra-2	1	0	0
Cyclist Facilities	Tra-3	3	0	3
Commuting Mass-Transport	Tra-4	5	0	0
Transport Design and Planning	Tra-6	1	1	0
	TOTAL	**12**	**1**	**3**
Water				
Occupant Amenity Water	Wat-1	5	0	2
Water Meters	Wat-2	1	1	0
Landscape Irrigation	Wat-3	2	0	2
Heat Rejection Water	Wat-4	4	0	4
Fire System Water	Wat-5	1	0	1
Potable Water Use for Equipment	Wat-6	1	0	1
	TOTAL	**14**	**1**	**10**
Materials				
Recycling Waste Storage	Mat-1	1	0	1
Building Re-use	Mat-2	0	na	0
Recycled Content & Re-used Products & Materials	Mat-3	2	0	1
Concrete	Mat-4	3	0	1
Steel	Mat-5	2	0	1
PVC	Mat-6	2	0	1
Timber	Mat-7	1	0	1
Design for Disassembly	Mat-8	1	0	0
Dematerialisation	Mat-9	1	0	0
Flooring	Mat-11	3	0	1
Joinery	Mat-12	1	0	1
Loose Furniture	Mat-13	4	0	1
Ceilings, Walls and Partitions	Mat-14	2	0	1
	TOTAL	**23**	**0**	**10**
Land Use & Ecology				
Conditional Requirement	Eco-Con	Conditional Requirement	Yes	/
Topsoil	Eco-1	1	0	1

Green Star - Healthcare v1 Credit Summary

Title	Credit No.	Points Available	Points Achieved	Points to be Confirmed
Re-use of Land	Eco-2	1	1	0
Reclaimed Contaminated Land	Eco-3	2	0	0
Change of Ecological Value	Eco-4	4	1	0
	TOTAL	**8**	**2**	**1**
Emissions				
Refrigerant ODP	Emi-1	1	1	0
Refrigerant GWP	Emi-2	2	0	0
Refrigerant Leaks	Emi-3	2	0	1
Insulant ODP	Emi-4	1	1	0
Watercourse Pollution	Emi-5	2	2	0
Discharge to Sewer	Emi-6	4	0	0
Light Pollution	Emi-7	1	1	0
Legionella	Emi-8	1	0	1
Trade Waste Pollution	Emi-9	1	1	0
	TOTAL	**15**	**6**	**2**
Sub-total weighted points:			**27**	**32**
Innovation				
Innovative Strategies and Technologies	Inn-1	2	0	0
Exceeding Green Star Benchmarks	Inn-2	2	0	0
Environmental Design Initiatives	Inn-3	1	0	0
	TOTAL	**5**	**0**	**0**
Total weighted points:			**27**	**32**

2.5 POINTS TO BE CONFIRMED

In order to achieve the minimum 4-star rating, a combination of the following credits are required to be achieved.

Table 2 *Summary of to be confirmed points*

Credit	Points TBC	Comments
Management		
MAN-12 Construction Indoor Air Quality Plan	3	This is a new credit to the Green Star rating tools. Requires the development and implementation of a Construction Indoor Air Quality (IAQ) Plan. Given the nature of the project and proximity to the existing buildings, it is expected that indoor air quality plans will be required as part of the project and this part of the requirement is simply an extension of those plans. The IAQ plan must include the requirement for all ductwork to be clean in accordance with NADCA CR 2006 standards prior to occupancy.
Indoor Environment Quality		
IEQ-2 Air Change Effectiveness	2	Air Change effectiveness is a function of the age of the air in the space occupied before it is exhausted. Air conditioning systems such as displacement ventilation meet this requirement fairly easily. It may be possible to meet the requirements of this credit with conventional ceiling diffuser, however it requires careful selection and layout of diffusers. CFD modelling will be required in either case.
IEQ-3 Carbon Dioxide and VOC Monitoring and Control	1	This credit can be achieved in one of two ways: 1. Measuring the VOC and CO_2 levels and actively controlling outside air based on these levels; or 2. Using a HVAC system with 100% outside air.
IEQ-4 Daylight	1	60% of areas are required to achieve minimum daylight factors or illuminance, as opposed to the 30% that has been allowed for. Daylight modelling will be required.
IEQ-5 Thermal Comfort	2	Thermal comfort modelling is required to demonstrate this credit based on the selected air-conditioning system.
IEQ-8 Volatile Organic Compounds	1	It is expected that all paints, adhesives/sealants, flooring, wall & ceiling coverings will be low VOC. To achieve the additional point mattresses are required to be Low VOC.
IEQ-11 Daylight Glare Control	1	This credit can be achieved in one of two ways: 1. Fixed shading devices which exclude direct sun for 80% of the year. Modelling is required; or 2. Individually controlled blinds or screens are fitted on all glazing.
IEQ-15	2	It is proposed that 80% of in-patient rooms will have individual thermal comfort control. Additional control of the administration

Credit	Points TBC	Comments
Individual Thermal Comfort Control		areas will need to be demonstrated to achieve these points.
Energy		
ENE-1 Greenhouse Gas Emissions	4	The energy consumption of the building can be improved in a number of ways. The primary method is the air conditioning system, however lighting and lighting control have a significant impact on the energy consumption. Building energy modelling will be required.
ENE-3 Peak Energy Demand Reduction	2	To achieve this credit, the design strategies generally require the use of co-generation, micro-turbines, photovoltaics, ice storage, phase change materials, or other 'big-ticket' systems.
Transport		
TRA-3 Cyclist Facilities	3	Space for staff and visitor bicycle storage, change and shower facilities would need to be incorporated into the building design.
Water		
WAT-1 Occupant Amenity Water	2	The specification of high WELS-rated fixtures and fittings has traditionally been able to achieve 2 points.
WAT-3 Landscape Irrigation	2	This credit can be achieved in one of two ways: 1. Design of a rainwater recycling system for landscape irrigation; or 2. Installing a xeriscape garden that does not require irrigation.
WAT-4 Heat Rejection Water	4	If no water-based heat rejection air-conditioning system is selected, then automatically achieves 4-points.
WAT-5 Fire System Water	1	This credit can be achieved in one of two ways: 1. Design of test water storage system for reuse on-site, which can be integrated with the landscape irrigations system; or 2. The fire protection system does not expel water for testing.
WAT-6 Potable Water Use for Equipment	1	This credit can be achieved in one of two ways: 1. 95% of the water requirements for once-through cooling of medical and lab equipment is sourced from non-potable water; or 2. 95% of all water-cooled medical and lab equipment uses cooling systems other than once-through cooling systems.
Materials		
MAT-1 Recycling Waste Storage	1	A dedicated recycling waste storage space is required that meets a number of conditions outlined in the technical manual.
MAT-3 Recycled Content & Re-used Products & Materials	1	Recycled materials represent at least 1% of the project's total contract value.
MAT-4	1	Reduced Portland cement quantities and replacement with industrial waste products or oversized aggregate.

Credit	Points TBC	Comments
Concrete		
MAT-5 Steel	1	Specific steel requirements are required to be met.
MAT-6 PVC	1	At least 60% of the PVC uses in the project are required to comply with the Best Practice Guidelines criteria.
MAT-7 Timber	1	95% of all timber products used are Forest Stewardship Council certified.
MAT-11 Flooring	1	Correct flooring, based on the Flooring Calculator, is selected.
MAT-12 Joinery	1	Correct joinery, based on the Joinery Calculator, is selected.
MAT-13 Loose Furniture	1	Correct furniture, based on the Furniture Calculator, is selected.
MAT-14 Ceilings, Walls & Parturitions	1	Correct ceilings, walls and partition materials, based on the Calculator, is selected.
Land Use & Ecology		
ECO-1 Topsoil	1	This credit requires a careful study into the quantity of topsoil present on site and a management plan describing the extent of construction works and its effect on topsoil. Plan must demonstrate how the integrity of the topsoil will be protected throughout the works.
Emissions		
EMI-3 Refrigerant Leaks	1	HVAC system containing refrigerants are contained in a moderately airtight enclosure and a refrigerant leak detection system is installed.
EMI-8 Legionella	1	If no water-based heat rejection air-conditioning system is selected, then automatically achieves credit point.

3 SUSTAINABILITY INITIATIVES

In accordance with the TS11 guidelines and the pursuit of sustainable design practice, the SAH redevelopment will incorporate a number of ESD initiatives. In addition to industry recognition, these ESD initiatives will serve to reduce the impact on the environment and minimise the costs associated with the running of the building.

3.1 PASSIVE DESIGN FEATURES

Passive design features play an important role in reducing the electrical energy consumption of the facility. Passive design features, if included early in the design stage, do not add significant cost to the development. The following sections list the proposed passive design features that are relevant to the development:

3.1.1 Building Fabric

Building Fabric design and materials such insulation and glazing, need to be optimally determined. An optimally designed building fabric will reduce the size and the cost of mechanical and electrical services infrastructure as well as the operating costs.

The Deemed-to-Satisfy (DTS) provisions of the 2010 BCA Section J set out the minimum thermal performance requirement for building elements, including roofs, walls, floors and glass. Although the TS11 guidelines require JV3 alternative verification, which involves detailed energy modelling, a 10% improvement on the DTS requirements will serve as the base case.

The following table presents the minimum requirements for the building fabric:

Table 3 *BCA DTS and TS11 building fabric requirements*

Building Element	BCA DTS Minimum R-value (W/m^2K)	TS11 Improved R-value (W/m^2K)
Roof	3.2	3.52
Walls	2.8	3.08
Floors	2.0	2.2

The complete BCA Section J requirements and specific façade glazing will be discussed in section 4 of this report.

3.1.2 Building Orientation

Generally, to utilise the benefits of passive solar design in Australian climates, most glazed areas should face north and incorporate a system of shading devices and overhangs that will exploit the altitude variation of the sun's path by providing shading during summer and allowing solar penetration during winter months.

Due to the orientation of the building on site this will not be possible, as the major façade's are oriented towards east and west, which will require significant glazing for ward rooms. This will have a significant impact on HVAC size and energy consumption. It will also increase glare due to low morning and evening sun angles.

Therefore the treatment of the east and west facing windows will be critical to exceed the requirements of section J and reduce energy consumption.

3.1.3 Façade Design

3.1.3.1 Modelling Overview

Due to the height of the building, the façade plays a critical role in the thermal performance of the building, as well as occupant thermal comfort.

Generally, horizontal external shading overhangs work well on the northern façade but are not effective on the east and west facades, where the sun angle falls below the line of the shading and produces a high solar load in summer.

The proposed façade system for the SAH redevelopment was examined using shadow analysis and solar exposure modelling. The analysis was undertaken using annual Sydney design weather data, and is based on peak summer temperature profiles. Due to the invariable nature of the façade, two typical ward layouts were modelled on the eastern and western facades.

The figures below illustrate the typical wards modelled:

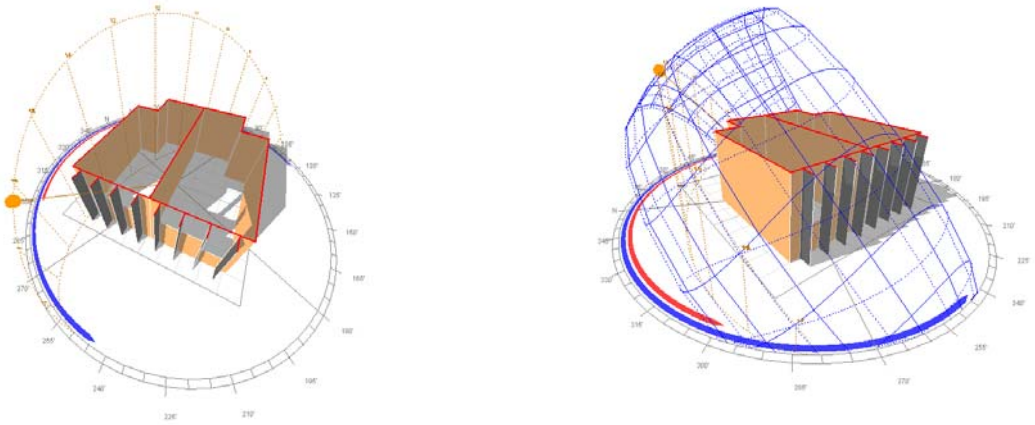


Figure 4 *Ecotect software model of typical façade cell with daily and annual solar paths*

3.1.3.2 Glass and Shading Scenarios

The following two glass types were used in the modelling

Table 4 *Specification of modelled glass*

Description	U-value (W/m^2K)	SHGC
Standard aluminium-framed single glazing	5.8	0.81
Double glazed low 'e' on aluminium framing	1.7	0.29

The single-glazed scenario was considered the reference base-case for the modelling analysis. Two other scenarios were then modelled in comparison to the base-case:

- Double glazed low 'e' glass with no shading; and
- Double glazed low 'e' glass with straight vertical louvres (600mm depth and spread apart at a distance of 975mm).

3.1.3.3 Modelling Results and Analysis

The table below outlines the modelling results for the scenarios outlined above. Cost savings have been approximated based on a coefficient-of-performance (COP) of 3.5.

Table 5 *Façade shading modelling results*

Description	Glazing Specification	Vertical Shading	Transmitted Solar Heat (W/m^2)	Net Heat Reduction (W/m^2)	Percentage Reduction (%)	HVAC Cost Saving ($/year)
East Façade	Single Glazed	None	354	-	-	-
	Double Glazed Low E	None	109	245	69.2%	$18,713
		Straight	99	255	72.0%	$19,476
West Façade	Single Glazed	None	447	-	-	-
	Double Glazed Low E	None	136	311	69.6%	$23,753
		Straight	113	334	74.8%	$25,510

As can be clearly seen, the savings afforded by the double glazed low ‘e’ glass over the standard single glazed, are significant. In addition to these considerable savings, single glazing would not achieve compliance against the BCA Section J requirements for glazing. Hence, the use of high performance double glazed low ‘e’ glass is considered an essential attribute of the building façade.

3.2 DOMESTIC HOT WATER

3.2.1 Solar Hot Water Collectors

To supplement an already efficient central gas-fired domestic hot water system, a solar boosted system is proposed (Figure 5). The system involves using evacuated-tube solar collectors on the roof to collect radiant heat from the sun. Using advanced controls, the system can be integrated with the gas-fired boiler to provide substantial pre-heating of the water, thus reducing the load on the boiler.

A solar hot water system with 100m^2 collectors will save approximately 70,000 kWh of electricity per year. This equates to a savings of around $9,500 p.a. This will additionally reduce CO_2 equivalent gas emissions by 64 tonnes per year, which is a substantial environmental benefit.

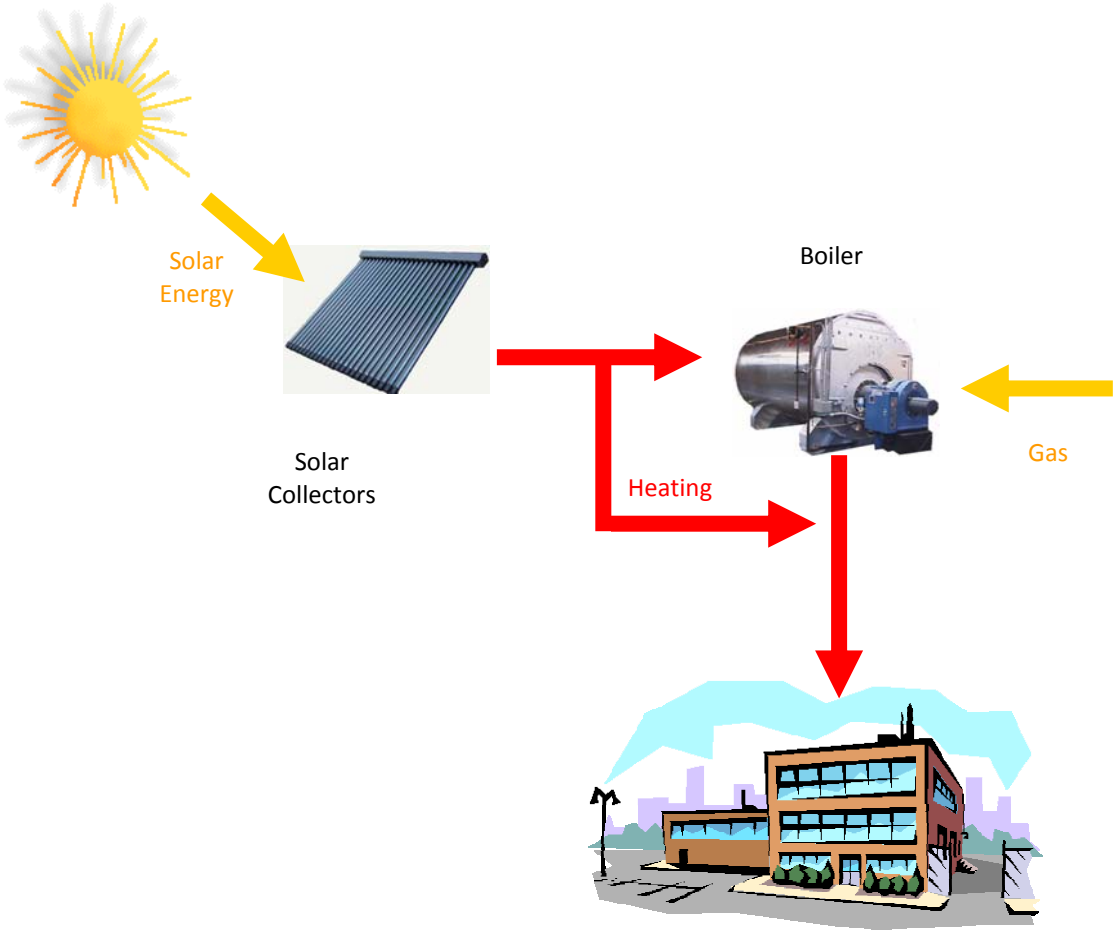


Figure 5 *Diagrammatic representation of solar-boosted hot water system.*

3.2.2 Air Conditioning Heat Recovery

Another option currently being investigated is the use of heat recovery from air conditioning systems. Air conditioning plant generates high volumes of low temperature hot water, this heat can be utilised to preheat the domestic hot water system by up to 20%.

3.3 AIR CONDITIONING SYSTEM

A detailed study of air conditioning types has been carried out for the SAH redevelopment, refer to the Air Conditioning Options Report, dated 14th April, 2009.

A summary of the results from this report are included in Appendix C.

It has been decided that the project shall employ a Variable-Air-Volume (VAV) air conditioning system; a system that has been used extensively around the world. As the name implies, the volume of air supply is varied to meet the temperature requirements of individual rooms and zones. VAV systems use variable speed drives (VSD's) on the supply air fan so that when the air conditioning requirement is low, the fans can slow down, thus saving fan energy.

A dedicated ceiling-mounted VAV box is provided for each room, and varies the quantity of supply air in the duct. The VAV box is connected to the Building Management System (BMS) and can therefore be controlled independently. This means that the set point in each room can be adjusted to meet patient request or to reduce energy when rooms are not in use.

The most frequent complaint about air conditioning in hospitals is cold air drafts blowing on patients in bed. Using conventional 4-way blow diffusers with VAV will not mitigate such complaints. It is therefore recommended that ceiling-mounted 'swirl diffusers' be used (refer Figure 6). These diffusers serve to reduce the amount of air blown directly on the patients by distributing the supplied air more evenly.

Figure 6 *Swirl ceiling-mounted diffusers*

The main benefits of VAV air conditioning systems include:

- Good control and thermal comfort;
- Central plant and recirculation of air throughout the building;
- Minimal distributed chilled water throughout the building;
- Minimal maintenance requirements in patient areas; and
- Extensive precedent use and contractor experience.

3.4 ADVANCED CONTROLS & AUTOMATION

Well designed and implemented controls are fundamental to achieving sustainable systems. While some of the controls strategies listed may seem obvious, it is alarming how often they are not included in projects. Due to their high importance in achieving a successful, sustainable project, they have been summarised in this section.

3.4.1 Building Management System

Building Management Systems (BMS) provide intelligent control to electrical and mechanical systems. The BMS varies the output of energy systems in accordance with actual indoor and outdoor conditions, which saves energy, reduces greenhouse gas emissions, prolongs equipment life and reduces maintenance. Therefore, despite the high upfront costs, the financial payback period of a BMS system is usually very short.

3.4.2 Economy Cycle

Economy cycle can be implemented for the air handling systems where outside ambient conditions are favourable and less than the internal conditions. In this case the cooling system turns off and the air handling system runs on full outside air and full relief air exhaust. This is a method of providing free cooling.

3.4.3 Variable Speed Drives

The cooling loads in the building in summer and during seasons with mild weather are significantly lower than the designed load. Therefore it is possible to reduce the supply air quantity during these periods without compromising the comfort conditions in the spaces and the minimum ventilation requirements set by Australian standard AS1668.2.

Variable Speed Drives (VSDs) will be installed on supply and return air fans in the AHUs. The VSD will be linked to the BMS. Weather conditions will dictate operational parameters.

VSDs on chilled water pumps that would be controlled by a pressure differential signal, hence maintaining minimum speeds required to provide sufficient water flow through the chiller.

3.4.4 CO_2 Monitoring

The existing quantity of air has been designed for the maximum occupancy level. However, during various periods of the day, occupancy levels vary significantly. Therefore it is not necessary to provide the design fresh air quantity when occupancy is low.

The installation of CO_2 sensors in the return air ducts will monitor CO2 levels and adjust levels of fresh air accordingly via dampers. This initiative will reduce energy consumption.

3.4.5 Lighting and Lighting Controls

Where artificial lighting is necessary, low energy lighting systems which reduce lighting costs and improve lighting quality should be employed. The following ESD initiatives associated with artificial lighting are currently being examined:

- Fluorescent luminaires to utilise high output T5 type lamps and electronic dimmable control gear to decrease energy usage while maintaining light output;
- Utilisation of compact fluorescent high efficiency lamps and electronic ballasts alleviating the use of incandescent or halogen lights; and
- Utilisation of high frequency electronic ballasts installed in all fluorescent luminaires to increase internal environment quality by avoiding low frequency flicker that may be associated with artificial lighting

In addition, lighting zoning should be arranged to facilitate optimal switching. Accordingly, lighting zones should be separated into functional spaces, which have the ability to be switched on or off according to the operational needs. If an automatic programmable lighting system (such as DALI or equivalent system) is installed, future changes in internal building layout will not require the re-wiring of the lighting system, but merely reprogramming.

Consideration is also being given to the installation of photoelectric cells to either automatically switch off or initiate dimming of interior lighting when daylight levels are sufficient.

Finally, occupancy sensors may also be used in areas where occupancy levels are sporadic to switch off lights when areas are unoccupied. Typical areas that may employ occupancy sensors are: meeting rooms, offices, toilets, utility rooms and outdoor areas.

3.4.6 Electrical Sub Metering

In successfully managing energy consumption it is important that sufficient data is available to building managers to allow them to monitor consumption and compare historical data and trends. Sub-metering allows building managers to fine-tune operational procedures to peak load lop, thereby minimising consumption and detecting any operational problems early.

This could include separate metering for:

- Chillers;
- Air handling fans;
- Heat pumps;
- Common area light and power; and
- Additional items which have a large energy use.

3.5 WATER EFFICIENCY AND RECYCLING

3.5.1 Water Efficient Fittings

Water efficient fixtures and fittings will be used throughout the project. This includes high-efficient fixtures and fittings for water basins, water closets, shower heads and waterless urinals.

By utilising these fittings, the occupant amenity potable water efficiency will be equivalent to a 5-star WELS rating as defined under the Water Efficiency Labelling & Standards (WELS) scheme.

In addition, waterless urinals or low water use urinals are a more recent introduction to the market and provide a cost effective way to achieve dramatic savings in water consumption. Waterless urinals require no flushing water connection and have no moving parts. The surface of the urinal is designed to shed urine and dry out. The trap at the base of the urinal is specially designed with a special sealing gel that prevents any odour transfer from the urine in the trap to the air.

3.5.2 Rainwater Harvesting

Rainwater harvesting is the capture of rainwater that is then filtered and finally stored for use both in and around buildings. Rain can be harvested from roofs, paved and unpaved areas and from stormwater drains. The amount harvested is dependent on rainfall quantity, rainfall pattern (the number of rainy days) and collectible area. The rain can then be stored in water tanks located above or below ground.

If it is absolutely certain that the water will not be used for drinking or washing, a simple filter to remove dirt particles and leaves will be sufficient before storage in a holding tank – this includes use for toilet flushing and watering purposes.

3.5.3 Stormwater Retention & Treatment

It is recommended that the following strategies be implemented to achieve a sufficient stormwater retention and treatment.

- Oil and sediment separators should be used in car parks and other point of high traffic density.
- Permeable paving materials, such as porous asphalt or porous concrete are highly effective in car parks and other paved areas.
- Grass-lined swales or channels can be used to treat run-off from roads with check damns intermittently spaced down the channel to reduce water velocity and improve treatment.

3.5.4 Water Efficient Irrigation

To reduce the consumption of potable water for landscape irrigation, systems that reuse water collected on site and utilise water efficient distribution systems are recommended. The project provides particular incentive to utilise water conserving systems as there will be extensive areas of landscape. On-site water collection systems include rainwater and stormwater collection. All landscape irrigation systems should comprise of subsoil drip systems and automatic timers with rainwater or soil moisture sensor control override.

Planting drought-tolerant vegetation, minimising lawn areas and using drip irrigation can reduce water use in the garden by 50% to 70% and overall water consumption by 20% to 25%. In addition, it is recommended to:

- Group plants with similar water requirements on common zones to match precipitation heads;

- Use drip irrigation for trees, shrub beds and areas of groundcover to eliminate evaporation losses;
- Choose low-volume, low-angle sprinklers for lawn areas;
- Select heads that fit the size and shape of the areas to be watered;
- Program automatic controllers for night irrigation to reduce losses due to evaporation and wind drift;
- Select controllers with adjustable watering schedules and moisture sensors to account for seasonal variations, and calibrate them during commissioning;
- Where possible, use rainwater for irrigation; and
- Place 7.5 to 10cm of mulch on planting beds each spring to minimize evaporation.

3.5.5 Fire Systems Water Consumption

Opportunity for saving potable water consumption is also currently being investigated, whereby sufficient temporary storage for fire protection system test water is provided and maintenance drain-downs for reuse onsite. Alternatively, a facility for the pump out and recovery of water for use off site can be utilised. This will enable the reduction of unnecessary waste of potable water during maintenance of fire services which can be considerable.

3.5.6 Water Meters

All major uses of water will be metered in order to monitor and improve rates of water consumption. This includes central domestic hot water and domestic cold water, irrigation systems, rainwater system and food court water consumption. By connecting the water meters to the BMS, this will also function as a water leak detection system to prevent excessive amounts of wasted potable water.

4 BCA SECTION J

4.1 INTRODUCTION

4.1.1 BCA Section J Compliance

Section J of the BCA sets regulations for energy efficiency for all types of buildings with respect to the building's nature, design and activity. The BCA offers two compliance methods that differ in complexity and flexibility.

The two compliance methods are:

- Deemed-To-Satisfy compliance.
- JV3 – Verification using a referenced building.

As outlined previously, the NSW Health sustainable building guideline *Technical Series TS11-Engineering Services and Sustainable Development Guidelines* (refer Appendix A), requires the undertaking of energy modelling in accordance with the JV3 provisions. Furthermore, a 10% improvement on the DTS provisions within the reference building models are required. This analysis shall be undertaken in the detailed design stage.

The following sections will provide an assessment of building fabric and glazing according to Deemed-to-Satisfy (DTS) provisions, incorporating the required 10% improvement. This will serve to identify the high-level building fabric and glazing requirements.

4.1.2 Building Fabric & Insulation

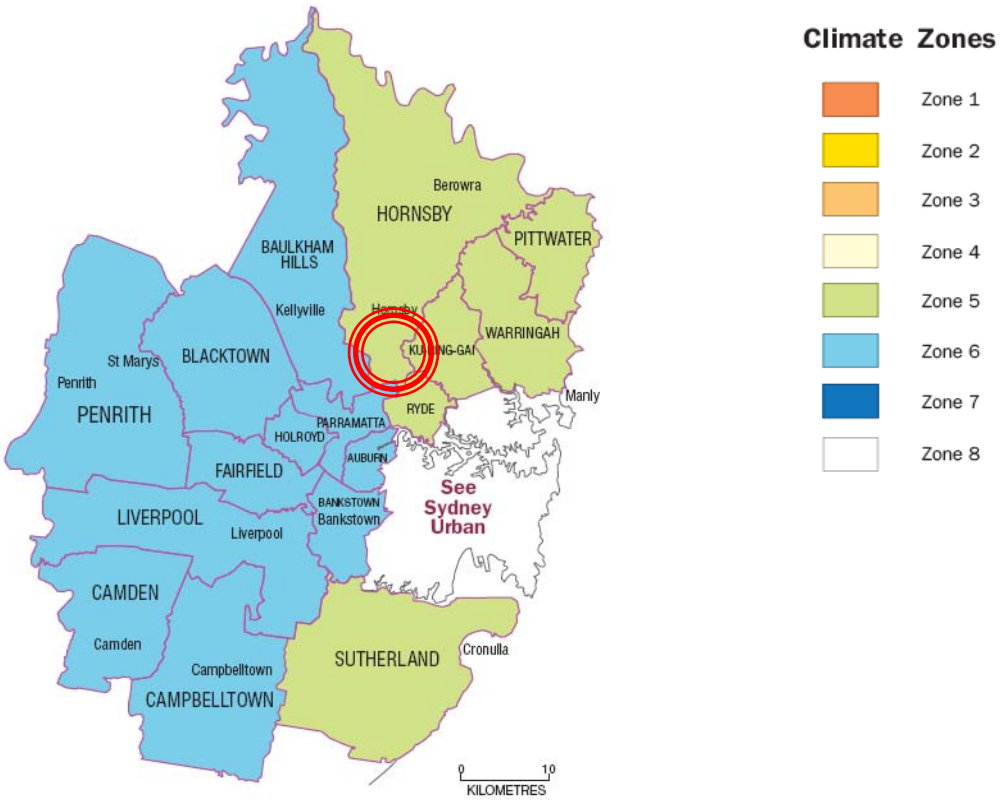
There are a wide range of insulation types that can be applied to this project to achieve BCA compliance, both in materials (eg: thermal barriers, convective insulators); and manufacturer (eg: Air-cell, Fletcher, CSR Bradford). This report is mainly limited to compliance being achieved through the use of standard convective or conductive insulators, commonly known as bulk insulation.

As a guide for the client to achieve compliance, a common market product has been used as a suggested solution (egg: Bradford 'Anticon'). A similar product from another manufacturer can be substituted provided that product achieves, as a minimum, the R-values required.

4.1.3 Building Classification & Climate Zone

The facility is located in Climate Zone 5 and is classified as a 9a building.

Figure 7 *Map of BCA Climate Zones for Sydney region.*



4.2 SECTION J1 BUILDING FABRIC

4.2.1 J1.1 Application of Part

Deemed to Satisfy provisions apply to building elements forming the envelope of all Class 9a spaces.

4.2.2 J1.2 Thermal Construction General

The installation requirements of J1.2 Thermal Construction General shall be complied to by the relevant building contractor.

4.2.3 J1.3 Roof and Ceiling Construction

The roof and ceiling construction is typically required to have a **minimum total R-value of 3.2**.

The following table outlines the proposed solid concrete roof structure of the facility with the corresponding R-value of each element:

Building Element	R-value
Outdoor air film	0.04
Rubber waterproof membrane	0.03
100mm solid concrete	0.07
100mm – 300mm non-reflective roof airspace	0.22
10mm plasterboard ceiling	0.06
Indoor air film	0.16
Total	**1.05**

This roof/ceiling construction achieves a total R-value of **1.05**.

To satisfy the minimum requirements, R2.15 of extra thermal resistance is needed within the roof/ceiling structure. The following table outlines a modified construction type that achieves compliance:

Building Element	R-value
Outdoor air film	0.04
Rubber waterproof membrane	0.03
100mm solid concrete	0.07
95mm Bradford Anticon Faced Glasswool Blanket	2.30
100mm reflective roof airspace	1.06
10mm plasterboard ceiling	0.06
Indoor air film	0.16
Total	**3.72**

This roof/ceiling construction achieves a total R-value of **3.72**, which satisfies the minimum BCA requirements and the 10% improvement requirement of TS11.

4.2.4 J1.4 Roof Lights

Any externally-placed glazed or transparent elements that permit natural light to enter the room below, or are at an angle of 0-70 degrees measured from the horizontal plane, are considered by the BCA as roof lights and require specific thermal performance.

4.2.5 J1.5 External Walls

The external wall construction is typically required to achieve a **minimum total R-value of 2.8**.

The following table outlines the proposed external wall structure of the facility with the corresponding R-value of each element:

Building Element	R-value
Outdoor air film	0.04
230mm precast concrete	0.12
20mm – 40mm non-reflective airspace	0.17
10mm plasterboard	0.06
Indoor air film	0.12
Total	**0.51**

This wall construction achieves a total R-value of **0.51**.

To satisfy the minimum requirements, a minimum R2.29 of extra thermal resistance is needed within the wall structure. The following table outlines a modified construction type that achieves compliance:

Building Element	R-value
Outdoor air film	0.04
230mm precast concrete	0.12
Sisalation reflective foil	0.00
Minimum 20mm reflective roof airspace	0.48
110mm Bradford Glasswool Partition Batts (11kg/m^3)	2.50
10mm plasterboard	0.06
Indoor air film	0.12
Total	**3.32**

This wall construction achieves a total R-value of **3.32**, which satisfies the minimum BCA requirements and the 10% improvement requirement of TS11.

4.2.6 J1.5 Internal Walls

The internal wall construction separating the conditioned and non-conditioned spaces, are typically required to achieve a **minimum Total R-value of 1.8**.

The following table outlines the proposed internal wall structure of the facility with the corresponding R-value of each element:

Building Element	R-value
Indoor air film	0.12
10mm plasterboard	0.06
70mm non-reflective airspace	0.17
10mm plasterboard	0.06
Indoor air film	0.12
Total	**0.53**

This wall construction achieves a total R-value of **0.53**.

To satisfy the minimum requirements, a minimum R1.27 of extra thermal resistance is needed within the wall structure. The following table outlines a modified construction type that achieves compliance:

Building Element	R-value
Indoor air film	0.12
10mm plasterboard	0.06
65mm Fletcher Pink Batts	1.50
Minimum 20mm non-reflective roof airspace	0.17
10mm plasterboard	0.06
Indoor air film	0.12
Total	**2.03**

This wall construction achieves a total R-value of **2.03**, which satisfies the minimum BCA requirements and the 10% improvement requirement of TS11.

4.2.7 J1.6 Floors

The floor construction separating the conditioned and non-conditioned spaces, are typically required to achieve a **minimum Total R-value of 2.0**. This includes a floor above or below a carpark or a plantroom.

In this particular climate zone, the minimum Total R-value of 2.0 may be reduced by R0.5 provided R0.75 is added to the Total R-value required for the roof and ceiling construction.

The following table outlines the proposed floor structure of the facility with the corresponding R-value of each element:

Building Element	R-value
Indoor air film	0.16
10mm vinyl tiles	0.05
150mm solid concrete	0.10
Indoor air film	0.16
Total	**0.47**

This wall construction achieves a total R-value of **0.47**.

To satisfy the minimum requirements, a minimum R1.53 of extra thermal resistance is needed within the floor structure. The following table outlines a modified construction type that achieves compliance:

Building Element	R-value
Indoor air film	0.16
10mm vinyl tiles	0.05
150mm solid concrete	0.10
80mm Bradford Glasswool building blanket	1.80
Indoor air film	0.16
Total	**2.27**

This floor construction achieves a total R-value of **2.27**, which satisfies the minimum BCA requirements and the 10% improvement requirement of TS11.

4.3 BCA SECTION J2 EXTERNAL GLAZING

4.3.1 J2.1 Application of Part

The Deemed-to-Satisfy Provisions of this part apply to the elements forming the envelope of the Class 9a conditioned spaces of the facility.

The Australian Building Codes Board (ABCB) provides a calculator for ascertaining how much glazing is permitted on each storey of each building façade.

4.3.2 J2.4 Glazing

The permitted window area is a function of the facade area, window thermal performance and shading on the facade.

High performance low 'e' double glazing with the following specifications was modelled throughout the facades:

- U-value: 1.7 W/m^{2}K
- SHGC: 0.29

A significant feature of the façade is the shading provided by the vertical fins. As the glazing calculator is not able to simulate vertical shading devices, the shading provided by the fins was measured using the solar exposure models. This was then entered into the glazing calculator as 1080mm deep overhangs, with a 2050mm offset from the bottom of the frames.

This assessment method, based on expert judgement, is deemed an equivalent approach to model the façade, in light of the limitations of the glazing calculator.

The building satisfies the minimum DTS external glazing requirements.

Details of the assessment are attached in Appendix F.

4.4 BCA SECTION J3 BUILDING SEALING

4.4.1 J3.1 Application of part

The Deemed-to-Satisfy Provisions of this part apply to the elements forming the envelope of the Class 9a spaces of the facility.

4.4.2 J3.2 Chimneys & flues

The chimney or flue of an open solid fuel burning appliance must be provided with a damper or flap than can be closed to seal the chimney or flue.

4.4.3 J3.3 Roof lights

Rooflights must be sealed, or capable of being sealed, when serving a conditioned space.

4.4.4 J3.4 Windows and doors

Doors, openable windows or the like which form part of the envelope of conditioned spaces must be fitted with a seal to restrict air infiltration. This seal may be a foam or rubber compressible strip, fibrous seal or the like.

A window complying with AS2047 automatically meets the sealing criteria.

Please note, these requirements do not apply to:

- louvres doors, or louvered windows.
- a fire door, or smoke door.
- a roller shutter door, roller shutter grille, or other security door or device.

4.4.5 J3.5 Exhaust fans

Miscellaneous exhaust fans, 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 such as the kitchen, change rooms etc.

4.4.6 J3.6 Construction of roofs, walls and floors

Roofs, walls, floors and any opening such as a window, door or the like which form part of the envelope of a conditioned space, the external fabric of a habitable room or a public area; must be constructed to minimise air leakage.

Elements must be enclosed by internal lining systems that are close fitting at ceiling, wall and floor junctions. Where this is not possible then building joints must be sealed by caulking, skirting, architraves, cornices or the like.

Please note, these requirements do not apply to openings, grilles and the like required for smoke hazard management.

4.4.7 J3.7 Evaporative coolers

There are no evaporative coolers in the proposed development.

4.5 BCA SECTION J4 AIR MOVEMENT

The section of the BCA is no longer relevant.

4.6 BCA SECTION J5 AIR CONDITIONING & VENTILATION SYSTEMS;

Compliance with this section is to be achieved by the mechanical building services design consultants and contractors.

4.7 BCA SECTION J6 ARTIFICIAL LIGHTING & POWER

Compliance with this section is to be achieved by the electrical building services design consultants and contractors.

4.8 BCA SECTION J7 HOT WATER SUPPLY

This clause does not apply for this climate zone and class of building

4.9 BCA SECTION J8 ACCESS FOR MAINTENANCE

This component of BCA section J is beyond the scope of this report at this stage.

APPENDIX A TS11 GUIDELINES

Guideline

Department of Health, NSW
73 Miller Street North Sydney NSW 2060
Locked Mail Bag 961 North Sydney NSW 2059
Telephone (02) 9391 9000 Fax (02) 9391 9101
http://www.health.nsw.gov.au/policies/

Technical Series TS11 - Engineering Services & Sustainable Development Guidelines

Document Number GL2008_002

Publication date 09-Jan-2008

Functional Sub group Corporate Administration - Asset Management
Corporate Administration - Finance
Personnel/Workforce - Occupational Health & Safety

Summary The Engineering Services and Sustainable Development Guidelines are intended as a handbook to be used during the briefing and design process. This guideline containing a summary and the full TS 11 document can be accessed on the www.healthfacilityguidelines.com.au/reference.htm . Engineering services account for approximately 35-40% of the capital costs in the construction of health care facilities. Given the significance of this investment, NSW Health is seeking to improve the delivery of these services by adopting a more innovative approach to engineering services design.

Author Branch Asset and Contract Services

Branch contact Nina Ceh 9391 9443

Applies to Area Health Services/Chief Executive Governed Statutory Health Corporation, Board Governed Statutory Health Corporations, Affiliated Health Organisations - Non Declared, Affiliated Health Organisations - Declared, Public Health System Support Division, Community Health Centres, NSW Dept of Health, Public Health Units

Audience Administration and all staff

Distributed to Public Health System, Community Health Centres, Dental Schools and Clinics, NSW Ambulance Service, NSW Department of Health, Public Health Units, Public Hospitals

Review date 09-Jan-2013

File No. 03/7793-2

Status Active

Director-General

ENGINEERING SERVICES AND SUSTAINABLE DEVELOPMENT GUIDELINES

Technical Series TS11

Engineering services account for approximately 35-40% of the capital costs in the construction of health care facilities. Given the significance of this investment, NSW Health is seeking to improve the delivery of these services by adopting a more innovative approach to engineering services design.

The requirement for all health care design is that it facilitates high quality patient care for the most cost effective capital and recurrent costs.

These Engineering Services and Sustainable Development Guidelines are intended as a handbook to be used during the briefing and design process.

The objectives of this document are:

- To allow the flexibility to facilitate creative/lateral thinking and innovation rather than adopting a prescriptive approach to design.
- To continually achieve better ways of delivering engineering services and sustainable development taking advantage of advances in technology.
- To drive cost efficiency in the provision of engineering services to achieve better value for money.

Structure of the Guidelines

This document contains a section entitled Design Process, generally covering all engineering disciplines, followed by sections for each individual discipline - Mechanical, Electrical, Communications, Lifts, Hydraulics and Fire Services.

The section for each discipline defines the provisions for the service and, in addition, the criteria and process for justifying departures.

Where a standard or code governs the design, the reference will be placed in a text box as below:

- Building Code of Australia (BCA)
- AS/NZS 3000 - Electrical Installations.

In addition, specific industry publications are referenced within the document. These references are given as additional guidance to designers.

Sustainable Development

The NSW Government aims to make buildings healthier and more affordable. It also aims to reduce the impact of buildings on the environment by reducing the demand on non-renewable resources such as energy and water, and reducing pollutants and greenhouse gas emissions.

NSW Health requires sustainable development principles and strategies to be applied to health facilities in accordance with Premier's Memorandum No 2003-2 High Environmental Performance for Buildings and the requirements of the Environmental Performance Guide for Buildings (EPGB).

The Government Energy Management Policy (GEMP) has set a target to reduce the State-wide total energy consumption of government buildings (both government-owned and leased) by 25% from 1995 to 2005. The policy requires new buildings and accommodation to be energy-efficient and cost-effective.

NSW Health is committed to achieving these targets.

All the sustainability issues and associated strategies described in the EPGB are to be addressed in the design, construction and operation of the works. The EPGB sustainability issues and associated strategies are available in detail on the website: http://asset.gov.com.au/environmentguide/

All the performance areas and associated strategies described in the EPGB are to be addressed in the Design of the Works.

NSW Health wishes to leverage its significant achievements in energy management to be a best practice energy management agency.

OBJECTIVES

The key sustainable development objectives are:

- comfortable and healthy indoor environment (in terms of thermal comfort, visual comfort and indoor air quality)
- minimised non-renewable resource consumption (e.g. energy, water) and environmental impacts (e.g. greenhouse, other air and water emissions, solid waste)
- cost-effectiveness over its whole life cycle.

SUSTAINABLE DEVELOPMENT DRIVERS

These objectives are underpinned by a number of sustainable development drivers including:

- Government Energy Management Policy (GEMP)
- objectives of the NSW Government's Sustainability Advisory Council
- NSW Water Conservation Strategy
- NSW Government's Waste Reduction and Purchasing Policy (WRAPP).

SUSTAINABLE BUILDING DESIGN

Some specific issues and requirements include:

- In conjunction with the functional requirements, the building form shall incorporate passive design considerations to minimise the intervention of engineering services, and to minimise energy use.
- The building's passive design and engineering services shall complement each other through an integrated design process involving all disciplines right from the beginning, to achieve the sustainable design outcomes for the whole building.
- The required sustainable design outcomes include thermal comfort, visual comfort and acoustic comfort for the building users, as well as ensuring good indoor air quality.
- The building form (including the shape, size, depth and orientation of the floor plates, etc.) shall be optimised to minimise solar heat gain, maximise natural daylight benefits and optimum access to diffuse natural light, and provide optimum HVAC outcomes.
- The mechanical services and building passive design shall complement each other in design and operation to jointly achieve the functional outcomes for the building, including providing an energy-efficient, healthy, thermally comfortable and acoustically acceptable indoor environment.
- Water conservation and water cycle management are to be included in the design (e.g. rainwater reuse, stormwater management, water recycling).
- Environmentally-sound materials (with minimal impact on the environment, minimised use of non-renewable resources, non-hazardous substances, minimised impact on indoor air quality and high recycled/recyclable content) are to be used wherever possible.
- The development shall be designed to improve upon the minimum requirement of Section J of the Building Code of Australia. It is a requirement of NSW Health that energy modelling be undertaken for all projects larger than

$10m. The energy modelling shall be undertaken in accordance with either verification method JV2 or JV3 from the BCA. The facility shall be designed such that the designed energy performance achieves a minimum of 10% improvement when compared with either the "stated value" or the deemed to satisfy reference building.

- For all projects greater than $10m an independent commissioning agent shall be engaged such as to ensure that all mechanical services and automated control systems are commissioned to meet the required function and for minimum energy use. The process shall follow the proforma identified in Greenstar, with appropriate adjustment to suit healthcare.

- For all projects greater than $10m the project shall undergo the Greenstar rating process, using the Greenstar Pilot Healthcare Tool, such as to achieve a minimum 4 star rating.

ENVIRONMENTAL OUTCOMES AND PERFORMANCE REPORTING

The required environmental outcomes to be achieved must be developed, identified and adopted in the development of the design to suit the strategies outlines in the EPGB. Consultants need to demonstrate how the design, including the proposed building services, will achieve the environmental outcomes required.

The consultant must provide a specific Environmental Performance Report (EPR) at the completion of the part of the design for each milestone in the form of electronic Excel files or included in the EPGM. The scope of the EPR reporting will be advised in the brief.

Responsibility

This document aims to achieve greater definition of engineering services at an earlier stage of the project and to clearly define the responsibilities of both user groups/briefing teams and the engineering designers.

The consultant team, in consultation with the user groups, are required to justify (in terms of clinical service need) any engineering service that are not in accordance with the Guidelines.

The designers are required similarly to justify any decisions not in accordance with the Guidelines and to demonstrate the logic (through life cycle costing analysis) of the systems proposed.

Engineering designers are also required to report their costs in a set cost format that requires a close focus on the actual design, rather than relying on per square metre rates or other broad bases of cost estimation. It is assumed that accepted engineering practice, relevant codes and statutory regulations will be observed as part of normal professional services.

- TS11- Engineering Services and Sustainable Development Guidelines can be accessed on http://www.healthfacilityguidelines.com.au/reference.htm
- Comment http://www.healthfacilityguidelines.com.au/contact.htm
- Questions can be emailed to HFG@DOH.HEALTH.NSW.GOV.AU

Professor Debora Picone AM
Director-General

APPENDIX B GREEN STAR INDEPENANT COMMISSIONING AGENT CRITERIA

GREEN STAR – HEALTHCARE v1 2009 TECHNICAL MANUAL

Man-4 Independent Commissioning Agent

POINTS AVAILABLE 1

AIM OF CREDIT

To encourage and recognise the appointment of an Independent Commissioning Agent from project design through to handover.

CREDIT CRITERIA

One point is awarded where an Independent Commissioning Agent has been appointed to:

- Provide commissioning advice to the building owner and the design team; and
- Monitor and verify the commissioning of all building systems.

COMPLIANCE REQUIREMENTS

Ensure that the submission adheres to all provisions of the Submission Requirements document found on the GBCA website.

The Independent Commissioning Agent must meet the following criteria:

- Be suitably qualified or experienced (i.e. be a registered professional engineer or qualified technician with relevant, documented working knowledge of either designing or commissioning the type of HVAC, hydraulic, electrical and fire suppression systems used in the project);
- Must not be an employee of any services design, contractor or sub-contractor organisation that has been involved in the installation of the commissioned systems;
- Must be an objective advocate of the building owner, with the following responsibilities:
  - Be engaged by, and report directly to the building owner;
  - Provide commissioning advice to the project team from the beginning of schematic design through practical completion of the project, interacting with the team throughout all stages of construction;
  - Be involved, at a minimum, at the beginning of each major stage in the documentation of the project (schematic design, design development, construction documentation, tendering and specifications) at the beginning of construction and regularly involved during the construction phase of the project;
  - Introduce commissioning standards and strategies early in the design process;
  - Review the basis of design and design intent as well as preliminary working drawings;
  - Develop and direct the commissioning process that covers the following wherever present: air distribution systems, boilers, automatic controls, lighting, refrigeration systems, water treatment systems and water distribution systems;
  - Set target requirements in the contract documents to ensure implementation of selected commissioning measures;
  - Coordinate with the building owner, design team and contractor throughout the commissioning, testing and adjustment phases;

GREEN STAR – HEALTHCARE v1 2009 TECHNICAL MANUAL

Man-4 Independent Commissioning Agent

- Observe, review and approve results of all testing undertaken by the contractor;
- Monitor and verify the commissioning of all systems;
- Prepare the final commissioning report including recommendations to the building owner on the performance of commissioned building systems; and
- Be involved in the quarterly fine-tuning process and the final re-commissioning of the building.

The Certified Assessor(s) will not award the point unless the role of the Independent Commissioning Agent fully meets the requirements above.

A suitably qualified ICA is defined as a registered professional engineer or qualified technician (such as a NEBB or ASHRAE certified technician) with relevant, documented working knowledge of either designing or commissioning the type of HVAC, hydraulic, electrical and fire suppression systems used in the project).

DOCUMENTATION: DESIGN RATING

Submit all the evidence and ensure it readily confirms compliance.

☐ CV of the Independent Commissioning Agent

☐ Letter of appointment

CV of the Independent Commissioning Agent detailing the qualifications and experience relevant to the project.

Letter of appointment by the building owner of the independent commissioning agent:

- Must state that the commissioning agent is an objective advocate of the building owner; and
- Must include the responsibilities for the commissioning agent outlined in this credit.

DOCUMENTATION: AS BUILT RATING

Submit all the evidence and ensure it readily confirms compliance.

☐ CV of the Independent Commissioning Agent

☐ Extract(s) from the Commissioning Report

CV of the Independent Commissioning Agent detailing the qualifications and experience relevant to the project.

Extract(s) from the Commissioning Report

- Summarising the major findings and recommendations of the commissioning process; and
- Stating the level of involvement in the project by the independent commissioning agent.

APPENDIX C SUMMARY OF A/C OPTIONS

Design Objective	***Option 1A VAV***		***Option 1B Thermafuse***		***Option 2 Low Temperature VAV***		***Option 3 Displacement***		***Option 4 Active Mass Cooling***		***Option 5 Fan Coil Units***		***Option 6 Active chilled beams***	
Spatial requirements	23m2 – Air riser	6	23m2 – Air riser	6	16.5m2 – Air riser	2	17.5m2 – Air riser	3	15.5m^2 – Air riser 1m^2 – water riser	2	14.5m2 – Air riser 1m2 – water riser	1	14.5m2 – Air riser 1m2 – water riser	1
Thermal Comfort control	Good control and thermal comfort	3	No individual set point control	4	Good control and thermal comfort.	3	Good control and thermal comfort.	2	Good control & superior thermal comfort.	1	Good control and thermal comfort.	3	Good control and thermal comfort.	3
Energy	Base line energy	6	Base line energy	6	15% estimated improvement	4	20% estimated improvement	3	30% estimated improvement	2	No energy improvement	6	35% estimated improvement	1
Indoor Environment Quality and Infection Control	Central recirculation of air throughout the building	6	Central recirculation of air throughout the building	6	No central recirculation of air to inpatient rooms. Local recirculation and mixing of air in each room	3	No central recirculation or local mixing of air to inpatient rooms. Single pass system.	2	No central recirculation or local mixing of air to inpatient rooms. Single pass system.	1	No central recirculation of air to inpatient rooms. Local recirculation and mixing of air in each room	3	No central recirculation of air to inpatient rooms. Local recirculation and mixing of air in each room	3
Installation and Servicing	Central plant, no maintenance required in patient areas. No distributed chilled water.	3	Central plant, minor maintenance required in patient areas	4	Central plant, no maintenance required in patient areas. No distributed chilled water.	3	Central plant, minor maintenance required in patient areas	3	Central plant and minor maintenance required in patient areas	4	Central plant and maintenance required in patient areas	6	Central plant and maintenance required in patient areas	5
Cost and Life Cycle	Capital Cost:$3.4M Base line	3	Capital Cost:$2.9M Lowest capital cost	2	Capital Cost:$3.4M Similar capital cost and life cycle, with lower energy	2	Capital Cost:$3.6M Similar capital cost and life cycle, with lower energy	1	Capital Cost:$4.2M High capital cost and similar life cycle, with significant energy reduction	4	Capital Cost:$4.4M High capital cost and short life cycle	6	Capital Cost:$3.8M High capital cost and similar life cycle, with significant energy reduction	5
Similar Projects	Used extensively throughout the world	1	Used extensively for commercial hospitals	1	Used extensively in commercial applications but not in hospitals.	6	Emerging trend for Sustainable hospitals in Australia	2	Has been used on limited similar projects	3	Used primarily for commercial private hospitals	2	Used primarily overseas, generally the capital cost excludes this option	3
Total Score		**28**		**29**		**23**		**16**		**17**		**27**		**21**

APPENDIX D BRADFORD BULK INSULATION DATA SHEETS

Bradford™
for smarter environments

GLASSWOOL PARTITION BATTS
(11/14 KG/M³)

GW PARTITION BATTS– DATA SHEET

Introduction

Bradford Partition Batts are a lightweight insulation product designed for the acoustic insulation of separating walls and office partitions in buildings.

Product Description

Bradford Glasswool Partition Batts are manufactured by spinning molten glass, containing up to 80% recycled content, into fine wool like fibres. These inorganic fibres are bonded together using a thermosetting resin. The product can be identified by its golden appearance.

Applications

Glasswool Partition Batts have been designed to provide superior sound control in commercial applications. They provide an inexpensive, high performance acoustic treatment for partitions and wall assemblies.
Bradford Partition Batts can achieve a range of acoustic ratings up to Rw + Ctr 50 and above when installed with Gyprock™ plasterboard and CSR Hebel™. Standard Glasswool Partition Batts are supplied at a width of 600mm for easy installation into commercial stud spacings.

Typical applications include partitions in;

- High rises
- Office buildings
- Internal fit outs in shopping centres

Benefits

- Lightweight insulation blanket
- Easily installed
- Excellent acoustic properties
- Helps reduce natural frequencies in walling systems
- Easily transported around site due to packaging
- Non combustible
- Made from biosoluble formulation

Available Facings

This product is not faced.

Health and Safety

This product is manufactured to the latest Fibre Bio-Soluble (FBS-1) Glasswool formulation and is not classified as hazardous according to the criteria of the ASCC (formally NOHSC) guidelines. For further information refer MSDS sheet on Bradford website.

SKU Table

Base Blanket Material R-value	Thickness (mm)	Nominal Length (m)	Width (mm)	Pieces per Pack	Nominal Coverage per Pack (m^2)	Nominal Coverage per Piece (m^2)	Nominal Pack Weight
11kg/m³							
R1.1	50	2.7	450	12	14.6	1.215	8.02
R1.1	50	2.7	600	10	16.2	1.62	8.91
R1.2	55	2.7	450	12	14.6	1.215	8.82
R1.2	55	2.7	600	12	19.4	1.62	11.76
R1.7	75	2.7	600	8	13.0	1.62	10.69
R2.5	110	7.5	600	2	9.0	4.50	10.89
14kg/m³							
R1.3	50	2.7	600	10	16.2	1.62	11.34
R1.8	75	2.7	450	10	12.2	1.215	12.76
R1.8	75	2.7	600	10	16.2	1.62	17.01

CSR

GW PARTITION BATTS

Physical Properties

Density	kg/m^3	11/14
Maximum Service Temperature		Glasswool: 350°C
Thermal Conductivity	Based on measurements made in accordance with AS2464:5 and AS2464:6	k Value = 0.043 W/m2K at 23°C
Fire Hazard Properties	When tested in accordance to AS/NZS 1530.3:1999	• Ignitability: 0 • Spread of flame: 0 • Heat Evolved: 0 • Smoke Developed: 0
Corrosion Resistance	When tested in accordance with BS 3958.5:1969	pH 7.5-8.0 Incapable of corroding steel
Moisture Absorption	When left in a controlled atmosphere of 50°C and 95% relative humidity for four days	Less than 0.2% by volume
Flow Resistivity		0.56 x 10^{4}mks Rayls/m
AS4859 Compliance	Complies with AS/NZ4859.1 "Materials for the thermal insulation of buildings"	Complies
Combustibility	When tested in accordance to AS/NZS 1530 Part1:1994	Non-combustible; Pass
Sample Specification		The insulation material shall be Bradford Glasswool Partition Wall Batt "R".... (specify R-value), xxmm.... (specify thickness) having a nominal density yykg/m^3.... (specify density). For installation specifications refer to the relevant Application Brochure in the Bradford Insulation Building Literature series.

GW PARTITION BATTS– DATA SHEET

Bradford™
for smarter environments

CSR Bradford Insulation
55 Stennett Rd, Ingleburn NSW 2565 Australia.
Telephone (02) 9765 7000 **Facsimile** (02) 9765 7002

www.bradfordinsulation.com.au

Publish date: 06/08 Doc ref:D G Part Bat A

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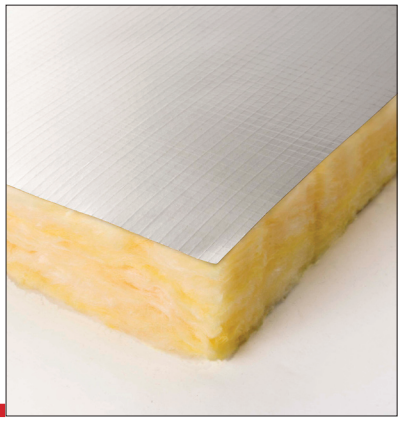
Bradford™
for smarter environments

ANTICON FACED GLASSWOOL BLANKET (11KG/M³)



ANTICON FACED GW BLANKET– DATA SHEET

Introduction

Bradford Anticon Roofing Blanket is lightweight insulation specially designed for use in residential and commercial buildings.

Product Description

Bradford Anticon Roofing Blanket consists of a glasswool blanket adhered to an impermeable reinforced reflective foil facing.

The glasswool blanket is manufactured by spinning molten glass, containing up to 80% recycled content, into fine wool like fibres. These are bonded together using a thermosetting resin. The Bradford Thermofoil facing extends 150mm beyond one longitudinal edge of the blanket to provide an overlap when installed. The product can be identified by its golden appearance and foil facing.

Applications

Anticon Roofing Blanket is designed to provide efficient thermal insulation and condensation control under metal deck, fibre cement and concrete roofs in residential or commercial applications. The name "Anticon" reflects the anti-condensation function of this product. Typical Applications include;

- Residential metal clad roofs
- Commercial and industrial metal clad and fibre cement roofs eg. offices, shopping centres, warehouses etc
- Under concerete slabs in carparks

For optimum thermal performance, bright side of the Thermofoil is positioned in a downward direction adjacent to a still air space. Anticon is designed to reduce rain and aircraft noise and can also substantially reduce reverberant noise within the building. For optimum acoustic treatment of rain noise on metal roofs use Bradford Acousticon.

Benefits

- Lightweight insulation blanket
- Available in a range of thicknesses to meet BCA energy efficiency proviisons.
- Reduces overall building energy usage
- Helps prevent condensation
- Reduces rain noise
- Can be stored externally due to water resistant packaging
- Can be custom cut to required length to reduce waste and installation time
- Non combustible
- Made from biosoluble formulation

Available Facings

Bradford Anticon Roofing Blanket is supplied with a range of factory applied reinforced laminated aluminium foil facings. Standard Anticon consists of Light Duty Thermofoil. For batten spacing >900mm or when premium tear and puncture resistance is required, specify Medium Duty or Heavy Duty Thermofoil facing foil.

To enhance the versatility of Anticon a number of other factory applied facings are available to order. e.g. Antiglare foil or Thermoplast white polyethylene coated foil. These orders may be subject to minimum order quantities and longer lead times Contact Bradford for further information.

Health and Safety

This product is manufactured to the latest Fibre Bio-Soluble (FBS-1) Glasswool formulation and is not classified as hazardous according to the criteria of the ASCC (formally NOHSC) guidelines. For further information refer MSDS sheet on Bradford website.

SKU Table

Product	Material R-value	Thickness (mm)	Nominal Length (m)	Nominal Width (mm)	Nominal Coverage	Nominal Pack Weight
Anticon 55	R1.3	60	15	1200	18	11.88
Anticon 55	R1.3	60	15	1400	21	13.86
Anticon 75	R1.8	80	15	1200	18	15.84
Anticon 95	R2.3	100	10	1200	12	13.2
Anticon 110	R2.5	110	10	1200	12	14.52
Anticon 100 HP	R2.5	100	10	1200	12	16.8
Anticon 130	R3.0	130	10	1200	12	17.16

CSR

ANTICON FACED GW BLANKET

Physical Properties

Density	kg/m^3	11
Maximum Service Temperature		Glasswool: 350°C; Reflective foil 70°C
Fire Hazard Properties	When tested in accordance to AS/NZS 1530.3:1999	• Ignitability: 0 • Spread of flame: 0 • Heat Evolved: 0 • Smoke Developed: 0
Corrosion Resistance	When tested in accordance with BS 3958.5:1969	pH 7.5-8.0 Incapable to corrode steel
Moisture Absorption	When left in a controlled atmosphere of 50°C and 95% relative humidity for four days	Less than 0.2% by volume
AS4859 Compliance	Complies with AS/NZ4859.1 "Materials for the thermal insulation of buildings"	Complies
Sample Specification		The insulation material shall be Bradford Anticon Glasswool Roofing Blanket, Anticon (55, 75, 95 100HP, 110, 130) faced with (Specify foil facing). For installation specifications refer to the Bradford Insulation Building Design Guide.

Sound Absorption

When tested in a reverberation chamber in accordance with AS 1045:1988

Product	**Thickness**	**Frequency (Hz)**							
	(mm)	125	250	500	1000	2000	4000	5000	NRC
Anticon 55 Thermofoil LD	60	0.34	0.86	1.04	0.41	0.2	0.07	0.04	0.65
Anticon 75 Thermofoil LD	80	0.60	1.21	1.21	0.41	0.28	0.10	0.12	0.70
Anticon 95 Thermofoil LD	100	0.72	1.43	1.43	0.43	0.26	0.14	0.08	0.75

ANTICON FACED GW BLANKET– DATA SHEET

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CSR Bradford Insulation
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www.bradfordinsulation.com.au

Publish date: 06/08 Doc ref: D G Anticon A

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APPENDIX E FLETCHER BULK INSULATION DATA SHEETS

Technical Data Sheet

Pink Batts®

Thermal Insulation for Ceiling & Walls

AS/NZS 4859.1 Materials for the Thermal Insulation of Buildings

Pink Batts comply with the Energy Efficiency provisions of the BCA for all types of thermal insulation to be certified by a NATA accredited organisation.

CODEMARK™
GM-08-CM30008

Australian Building Codes Board Certificate of Conformity

Certified Product - AS/NZS4859.1
Global-Mark.com.au®
ID Number: 100577

Quality Management • ISO 9001
Global-Mark.com.au®

ENVIRONMENTAL CHOICE AUSTRALIA
FLI - 2007
GECA 33-2007 - Building Insulation
www.geca.org.au

Environmental Choice Australia Certified Product

PINK BATTS™
Comfort for Keeps

Product Description and Typical Applications

Pink Batts®, Australia's favourite insulation, are made from lightweight, flexible and resilient glasswool (sometimes refered to as mineral wool), specially designed for the thermal insulation of ceilings and walls in domestic and commercial buildings. They have the added benefit of being an effective sound absorber and so contribute to both the thermal and acoustic comfort of building occupants. The comprehensive range of sizes and R-values available ensures there is an efficient and effective Fletcher Insulation™ *Pink Batt* available for any application. *Pink Wall Batts* are stiffened to fit snugly between standard spacing wall studs – both timber and steel – without sagging and should be installed at the time of construction before fixing internal lining.

Physical Characteristics

Material R-value (m^2 k/w)	Batt Size (mm)	Thickness (mm)	Batts Per Pack	Area Per Pack (m^2)	Coverage Per Pack (m^2)
Wall Batts					
R1.5	1160 x 430	65	16	8.0	9.0
	1160 x 580	65	16	10.8	12.2
R2.0	1160 x 430	90	16	8.0	9.0
	1160 x 580	90	16	10.8	12.2
R2.0HD*	1160 x 430	70	16	10.8	12.2
	1160 x 580	70	16	10.8	12.2
R2.5HD*	1160 x 430	90	12	6.0	6.8
	1160 x 580	90	12	8.1	9.1

Pink Batts are also available in 1160x480mm & 1200x600mm to suit various stud spacing.
*Minimum order quantity may apply.

Ceiling Batts					
R2.5	1160 x 430	115	16	8.0	9.0
	1160 x 580	115	16	10.8	12.2
R3.3	1160 x 430	150	16	8.0	9.0
	1160 x 580	150	16	10.8	12.2
R3.5	1160 x 430	160	16	8.0	9.0
	1160 x 580	160	10	6.7	7.6
R3.8	1160 x 430	165	16	8.0	9.0
	1160 x 580	165	10	6.7	7.6
R4.0	1160 x 430	170	10	5.0	5.6
	1160 x 580	170	10	6.7	7.6
R5.0	1160 x 430	215	8	4.0	4.5
	1160 x 580	215	8	5.0	6.1
R6.0	1160 x 430	250	6	3.0	3.4
	1160 x 580	250	6	4.0	4.5

Green Star Compliant

The Green Building Council of Australia (GBCA) strongly recommends third party validation of insulation products environmental merit by GECA - Good Environmental Choice Australia (www.gbca.org.au). All GECA certified products automatically achieve 100% product score in the Green Star calculators. GECA scientific research is based on function and overall environmental and human health in conformance to ISO14024. GECA certification provides a clear, credible guide to products that are sustainable and improve the quality of the environment.

Fletcher Insulation is committed to providing environmentally sustainable products. *Fletcher Insulation* products have Zero Ozone Depleting Potential in both manufacture and composition, complying with the GreenStar Insulant ODP Emissions credit requirement. Air quality is maintained with total Volitile Organic Compound (VOC) emissions below quantifiable levels.

Fletcher™ Insulation

Creating an environmentally sustainable future

NON-COMBUSTIBLE

made from recycled materials

The production of environmentally sustainable FBS-1 Glasswool Bio-Soluble Insulation utilizes approximately 70% recycled waste glass.

✓Low Allergen

Low Allergen content with the ability to moderate temperature changes.

FBS-1 GLASS WOOL BIO-SOLUBLE INSULATION

Fletcher Insulation glasswool products are manufactured from FBS-1 Bio-Soluble Glass Wool™. FBS-1 Bio-Soluble Glass Wool™ is not classified as hazardous according to the criteria of the Australian Safety and Compensation Council (formerly NOHSC), Approved Criteria for Classifying Hazardous Substances (NOHSC: 1008) 3rd Edition. Fletcher Insulation glasswool is classified as safe to use, refer to our MSDS.

made™ and proud of it

Technical Data Sheet

AS1530.1 Test for Combustibility of Materials

Testing conducted by CSIRO in accordance with AS1530 Part 1 concluded that *Pink Batts* are non-combustible.

The BCA deemed to satisfy provisions require walls important to the structural integrity of commercial buildings to be constructed wholly of materials that are non-combustible. Fire rated (FRL) walls between tenancies and common walls of multi-level apartment buildings also must be constructed wholly of materials that are non-combustible. The BCA states that if materials used in an assembly contain combustible components, then the assembly is combustible.

Incorporating non-combustible *Pink Batts* into wall systems allows builders to gain acoustic and thermal benefits while still complying with the BCA requirement to maintain structural integrity and for minimizing risk to occupants from smoke inhalation and fire in Class 2 to 9 buildings.

AS1530.3 Early Fire Hazard Properties of Materials

Pink Batts exhibit the following characteristics when tested in accordance with AS1530 Part 3.

Ignitability Index	0
Spread of Flame Index	0
Heat Evolved Index	0
Smoke Developed Index	0-1

Moisture Resistance

In the event of *Pink Batts* becoming wet, they should be dried prior to installation to obtain maximum performance and prevent damage to other building elements. *Pink Batts* absorb less than 0.2% moisture by volume when exposed to environmental conditions of 50˚C and 95% relative humidity for four days.

Alkalinity

When tested in accordance with British Standard 3958, *Fletcher Insulation* glasswool products are slightly alkaline pH9 (neutral is pH7). They will not promote or accelerate the corrosion of steel or galvanised steel studs provided they are protected from external contamination.

Maximum Service Temperature

Fletcher Insulation Pink Batts have a maximum service temperature of 340˚C.

Specification Notes

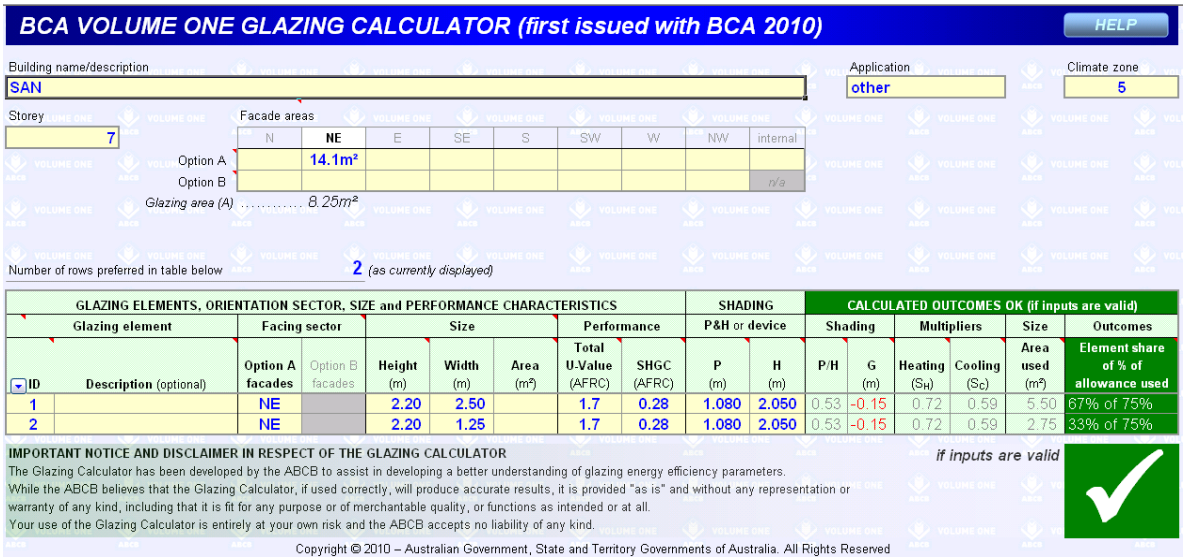
State the following:

- Product name - *Pink Batts*
- Material R-Value required
- Joist or stud spacing
- Area involved

Fletcher™ Insulation

Freecall SALES **1300 65 44 44** Technical Services **1800 000 878**
Email **info@insulation.com.au** Web **www.insulation.com.au**

APPENDIX F BCA GLAZING CALCULATION



BCA VOLUME ONE GLAZING CALCULATOR (first issued with BCA 2010) HELP

Building name/description: SAN | Application: other | Climate zone: 5

Storey: 7

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A		14.1m²							
Option B									n/a

Glazing area (A) 8.25m²

Number of rows preferred in table below: 2 *(as currently displayed)*

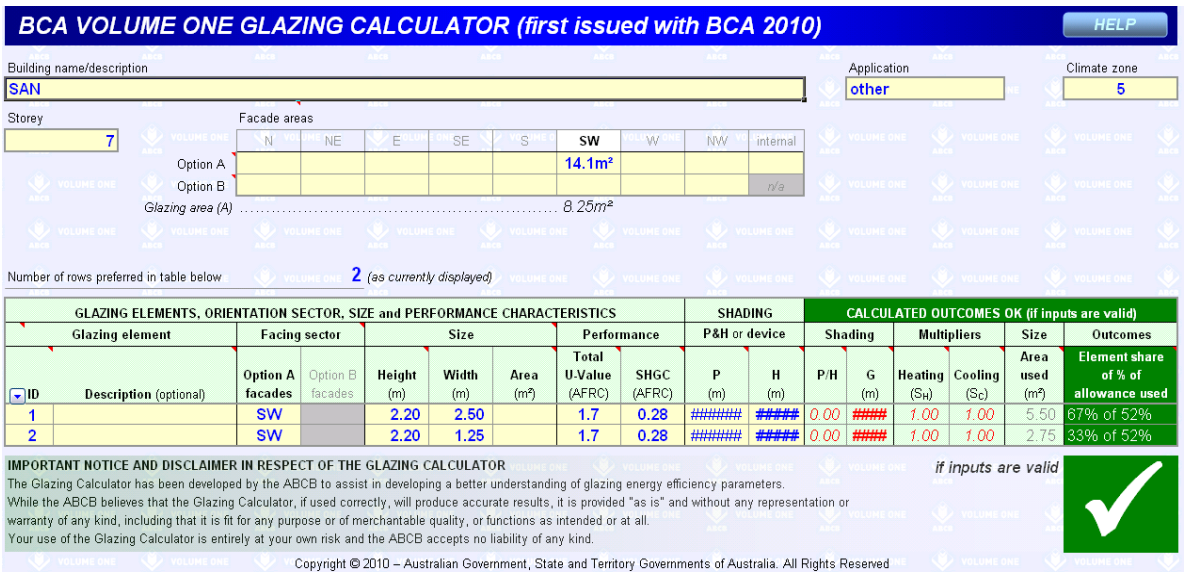
GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device	Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total U-Value (AFRC)	SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1		NE		2.20	2.50		1.7	0.28	1.080	2.050	0.53	-0.15	0.72	0.59	5.50	67% of 75%
2		NE		2.20	1.25		1.7	0.28	1.080	2.050	0.53	-0.15	0.72	0.59	2.75	33% of 75%

IMPORTANT NOTICE AND DISCLAIMER IN RESPECT OF THE GLAZING CALCULATOR

The Glazing Calculator has been developed by the ABCB to assist in developing a better understanding of glazing energy efficiency parameters.
While the ABCB believes that the Glazing Calculator, if used correctly, will produce accurate results, it is provided "as is" and without any representation or warranty of any kind, including that it is fit for any purpose or of merchantable quality, or functions as intended or at all.
Your use of the Glazing Calculator is entirely at your own risk and the ABCB accepts no liability of any kind.

if inputs are valid

Figure 8 *Eastern façade glazing calculator*



BCA VOLUME ONE GLAZING CALCULATOR (first issued with BCA 2010) HELP

Building name/description: SAN | Application: other | Climate zone: 5

Storey: 7

Facade areas

	N	NE	E	SE	S	SW	W	NW	internal
Option A						14.1m²			
Option B									n/a

Glazing area (A) 8.25m²

Number of rows preferred in table below: 2 *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS								SHADING		CALCULATED OUTCOMES OK (if inputs are valid)					
Glazing element		Facing sector		Size			Performance		P&H or device	Shading		Multipliers		Size	Outcomes
ID	Description (optional)	Option A facades	Option B facades	Height (m)	Width (m)	Area (m²)	Total U-Value (AFRC)	SHGC (AFRC)	P (m)	H (m)	P/H	G (m)	Heating (S_H)	Cooling (S_C)	Area used (m²)	Element share of % of allowance used
1		SW		2.20	2.50		1.7	0.28	#######	#####	0.00	####	1.00	1.00	5.50	67% of 52%
2		SW		2.20	1.25		1.7	0.28	#######	#####	0.00	####	1.00	1.00	2.75	33% of 52%

IMPORTANT NOTICE AND DISCLAIMER IN RESPECT OF THE GLAZING CALCULATOR

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Your use of the Glazing Calculator is entirely at your own risk and the ABCB accepts no liability of any kind.

if inputs are valid

Figure 9 *Western façade glazing calculator*