DA | 479 | 2010 'A'

CUSTOMER SERVICE CENTRE
- 9 SEP 2011
RECEIVED

Request to modify a major project

NSW GOVERNMENT
Department of Planning

Date duly made: ___/___/____ Modification No. _____

1. Before you lodge

This form is required under section 75W of the *Environmental Planning and Assessment Act 1979* (the Act) in order to request the Minister to modify the Minister's approval to carry out a project or concept plan to which Part 3A of the Act applies.

Before making this request, it is recommended that you first consult with the Department of Planning (the Department) concerning your modification. The Director-General may issue environmental assessment requirements that must be complied with before your request will be considered by the Minister.
If the changes proposed by the modification will result in a project that is consistent with the existing approval, the Minister's approval for a modification is not required.

Disclosure Statement
Persons making a request to modify a project or concept plan are required to declare reportable political donations (including donations of or more than $1,000) made in the previous two years.

Note: For more details about political donations disclosure requirements, including a disclosure form, go to **www.planning.nsw.gov.au/donations**.

Lodgement
All modification requests must be lodged with the Director-General of the Department of Planning, by courier or mail. An electronic copy should also be e-mailed to the assessment contact officer assigned to the project.

NSW Department of Planning
Ground floor, 23-33 Bridge Street, SYDNEY NSW 2000
GPO Box 39 SYDNEY NSW 2001
Phone 1300 305 695

2. Details of the proponent

Company/organisation/agency: University of New South Wales
ABN: 57 195 873 179

☒ Mr ☐ Ms ☐ Mrs ☐ Dr ☐ Other

First name: Geoffrey
Family name: Leeson

SECTION 96 APPLICATION No. 479/10 A
RANDWICK CITY COUNCIL

Position: Project Director, Facilities Management

STREET ADDRESS

Unit/street no.:
Street name: Level 3 Mathews Building

Suburb or town: Kensington
State: NSW
Postcode: 2052

POSTAL ADDRESS (or mark 'as above')
As Above

Suburb or town:
State:
Postcode:

Randwick City Council
09 SEP 2011
Records Received

Daytime telephone: 02 93853431
Fax:
Mobile: 0414 715 124

Email: g.leeson@unsw.edu.au

3. Identify the land

STREET ADDRESS (where relevant)

Unit/street no.: 333

Street or property name: Anzac Parade

Suburb, town or locality: Kensington

Postcode: 2052

Local government area(s): Randwick

State Electorate(s): Kingsford-Smith

REAL PROPERTY DESCRIPTION

Lot 1 DP 510271

Note: The real property description is found on a map of the land or on the title documents for the land. If you are unsure of the real property description, you should contact the Department of Lands.

Please ensure that you place a slash (/) to distinguish between the lot, section, DP and strata numbers. If the proposed modification applies to more than one piece of land, please use a comma to distinguish between each real property description.

OR: detailed description of land attached: ☐

MAP: A map of the site and locality should also be submitted with this request.

4. Details of the original major project or concept plan

Briefly describe what the original approval allows

Redevelopment of Wallace Wurth Building at UNSW Kensington Campus

What was the original project application no.?: MP09_0075

What was the date of the approval?: 27/11/2011

What was the original application fee?:

Note: Clause 245K of the *Environmental Planning and Assessment Regulation 2000* provides information on calculating the maximum fee for a request for modification.

5. Describe the modification you propose to make to the approval

Describe the proposed modification

Design amendments to northern façade, changes to approved tree removal. Refer attached report for further details.

Your modification request may need to be accompanied by an Environmental Assessment, including plans. An electronic and hard copy of this document will be required.

ESTIMATED CAPITAL INVESTMENT VALUE

Please indicate the estimated capital investment value (CIV) of the modification to the project approval or concept plan (excluding GST).

$n/a

FULL TIME EQUIVALENT JOBS

Please indicate the number of jobs created by the proposed modification. This should be expressed as a proportion of full time equivalent (FTE) jobs over a full year.

Construction jobs (FTE) 400 Operational jobs (FTE) 740

6. Landowner's consent (where required)

As the owner(s) of the above property, I/we consent to this request being made by the proponent:

Land
Lot DP1 510271

Signature

Name
PETER M'GEORGE

Date
09/09/11

Land

Signature

Name

Date

Note: Under Clause 8F of the *Environmental Planning and Assessment Regulation 2000* (the Regulation), certain applications for approval under Part 3A of the Act do not require consent of the landowner, however, the proponent is required to give notice of the application (e.g. linear infrastructure, mining & petroleum projects, and critical infrastructure).

7. Political donation disclosure statement

Persons making a request to modify a project or concept plan are required to declare reportable political donations (including donations of or more than $1,000) made in the previous two years.

Have you attached a disclosure statement to this request?

☐ Yes
☒ No

Note: For more details about political donations disclosure requirements, including a disclosure form, go to **www.planning.nsw.gov.au/donations**.

8. Proponent's signature

As the proponent(s) of the project and in signing below, I/we hereby:

- provide a description of the modification to the project approval or concept plan and address all matters required by the Director-General pursuant to Section 75W of the Act, and
- declare that all information contained within this form is accurate at the time of signing.

Signature

Name
PETER M'GEORGE

Date
09/09/11

In what capacity are you signing if you are not the proponent

Name, if you are not the proponent

RPS

Section 75W Modification Application

UNSW Wallace Wurth Building (MP09_0075)

RPS

Sydney Office
Level 12, 92 Pitt Street, GPO Box 4401, Sydney NSW Australia 2001
T +61 2 8270 8300 F +61 2 8270 8399 E sydney@rpsgroup.com.au W rpsgroup.com.au

Our Ref: 08365
Date: 7 September 2011

Attn: Roger Quinton
Randwick City Council
33 Frances Street
Randwick NSW 2031

Via: email

Dear Roger

RE: Section 75W Modification Application – UNSW Wallace Wurth Building (MP09_0075)

In accordance with the provisions of Section 75W (s75W) of the Environmental Planning and Assessment (EP&A) Act 1979 and on behalf of our client UNSW, we hereby submit this s75W Application to modify the Minister's approval for the redevelopment of the Wallace Wurth Building at the UNSW Kensington Campus (Project Application 09_0075).

This modification application addresses refinements to the façade due to design development and feedback from the University's Campus Development Advisory Panel (CDAP). It also addresses the proposed treatment of a number of trees on the site.

The Director-General has delegated his functions in relation to Section 75W applications for Project Approval MP09_0075 to Randwick Council (Instrument of Delegation signed 29 August 2011). This submission is therefore made to Randwick City Council. It describes and explains the proposed modifications to the approved project and assesses the impacts of the changes.

The application also includes:

- Appendix A – Annotated drawings of the proposed modifications
- Appendix B – Architectural Design Statement by Lahznimmo Architects on proposed modifications & external finishes
- Appendix C – Section J Verification Report prepared for the revised design
- Appendix D – Correspondence from Lend Lease to Randwick City Council regarding trees
- Appendix E – Revised Arborist Report
- Completed Request to Modify a Major Project Application form, and
- Electronic (CD) copy of the application.

1. Background

On 27 November 2010, the Minister for Planning granted approval subject to conditions to Major Project Application (MP 09_0075), comprising the *redevelopment of the existing Wallace Wurth Building at UNSW Kensington Campus, including demolition of an existing single storey administration building (B27) and a dangerous goods store (D27), refurbishment of the existing*

Wallace Wurth Building, an additional level above the west wing of the building and construction of new seven storey extension to the north and south of the existing east wing of the building.

UNSW has appointed Lend Lease as the design and construction agent with responsibility to deliver the project on behalf of the University.

2. Scope of Section 75W

Section 75W(2) states that:

The proponent may request the Minister to modify the Minister's approval for a project. The Minister's approval for a modification is not required if the project as modified will be consistent with the existing approval under this Part.

There are a number of minor, inconsequential changes to the design of the building which have evolved during preparation of the detailed design documentation of the building and which are included on the plans submitted as part of this s75W. In accordance with section 75W(2), these minor changes are considered to be consistent with the existing approval and therefore do not require approval under Section 75W. Advice has been sought from a Principal Certifying Authority which confirms that these minor amendments are consistent with the existing approval.

Those changes not considered consistent with the existing approval are the subject of this section 75W application. These changes have been "bubbled" in red on the relevant submitted plans (South and North Elevation). .

It is also relevant to note that section 75W modification applications do not require a demonstration that proposed modifications result in a development that is "substantially the same" as that approved, as is the case for Section 96 applications.

3. Proposed Modifications

This amendment seeks to modify the façade treatment of the north façade of the building and trees on the Botany and High Street frontages of the site.

Wording of Consent

The consent is to be amended in the following manner.

1. Updating the date and revision information in the table in Condition A2 *Development in Accordance with Plans and Documents* for the following plans:

Drawing No.	Revision	Name of Plan	Date
C27-A-C-EA 06	02	Ground Floor	12 August 2011
C27-A-C-EA 07	02	Level 1 Plan	12 August 2011
C27-A-C-EA 08	03	Level 2 Plan	12 August 2011
C27-A-C-EA 09	03	Level 3 Plan	12 August 2011
C27-A-C-EA 10	03	Level 4 Plan	12 August 2011
C27-A-C-EA 11	03	Level 5 Plan	12 August 2011
C27-A-C-EA 12	03	Level 6 Plan	12 August 2011
C27-A-C-EA 16	02	South and North Elevations	2 September 2011

2. Delete last paragraph of Condition B13 and replace with:

Approval is granted for the removal of those trees listed in the Aboriculture Assessment by the ENTS Tree Consultancy, dated 29 June 2011.

RPS

Modifications to Façade Design

The proposed modifications subject to this section 75W application are summarised below and documented on the notated plans in Appendix A. An Architectural Design Statement prepared by Lahznimmo Arhcitects is provided in Appendix B, which provides further detail in relation to the proposed changes.

Proposed Amendments	Discussion of Impacts
Northern Façade - East Wing	
Substitution of approved 4 storey high horizontal aluminium louvred screen and curtain wall with a pre-cast concrete spandrel and integrated vertical precast fins.	Returning of precast expression around north east corner of building provides a more cohesive relationship with adjacent Lowy Cancer Research Centre, which has a similar materials palette. The consolidation of the corner building as a single architectural expression rather than a combination of different treatments and materials creates a more legible and identifiable landmark corner building for the campus. The louvred screen whilst resolving shading issues has a homogenous and unvaried architectural expression. The modified proposal with precast, coloured back glass and vertical fins introduces texture, variation, depth and shadow to the façade creating a more visually interesting and articulated façade.
Minor increase (0.55m) in wall height of eastern level 7 plantroom. There are no changes to the overall height of the building, which is to remain at RL95.00 (measured from exhaust flues).	The minor increase in height will not have a significant impact in terms of overshadowing or visual impact. The plantroom is setback substantially from the northern and eastern roof edges (11.5m and 4.5m respectively) and will therefore have little visual impact from the street. There are no changes proposed to the exhaust flues in terms of height or exhaust velocity. There is therefore no requirement to consult with Sydney Airports Corporation Ltd.
Northern Façade - West Wing	
Replacement of the approved 6-storey high vertical glazed window in the existing riser of the building and external screen of louvres with precast panels.	Maintaining the existing extent of solid wall proportionally complements the northern end of the new east wing and simplifies the building's expression into two key elements divided by the atrium. The solidity of the precast blade wall to the north west wing provides a counterpoint to the more transparent north-east building, which is a combination of filigree precast fins and glazing. Maintaining the existing extent of solid wall complements the solidity of the adjacent blade wall to the Lowy Cancer Research Centre which reinforces the pedestrian campus gateway (established by Lowy) and creates a cohesive relationship between the two buildings.
Small reduction in parapet height of 0.49m (from RL87.50 to RL87.01)	There will be no adverse impacts associated within this minor reduction in height.

Proposed Tree Changes

A number of changes are proposed to the treatment of trees along the Botany and High Street frontages of the site. This is due to the following reasons:

- Some trees proposed to be retained have deteriorated since the project was approved.
- One tree approved to be removed is now to be retained based on advice from the Royal Botanic Gardens that it is a rare form of the species.
- Impact on the trees within the site boundary and Council footpath due to construction activities such as scaffolding, materials handling, construction traffic, etc.

- An increase in the width of footpath along High Street which will interfere with root / trunk of those existing trees that are above the level of the existing footpath.

The following table summaries the proposed changes, which are also addressed in the Aboriculture Assessment at Appendix E.

Tree No.	Approved	Proposed	Comment
1	Retained	Removed	
2	Retained	Removed	
3	Retained	Removed	
4	Removed*	Retained	*noted in approval as requiring further Council approval
7	Removed	Retained	
11	Removed	Retained	
All other trees			
39 & 40	n/a	Removed	Minor street trees to be removed and replanted following construction works

An onsite meeting was held on 16 June 2011 with representatives from Randwick City Council, UNSW, Spackman Mossop Michaels (landscape architect), The Ents Tree Consultancy (arborist) and Lend Lease (project managers) to discuss the changes to tree removal.

At this meeting Randwick City Council requested the following information:

1. Arboriculture Assessment confirming impact of the proposed tree changes noted above

2. Revised plan indicating proposed tree layout

These were prepared (refer Appendix E for report and plan) and provided to David Meredith for his consideration on 29 June 2011. David responded on 20 July 2011 (refer email in Appendix D) and noted that *"...should any of the street trees along the Botany Street frontage need to be removed for hoardings, construction access or similar, Council would not object; however, we will require that removal and replacement costs be borne wholly by the UNSW."*

In this email, Council also states *"...no objections are raised to the changes being sought....."* but requested the proposed changes be addressed in a formal application to the relevant consent authority.

The proposed changes are therefore included in this Section 75W application, which is seeking to formalise Council's in principle support to the changes.

4. Likely Environmental Impacts from Proposed Modification

As set out in the table above, the impacts from the proposed modifications are considered to be either positive or minor in nature. The proposed modifications do not alter the uses within the site, access to the site, the footprint of the building or the student or staff population.

The modifications to the northern façade will improve the relationship of the building with the adjacent Lowy Cancer Research Centre and result in a more legible and identifiable corner landmark for the campus. The modifications have been considered in detail by a nominated representative of the UNSW Campus Development Advisory Panel (CDAP), who has indicated her support for the proposed changes.

The minor increase in wall height (0.55m) on the east wing will not have a significant impact on the streetscape. The maximum height of the building is not proposed to change.

The Section J Report in Appendix C demonstrates the proposed alterations to the building design meet the minimum energy performance requirements in building services and fabric design.

The proposed changes to trees will not result in a net loss of numbers from that approved, with 3 to be removed and 3 to be retained. The changes will result in a rare form of the species that was approved for removal to be retained, which is a positive outcome. Council have previously indicated that they are supportive of the amendments.

No issues are raised by the proposed modifications related to the "Key Assessment Requirements" within the Director General's Requirements for the original Part 3A Project Application. The modifications do not raise any issues related to the planning controls for the site.

Therefore there will be no adverse impacts from the development stemming from the modifications.

5. Statement of Commitments

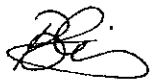
The modifications do not raise any issues related to the Statements of Commitments. These Commitments will remain part of the Consent, as modified by the revised plans and supporting reports. The Commitments will be implemented by the Applicant.

6. Conclusion

As outlined above the proposed modifications will retain the intent of the original project approval dated November 2010. The proposal supports UNSW's major development initiative to improve the campus. The modifications are considered minor and appropriate. The changes will have no substantive environmental impacts which are different to the approved project.

We trust this information is sufficient for your purposes, however should you require any further details or clarification, please do not hesitate to contact the writer by telephone.

Yours sincerely
RPS



Belinda Lewis
Senior Planner

RPS

Appendix A

Annotated drawings of the proposed modifications

RPS

Appendix B

Architectural Design Statement by Lahznimmo Architects on proposed modifications and external finishes

ARCHITECTS IN ASSOCIATION

lahznimmo
architects

WilsonArchitects

Design Statement - Changes to North Façade
WALLACE WURTH RE-DEVELOPMENT

12th August 2011

East Wing – North Facade
The August 2010 EA scheme proposed a four storey high horizontal aluminium louvred screen in front of a curtain wall. The developed façade substitutes the "louvred screen" with a precast concrete spandrel with integrated vertical precast fins for shading similar to the language of eastern facade. The extent of glazing is similar with the revised proposal replacing 25% of vision panel with colour back glass to address solar control and heat gain. Again this treatment is consistent with the eastern façade.

This refinement of the design has several distinct urban design benefits:

- The returning of the precast expression around the north east corner of the campus provides a more cohesive relationship with the adjacent Lowy Cancer Research Centre, which shares a similar materials palette.

- The consolidation of the corner building as being a single architectural expression rather than a combination of expressions and materials creates a more legible and identifiable landmark corner building to the campus.

- The Louvred Screen whilst resolving shading issues has a homogenous and unvaried architectural expression. The developed proposal utilising precast, coloured back glass and vertical fins introduces texture, variation, depth and shadow to the facade creating a visually more interesting and articulated facade than the screen proposal.

The August 2010 EA scheme also proposed a wall height to the eastern level 7 plantroom of RL90.00. The current scheme proposes a marginally higher parapet level of RL90.55 but given the substantial setbacks from the northern and eastern roof edges (11.5m and 4.5m respectively) there will not be a significant impact on the streetscape.

West Wing – North Facade
The August 2010 EA scheme proposed a six storey high vertical glazed window cut into the existing riser of Wallace Wurth with a continuous external screen of louvres. The existing brick cladding to the riser is to be replaced with precast panels. This expression extends up to the new Level Six.
The developed proposal removes this section of glazing allowing the current extent of solid wall to be maintained and extended up to the new level six.

This refinement of the design has several distinct urban design benefits:

- Maintaining the existing extent of solid wall proportionally complements the Northern end of the new east wing as well as simplifying the building's expression into two key elements divided by the atrium. The solidity of the precast blade wall to the North West Wing provides a counterpoint to the more transparent north-east building which is a combination of filigree precast fins and glazing.

- Maintaining the existing extent of solid wall complements the solidity of the adjacent blade wall to the Lowy Cancer Research Centre assisting in reinforcing the Pedestrian Campus Gateway already established by Lowy as well as creating a cohesive relationship between the two buildings.

The August 2010 EA scheme also proposed a parapet height of RL87.50. The current scheme proposes a marginally lower parapet, ie RL87.01.

Lahz Nimmo Architects Pty Ltd
ABN 33 075 924 097

Suite 404, 3 Gladstone St
Newtown NSW 2042 Australia

T 02 9211 1220
F 02 9211 1554

info@lahznimmo.com
www.lahznimmo.com

Nominated Architects
Annabel Lahz #5624
Andrew Nimmo #5627

WilsonArchitects

364 Boundary Street, Spring Hill
Brisbane QLD 4000 Australia

T 07 3831 2755
F 07 3832 1129

RPS

Appendix C

Section J Verification Report prepared for the revised design

Section J Verification (JV3) Assessment Report

Wallace Wurth Redevelopment

University of New South Wales

Prepared for
Lend Lease

23 August 2011

Reference: 10018.01

Revision: 02

Surface Design

Document prepared by:

Surface Design Pty Ltd
ABN 19 570 343 498
68 York Street, SYDNEY NSW 2000 Australia
T: +61 2 9249 1400
E: sydney@surfacedesign.com.au

Document control

Revision	Date	Revision details	Author	Verifier	Approver
01	22 November 2011	Issued for comment	AA		
02	23 August 2011	Preliminary Issue for comments	AA	BMD	

Contents

1.3 Results

Figure 1 and Table 1 below shows the predicted energy consumption from the three scenarios noted above.

Figure 1: Predictive Annual Energy Consumption for each Scenario

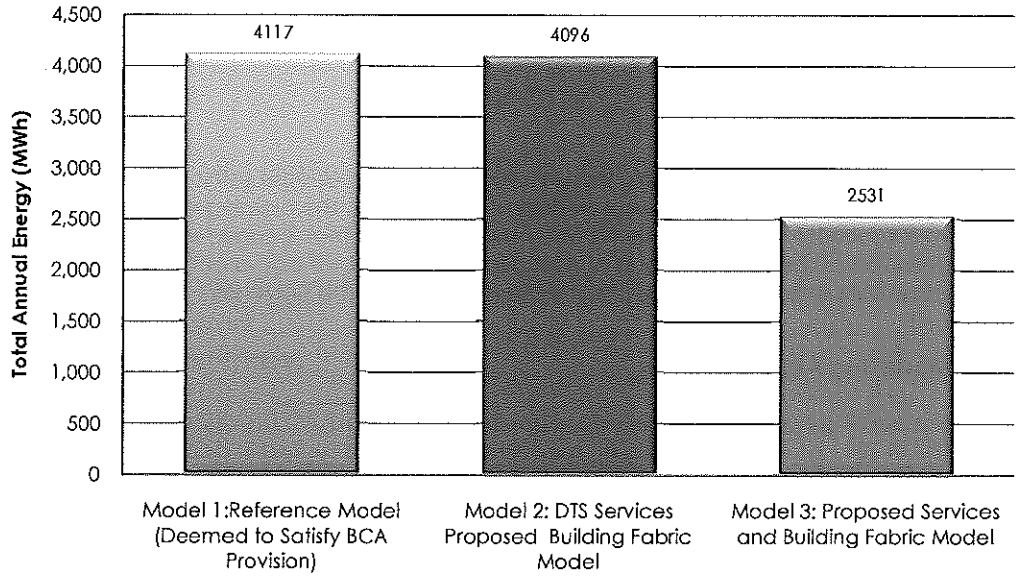


Table 1: Predicted Energy Consumption

Total Annual Energy Consumption	MWh	Improvement (%)
Model 1: Reference Model: DTS services and Fabric	4,117	Energy Benchmark
Model 2: DTS services and Proposed Fabric Model	4,096	0.5%
Model 3: Proposed services and Proposed Fabric Model	2,531	38.5%

Figure 1 and Table 1 demonstrate that the total annual energy consumption for Model 2 and Model 3 is lower than the Reference Model (Model 1) energy benchmark.

2. Introduction

2.1 Purpose of Report

This document demonstrates compliance with Building Code of Australia Energy Efficiency provisions of Part J 2011 for the Wallace Wurth redevelopment project within the University of New South Wales Kensington Campus. The document has been prepared on behalf of Lend Lease for submission to the University of New South Wales. This document will form part of the Construction Certificate documentation submission and relates to the proposed redevelopment works only.

2.2 Project Description

The redevelopment of the Wallace Wurth building includes the establishment of new teaching and research spaces along the east portion of the building. An atrium / void space has been created between the existing and new floor plates to promote natural daylighting. The project will add around 8,000 m^2 of additional laboratory spaces that will support existing facilities of the University. The redevelopment will also include refurbishment of the existing building services currently serving the Wallace Wurth building.

2.3 Building Code Australia Provisions

The provisions of Building Code of Australia 2011 that apply to the project include:

- Parts J1 – J8 inclusive except for the atrium space that has been designated as a 'Unconditioned space'
- Climate Zone 5
- Class 5, 6, 8 and 9b provisions

2.4 Reference Documents

This report and assessment has been undertaken in reference to the architectural and services design drawings provided by the design team as illustrated in table 2. Refer to Appendix B for floor plans used in the assessment.

Table 2: Reference Drawings

Wallace Wurth Redevelopment	Drawing Number	Stage	Rev No.	Reference
Architectural References				
Lower Ground Floor Plan	C27-A-C-0301	CD	05	Lahznimmo Architects dated 21 August 2011
Ground Floor Plan	C27-A-C-0302	CD	04	
Level 1 Floor Plan	C27-A-C-0303	CD	03	
Level 2 Floor Plan	C27-A-C-0304	CD	03	
Level 3 Floor Plan	C27-A-C-0305	CD	03	
Level 4 Floor Plan	C27-A-C-0306	CD	03	
Level 5 Floor Plan	C27-A-C-0307	CD	03	
Level 6 Floor Plan	C27-A-C-0308	CD	03	
Level 7 Floor Plan	C27-A-C-0309	CD	03	
Roof Plan	C27-A-C-0510	C	02	
North & South Elevation Drawing	C27-A-C-3004	C	03	
East Elevation Drawing	C27-A-C-3005	C	03	
West Elevation Drawing	C27-A-C-3006	C	03	

Electrical Services References				
Lighting schedule	C27-E-C-3602	DD	A	Aurecon dated 02 March 2011
Lower Ground Floor Plan	C27-E-C-3630	DD	01	Aurecon dated 1st October 2010
Ground Floor Plan	C27-E-C-3631	DD	03	
Level 1 Floor Plan	C27-E-C-3632	DD	03	
Level 2 Floor Plan	C27-E-C-3633	DD	03	
Level 3 Floor Plan	C27-E-C-3634	DD	03	
Level 4 Floor Plan	C27-E-C-3635	DD	03	
Level 5 Floor Plan	C27-E-C-3636	DD	03	
Level 6 Floor Plan	C27-E-C-3637	DD	03	
Level 7 Floor Plan	C27-E-C-3638	DD	02	
Early works Electrical Specification	C27-E-G-3601		03	Aurecon dated 02 March 2011
Security Specification	C27-E-G-3701	-	01	Aurecon dated 1st October 2010
Audio Visual Specifications	C27-E-G-3801	-	01	
Mechanical Services References				
Lower Ground Floor layout	C27-K-C-100	DD	01	AECOM dated 22 July 2011
Lower Ground Floor Plant room layout	C27-K-C-101	DD	01	
Ground Floor layout	C27-K-C-102	DD	01	
Level 1 layout	C27-K-C-104	DD	01	
Level 2 layout	C27-K-C-105	DD	01	
Level 3 layout	C27-K-C-106	DD	01	
Level 4 layout	C27-K-C-107	DD	01	
Level 5 layout	C27-K-C-108	DD	01	
Level 6 layout	C27-K-C-109	DD	01	
Level 7 layout Sheet 1	C27-K-C-110	DD	01	AECOM dated 1st October 2010
Level 7 layout Sheet 2	C27-K-C-111	DD	01	
Level 7 layout Sheet 3	C27-K-C-112	DD	01	
Level 7 layout Sheet 4	C27-K-C-113	DD	01	
Air Schematic – East	C27-K-C-300	DD	01	
Air Schematic – West	C27-K-C-301	DD	01	
Chilled Water Schematic	C27-K-C-302	DD	01	
Heating Water Schematic	C27-K-C-303	DD	01	
Central Plant Existing and Demolition	C27-K-C-600	DD	01	
Central Plant New layout	C27-K-C-601	DD	01	
Cooling Towers layout	C27-K-C-900	DD	01	
Mechanical Early works Specification	60148215	-	01	AECOM dated 18 July 2011
Mechanical Schedule	60148215	-	01	AECOM dated 1st October 2010
Lifts Specification	60148215		04	19 August 2011

3. Section J Verification Assessment

3.1 Project Assessment Methodology

The building has been modelled to Specification JV and JV3 provisions of Building Code of Australia (BCA) 2011 provisions. A Baseline model has been constructed in accordance with the 'Deemed to Satisfy' provisions of the BCA and the Proposed model as per the proposed design requirements.

The JV3 assessment is undertaken in reference to the proposed building fabric and services to the new extension only. Existing building fabric and services for the development have been included in the JV3 assessment without any variation to the performance across the simulations models.

To achieve compliance under JV3 the proposed building fabric and proposed building services have been modelled to calculate the annual energy consumption of the building. Three simulation models are required to be undertaken to demonstrate compliance:

The annual energy consumption for Model 2 and Model 3 must be below the energy budget determined in the Reference model (Model 1).

- **Model 1: Reference Model** building with both building fabric and services outlined in JV3 that comply with the 'Deemed to Satisfy' (DTS) provisions of the BCA.
  Reference Model sets the **Energy Budget** for the building.

- **Model 2: DTS Services & Proposed building fabric Model** with Proposed building fabric and the building services as defined in JV3 that comply with the 'Deemed to Satisfy' (DTS) provisions of the BCA.
  The model demonstrates the proposed building fabric is equal or better than the 'DTS' building fabric.

- **Model 3: Proposed Model** with Proposed building fabric and the proposed building services.
  The model **demonstrates the proposed building services is equal or better than the 'DTS' services**

In determining areas within the building that are to be assessed under this verification assessment the following methodology was applied:

1. New additions and extensions to the existing Wallace Wurth west wing and extension to the East Wing have been assessed to 2011 provisions for both building fabric and services
2. Existing areas or building fabric not altered or upgraded as part of the works do not form part of this assessment. The same constructions and services were assessed in both models (baseline and proposed building)
3. Existing services to the building that are not being upgraded are not subject to 2011 energy efficiency provisions.
4. The atrium space is considered an unconditioned space and is separated from the rest of the building by an envelope.

The following table summarises the elements of the building that were assessed as part of this study:

Table 3: Assessment of building elements in the JV3 simulation

Zone	Building Element	Level(s)	Scope of this Study	Notes
Whole building	Building services	Lower Ground	Yes	Where additions to services are proposed only
Whole building	Existing building constructions between unconditioned and conditioned spaces	Lower Ground	No	Where no alterations are proposed to existing rooms / constructions and between floors
Whole building	New building constructions between unconditioned and conditioned spaces	All levels	Yes	Where new walls are proposed only
East Wing	New floor constructions	Ground	Yes	New floor constructions to be assessed
West Wing	Facade West elevation	Ground to Level 5 inclusive	No	Existing building fabric not altered as part of this refurbishment
West Wing	Facade West elevation	Level 6	Yes	New addition
West Wing	Facade South elevation	Ground to Level 5 inclusive	No	Existing building fabric not altered as part of this refurbishment
West Wing	Facade North elevation	Ground to Level 6 inclusive	Yes	Existing building fabric to be upgraded
West Wing	Facade East elevation	Ground to Level 6 inclusive	Yes	Existing building fabric to be upgraded
West Wing	Existing internal wall constructions separating conditioned and unconditioned spaces	Ground to Level 6 inclusive	No	Existing building fabric not altered as part of this refurbishment
West Wing	Internal atrium glazing to east elevation	Ground to Level 6 inclusive	Yes	Existing external glazing to be replaced
West Wing	Internal atrium east constructions	Ground to Level 6 inclusive	Yes	Existing external constructions to be refurbished
West Wing	Services	Ground to Level 6 inclusive	Yes	Where refurbishments are expected only
Atrium	External glazing and roof light	Ground to Level 7 inclusive	Yes	The roof light and glazing around the building to comply with Section J glazing provision
East Wing	Facade East elevation	Ground to Level 6 inclusive	Yes	New additions
East Wing	Facade North elevation	Ground to Level 6 inclusive	Yes	New additions
East Wing	Facade South elevation	Ground to Level 6 inclusive	Yes	New additions
East Wing	Building services	Ground to Level 6 inclusive	Yes	New services

3.2 Project Specific Details

The atrium space for the building has been deemed a non-conditioned space in accordance with Building Code of Australia (BCA) 2011 definition.

3.3 Modelling Assumptions & limitations

Description	Comments
HVAC system	The HVAC control system is modelled using the Apache HVAC interface within IES software to achieve the design room conditions as required under BCA Part J provision. It does not and cannot fully represent all of the intricacies of the actual HVAC system and performance. The HVAC system (schematic illustrating the number of AHU/ FCU serving each functional space) is modelled based on Mechanical drawings provided by AECOM dated 22 July 2011. At this stage, the proposed services specifications (i.e. revised airflow rate, total cooling capacity) have not been finalised. The system specifications modelled are based on design details provided by AECOM dated 1st October 2010 and assumption has been made to alter the specifications to suit the new architectural layout. DTS Mechanical fan motor efficiency is assumed to be at 75%. Process coolers energy consumption is derived using Excel Spreadsheet calculations which use Energy Efficiency ratio specified in the BCA provision (reference model) and Mechanical specifications provided by AECOM. Overall HVAC energy consumption for Wallace Wurth is modelled based on percentage cooling/ heating capacity allocated by AECOM for Stage 1.
Building envelope	Building fabric has been assumed in line with the constructions specified under DTS provision for reference model. Proposed glazing specifications is included in deriving annual energy consumption for the proposed model The shading devices on the east and north facade are incorporated in the simulation within the glazing construction interface using solar incidences and transmission factors values to define the shading properties and performance. Physical Shading devices (fixed horizontal louvers) on the east and north facade has not been modelled to reduce simulation run time. Surrounding buildings are included in the assessment to evaluate the overall impact on the energy performance for Wallace Wurth. The dimensions of surrounding building s are estimated and do not represent the actual building profile. Infiltration rates have been included in all the simulation models at 1.0 air change per hour.
Lighting power density	The Lighting density is modelled in the proposed model is based on data in the specification provided by Aurecon dated 1st October 2010 and lighting schedule dated 2 March 2011. The data includes number of light fixtures within each individual space and power rating. At this stage, the proposed services specifications (i.e. lighting density) have not been finalised. The system specifications modelled are based on design details provided by Aurecon dated 1st October 2010 and assumption has been made to alter the specifications to suit the new architectural layout.
Lift motor efficiency	Energy consumption for elevators is calculated based on assumptions made to motor rating, trip time and number of start/stops per day. This is undertaken due to insufficient information provided by the design team at this stage. It is anticipated that details will be available after tender approval

3.4 Software

Energy modelling of the development has been undertaken using IES Virtual Environment software (VE version 6.4) which utilises Apache System to calculate the annual energy consumption of the building. Apache is recognised by the BCA as a compliant energy modelling software and has satisfied the BESTEST (Building Energy Simulation Test) with the International Energy Agency (IEA). The computer model has been created to account for all physical, climatic and geographic attributes of the proposed development to predict the energy performance of the building over a 12 month period.

The computer simulation software does not fully cover for the ventilation mechanical fans, process coolers and vertical transport system. The energy usage associated with these items is calculated separately using Microsoft Excel. These calculations are included in the Appendices.

3.5 Disclaimer

This energy assessment provides an estimate of building performance. This estimate is based on a necessarily simplified and idealised version of the building that does not and cannot fully represent all of the intricacies of the building once built. As a result, simulation results only represent an interpretation of the potential performance on the building. No guarantee or warrantee of building in practice can be based on simulation results alone. An official assessment in operation is recommended.

The energy assessment is greatly dependent on the building inputs relating to the building constructions and all HVAC equipment and other equipment from the design team. The operational performance of the tenancy will be highly dependent on the actual operational characteristics of the tenancy. This report is intended to provide an estimate and guide to the potential performance of the building and has been undertaken in accordance with the acceptable methodology in accordance with BCA 2011 requirements

3.6 Building Model and Geometry

The 3D computer model has been created using the architectural plans in section 2.4 and proposed building fabric to represents the physical characteristics of the building. Appendix B shows the architecture floor plans used in this analysis.

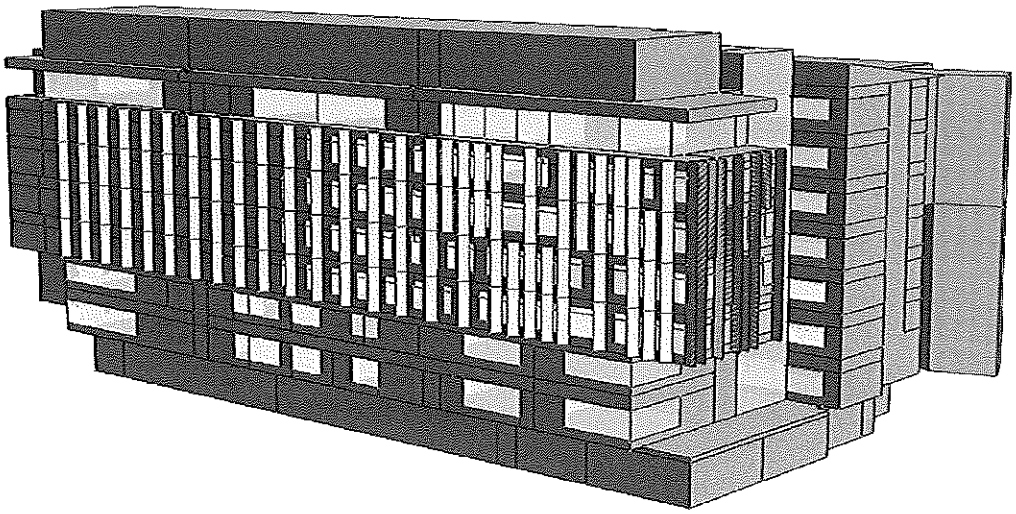


Figure 2: North East View

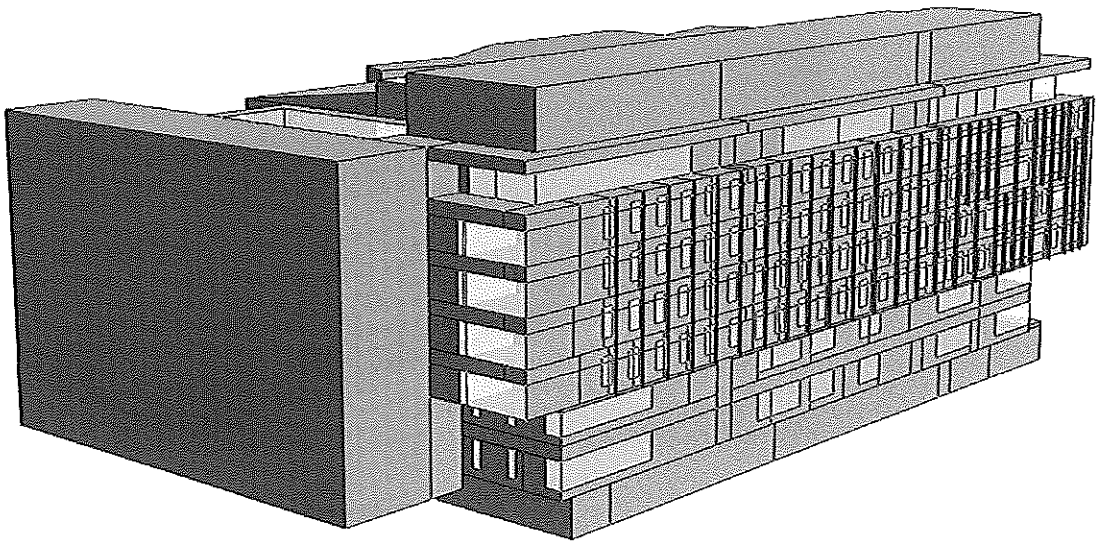


Figure 3: South East View

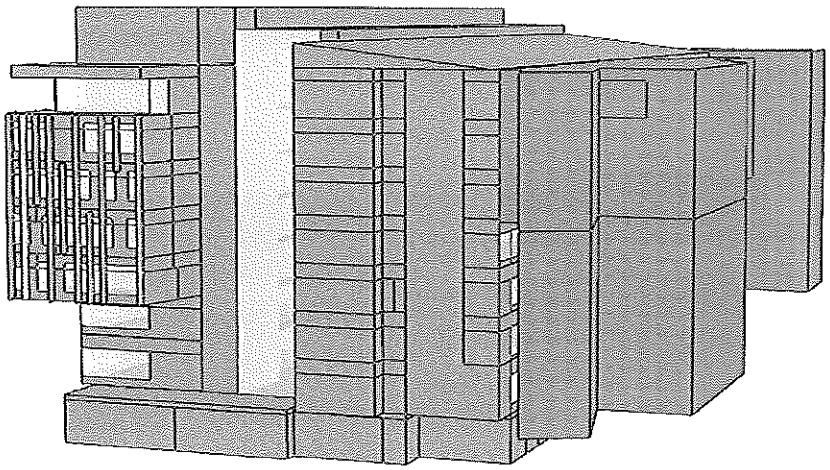


Figure 4: North West View

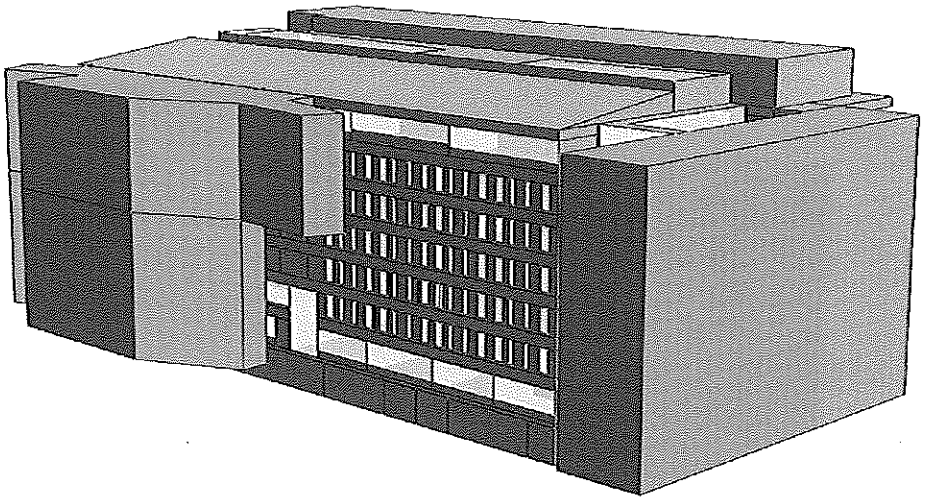


Figure 5: South West View

4. BCA 'Deemed to Satisfy' (DTS) Input Parameters

This section identifies the 'Deemed to Satisfy' (DTS) provision used in modelling:

- Reference Model (**Model 1**) – DTS Services and DTS Building Fabric
- DTS services & proposed building Fabric Model (**Model 2**) – DTS services only

4.1 Building Fabric

Table 4 illustrates the BCA 2011 Part J 'Deemed to Satisfy' building constructions thermal resistance values used in the Reference Model (Model1).

Table 4: BCA Building Fabric specification input parameters

Building Fabric	BCA Total R-value
Roof to External	3.7
Ceiling/ Floor	2.0
External Wall	2.8
Internal Wall (Separating non-conditioned space with outside air ventilation rate of 1.5 air change per hour)	1.0
Internal Wall (Others)	1.8
Existing external walls not subject to refurbishment	0.5
Existing internal walls not subject to refurbishment	0.5

4.2 DTS Glazing

Table 5 illustrate the Glazing specifications used in the Reference Model (Model 1). The DTS values are derived using the BCA 2011 volume one glazing calculator issued by the Building code of Australia. Refer to Appendix C for section J glazing calculator outputs.

Table 5: Simulation input glazing specifications for Reference Model

Glazing Specification			Location		Description
U-value	SHGC	VLT (%)			
North Facade					
6.2	0.90	50	East Wing	G, L1, L6	
6.2	0.79	50		L2 to L5	
South Facade					
6.2	0.50	50	East Wing	G to L6	
East Facade					
6.2	0.42	50	East Wing	G	
			West Wing		North End
6.2	0.90	50	East Wing	L1	
			West Wing		North End
6.2	0.74	50	East Wing	L2-L5	
			West Wing		North End
6.2	0.26	50	East Wing	L6	
			West Wing		North End
West Facade					
5.5	0.8	50	West Wing	G to L3	Existing North End
1.7	0.23	50		G-L5	Existing South End
6.2	0.70	50		L6	New level
Atrium Glazing Specifications					
5.5	0.45	50	Atrium	L1 to L6	North end
4.2	0.45	50	Atrium	G	North end
6.0	0.60	50	Atrium	L1 to L6	South End
5.5	0.60	50	Atrium	G	South end
2.7	0.30	60	Roof Light	L7	Roof
Internal Glazing					
6.5	0.5	55	East & West Wing	G to L6	Internal
Link way					
6.0	0.6	60	Bio-science to Wallace Wurth West wing	G - L6	Not assess in Section J part 2- Unconditioned and Separated area

4.3 Lighting Density

The following DTS lighting power densities have been modelled along with the default lighting schedule outlined under Section J of the BCA. Table 6 illustrates the DTS lighting power densities used in the Reference Model (Model 1) and DTS services & proposed building fabric Model (Model 2).

Table 6: BCA lighting power Density used in the reference model

Space	BCA 2011 Maximum illumination power density (W/m²)
Auditorium	10
Corridors	8
Laboratory – Artificially lit to an ambient level of 400 lux or more	12
Plant room	5
Office – Artificially lit to an ambient level of 200 Lux or more	9
School- General Purpose learning areas and tutorials room	8
Storage with Shelving no higher than 75% of the height of the aisle lighting	8
Service Area, Cleaners room and the like	5
Toilet, locker room, staff room, rest room and the like	6

4.4 Lighting Zoning and Hours

The lighting zoning has been incorporated to reflect the lighting zoning layout specified in the early works electrical services tender package provided by Aurecon dated 2 March 2011. The lighting zones are required under BCA JV3 requirements to be identical in all the simulated Models. The lighting Hours have been modelled to reflect variations in lighting power density and emitted heat loads based on the operational profiles schedules specified under BCA 2011 Section J. Refer to Appendix A for occupancy and operational profiles.

4.5 Process equipment load and Hours

The process heat load density has been included in all the simulated models in accordance to BCA 2011 Table 2h requirements. The equipment hours have been modelled to reflect variations in emitted process heat loads within the occupied space based on the operational profiles schedules specified under BCA 2011 Section J. This is undertaken to assess the overall cooling and heating capacity required to mitigate the heat loads within the occupied space. Refer to Appendix A for occupancy and operational profiles.

Table 7: Process Load Heat gains

Space	BCA 2011 Internal heat Gains (W/m²)	Comments
Class 5 Office, Class 8 laboratory	15	Actual Process load is assumed to be similar to values assumed under BCA 2011. This is undertaken to evaluate the overall efficiency of the Proposed HVAC system to mitigate the same amount of heat load

4.6 Vertical Transport system

The development is served by a vertical transport system which includes 3 (off) passenger lifts located in the West Wing and a Goods lift located in the East Wing. The lifts are designed to serve each level during hours of occupancy

The energy consumption of the lifts in the Reference model and DTS services & proposed building fabric Model (Model 1& 2) is calculated based on 8kWh/m² as specified in the NABERS Energy Guide to Building Energy Estimation version 2009-August. Table 8 illustrates the calculations undertaken to derive the annual lifts energy consumption for the Model 1 and Model 2.

Table 8: Proposed Lift system calculations

Description	Estimated Values
NABERS Lift energy consumption (kWh/m²)	8
Net Lettable Area (NLA) (m²)	17,562
Total annual energy consumption (MWh/year)	140.5

4.7 Mechanical Chillers

The cooling system modelled for the Reference Model and DTS services & Proposed building fabric Model (Model 2) consist of three (3 off) water- cooled chiller with a total cooling capacity of 3,870 $kW_{refrigerant}$ and 2 (off) Air-Cooled refrigeration unit (Duty, Standby).

The cooling capacity and energy consumption of the water-cooled chiller is apportioned based on the mechanical system design provided by AECOM dated 1st October 2010. The percentage of cooling required by Wallace Wurth redevelopment (Stage 1) is estimated to be 78% of the total central chiller plant cooling capacity which is also serving the bioscience master plan and Biomedical Theatre. The DTS chillers are modelled with an Energy Efficiency ratio specified under the BCA 2011 DTS provision as specified in Part J5 *Air-Conditioning and Ventilation Systems*.

Table 9 illustrates the DTS input parameter used in Model 1 and Model 2.

Table 9: DTS Chiller efficiency used in assessment

Description	DTS Energy Efficiency ratio For Integrated part load
Water cooled Chiller	5.2
Description	DTS Energy Efficiency ratio For Full load
Air-cooled or evaporative cooled Chiller	2.5

4.8 Mechanical Boilers

The Heating system modelled for both Model 1 and Model 2 consist of two (2off) Tomlinson Boiler which provides a total heating capacity of approximately 1400 $kW_{heating}$ to the Wallace Wurth redevelopment as proposed in the mechanical system design tender package provided by AECOM dated 1st October 2010.

The DTS boilers are modelled with an Energy Efficiency ratio specified under the DTS provision as specified in Part J5 *Air-Conditioning and Ventilation Systems.*

Table 10: DTS Boiler Efficiency used in the Model 1 and Model 2

Fuel Type	Rated Capacity ($kW_{heating}$)	BCA 2011 DTS requirements Minimum gross thermal efficiency (%)
Gas	More than 750	83

4.9 Process coolers

The two (2 off) process coolers with a cooling capacity of $18kW_r$ each provides conditioned air to the 4°C Cool Rooms and -20°C Freezer Rooms located throughout the proposed redevelopment. The refrigeration system includes an evaporator (EVP) unit located under the ceiling of each Cool/Freezer room ceiling and associated condensing unit located in the roof plant room.

The annual energy consumption for Model 1and Model 2 is calculated based on a minimum energy efficiency ratio of 2.5 as specified in Table 9.

4.10 Air Handling Units (AHU) and Fan coil Units (FCU)

There are 31 separate air handling units (AHU) which provide conditioned air to the individual occupied zones via variable air volume (VAV) boxes in the East wing. The existing West Wing is served by 85 fan coil units (FCU) and three (3 off) pre-air conditioning AHUs which provide pre-conditioned air to the FCUs. This is to design to minimise the overall heating and cooling loads on the FCUs.

The AHUs and FCUs are modelled in accordance with the DTS provision as specified in Part J 5 for Model 1 and Model 2. Table 11 illustrates the DTS input parameter used in the assessment. Refer to Appendix E for details of calculation.

Table 11: DTS Fan power values used in the assessment

Air-conditioning sensible heat load (W/m^2 of the floor area of the conditioned space)	BCA DTS requirements	
	For air-condition system serving not more than 500 m^2	For air-condition system serving more than 500 m^2
Up to 100	4.1	6.4
101 to 150	7.3	10.4
151 to 200	10.5	14.1
201 to 300	17.1	21.5
301 to 400	23.6	28.4

Air-conditioning sensible heat load (W/m² of the floor area of the conditioned space)	BCA DTS requirements	
	For air-condition system serving not more than 500 m²	For air-condition system serving more than 500 m²
More than 400	Use 0.07W of fan power for each Watt of internal load	Use 0.09W of fan power for each Watt of internal load

4.11 Mechanical Pumps

The mechanical system design for the Wallace Wurth redevelopment consists of 5 OFF Chilled water pumps, two (2 off) Condenser water pumps and two (2 off) Hot water Pumps (1xDuty, 1xStandby) to reticulate conditioned water used for space heating and cooling. The mechanical pumps for the Model 1 and Model 2 are modelled based on the DTS provision as specified in Part J5.

Table 12 illustrates the DTS input parameter used in the assessment. Refer to Appendix E for details of calculations.

Table 12: DTS Pump power used in the assessment

Cooling or Heating load (W/m² of the floor area of the conditioned space)	BCA DTS requirements		
	Chilled Water	**Condenser Water**	**Heating Water**
Up to 100	1.3	0.9	1.1
101 to 150	1.9	1.2	1.3
151 to 200	2.2	2.2	1.7
201 to 300	4.3	3.0	2.5
301 to 400	5.0	3.6	3.2
More than 400	5.6	5.6	3.6

4.12 Cooling tower

The mechanical system design includes four (4 off) cooling towers located on the Bioscience link roof which serves the Bioscience building, Wallace Wurth and Lowy Building.

The energy consumption of the cooling tower fan is apportioned based on the cooling load and condenser water flow rate required for Wallace Wurth only. The percentage of cooling required by Wallace Wurth redevelopment (Stage 1) is estimated to be 78% of the total central cooling plant which is also serving the bioscience master plan and Biomedical Theatre. The percentage figure is provided by AECOM dated 1st October 2010. Table 13 illustrates the values calculated in Model 1 and Model 2.

Table 13: DTS cooling tower energy rating

Equipment	BCA DTS requirements
	Propeller or axial fan
Cooling Tower	310W of fan power for each L/s of cooling water circulated

4.13 Ventilation Fans: - Miscellaneous Exhaust Systems and Fume Cupboards

The general exhaust, toilet exhaust and fume cupboard extraction fan systems are provided for the East and west Wing of the development. The annual energy consumption of the exhaust fans for the Model 1 and Model 2 is derived in accordance to the BCA 2011 Part J5.2.

The DTS results are calculated based on mechanical ventilation fan power to airflow ratio of 0.75W/(L/s) with filters for air flow rates above 1000 L/s as specified under BCA 2011 Part J5.2. Refer to Appendix E for details of calculations.

4.14 Outdoor air economiser

Outdoor air economisers are incorporated in the in the assessment. The values used in the simulations are based on the DTS provision specified under BCA 2011 Part J5 requirements. The DTS requirements under BCA 2011 Part J5 specified that an outdoor air economy cycle shall be provided in climate zone 5 when the air-conditioning unit capacity is over $35kW_{refrigerant}$.

4.15 Domestic Hot Water system

The energy consumption of the Domestic hot water system has been modelled in Model 1 with reference to the daily consumption rate and occupancy profile for class 5 office and 8 Laboratory building specified under BCA 2011 DTS provisions. Table 14 illustrates the daily hot water usage used in the assessment.

Table 14: Daily hot water consumption rate used in reference and proposed model

Application	Daily consumption rate
Office, Laboratory	4 L/person

5. Proposed fabric and Proposed services Input Parameters

This section identifies the 'Deemed to Satisfy' (DTS) provision used in modelling:

- DTS services & proposed building Fabric Model (**Model 2**) – Proposed Building Fabric only
- Proposed Model (**Model 3**) – Proposed Services and Proposed Building Fabric

5.1 Building Fabric

Table 15 illustrates the proposed building constructions provided in the Model 2 and 3. Refer to Appendix F for proposed construction details.

Table 15: Building Fabric specification input parameters

Building Fabric	BCA 2011 Total R-Value requirement	Calculated Total R-value with system configuration + insulation	Insulation requirements
Roof			
ER1: Roof to External (parapet) FT11, FT10, FT11B, FT12/13	R3.7	4.18(Down) 4.06 (Up)	R3.50 (30kg/m3 – 115mm thick)
ER2: Roof to External (Steel Sheeting configurations) FT1, FT14, FT23 (facade details 1 drawing 3020)	R3.7	3.98(Down) 3.86 (Up)	R3.50 (30kg/m3 – 115mm thick)
Ceiling			
Ceiling/ Floor – FT9 & FT10,12,13,15 (facade details 6 drawing 3020)	R2.0	R2.27 (Down) R2.16 (up)	R1.50 (30kg/m3 – 65mm thick)
External Wall			
EW-01a: External Wall section A, B, C, D, E Typical Level 2 to 5 (FT8, FT10,FT12, FT13, FT21)	R2.8	R3.02	R2.50 (30kg/m3 – 95mm thick)
EW-01b: External Wall section to Slab Typical	R2.8	R2.90	R2.50 (30kg/m3 – 95mm thick)
EW-02: External wall section G Typical Level G to 6 (Stairs FT7)	R2.8	R2.84	R2.60 (30kg/m3 – 95mm thick)
EW-03: External Precast Wall section K Typical Level G to 6 (FT 1)	R2.8	R2.91	R1.80 (30kg/m3 – 65mm thick)
EW-04: External Wall section M Typical Level G to 6 (FT 18)	R2.8	R2.95	R2.20 (30kg/m3 – 95mm thick)
EW-05: External wall section P Typical Level G to 7 (FT16)	R2.8	R2.91	R2.50 (30kg/m3 – 95mm thick)
Internal Wall			
IW-01: Internal wall 9FC + 76 Stud + 190 BLK	R1.80	R1.95	R1.50 (30kg/m3 – 65mm thick)
IW-02: Internal wall 13mm Plasterboard + 76 Stud + 13mm Plasterboard	R1.80	R1.89	R1.50 (30kg/m3 – 65mm thick)
IW-03: Internal wall Concrete + 13mm Plasterboard	R1.00	R1.16	R0.70 (30kg/m3 – 40mm thick)
IW-04: Internal wall 9FC + 76 Stud + 13mm Plasterboard	R1.80	R1.95	R1.60 (30kg/m3 – 65mm thick)
IW-05: Internal wall 9FC + 40 furring + Concrete	R1.80	R1.92	R1.50 (30kg/m3 – 65mm thick)
IW-06: Internal wall 9FC + 40 furring + 190 BLK	R1.80	R1.95	R1.50 (30kg/m3 – 65mm thick)

Building Fabric	BCA 2011 Total R-Value requirement	Calculated Total R-value with system configuration + insulation	Insulation requirements
IW-07: Internal wall 9FC + 76 Stud + 9FC	R1.80	R1.91	R1.60 (30kg/m3 – 65mm thick)
IW-08: Internal wall 9FC + 28 furring + 190 BLK	R1.80	R1.95	R1.50 (30kg/m3 – 60mm thick)
IW-09: Internal wall 9FC + 76 Stud w insulation + 10 mm air gap + 190 BLK	R1.80	R1.92	R1.30 (30kg/m3 – 65mm thick)
Existing Building fabric without insulation (verified in JV3 modelling)			
Existing external walls not subject to refurbishment	0.5	NA	NA
Existing internal walls nit subject to refurbishment	0.5	NA	NA

5.2 Proposed Glazing

Table 16 illustrates the Glazing specifications used in the Model 2. The proposed glazing performance is evaluated using the BCA 2011 volume one glazing calculator and the glass specifications achieved compliance under the BCA 2011 Part J2 requirement. Refer to Appendix C for section J glazing calculator outputs.

Table 16: Simulation input glazing specifications for Model 2

Glazing Specification			Location		Description
U-value	**SHGC**	**VLT (%)**			
North Facade					
3.0	0.26	50	East Wing	G, L1, L6	
3.0	0.37	50		L2 to L5	
South Facade					
3.0	0.26	50	East Wing	G, L1, L6	
3.0	0.37	50		L2 to L5	
East Facade					
3.0	0.26	50	East Wing	G, L1, L6	
3.0	0.37	50		L2 to L5	
5.5	0.48	50	West Wing	G to L6	North End
West Facade					
5.5	0.8	50	West Wing	G to L3	Existing North End
1.7	0.23	50		G-L5	Existing South End
3.0	0.37	50		L6	New level
Atrium Glazing Specifications					
5.5	0.45	50	Atrium	L1 to L6	North end
4.2	0.45	50	Atrium	G	North end
6.0	0.60	50	Atrium	L1 to L6	South End
5.5	0.60	50	Atrium	G	South end
2.7	0.30	60	Roof Light	L7	Roof

Internal Glazing					
6.5	0.75	55	East & West Wing	G to L6	Internal
Link way					
6.0	0.6	60	Bio-science to Wallace Wurth West wing	G - L6	Not assess in Section J part 2- Unconditioned and Separated area

5.3 Building Sealing Requirements

The following provisions apply to the development for Part J3 building sealing requirements.

5.3.1 Windows and Doors

All doors and windows or the like are to be fitted with a seal that is to restrict air infiltration where they form part of the building envelope to a conditioned space. Seals may be in the form of rubber compressible strips, fibrous seal or the like.

These requirements do not apply to:

- Windows complying with AS 2047; or
- Louvre doors, louvre windows or other such openings
- Fire doors or smoke doors
- Roller shutters or other security door or device installed only for out-of-hours security

Main entrances to the building if leading to conditioned spaces are to be fitted with self closing doors, airlock or similar devices, designed to avoid heat loss or gain through inadvertently leaving external doors open are to be included in the building design to minimise heat gains or losses are to be installed to all conditioned spaces that provide separation to exterior environment.

5.3.2 Roofs / Ceilings

Roofs, ceilings, walls and floors are to be constructed in such a way as to minimise air leakage and infiltration. The construction should be enclosed by an internal lining system, which is close fitting at the junctions of walls, ceilings, floors and roofs.

5.3.3 Insulation Installations

All insulation is to comply with AS/NZS 4859.1 and be installed in accordance with the following:

- Insulation to abut or overlap adjoining insulation except at supporting members such as studs, noggings, joists, furring channel and the like where the insulation must butt against the member;
- Forms a continuous layer barrier with ceilings, walls, bulkheads, floors or the like that inherently contribute to the thermal barrier; and
- Bulk insulation is to be installed such that it maintains its position and thickness, other than where it crosses roof battens, water pipes, electrical cabling or the like;
- In a ceiling where there is no bulk insulation or reflective insulation to be located in the wall beneath, the insulation must overlap the wall by not less than 50mm Insulation is not to affect the safe or effective operation of any services.

5.4 Lighting Density – To be confirmed and provided on completion of services design

The lighting power densities have been modelled along with the default lighting schedule outlined under Section J of the BCA. Table 17 illustrates the proposed lighting power densities used in Model 3. Refer to Appendix D for lighting fixture count provided by Aurecon dated 1st October 2010.

Table 17: Proposed lighting power Density used in the Model 3

Space	Proposed illumination power density (W/m²)
Auditorium	9
Corridors	8
Laboratory – Artificially lit to an ambient level of 400 lux or more	10.5
Plant room	8
Office – Artificially lit to an ambient level of 200 Lux or more	6
School- General Purpose learning areas and tutorials room	6
Storage with Shelving no higher than 75% of the height of the aisle lighting	7.5
Service Area, Cleaners room and the like	5
Toilet, locker room, staff room, rest room and the like	5

5.5 Lighting Zone and Hours

The lighting zoning has been incorporated to reflect the lighting zone layout specified in the electrical services tender package provided by Aurecon dated 1st October 2011. The lighting zones are required under BCA JV3 requirements to be identical in all the simulated Models. The lighting Hours have been modelled to reflect variations in lighting power density and emitted heat loads based on the operational profiles schedules specified under BCA 2011 Section J. Refer to Appendix A for occupancy and operational profiles.

5.6 Process equipment load and Hours

The process heat load density has been included in all the simulated models in accordance to BCA 2011 requirements. The process heat loads has been used in all simulation models for the purpose of evaluating the proposed HVAC system performance against the DTS provision in mitigating the heat generated by process equipments.

The equipment hours have been modelled to reflect variations in emitted process heat loads within the occupied space based on the operational profiles schedules specified under BCA 2011 Section J. Refer to Appendix A for occupancy and operational profiles.

Table 18: Process Load Heat gains

Space	Proposed Internal heat Gains (W/m²)
Class 5 Office, Class 8 laboratory	15

5.7 Vertical Transport system

The energy consumption of the proposed vertical transport system is derived based on a nominated average lift motor rating of 4 kW and 500 start/stops per day for all lifts. The typical trip time designated in the calculation is estimated to be 120 seconds between maximum floor platforms. Table 19 illustrate the calculations undertaken to derived the annual lifts energy consumption for the propose model (Model 3).

Table 19: Proposed Lift system calculations

Description	Estimated Values*
Average Lift motor rating (kW)	4
Hours of operation per year	3,120
Lift motor efficiency (regenerative) (%)	85
Trip time between Max floor platform (s)	120
Average start/stop per day (all lifts)	500
Total annual energy consumption (MWh/year)	115

** It is recommended that detailed lift specifications be provided by design team after tender process to facilitate in updating the lift energy consumption.*

5.8 Mechanical Chillers

The cooling system modelled for the Model 3 consist of three (3 off) water- cooled chiller with a total cooling capacity of 3,870 kWr and two (2 off) Air-Cooled refrigeration unit (Duty, Standby).

The cooling capacity and energy consumption of the water-cooled chiller is apportioned based on the mechanical system design provided by AECOM dated 1st October 2010. The percentage of cooling required by Wallace Wurth redevelopment (Stage 1) is estimated to be 78% of the total central chiller plant cooling capacity which is also serving the bioscience master plan and Biomedical Theatre.

The proposed chillers Energy Efficiency ratios are modelled based on the mechanical equipment specification provided by AECOM. Table 20 illustrates the proposed input parameter used in Model 3.

Table 20: Proposed Chiller efficiency used in Model 3

Equipment	Proposed Energy Efficiency ratio For Integrated part load	
Water cooled Chiller	100%	5
	75%	8.11
	50%	12.30
	25%	13.90
Proposed Energy Efficiency ratio - For full load		
Air-cooled or evaporative cooled chiller	2.5	

5.9 Mechanical Boilers

The Heating system modelled for Model 3 consist of two (2 off) Tomlinson Boiler which provides a total heating capacity of approximately 1400 $kW_{heating}$ to the Wallace Wurth redevelopment as proposed in the mechanical system design tender package provided by AECOM dated 1st October 2010. The proposed boilers are modelled based on the mechanical equipment specification provided by AECOM.

Table 21: Proposed Boiler Efficiency used in the assessment

Fuel Type	Rated Capacity ($kW_{heating}$)	Proposed Boiler specification Minimum gross thermal efficiency (%)
Gas	More than 750	83

5.10 Process coolers

The two (2 off) process coolers with a cooling capacity of 18kW_r each provides conditioned air to the 4°C Cool Rooms and -20°C Freezer Rooms located throughout the proposed redevelopment. The refrigeration system includes an evaporator (EVP) unit located under the ceiling of each Cool/Freezer room ceiling and associated condensing unit located in the roof plant room.

The annual energy consumption for the Process coolers in Model 3 is calculated based on a minimum energy efficiency ratio of 2.5 as specified in Table 20.

5.11 Air Handling Units (AHU) and Fan coil Units (FCU)

There are 30 separate air handling units (AHU) which provide conditioned air to the individual occupied zones via variable air volume (VAV) boxes in the East wing. The existing West Wing is served by 82 fan coil units (FCU) and three (3 off) pre-air conditioning AHUs which provide pre-conditioned air to the FCUs. This is to design to minimise the overall heating and cooling loads on the FCUs.

The proposed fan energy consumption is derived based on the proposed fan static pressure, motor efficiency and air flow rates nominated in the mechanical equipment specification provided by AECOM dated 22 July 2011. Refer to Appendix D for details of calculation.

5.12 Mechanical Pumps

The mechanical system design for the Wallace Wurth redevelopment consists of five (5 off) Chilled water pumps, two (2 off) Condenser water pumps and two (2 off) Hot water Pumps (1xDuty, 1xStandby) to reticulate conditioned water used for space heating and cooling.

The proposed pump energy consumption is derived based on the static pressure, pump efficiency and chilled & water flow rates nominated in the mechanical equipment specification provided by AECOM dated 1st October 2010. Refer to Appendix D for details of calculation

5.13 Cooling tower

The mechanical system design includes 4 OFF cooling towers located on the Bioscience link roof which serves the Bioscience building, Wallace Wurth and Lowy Building.

The energy consumption of the cooling tower fan is apportioned based on the cooling load and condenser water flow rate required for Wallace Wurth only. The percentage of cooling required by Wallace Wurth redevelopment (Stage 1) is estimated to be 78% of the total central cooling plant which is also serving the bioscience master plan and Biomedical Theatre. The percentage figure is provided by AECOM dated 1st October 2010.

The energy consumption has been calculated based on the proposed motor shaft power, heat motor efficiency and static pressure specified in the design tender package provided by AECOM dated 1st October 2010.

5.14 Ventilation Fans: - Miscellaneous Exhaust Systems and Fume Cupboards

The general exhaust, toilet exhaust and fume cupboard extraction fan systems are provided for the East and west Wing of the development. The annual energy consumption of the miscellaneous fans for Model 3 is derived based on the proposed fan static pressure, fan efficiency and air flow rates nominated in the design tender package provided by AECOM 1st October 2010. Refer to Appendix D for details of calculations.

5.15 Outdoor air economiser

Outdoor air economisers are incorporated in the proposed mechanical system design and have been included in the Section JV3 assessment. The proposed outdoor air economiser is modelled to operate when the return air enthalpy is higher than the outside air enthalpy and when cooling is required. The modulation of outside airflow rate is specified within the simulation as proposed in the mechanical equipment specification provided by AECOM.

5.16 Domestic Hot Water system

The energy consumption of the Domestic hot water system has been modelled in Model 3 with reference to the daily consumption rate and occupancy profile for class 5 office and 8 Laboratory building specified under BCA 2011 DTS provision. Table 22 illustrates the daily hot water usage used in the assessment.

Table 22: Daily hot water consumption rate used in reference and proposed model

Application	Daily consumption rate
Office, Laboratory	4 L/person

6. Results

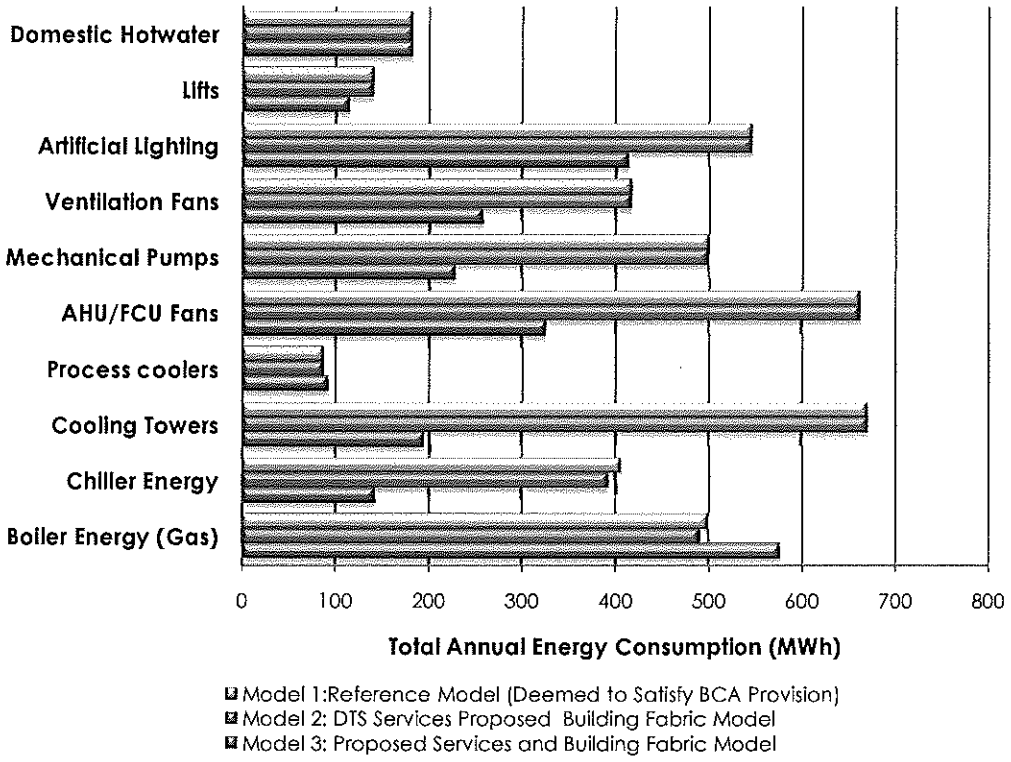
6.1 Modelling Results

The results indicate that the proposed model (Model 3) achieved an annual energy consumption of 2,531 MWh which is 38.5% below the reference model (Model 1).

Table 23: Energy End-Use breakdown summary

Description	Reference Model (Model 1)	DTS services & Proposed Fabric (Model 2)	Proposed Model (Model 3)
Boiler Energy Gas	500	492	577
Chiller Energy	407	394	142
Cooling Tower	671	671	195
Process coolers	88	88	92
AHU/FCU Fans	663	663	326
Mechanical Pumps	501	500	229
Ventilation Fan	417	417	258
Lighting	547	547	414
Lifts	140	140	115
Domestic Hot water	183	183	183
Total Energy (MWh)	4,117	4,096	2,531

Figure 6: Energy End- use breakdown summary for assessment



7. References

The following references are used in the Section JV3 assessment.

Description	Version
BCA 2011	Volume one
AS 1668.2	1991
NABERS Energy Guide to Building Energy Estimation	2009-August
Rheem Hot water – Commercial	A1006
Kone and Otis elevator specifications	Gen2 Lux and Eco system

Table 29: Calculation for determining DTS and Proposed Energy consumption for Ventilation and miscellaneous fan

ITEM	Hours of operation	Airflow (L/s)	BCA power ratio W/L/s	BCA output power KW	BCA annual power consumption (KWh)	Proposed Static pressure (Pa)	Proposed annual energy consumption KWh
OAF-LG-01	4004	1125	0.75	0.84375	3378.375	400	1801.8
OAF-LG-02	4004	500		0	500.5	250	500.5
OAF-LG-03	4004	1650	0.75	1.2375	4954.95	400	2642.64
OAF-LG-04	4004	1200	0.75	0.9	3603.6	250	1201.2
OAF-L7.01	4004	1550	0.75	1.1625	4654.65	400	2482.48
OAF-L7.02	4004	1550	0.75	1.1625	4654.65	400	2482.48
EF-LG-01	4004	400		0	800.8	500	800.8
EF-LG-02	4004	100		0	300.3	750	300.3
EF-LG-03	4004	300		0	600.6	500	600.6
EF-LG-04	4004	875		0	2627.625	750	2627.625
EF-LG-05a	4004	11340	0.75	8.505	34054.02	750	34054.02
EF-LG-05B	4004	11340	0.75	8.505	34054.02	750	34054.02
EF-LG-06	4004	170		0	374.374	550	374.374
EF-LG-07	4004	450		0	900.9	500	900.9
EF-LG-08	4004	1710	0.75	1.2825	5135.13	750	5135.13
EF-L1.01	4004	2000	0.75	1.5	6006	500	4004
EF-L3-01	4004	400		0	800.8	500	800.8
EF-L4-01	4004	400		0	800.8	500	800.8
EF-L4-02	4004	900		0	2702.7	750	2702.7
EF-L4-03	4004	1100	0.75	0.825	3303.3	1000	4404.4
EF-L4-04	4004	75		0	150.15	500	150.15
EF-L4-05	4004	85		0	170.17	500	170.17
EF-L6-01	4004	1150	0.75	0.8625	3453.45	750	3453.45
EF-L6-02	4004	350		0	1051.05	750	1051.05
EF-L6-03	4004	350		0	1051.05	750	1051.05
EF-L6-04	4004	550		0	1651.65	750	1651.65
EF-PC2-C	4004	2400	0.75	1.8	7207.2	500	4804.8
EF-GBS-01	4004	200		0	240.24	300	240.24
EF-GBS-02	4004	85		0	102.102	300	102.102
TEF-L7-01	4004	3000	0.75	2.25	9009	500	6006
TEF-L7-02	4004	895		0	1791.79	500	1791.79
TEF-L7-03	4004	850		0	1701.7	500	1701.7

ITEM	Hours of operation	Airflow (L/s)	BCA power ratio W/L/s	BCA output power kW	BCA annual power consumption (kWh)	Proposed Static pressure (Pa)	Proposed annual energy consumption kWh
SEF-L7-01	4004	10000	0.75	7.5	30030	300	12012
SEF-L7-02	4004	10000	0.75	7.5	30030	300	12012
SEF-L7-03	4004	10000	0.75	7.5	30030	300	12012
SEF-L7-04	4004	10000	0.75	7.5	30030	300	12012
SEF-L7-05	4004	10000	0.75	7.5	30030	300	12012
SEF-L7-06	4004	10000	0.75	7.5	30030	300	12012
SEF-L7-07	4004	9000	0.75	6.75	27027	300	10810.8
SPF-L7-01	4004	18000	0.75	13.5	54054	500	36036
GEF-1	4004	2400	0.75	1.8	7207.2	750	7207.2
GEF-2	4004	2400	0.75	1.8	7207.2	750	7207.2
Total					417463.046		258178.921

Table 30: Calculation for determining DTS and Proposed Energy consumption for mechanical pumps

LOWER GROUND	Total cooling capacity (kW)	Total cooling Sensible capacity (kW)	Total heating capacity (kW)	HW flow (l/s)	CHW flow (l/s)	Supply air (l/s)	OA (l/s)	RA (l/s)	Approx Area (m2)	cooling/ heat load per sqm	BCA Maximum chilled water Pump power (W/m2)	BCA Maximum Condenser water Pump power (W/m2)	BCA Maximum Hot water Pump power (W/m2)	Chilled water pump power kW	Condenser water pump power kW	Hot water pump power kW
AHU-LG-02	52.4	41.9	42.4	0.7	2.1	2065	2065	0	192	218.2	4.3	3	2.5	0.83	0.58	0.48
AHU-LG-03A/B	90.1	75.2	75.6	1.2	3.6	3585	3585	0	357	210.6	4.3	3	2.5	1.54	1.07	0.89
AHU-LG-04A/B	8.3	6.4	5.9	0.1	0.3	290	290	0	28	228.6	4.3	3	2.5	0.12	0.08	0.07
AHU-LG-05	38.1	31	29.5	0.5	1.5	1440	1440	0	152	203.9	4.3	3	2.5	0.65	0.46	0.38
AHU-LG-06	160	98.6	78.2	1.2	6.4	3470	3470	0	314	314.0	5	3.6	3.2	1.57	1.13	1.00
FCU-LG-01	14.4	13.9			0.6	1135	20	1115	27.5	505.5	5.6	5.6	3.6	0.15	0.15	0.10
FCU-LG-02	15.4	15			0.6	1207	20	1187	27.4	547.4	5.6	5.6	3.6	0.15	0.15	0.10
FCU-LG-03	14.9	14.5			0.6	1170	20	1150	32.6	444.8	5.6	5.6	3.6	0.18	0.18	0.12
FCU-LG-04	32.4	19.7	16		1.3	725	725	0	100	197.0	2.2	2.2	1.7	0.22	0.22	0.17
FCU-LG-05	2.6	2.1	1		0.1	155	50	105	29	72.4	1.3	0.9	1	0.04	0.03	0.03
FCU-LG-06	9.9	9.6			0.4	770	20	750	12	800.0	5.6	5.6	3.6	0.07	0.07	0.04
CASS-LG-01	4.5	3.5			0.2	400		400	57	61.4	1.3	0.9	1	0.07	0.05	0.06
CASS-LG-02	4.5	3.5			0.2	400		400	57	61.4	1.3	0.9	1	0.07	0.05	0.06
PRECON-LG-01		153			6.6	7100	7100	0	1385.5	110.4	1.9	1.2	1.3	2.63	1.66	1.80
GROUND														0.00	0.00	0.00
AHU-G-01	81.9	51	42.7	0.7	3.3	2385	1995	390	272	187.5	2.2	2.2	1.7	0.60	0.60	0.46
AHU-G-02	39.3	25.1	15	0.2	1.6	1345	720	625	152	165.1	2.2	2.2	1.7	0.33	0.33	0.26
AHU-G-03	52.3	32.6	25.1	0.4	2.1	1935	1095	840	142	229.6	4.3	3	2.5	0.61	0.43	0.36
AHU-G-04	70.3	62.5	14.2	0.2	2.8	3650	456	3194	261	239.5	4.3	3	2.5	1.12	0.78	0.65
AHU-G-05	60.1	53.5	6.5	0.1	2.4	3210	275	2935	180	297.2	4.3	3	2.5	0.77	0.54	0.45
FCU-G-01	16.6	10.1			0.7	530	325	205	50.1	201.6	4.3	3	2.5	0.22	0.15	0.13
FCU-G-02	15.5	9.9			0.6	490	330	160	50.1	197.6	2.2	2.2	1.7	0.11	0.11	0.09
FCU-G-03	12.9	7.7			0.5	300	300	0	47	163.8	2.2	2.2	1.7	0.10	0.10	0.08
FCU-G-04	12.9	7.7			0.5	300	300	0	47	163.8	2.2	2.2	1.7	0.10	0.10	0.08
FCU-G-05	12	7.6			0.5	460	300	160	46	165.2	2.2	2.2	1.7	0.10	0.10	0.08

LOWER GROUND	Total cooling capacity (kW)	Total cooling Sensible capacity (kW)	Total heating capacity (kW)	HW flow (l/s)	CHW flow (l/s)	Supply air (l/s)	OA (l/s)	RA (l/s)	Approx Area (m2)	cooling/ heat load per sqm	BCA Maximum chilled water Pump power (W/m2)	BCA Maximum Condenser water Pump power (W/m2)	BCA Maximum Hot water Pump power (W/m2)	Chilled water pump power kW	Condenser water pump power kW	Hot water pump power kW
FCU-G-06	11.7	7.4			0.5	460	300	160	49	151.0	2.2	2.2	1.7	0.11	0.11	0.08
FCU-G-07	8.2	6.8			0.3	550	75	475	75	90.7	1.3	0.9	1	0.10	0.07	0.08
FCU-G-08	16.8	13.7			0.7	1060	140	920	46	297.8	4.3	3	2.5	0.20	0.14	0.12
FCU-G-09	38	24.5			1.5	1325	730	595	143	171.3	2.2	2.2	1.7	0.31	0.31	0.24
FCU-G-10	18.3	14.5			0.7	1215	200	1015	127.3	113.9	1.9	1.2	1.3	0.24	0.15	0.17
FCU-G-11	5	4			0.2	420		420	9.5	421.1	5.6	5.6	3.6	0.05	0.05	0.03
FCU-G-12	10.8	10.4			0.4	845	60	785	184.6	56.3	1.3	0.9	1	0.24	0.17	0.18
FCU-G-13	5.8	4.4			0.2	410	210	200	22	200.0	4.3	3	2.5	0.09	0.07	0.06
FCU-G-14	18.1	17			0.7	1665	1665	0	120	141.7	1.9	1.2	1.3	0.23	0.14	0.16
FCU-G-15	10.2	7.7			0.4	660	400	260	46.4	165.9	2.2	2.2	1.7	0.10	0.10	0.08
FCU-G-16	39.3	27.1			1.6	1600	650	950	157	172.6	2.2	2.2	1.7	0.35	0.35	0.27
FCU-G-17	31.4	21			1.2	1365	640	725	153	137.3	1.9	1.2	1.3	0.29	0.18	0.20
LEVEL 1														0.00	0.00	0.00
AHU-L1-01	46.2	31.2	17.6	0.3	1.8	1420	800	620	230	135.7	1.9	1.2	1.3	0.44	0.28	0.30
AHU-L1-02	56.6	38.1	17.7	0.3	2.3	1850	835	1015	311.5	122.3	1.9	1.2	1.3	0.59	0.37	0.40
AHU-L1-03	28.5	31.3	20.8	0.3	1.8	2010	800	1210	237	132.1	1.9	1.2	1.3	0.45	0.28	0.31
AHU-L1-04	57.4	41.5	22.2	0.4	2.3	2425	845	1580	295	140.7	1.9	1.2	1.3	0.56	0.35	0.38
AHU-L1-05	71.5	49.9	29.3	0.5	2.8	3005	1145	1860	300	166.3	2.2	2.2	1.7	0.66	0.66	0.51
AHU-PC3.A	28.5	18.2	14.2	0.2	1.1	700	700	0	66.5	273.7	4.3	3	2.5	0.29	0.20	0.17
AHU-PC3.L	23.5	13.2	12.7	0.2	0.9	700	700	0	66.5	198.5	2.2	2.2	1.7	0.15	0.15	0.11
FCU-L1-1	10	7.5			0.4	655	330	325	245	30.6	1.3	0.9	1	0.32	0.22	0.25
LEVEL 2														0.00	0.00	0.00
AHU-L2-01	113	79.7	45.4	0.7	4.5	4595	2000	2595	675.5	118.0	1.9	1.2	1.3	1.28	0.81	0.88
AHU-L2-02	63.1	50.3	21.3	0.3	2.5	3910	640	3270	453	111.0	1.9	1.2	1.3	0.86	0.54	0.59
FCU-L2-01	11.4	9.7			0.5	1680	220	1460	250	38.8	1.3	0.9	1	0.33	0.23	0.25
FCU-L2-02	7.3	6.2			0.3	1310	140	1170	108	57.4	1.3	0.9	1	0.14	0.10	0.11

LOWER GROUND	Total cooling capacity (kW)	Total cooling Sensible capacity (kW)	Total heating capacity (kW)	HW flow (l/s)	CHW flow (l/s)	Supply air (l/s)	OA (l/s)	RA (l/s)	Approx Area (m2)	cooling/ heat load per sqm	BCA Maximum chilled water Pump power (W/m2)	BCA Maximum Condenser water Pump power (W/m2)	BCA Maximum Hot water Pump power (W/m2)	Chilled water pump power kW	Condenser water pump power kW	Hot water pump power kW
FCU-L2-03	10.3	9.4			0.4	1045	110	935	91	103.3	1.9	1.2	1.3	0.17	0.11	0.12
FCU-L2-04	9.2	8.3			0.4	715	110	605	55	150.9	1.9	1.2	1.3	0.10	0.07	0.07
FCU-L2-05	15.4	14.1			0.6	1310	170	1140	118	119.5	1.9	1.2	1.3	0.22	0.14	0.15
FCU-L2-06	7.7	6.3			0.3	780	180	600	228	27.6	1.3	0.9	1	0.30	0.21	0.23
FCU-L2-07	10	7.5			0.4	655	330	325	245	30.6	1.3	0.9	1	0.32	0.22	0.25
FCU-L2-08	12	11			0.5	1000	50	950	27	407.4	5.6	5.6	3.6	0.15	0.15	0.10
FCU-L2-09	3.2	2.2			0.1	195	150	45	42	52.4	1.3	0.9	1	0.05	0.04	0.04
FCU-L2-10	3	2.3			0.1	195	150	45	41	56.1	1.3	0.9	1	0.05	0.04	0.04
FCU-L2-11	3	2.3			0.1	195	150	45	41	56.1	1.3	0.9	1	0.05	0.04	0.04
FCU-L2-12	3.6	2.5			0.1	220	150	70	43	58.1	1.3	0.9	1	0.06	0.04	0.04
FCU-L2-13	4.3	2.9			0.2	160	80	80	24	120.8	1.9	1.2	1.3	0.05	0.03	0.03
CASS-2.1	15	14.6			0.6	1200	20	1180	28	521.4	5.6	5.6	3.6	0.16	0.16	0.10
LEVEL 3														0.00	0.00	0.00
AHU-L3-01	110	65.6	59.3	0.9	4.4	2950	600	2350	365	179.7	2.2	2.2	1.7	0.80	0.80	0.62
AHU-L3-02	50.6	35.2	18.8	0.3	2	2015	900	1115	336.6	104.6	1.9	1.2	1.3	0.64	0.40	0.44
AHU-L3-03	64.5	51.6	21.5	0.3	2.6	3625	650	2975	453	113.9	1.9	1.2	1.3	0.86	0.54	0.59
FCU-L3-06	4.26	3.79	2.4	0.1	0.2	336	60	276	57.4	66.0	1.3	0.9	1	0.07	0.05	0.06
FCU-L3-07	10.3	9.58	4.24	0.1	0.4	822	90	732	89.4	107.2	1.9	1.2	1.3	0.17	0.11	0.12
FCU-L3-08	20.7	19.3	7.16	0.1	0.8	1658	173	1485	222	86.9	1.3	0.9	1	0.29	0.20	0.22
FCU-L3-09	7.62	6.2	3.89	0.1	0.3	532	180	352	85	72.9	1.3	0.9	1	0.11	0.08	0.09
FCU-L3-10	13	9.85	10.6	0.2	0.5	845	500	345	245	40.2	1.3	0.9	1	0.32	0.22	0.25
FCU-L3-11	4.3	2.92	1.73	0.1	0.2	161	80	81	24	121.7	1.9	1.2	1.3	0.05	0.03	0.03
CASS-3.1	15	14.6			0.6	1200	20	1180	25.6	570.3	5.6	5.6	3.6	0.14	0.14	0.09
CASS-3.2	15	14			0.6	1200	20	1180	21.6	648.1	5.6	5.6	3.6	0.12	0.12	0.08
LEVEL 4														0.00	0.00	0.00
AHU-L4-01	83	64.9	25.7	0.4	3.3	4550	910	3640	674	96.3	1.3	0.9	1	0.88	0.61	0.67

LOWER GROUND	Total cooling capacity (kW)	Total cooling Sensible capacity (kW)	Total heating capacity (kW)	HW flow (l/s)	CHW flow (l/s)	Supply air (l/s)	OA (l/s)	RA (l/s)	Approx Area (m2)	cooling/ heat load per sqm	BCA Maximum chilled water Pump power (W/m2)	BCA Maximum Condenser water Pump power (W/m2)	BCA Maximum Hot water Pump power (W/m2)	Chilled water pump power kW	Condenser water pump power kW	Hot water pump power kW
AHU-L4-02	63.6	50.6	20.8	0.3	2.5	3930	650	3280	453	111.7	1.9	1.2	1.3	0.86	0.54	0.59
FCU-L4-01	8.64	8.13	2.26	0.1	0.3	697	63	634	112.5	72.3	1.3	0.9	1	0.15	0.10	0.11
FCU-L4-02	10.5	9.28	4.62	0.1	0.4	1056	154	902	161	57.6	1.3	0.9	1	0.21	0.14	0.16
FCU-L4-03	48.1	128.1	26.2	0.4	1.9	1350		1350	182	703.8	5.6	5.6	3.6	1.02	1.02	0.66
FCU-L4-04	26.7	23.5	12.8	0.2	1.1	2016	502	1514	154	152.6	2.2	2.2	1.7	0.34	0.34	0.26
FCU-L4-06	13.7	10	10.8	0.2	0.5	861	500	361	0	0.0	0	0		0.00	0.00	0.00
FCU-L4-07	12	12			0.5	1000	50	950	37	324.3	5	3.6	3.2	0.19	0.13	0.12
FCU-L4-08	6.45	5.78	2.02	0.1	0.3	702	91	611	112	51.6	1.3	0.9	1	0.15	0.10	0.11
FCU-L4-09	8.38	7.84	1.87	0.1	0.3	673	73	600	88.7	88.4	1.3	0.9	1	0.12	0.08	0.09
FCU-L4-10	4.3	2.92	1.73	0.1	0.2	161	80	81	24	121.7	1.9	1.2	1.3	0.05	0.03	0.03
CASS-4.1	10	8.5			0.4	800	20	780	0	0.0	0	0		0.00	0.00	0.00
CASS-4.2	10	8.5			0.4	800	20	780	0	0.0	0	0		0.00	0.00	0.00
CASS-4.3	10	8.5			0.4	800	20	780	0	0.0	0	0		0.00	0.00	0.00
CASS-4.4	10	8.5			0.4	800	20	780	0	0.0	0	0		0.00	0.00	0.00
CASS-4.5	10	8.5			0.4	800	20	780	0	0.0	0	0		0.00	0.00	0.00
CASS-4.6	10	8.5			0.4	800	20	780	0	0.0	0	0		0.00	0.00	0.00
CASS-4.8	10	8.5			0.4	800	20	780	28.7	296.2	4.3	3	2.5	0.12	0.09	0.07
CASS-4.9	15	14.6			0.6	1200	20	1180	24.3	600.8	5.6	5.6	3.6	0.14	0.14	0.09
LEVEL 5														0.00	0.00	0.00
AHU-L5-01	64	46.4	22.5	0.4	2.5	4060	1000	3060	470	98.7	1.3	0.9	1	0.61	0.42	0.47
AHU-L5-02	74.3	57.7	24.6	0.4	3	4420	820	3600	440	131.1	1.9	1.2	1.3	0.84	0.53	0.57
FCU-L5-01	9.46	8.31	4.21	0.1	0.4	713	145	568	119	69.8	1.3	0.9	1	0.15	0.11	0.12
FCU-L5-02	6.25	5.37	2.83	0.1	0.2	461	113	348	77	69.7	1.3	0.9	1	0.10	0.07	0.08
FCU-L5-03	4.61	3.72	2.56	0.1	0.2	319	121	198	49	75.9	1.3	0.9	1	0.06	0.04	0.05
FCU-L5-04	5.2	4.39	2	0.1	0.2	363	110	253	87.4	50.2	1.3	0.9	1	0.11	0.08	0.09
FCU-L5-05	5.45	4.64	2.43	0.1	0.2	384	110	274	81	57.3	1.3	0.9	1	0.11	0.07	0.08

LOWER GROUND	Total cooling capacity (kW)	Total cooling Sensible capacity (kW)	Total heating capacity (kW)	HW flow (l/s)	CHW flow (l/s)	Supply air (l/s)	OA (l/s)	SA (l/s)	Approx Area (m2)	cooling/ heat load per sam	BCA Maximum chilled water Pump power (W/m2)	BCA Maximum Condenser water Pump power (W/m2)	BCA Maximum Hot water Pump power (W/m2)	Chilled water pump power kW	Condenser water pump power kW	Hot water pump power kW
FCU-L5-06	16.9	15.3	7.2	0.1	0.7	1310	205	1105	158	96.8	1.3	0.9	1	0.21	0.14	0.16
FCU-L5-07	8.78	7.3	4.02	0.1	0.3	703	200	503	121.4	60.1	1.3	0.9	1	0.16	0.11	0.12
FCU-L5-08	16.6	11.7	13.6	0.2	0.7	1008	650	358	0	0.0	0	0		0.00	0.00	0.00
FCU-L5-09	7.41	6.38	2.94	0.1	0.3	766	140	626	115	55.5	1.3	0.9	1	0.15	0.10	0.12
FCU-L5-10	8.85	7.44	3.98	0.1	0.4	1489	190	1299	126	59.0	1.3	0.9	1	0.16	0.11	0.13
FCU-L5-11	3.93	2.55	1.74	0.1	0.2	129	80	49	24	106.3	1.9	1.2	1.3	0.05	0.03	0.03
CASS-5.1	15	14.6			0.6	1200	20	1180	42	347.6	5	3.6	3.2	0.21	0.15	0.13
LEVEL 6														0.00	0.00	0.00
AHU-L6-01	43.3	33.8	20.1	-	1.7	2365	480	1885	260	130.0	1.9	1.2	1.3	0.49	0.31	0.34
AHU-L6-02	32.3	20.3	17.6	0.3	1.3	840	840	0	83	244.6	4.3	3	2.5	0.36	0.25	0.21
AHU-L6-03	28.7	18.1	15.6	0.2	1.1	750	750	0	83	218.1	4.3	3	2.5	0.36	0.25	0.21
AHU-L6-04	22.9	19.2	11.1	0.2	0.9	1850	185	1665	264	72.7	1.3	0.9	1	0.34	0.24	0.26
FCU-L6-01	7.34	6.47	3.65	0.1	0.3	1123	110	1013	98	66.0	1.3	0.9	1	0.13	0.09	0.10
FCU-L6-02	7.85	6.91	3.65	0.1	0.3	593	120	473	98	70.5	1.3	0.9	1	0.13	0.09	0.10
FCU-L6-03	3.22	2.47	2.17	0.1	0.1	212	99	113	25	98.8	1.3	0.9	1	0.03	0.02	0.03
FCU-L6-04	3.03	2.94	1.15	0.1	0.1	281	10	271	54	54.4	1.3	0.9	1	0.07	0.05	0.05
FCU-L6-05	5.85	5.08	2.89	0.1	0.2	436	100	336	88	57.7	1.3	0.9	1	0.11	0.08	0.09
FCU-L6-06	6.93	5.94	2.92	0.1	0.3	509	120	389	82	72.4	1.3	0.9	1	0.11	0.07	0.08
FCU-L6-07	17.9	16.5	7.3	0.1	0.7	1416	190	1226	179	92.2	1.3	0.9	1	0.23	0.16	0.18
FCU-L6-08	10.2	9.05	4.28	0.1	0.4	844	160	684	152	59.5	1.3	0.9	1	0.20	0.14	0.15
FCU-L6-09	13.3	10.5	11.8	0.2	0.5	900	380	520	245	42.9	1.3	0.9	1	0.32	0.22	0.25
FCU-L6-10	12	12			0.5	100	50	50	99	121.2	1.9	1.2	1.3	0.19	0.12	0.13
FCU-L6-11	8.75	7.56	3.73	0.1	0.3	689	160	529	113	66.9	1.3	0.9	1	0.15	0.10	0.11
FCU-L6-12	10.2	8.75	4.45	0.1	0.4	796	190	606	30	291.7	4.3	3	2.5	0.13	0.09	0.08
FCU-L6-13	12	8.78	6.12	0.1	0.5	574	160	414	45	195.1	2.2	2.2	1.7	0.10	0.10	0.08
FCU-L6-14	6.12	3.71	2.97	0.1	0.2	161	140	21	20	185.5	2.2	2.2	1.7	0.04	0.04	0.03

LOWER GROUND	Total cooling capacity (kW)	Total cooling Sensible capacity (kW)	Total heating capacity (kW)	HW flow (l/s)	CHW flow (l/s)	Supply air (l/s)	OA (l/s)	RA (l/s)	Approx Area (m2)	cooling/ heat load per sqm	BCA Maximum chilled water Pump power (W/m2)	BCA Maximum Condenser water Pump power (W/m2)	BCA Maximum hot water Pump power (W/m2)	Chilled water pump power kW	Condenser water pump power kW	Hot water pump power kW
FCU-L6-15	6.23	3.82	3.09	0.1	0.2	171	140	31	20	191.0	2.2	2.2	1.7	0.04	0.04	0.03
FCU-L6-16	12	12	22	0.4	0.5	1000	50	950	20	600.0	5.6	5.6	3.6	0.11	0.11	0.07
PRECON-L7-01	81.9	42.2	59.9	1	3.3	3250	3250	0	0					0.00	0.00	0.00
PRECON-L7-02	169	87.2	122.7	2	6.7	6745	6745	0	0					0.00	0.00	0.00
total	**3102.01**	**2543.17**	**1215.5**	**20.3**	**130.6**	**164092**	**65615**	**98477**	**17831.6**	**20334.15839**	**289.1**	**231**	**196.1**	**36.76881**	**26.96376**	**25.29929**

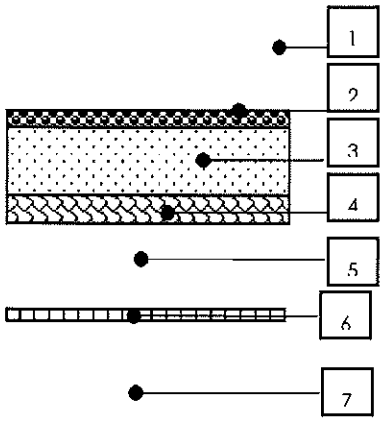
Proposed hot water pump (kW)	10.25
Proposed condenser water pump (kW)	45.24
Proposed chilled water pump (kW)	66.25

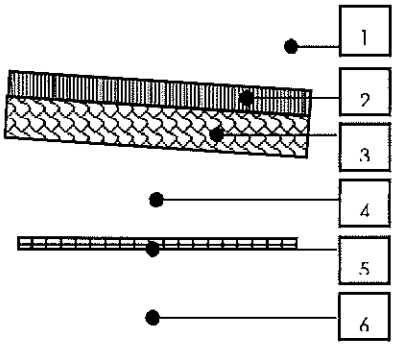
Appendix F

Proposed Building Fabric Calculation

- Roof
- Ceiling/Floor
- External Wall
- Internal Wall

External roof

ER-01: External roof	Item	Description	R-value Unventilated	
			Up	Down
	1.	Outdoor air film (7 m/s)	0.04	0.04
	2.	Waterproof membrane, rubber synthetic (4mm, 961 kg/m3)	0.03	0.03
	3.	Dense concrete (250mm)	0.174	0.174
	4.	**Insulation (density 30kg/m² 115mm thick or similar)**	**3.50**	**3.50**
	5.	Air cavity (100mm to 300mm, non-ventilated)	0.15	0.22
	6.	Plasterboard (10 mm)	0.06	0.06
	7.	Indoor air film (still air)	0.11	0.16
	Total R-value		**4.06**	**4.18**

ER-02: External roof (Steel Roof sheeting configurations)	Item	Description	R-value Unventilated	
			Up	Down
	1.	Outdoor air film (7 m/s)	0.04	0.04
	2.	Steel Sheeting	0.00	0.00
	3.	**Insulation (density 30kg/m² 115mm thick or similar)**	**3.50**	**3.50**
	4	Air cavity (100mm to 300mm, non-ventilated)	0.15	0.22
	5.	Plasterboard (10 mm)	0.06	0.06
	6.	Indoor air film (still air)	0.11	0.16
	Total R-value		**3.86**	**3.98**