2 BUILDING DESIGN

2.1 Generally

The design and construction of each building shall be economical in use of space.

Expensive exterior and interior finishes are to be avoided.

The placing of protruding building services and equipment on building facades and rooftops should be avoided.

Flexibility for future use of building spaces is to be considered an important design parameter and the probable effect on the building and services requirements is to be assessed in relation to future change of use.

External walls, especially off-form concrete walls, are to be '**anti graffiti**' treated to 2.5m high or agreed height with Project Manager with a non-sacrificial coating.

Life cycle costs must be minimised as University buildings are to endure for at least 100 years. For life cycle costing analysis, the University recommends a 5% discount rate over a life of 20 years.

Maintainability…….

SECTION UNDER REVIEW, SUBJECT TO FURTHER NOTICE.

- **Solar Control**
  Refer also Functional Controls, Section 2.3 and the University's Standard Building Environmental Brief.

  Architects must design to screen against solar heat and glare (especially from lower level roofs) on the faces of their buildings and to avoid reflection problems for adjacent buildings.

  Where possible, advantage should be taken of sun control devices (horizontal sunscreens, etc.) as access ways for the facilitation of window cleaning.

  Fixing battens, pelmet boards or other means should be provided for the fitting of curtains or internal blinds.

- **Wind Around Buildings**
  For an individual building or groups of buildings architects shall design to avoid problems of wind turbulence.

2.2 Facilities Planning

2.2.1 Academic, Research and Administrative Workplaces

Workplace planning is to be undertaken to address:

- Functional and ergonomic work environment.
- Opportunity for informal and formal communication
- Privacy when performing concentrated tasks
- Opportunity for acoustic privacy for meetings and telephone conversations
- Collaborative work practices
- High quality ambient environment
- Appropriate access to book and files storage

- Individual space for displaying notes and other materials
- Opportunity to relax, eat and drink and reflect on work away from workplace

The planning process will address:

- User group work practices
- User group specific needs
- Technical and physical constraints
- Cost
- Other requirements of the University's Planning and Design Guidelines.

The preferred planning outcome may include the following options:

- Office Space
- Open Plan Workplace

Guide descriptions of these planning options and guidelines for physical space provisions are as follows:

2.2.2 Office Space

An office/room for one occupant with appropriate storage, spread and meeting space to meet the occupant's functional requirements.

Where a single office environment is the preferred planning outcome guideline areas are as follows:

1.	Senior Member University Executive (EG- VP, DVC,PVC)	24-27m^2
2.	Executive Staff Academic / General (EG - Dean/Director)	15–18m^2
3.	Senior Staff: Academic / General (EG Assoc Dean/HOS/Branch Mgr)	12-15m^2
4.	Academic / Other General Staff with specific need for office space	12-15 m^2
5.	Research/Post Doctorate/Academic (part time)Shared Space	6 – 8 m^2
6.	Waiting space – to suit functional requirement	

Note: A business case approved by Director of F&S with endorsement from respective Centre Directors will be required for a single dedicated office for general staff below HEW10. Similarly an approved business case from the Faculty Dean and Director of F&S will be required for academic staff requiring a single of below Academic Level D/E.

2.2.3 Open Plan Workspace

An open area work environment with shared team spaces supported by meeting/retreat spaces.

Where an open plan workspace is the preferred outcome guideline areas are as follows:

1.	Academic (full time)	6 – 8m^2
2.	Research/Post Doctorate/Academic (part time)	6 – 8m^2
3.	General Staff	6 – 8m^2
4.	Post Graduate Students	2 – 4 m^2
5.	Support Space:	
	Storage Space (per occupant)	1m^2
	Meeting/Collaborative (per occupant)	2m^2
6.	Waiting Space – to suit functional requirements	

2.2.4 Teaching and Learning Facilities

As a guideline for preliminary planning the guide areas for Teaching and Learning Facilities are as follows. Specific purpose facilities will require adjustments provided by the University.

Lecture Theatres	
Stepped floor- up to 100	2m² / seat
above 100	1.7m² / seat
Lecture/Tutorial Rooms	2m² / seat
Minimum room size	30 students
Library	
Reading space including associated passageways	0.5 – 1.5m² / EFTSL
Open access book stacks Including gangways and aisles	6m² / 1000 volumes
Compactus storage areas Including aisles	36m² / 1000 volumes

Areas are measured in accordance with Tertiary Education Facilities Management Association (TEFMA) definitions. Utilisation and areas/student to TEFMA Benchmarks can be provided by the University.

2.2.5 Planning

A mature campus will have the following provision of space by broad functional area:

Academic	50%
Administrative	12%
Commercial	4%
General Teaching	12%
Library	10%
Student Services	8%
Other	4%

Planning solutions for individual buildings will be benchmarked against this ratio across the Campus.

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2.3 Sustainable Design

2.3.1 Introduction

Purpose

Ecological Sustainable Design means to design buildings with longevity, minimal impact on the environment, providing an ambiance that makes the best use of natural resources. The purpose of these Sustainability Guidelines is to provide guidance to designers in respect to ecological sustainable design. (ESD): there are three key ways to achieve this:

- Compliance with the six environmental performance indicators, see section 2.3.1.1
- Incorporating Green Star building design features to a minimum standard of 4 stars with the target of reaching 5 stars. Please see section for further info on how ECU

incorporates Green Star features into its building design. Please note ECU does not apply for Green Star accreditation certificates but does aim to incorporate green star design features into its building design.

- Meeting the requirements for design documentation and review according to the process shown in section 2.3.1.2

This document provides a step by step guide which will allow one stage to be reviewed prior to proceeding to the next stage of design development.

However this section is not a complete guide to the sustainable features to be included in building design and for a complete understanding of sustainable building features this section must be read in conjunction with other sections of the Design Guidelines.

This document is a guide to the various green building approaches and technologies available to designers. There are many guidelines and case studies, and much literature on this subject, and designers are expected to be aware of best practice and able to apply it to ECU projects.

2.3.1.1 Environmental Performance Indicators

The following environmental performance indicators established by ECU are to apply to all building projects. Additional indicators may be established for specific projects.

Thermal Comfort

Objective: To ensure the thermal comfort of building occupants in normal operating conditions

Indicator: Predicted Mean Vote (PMV) as measured in accordance with ISO 7730

Target: PMV in the range of -1 to +1.

Indoor Air Quality

Objective: To ensure indoor air is free from contaminants and contains ample amounts of fresh air.

Indicator: Indoor CO^2 concentration

Target: 700 ppm (average over 8 hour period)1

Materials Intensity

Objective: To minimise the energy embodied in construction materials

Indicator: Embodied Energy (GJ/m^2) as calculated in accordance with Appendix (a)

Target: To be established during the Concept Design phase
[Nominally in the range 14-18 GJ/m^2]

Operational Energy Consumption

Objective: To minimise the total energy consumed within the building

Indicator: Energy consumption (MJ / m^2 pa) calculated in accordance with Appendix (b)

[1] **Reference: ANSI / ASHRAE 62-1999**

Target: To be established during the Concept Design phase
[Nominally in the range 290-323 MJ / m^2 pa]

Greenhouse Gas Emissions

Objective: To minimise the emissions of greenhouse gases from energy sources

Indicator: Greenhouse emissions (T CO^2-e / m^2) to be calculated in accordance with Appendix (c)

Target: To be established during the Concept Design phase
[Nominally in the range 79-88T CO^2-e / m^2]

Scheme Water Consumption

Objective: To minimise the consumption of water from scheme sources

Indicator: Potable water consumption (L / day /m^2) to be calculated in accordance with Appendix (d)

Target: To be established during the Concept Design phase
[Nominally in the range 0.20 - 0.25 L / day /m^2]

2.3.1.2 Design Process

Optimal sustainability outcomes will only be achieved through an integrated design approach which involves collaboration between all consultants at all stages of design.

The design team will establish working arrangements which establish clear design responsibilities for each of the sustainability objectives, including how multi-disciplinary teams will work together to achieve the desired outcomes.

The steps and design process to achieve the final design, are as follows:

Step 1: Preliminary Analysis

Step 2: Establishment of Sustainability Targets

Step 3: Concept Design

Step 4: Schematic Design

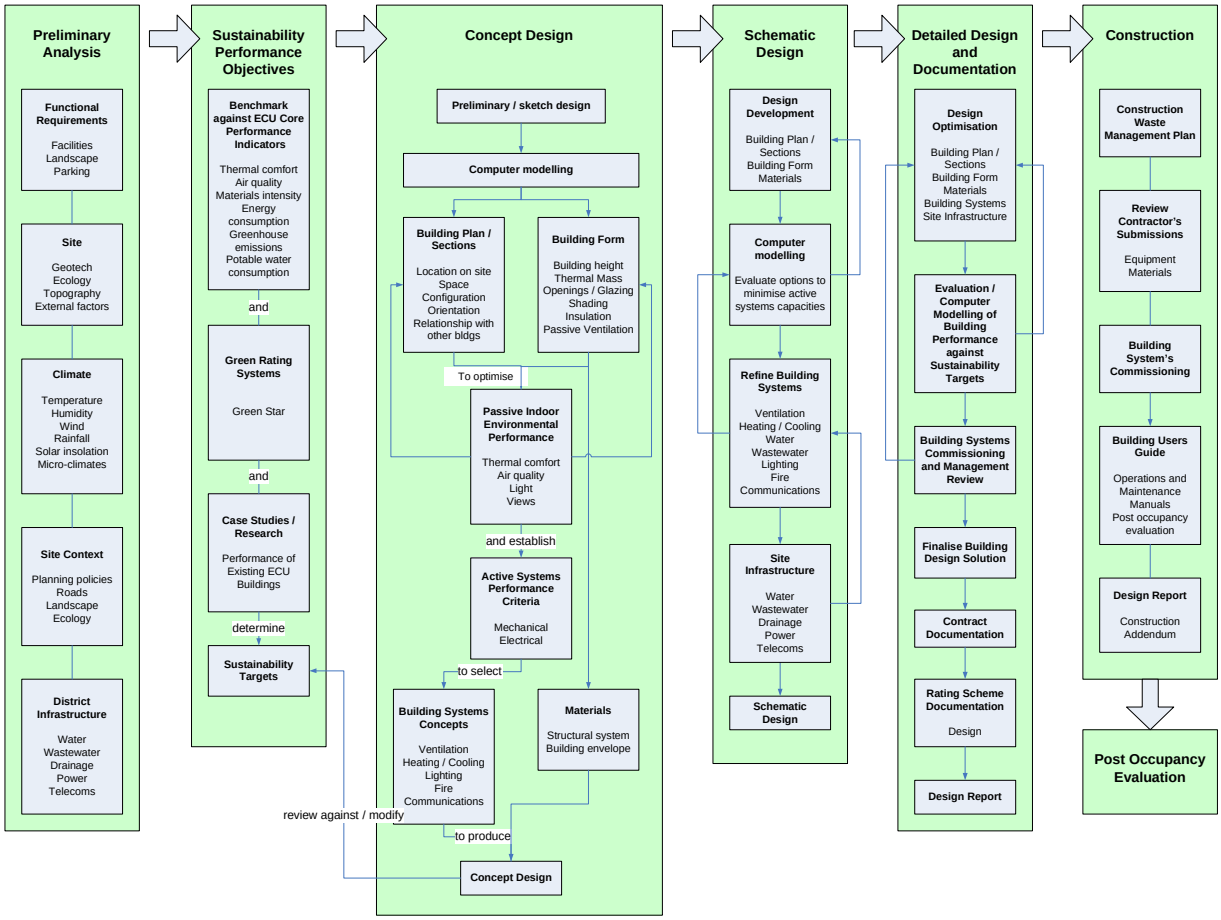
Step 5: Detailed Design and Documentation

Step 6: Construction and Commissioning

Step 7: Post Occupancy Evaluation

Further explanation of each stage is contained in the following sections.

Figure 1:Flow chart showing the design process


Preliminary Analysis
Functional Requirements
Facilities
Landscape
Parking
Site
Geotech
Ecology
Topography
External factors
Climate
Temperature
Humidity
Wind
Rainfall
Solar insolation
Micro-climates
Site Context
Planning policies
Roads
Landscape
Ecology
District Infrastructure
Water
Wastewater
Drainage
Power
Telecoms
Sustainability Performance Objectives
Benchmark against ECU Core Performance Indicators
Thermal comfort
Air quality
Materials intensity
Energy consumption
Greenhouse emissions
Potable water consumption
and
Green Rating Systems
Green Star
and
Case Studies / Research
Performance of Existing ECU Buildings
determine
Sustainability Targets
Concept Design
Preliminary / sketch design
Computer modelling
Building Plan / Sections
Location on site
Space Configuration
Orientation
Relationship with other bldgs
Building Form
Building height
Thermal Mass
Openings / Glazing
Shading
Insulation
Passive Ventilation
To optimise
Passive Indoor Environmental Performance
Thermal comfort
Air quality
Light
Views
and establish
Active Systems Performance Criteria
Mechanical
Electrical
to select
Building Systems Concepts
Ventilation
Heating / Cooling
Lighting
Fire
Communications
Materials
Structural system
Building envelope
review against / modify
to produce
Concept Design
Schematic Design
Design Development
Building Plan / Sections
Building Form
Materials
Computer modelling
Evaluate options to minimise active systems capacities
Refine Building Systems
Ventilation
Heating / Cooling
Water
Wastewater
Lighting
Fire
Communications
Site Infrastructure
Water
Wastewater
Drainage
Power
Telecoms
Schematic Design
Detailed Design and Documentation
Design Optimisation
Building Plan / Sections
Building Form
Materials
Building Systems
Site Infrastructure
Evaluation / Computer Modelling of Building Performance against Sustainability Targets
Building Systems Commissioning and Management Review
Finalise Building Design Solution
Contract Documentation
Rating Scheme Documentation
Design
Design Report
Construction
Construction Waste Management Plan
Review Contractor's Submissions
Equipment
Materials
Building System's Commissioning
Building Users Guide
Operations and Maintenance Manuals
Post occupancy evaluation
Design Report
Construction
Addendum
Post Occupancy Evaluation

2.3.2 Preliminary Analysis

A full analysis of all factors affecting the design is required before the process of developing building concepts is commenced. Figure 1 sets out the issues to be considered. A brief report setting out the findings of this analysis shall be provided to ECU prior to commencement of Concept Design. Although this analysis will be relevant to many aspects of design, the report should particularly establish the opportunities for, and constraints to, achievement of sustainability objectives.

In particular the following should be carefully evaluated during the analysis phase in respect of sustainability opportunities / constraints.

Site

Geotechnical Conditions:	opportunities for ground coupling, groundwater for non-potable water
Ecology:	protection of important ecological assets including existing vegetation and trees with significant habitat features are to be incorporated into building design.
Topography	exposure to prevailing winds / storms, opportunities for incorporating existing and proposed topography to create thermal mass around the building.

Climate

It is ECU's objective to ensure that all buildings are designed to be responsive to the climate, which will require modelling of the design to evaluate performance against the sustainability indicators. This modelling will be based on standard "climate files" which are specific to regions. ECU embraces the need to consider climate change science in building design and to consider future climatic predictions for Perth.

The climate analysis shall include both:

- the region specific climate data in respect of those factors which will affect design including: Temperature, Humidity, Wind, Rainfall, and Solar isolation; and
- An analysis of the micro-climate at the site will be necessary to ensure that local factors are properly considered.

Existing Infrastructure

In order to ensure that the concept design properly evaluates opportunities for alternative approaches to service provision, a thorough analysis of the infrastructure existing on the campus, and in the surrounding area will be required, including:

Water	minimise the use of groundwater resources, minimise the use of scheme water and provide opportunities to catch water on site and use water on site. ECU does not recycle water however if this is feasible we encourage designers to investigate this option.
Wastewater	Ensure wastewater infrastructure does not pollute or create contamination to waste water resources. Aim to

	reuse wastewater on site where possible to reduce the consumption of scheme water.
Drainage	Incorporate Rainwater / stormwater capture into building design, consider water sensitive urban design
Power	Incorporate renewable energy options into building design as a way of reducing carbon emissions.and at least 5% of the total power useage with photovoltaic technology.
Telecoms	Communications, building control potential

2.3.3 Establishment of Sustainability Targets

The results of the preliminary analysis provides an initial evaluation of the constraints and opportunities to meet ECU's core sustainability performance objectives.

This information should be considered in conjunction with:

- Performance data from other ECU buildings, and other relevant education building projects available;
- The Green Star – Education rating tool, the NABERS scheme and other relevant green building evaluation schemes; and
- Best practice examples of sustainable building design in Perth.

This information will be used to confirm / expand the core performance objectives and indicators set out above, and determine appropriate targets for each indicator. This process will occur in a workshop involving key members of the design team and ECU, and be documented.

Targets will be set on the basis of both environmental performance and project cost. Although the cost implications of various targets may not be able to be accurately assessed at this stage, a qualitative estimate of both capital and life cycle costs shall be made.

At this stage, before any significant design analysis has commenced, it may not be possible to set targets for all indicators, e.g. energy consumption or greenhouse gas emissions. In this case an interim target will be set, and confirmed or modified at a later stage of the design.

2.3.4 Concept Design

Overview

During the early stages of the Concept Design phase an emphasis should be placed on developing a building plan that optimises the passive performance of the building, and hence minimises the loads on the active building systems, particularly heating, cooling, ventilation and lighting. This process is the foundation of energy efficient building design.

With the key loads identified, the development of options for building systems will then be undertaken. Building materials will be selected to achieve the required characteristics in respect of thermal performance and embodied energy as well as architectural and structural considerations.

The achievement of optimal sustainability outcomes requires a fully integrated design approach, with architects and engineers working closely together. The following sections outline the key aspects to this integration.

Passive Building Performance

Without the influence of active systems the key indoor characteristics of a building (thermal comfort, air quality, light and views) are a function of:

Building Plan / Sections	Location on site, Space Configuration, Orientation, Relationship with other buildings etc
Building Form	Building height, Thermal Mass, Openings / Glazing, Shading, Insulation, Natural Ventilation
The Climate	Temperature, Humidity, Wind, Rainfall, and Solar isolation.

Consideration of these factors should be central to development of the early concepts. Computer modelling is likely to be required during this stage to efficiently consider alternative building plans / sections / forms, particularly with respect to thermal comfort, natural ventilation and day lighting.

This process will be architect-led but will involve HVAC, Electrical and Structural engineering input.

A design workshop will be held early in the Concept Phase with ECU to present and discuss alternative building plans / sections / forms in light of the project's sustainability indicators and targets, and capital and lifecycle cost implications.

Building Systems Concepts

Development of alternative building plans / sections / forms, together with the functional requirements of the project will establish approximate building system loads, e.g. ventilation, heating / cooling, lighting, fire, communications.

The development of design concepts for ventilation, heating / cooling and lighting will be mainly informed by thermal comfort, air quality, energy and water efficiency objectives.

Materials

Development of alternative building plans / sections / forms will establish the requirements for materials in respect of the structural and thermal performance of materials and sections. This, together with the functional requirements of the project will enable preliminary materials selection to occur.

Options to be evaluated will be mainly informed by the materials intensity objectives, which will require an understanding of the embodied energy of various materials.

Materials are to be sourced locally and or from reused materials as a first preference to reduce the embodied energy of the product. Suppliers to provide information on where the product comes from, how it was made and to be incorporated into the Environmental Management plan

Finalising the Concept

A workshop will be held with ECU just prior to completion of the Concept Design phase. In this workshop the design team will present the various alternative concepts considered and discuss their performance against the following:

- The project's functional requirements;
- The sustainability objectives / targets; and
- Capital and lifecycle costs

This workshop will confirm the sustainability targets to be achieved on the project, and provide guidance to the design team for finalising the Concept Design.

The Concept Design deliverables will include a sustainability report containing the Preliminary Analysis, the establishment of Project Targets, documentation of the alternatives considered, and a justification of the proposed Concept based on functional, sustainability and cost considerations.

2.3.5 Schematic Design

Design Development

Further development of the design will involve the refinement of the Building Plan / Sections; the Building Form, and Materials.

Computer Modelling / Simulation

Computer modelling will be used to evaluate the environmental performance of the building and to evaluate options to minimise the capacity of active systems. Energy modelling will follow the Green Star / NABERS Energy simulation validation protocol.

The modelling will facilitate the refinement of the building systems including Ventilation, Heating / Cooling, Water, Wastewater, Lighting, Fire Control and Communications. Again alternative options shall be considered and compared, using the sustainability targets as a guide.

Site Infrastructure

Consideration of the buildings systems will also inform, and be informed by potential options with respect to site infrastructure, including Water, Wastewater, Drainage, Power and Telecoms.

Finalising Schematic Design

A workshop will be held with ECU just prior to completion of the Schematic Design phase. In this workshop the design team will present the various alternative concepts considered and discuss their performance against the following:

- The project's functional requirements;
- The sustainability objectives / targets; and
- Capital and lifecycle costs

This workshop will confirm the design solution and provide guidance to the design team for documenting the project.

The Schematic Design deliverables will include a sustainability report outlining the process of design development, documentation of the alternatives considered, and a justification of the proposed Scheme based on functional, sustainability and cost considerations.

2.3.6 Detailed Design and Documentation

Design Optimisation

The first part of the documentation phase of the project involves the further refinement of Building Plan / Sections, Building Form, Materials, Building Systems and Site Infrastructure with a view to optimising the building as an integrated system.

The optimisation process will involve further computer modelling and other evaluation of the building performance against the selected sustainability targets.

Building Systems Commissioning and Management Review

Prior to finalising the design solution, a review will be undertaken with the participation of ECU to ensure that the strategy for equipment selection, commissioning of the building systems and their post-construction management is resolved and agreed, including:

- Measurement (including metering);
- Control of the building's active systems;
- Commissioning requirements
- Systems monitoring and tuning through the Defects Liability Period, handover to ECU and post occupancy

Contract Documentation

Prior to the completion of the Contract Documentation a review will be undertaken with the participation of ECU to ensure that the drawings, specifications and contract requirements are comprehensive in respect of the sustainability elements of the design and will result in the realisation of the sustainability performance targets.

The contract documents will include the requirements of the Contractor in respect of best practice construction waste management, including the preparation of a Waste Management Plan.

The specifications will include a "Sustainability" section which will set out the sustainability objectives and targets and outline the relevant design measures with reference to key drawings and specifications, including those related to commissioning and tuning of the building systems.

Rating Scheme Documentation

If the project is seeking certification to Green Star or other rating schemes, the preparation of the necessary documentation will proceed in parallel with the Contract Documentation process.

Sustainability Report

As part of the project deliverables a sustainability report will be prepared which incorporates the reporting at Concept and Schematic Design stage and outlines the final design solution and how it will achieve the sustainability objectives and targets.

In particular the report will set out the strategy for measuring, monitoring and management of the building's systems and the contractual arrangements for commissioning, tuning and handover to ECU.

2.3.7 Construction and Commissioning

Construction Management

Management of the construction phase will be structured to ensure that the sustainability objectives and targets will be achieved. In particular the following will be considered:

- Construction Waste Management Plan - development, approval and monitoring
- Review Contractor's Submissions for equipment and materials
- Building System's Commissioning – preparation and supervision

Building Users Guide

During the construction phase a comprehensive Building Users Guide will be prepared. The guide will describe the design measures taken to achieve the sustainability targets, outline how the building systems work and describe how building users and occupants operate the building to ensure optimal performance and efficiency.

The Guide will be prepared as an online resource suitable for all users and occupiers. The Guide will provide an appropriate link to detailed Operations and Maintenance Manuals for use by ECU's facilities management team.

The Guide will also include a section on the measures that will be undertaken post-occupancy to evaluate the performance of the building as set out in Section **Error! Reference source not found.** below.

Sustainability Report

An addendum to the sustainability report will be prepared at the time of practical completion, which takes into account any modifications to the design arising from construction or clarifications necessary following commissioning and building tuning.

2.3.8 Post Occupancy Evaluation

Prior to Practical Completion a workshop will be held involving ECU facilities management staff, the key members of the design / construction teams and equipment suppliers to establish an appropriate approach to post occupancy evaluation.

Measures will be identified to evaluate the post-occupancy performance of the building against the required functional characteristics of the building and the sustainability targets. These measures will involve a combination of measurement and monitoring of the building's systems and surveys of occupants and ECU's facilities management staff.

The post occupancy evaluation methodology will be incorporated in the Building User's Guide.

Appendix

a) Calculation of Embodied Energy

Embodied Energy Calculation

The calculation should follow the guidance provided by the Centre for Design at RMIT University (see http://buildlca.rmit.edu.au/).

The case studies from RMIT provide guidance on the main sources of embodied energy in buildings which should be the focus of attention.

Note: Due to the gaps in data, and different definitions of embodied energy, these calculations cannot be considered as accurate inventories of energy / carbon emissions.

Embodied Energy Target Setting

Due to the lack of benchmarked data and potential complexity of embodied energy calculations it is envisaged that the scope of embodied energy calculations will be limited to the main sources of energy / emissions.

The main focus for target setting is:

- To ensure the design achieves better outcomes than conventional practice; and
- To compare different building systems / materials selections;

  rather than the achievement of any particular target embodied energy figures.

Accordingly it is envisaged that targets will be set as a result of option studies during concept design.

The summary of embodied energy calculations from various case studies by RMIT quotes an EE figure of 15.76 GJ/m2 for an educational facility.

ECU B21 Health & Wellness Building - Embodied Energy

	Qty	Unit	EE coeff	Unit	Embodied Energy	
Groundwork						
Excavation	1,341	m3	0.036	GJ/m3	48	GJ
Rock excavation	20	m3	0.036	GJ/m3	1	GJ
Fill (sand)	1,040	m3	0.036	GJ/m3	37	GJ
				Total	**86**	**GJ**
Structural Steel & Metalworks						
Steel	**994**	**t**	**64.6**	**GJ/t**	**64,202**	**GJ**
Reinforcing steel	635	t	64.6	GJ/t	41,000	
Structural steel	358	t	64.6	GJ/t	23,106	
Galvanised steel	1.5	t	64.6	GJ/t	97	
Aluminium	**569**	**t**	**159.5**	**GJ/t**	**90,782**	**GJ**
Wall cladding	25	t	159.5	GJ/t	3,985	
Sun control screens	519	t	159.5	GJ/t	82,813	
External windows and doors	25	t	159.5	GJ/t	3,984	
				Total	**154,985**	**GJ**
Concrete						
Concrete	5,130	m3	0.4	GJ/m3	2,052	GJ
Precast concrete	300	m3	0.4	GJ/m3	120	
In-situ concrete	4,790	m3	0.4	GJ/m3	1,916	
Piles	31	m3	0.4	GJ/m3	12	
Cavity fill	10	m3	0.4	GJ/m3	4	
Blockwork	80	m2	0.21	GJ/m2	17	
				Total	**2,052**	**GJ**
Building Envelope						
Plastering (3:1 ratio)	19	m3	4.4	GJ/m3	83	GJ
Brickwork & Mortar	7,939	m2	0.75	GJ/m2	5,954	GJ
Limestone	34,816	kg	0.3	MJ/kg	10	GJ
Glazing	26	t	13.9	GJ/t	358	GJ
Roofing & Wall Cladding	17	t	64.6	GJ/t	1,089	GJ
Sheet steel	17	t				
Carpentry & Joinery						
Glasswool batts	6,881	m2	0.097	GJ/m2	667	GJ
				Total	**8,163**	**GJ**
Paving & Tiling (Internal Finishes)						
Carpet	6,991	m2	0.804	GJ/m2	5,621	GJ
Floor vinyl	2,358	m2	0.2	GJ/m2	472	GJ
Wall vinyl	151	m2	0.2	GJ/m2	30	GJ
Ceramic tiles	1,264	m2	0.29	GJ/m2	367	GJ
Stone tiles	17,983	kg	5.9	MJ/kg	106	GJ
				Total	**6,595**	**GJ**

Total embodied energy	171,881	**GJ**
Total floor area	**10,550**	**m2**
Total Embodied Energy/m2	**16,292**	**MJ/m2**
	16.3	GJ/m2

Exclusions

The following items from the Bill of Quantities were excluded:

- Formwork
- Stud work wall framing
- Waterproofing
- Operable walls
- Metal door frames
- Soffit linings
- Handrails & Balustrades
- Projection screens
- Toilet accessories
- Skirting
- Carpentry & joinery
- Capping and flashings
- Gutters
- Lift Services
- Hydraulic Services
- Ceilings, partitions and linings
- Mirrors
- Painting
- Site works

Sources of EE coefficients

- RMIT: Greening the Building Life Cycle Study - http://buildlca.rmit.edu.au/CaseStud/EE/EEmethod.html
- University of Bath - Inventory of Carbon & Energy - http://www.bath.ac.uk/mech-eng/sert/embodied/

Material densities

- http://www.greenspec.co.uk/html/materials/embodied_energy.html
- University of Bath - Inventory of Carbon & Energy - http://www.bath.ac.uk/mech-eng/sert/embodied/

b) Operational Energy

Operational Energy Calculation

The calculation of operational energy consumption will be based on energy modelling of the building in accordance with the Green Star / NABERS Energy simulation validation protocol.

Operational Energy Targets

Targets will be set during the concept design phase and shall be based on the achievement or the exceeding of best practice for the particular type of building under consideration.

It is expected that targets will meet or exceed the “conditional requirements” determined from the Green Star Education energy calculator.

Green Star – Education v1 Energy Calculator determines the benchmark for each project based on the composition of space types within each project.
The conditional requirements are:

Universities Conditional Requirements	*(kgCO2-e/m2/annum)*
Teaching/classroom spaces	82
Dry labs/specialty learning spaces and libraries	88
Office/administrative spaces	79
Common spaces	57
Wet labs (varies based on density of fume cupboards)	
Gymnasiums	143
Car parks	52

The methodology used to establish the conditional requirement for each space type is detailed in the Green Star – Education v1
Energy Calculator Standard Practice Benchmark document available on the GBCA website. The predicted greenhouse gas emissions must be determined using energy modeling in accordance with the final and current version of the Green Star – Education v1 Energy Calculator.

c) Greenhouse Gas Emissions

Greenhouse Gas Calculation Method

Base calculation – operational energy

Greenhouse gas emissions shall be calculated from the Green Star Education energy calculator. Although the Green Star calculations include an allowance for on-site renewable energy generation, this should not be included in the Base calculation.

Net calculation

The net greenhouse calculation shall be the Base calculation, less the following:

- The proportion of electrical energy to be purchased under the Green Power scheme in accordance with ECU's contemporary environmental policy;
- Any onsite renewable energy generation
- Any project specific carbon offset initiative (methodology to be in accordance with the Voluntary Carbon Standard (see http://www.v-c-s.org/index.html)

Greenhouse Gas Target

The greenhouse gas target will be set during the Concept Design phase during which options will be considered for the building's thermal performance, energy demand management, energy efficient equipment, low carbon energy sources, renewable energy, ECU's policy in respect of Green Power purchase and carbon offsets.

It is expected that targets will meet or exceed the "conditional requirements" determined from the Green Star Education energy calculator.

d) Potable Water Consumption

Potable Water Calculation

Potable water consumption shall be calculated from the Green Star Education calculator. The Green Star calculations include an allowance for on-site rainwater, grey water and black water use but do not include any provision for use of stormwater or groundwater, and separate account for these sources will need to be made.

Potable Water Targets

The potable water target will be set during the Concept Design phase during which options will be considered for substituting potable water with rainwater, stormwater, groundwater, grey water and / or black water for approved non-potable uses in the local jurisdiction.

It is envisaged that the target set will achieve at least 3 points as calculated by the Green Star Education calculator.

2.4 Acoustic Requirements

2.4.1 Generally

The intention of this Acoustic Brief is to establish design standards for the acoustics of new university buildings.

2.4.2 Acoustic Terminology

Rw = Weighted Sound Reduction Index (Previously STC – Sound Transmission Class)
Is a measure of the acoustic effectiveness of a building partition, door, floor or other building element with regards to reducing airborne noise transmission from one side of the element to the other (i.e. single pass). This value is the 'design rating' of the element, as established via measurements in an acoustic laboratory in accordance with relevant Australian Standards. It is often referred to as a measure of the airborne sound insulation provided between two spaces.

D'ntw = Weighted Standardised Level difference (Previously FSTC)
Is similar to the Rw value, except that values are established via field measurements. It is recognised that normal building tolerances and flanking transmission paths have an effect on building elements when installed, generally resulting in a reduction in the field measured values. It is common for the D'ntw of a partition system to be approximately 5 points lower than the Rw results of the same system tested in a controlled laboratory environment.

Dncw = Weighted suspended ceiling normalised level (Previously CAC)
Previously expressed as the Ceiling Attenuation Class, this is a measure of the acoustic effectiveness of a ceiling system with regards to reducing airborne noise transmission from one room to another, through a common ceiling space. This value is the laboratory rating of the element, as established via measurements in accordance with relevant Australian Standards.

LAeq = "**A- weighted" equivalent continuous noise level**
This is the constant sound level over a stated time period, which is equivalent in total sound energy to a variable sound level over the same time period. Often simply referred to as the 'average sound level' for a given time interval.

Note - Current Australian Standards use Leq noise levels for 'architectural acoustic' criteria, including noise from 'mechanical systems' etc. Noise Rating (NR) curves previously used for the assessment of noise from mechanical services are no longer commonly used, and are not included in current Australian Standards.

RT = Reverberation Time
RT is a common measure of the acoustical environment achieved in a space. It is the time taken in seconds for sound energy to decay by 60 dB. Reverberation control is typically required to enable clear speech communication in spaces, or to control general 'noisiness' in open plan and public spaces.

2.4.3 Compliance with Codes and Standards

Unless otherwise required, the consultant shall execute all work undertaken in accordance with the relevant Australian Standards, Building Codes, Acts, etc and the Building Code of Australia.

However, many acoustic standards are not covered by the above and if not already included in this Design Brief, will need to be specifically developed by the consultant for the project (in consultation with the appropriate client representatives).

2.4.4 Implementation for Existing Facilities

It is recognised that implementation of all acoustic requirements may not be possible in retrofit of existing buildings. Where major building elements are to be modified, the changes must be in accordance with current acoustic standards. Where a change affects another space, the acoustic conditions of that space must not be downgraded. In some cases the other space will require upgrading to meet current standards.

2.4.5 Planning

Objective – To ensure that due consideration is given to cost effective planning options that support good acoustic design, reducing the requirement for more costly technical construction solutions.

There is a diverse range of technical acoustic requirements for spaces throughout university facilities. Planning is often fundamental in achieving a good acoustic environment within an educational building. It is usually possible to plan new buildings to avoid expensive technical solutions, in the achievement of acceptable acoustic conditions. The '*noise sensitive'* or '*noise intensive'* nature of specific areas requires careful consideration from the earliest stages of a design.

Some general planning issues that should be considered at the earliest stages include:

- External noise sources such as road traffic.
- Noise emission from mechanical equipment and plant rooms, including lift motor rooms, chillers / condensers, air handling plant, fume / dust extractors etc.
- Avoid location of 'noise sensitive' spaces adjacent to 'noise generating' spaces. For example - keep spaces with low tolerance to noise intrusion such as private offices and teaching spaces acoustically separated from noisy spaces such as plant rooms.

2.4.6 Environmental Regulations (Noise)

Objective – To control noise emissions from facilities to meet the requirements of the Environmental Protection (Noise) Regulations 1997, (as amended).

These regulations set the maximum permissible sound level allowed at 'neighbouring premises', for various times of the day. All aspects of these regulations must be met in full. The major design issues to be considered include:

- Noise emission from external plant and equipment, including refrigeration plant, chillers / condensers, fume / dust extraction, emergency generators etc.
- Noise break-out from enclosed mechanical equipment and plant rooms, particularly via ventilation paths

- Breakout noise from enclosed activity areas, including; i) spaces where music or audio equipment are accommodated ii) spaces incorporating use of workshop type equipment including cut off saws, grinders and similar.

- Noise emission from outdoor activity, including live performance, amplified music etc

- Noise emission from service / loading areas, including driveways.

These issues must be considered at the earliest design stages. In particular, the project Mechanical Consultant must give due consideration to the location of significant external mechanical plant, and the potential for environmental noise emissions to neighbouring premises as well as adjacent university buildings.

NOTE:
There are no formal regulations or design standards regarding control of noise emissions to pedestrian or outdoor areas within a property (campus). However, a useful guide to maintain general amenity is as follows:

Noise received at façade of adjacent university building; ≤ LAeq 50 dB(A)]
- Noise received at general transient / pedestrian areas; ≤ LAeq 50 dB(A)
- Noise received at general purpose courtyards; LAeq ≤ 45 dB(A)

It must be noted that these levels will still be considered to be clearly audible when ambient conditions are otherwise quiet. More stringent requirements may be appropriate for specific outdoor areas such as amphitheatres or 'special use' courtyards etc. Requirements for these spaces are to be determined on a project-by-project basis.

2.4.7 Indoor Ambient Noise Levels

Objective – to ensure appropriate indoor ambient noise levels are achieved in various spaces, relative to the acoustic sensitivity of proposed activity.

The background or 'ambient' noise levels within unoccupied spaces shall not exceed the levels set in Australian Standard AS/NZS 2107 "Acoustics - Recommended Design Sound Levels and Reverberation Times for Building Interiors".

The 'design sound levels' recommended in this standard relate to the background noise level in a room as a result of noise from the following sources:

Building Services

- Ventilation and air-conditioning systems
- Hydraulic services / plumbing
- Lighting and other fixed electrical equipment.

External Sources

- Road traffic
- Neighbouring industrial and commercial operations
- Externally located plant
- Activity noise from adjacent facilities located on the campus

Activity noise from adjacent spaces

- Consideration should also be given to the potential noise levels and noise character generated by the normal range of activities within the building. The control of room-to-room noise transfer is addressed by the airborne sound insulation requirements defined in section 7.0 of this Acoustic Brief. This intention is that noise intrusion as a result of activity noise should not exceed the maximum LAeq levels set out in AS/NZS2107, based on assessment period of LAeq, 30 min.

Rain Noise

- Rain noise on metal roofing and stormwater disposal (including box gutters and downpipes) generally requires special consideration. This issue may require in-depth acoustic design, depending on the use of potentially effected spaces. As a general guide, noise intrusion to 'noise sensitive' spaces such as Lecture Theatres and general purpose Auditoria should not exceed the recommended 'design sound levels', as summarised in Table 3A (below). For Offices and Flexible Learning Spaces, levels up to 5dB above the stated 'satisfactory' criteria are likely to be acceptable.

Table 3A sets out a summary of relevant 'design sound levels', based on AS/NZS 2107 "Acoustics - Recommended Design Sound Levels and Reverberation Times for Building Interiors".

TABLE 3A - DESIGN SOUND LEVELS

Type of Occupancy or Activity	Recommended 'design sound level, LAeq dB(A)	
	Satisfactory	**Maximum**
EDUCATIONAL		
Audio Visual Areas	35 dB(A)	45 dB(A)
Cafeterias	45 dB(A)	50 dB(A)
Computer Rooms		
Teaching	40 dB(A)	45 dB(A)
Laboratories	45 dB(A)	50 dB(A)
Conference Rooms	35 dB(A)	40 dB(A)
Corridors and Lobbies	45 dB(A)	50 dB(A)
Flexible Teaching Spaces	35 dB(A)	45 dB(A)
Gallery Spaces	40 dB(A)	45 dB(A)
Gymnasiums	45 dB(A)	55 dB(A)
Interview / Student support	40 dB(A)	45 dB(A)
Laboratories		
Teaching	35 dB(A)	45 dB(A)
Working	40 dB(A)	50 dB(A)
Lecture Rooms (up to 50 seats)	30 dB(A)	35 dB(A)
Lecture Theatres		
Without speech reinforcement	30 dB(A)	35 dB(A)
With speech reinforcement	35 dB(A)	45 dB(A)
Libraries		
General Areas	40 dB(A)	50 dB(A)
Reading Areas	40 dB(A)	45 dB(A)
Stack Areas	45 dB(A)	50 dB(A)
Toilets	50 dB(A)	55 dB(A)
Video Conference	35 dB(A)	40 dB(A)
MUSIC / PERFORMANCE		
Recording Studios #1	25 dB(A)	30 dB(A)
Music Studio	30 dB(A)	35 dB(A)
Drama Studios	35 dB(A)	40 dB(A)
Dance Studio	40 dB(A)	45 dB(A)
Ensemble Room	35 dB(A)	40 dB(A)
Small Practice / Tutorial Room	40 dB(A)	45 dB(A)
Performance / Recital Space *(including 'multi-purpose auditoria)*	30 dB(A)	35 dB(A)
OFFICE ACCOMMODATION		
Board / Conference Rooms	30 dB(A)	40 dB(A)
Corridors and Lobbies	45 dB(A)	50 dB(A)
General /Open Plan Offices	40 dB(A)	45 dB(A)
Private Offices	35 dB(A)	40 dB(A)
Reception Areas	40 dB(A)	45 dB(A)
Undercover Carpark	55 dB(A)	65 dB(A)

NOTES
1 Any space that accommodates recording facilities requires a project specific brief to be developed by the project Acoustic Consultant, depending on the standard of studio required.

2.4.8 Mechanical Acoustics

Objectives

(a) to ensure noise from mechanical equipment is not considered intrusive and does not negatively impact on activity in a space.

(b) to avoid situations where mechanical systems downgrade the acoustic integrity of acoustically rated construction elements.

Design Sound Levels

As set out in Section 3 above, the background noise level resulting from operation of mechanical plant should not exceed the levels set in Australian Standard AS/NZS 2107.

Tonal and intermittent noises are often considered to be more intrusive than other types of noise at the same level. Noise intrusion from mechanical sources to 'noise sensitive' spaces from equipment should therefore be constant in nature and must not contain significant tonal or intermittent characteristics. Tonality should be addressed in accordance with the procedure set out in AS/NZS 2107.

Fan noise, breakout noise, regenerated noise, radiated noise and any other acoustic/vibration emissions need to be considered.

Supply and return air paths must be checked to ensure that sound isolation between spaces is not compromised via 'cross talk' type sound transmission. Where necessary appropriate silencers or other suitable methods of sound attenuation must be provided.

The mechanical system and equipment acoustics (serviced room noise levels) form part of the Mechanical Consultants scope of work, including duct-borne noise transmission. This is because the acoustic design of the ductwork and required attenuation is integral to the system design, and must be addressed by the mechanical engineer from the outset of the proposed mechanical scheme.

The Acoustic Consultant shall address radiated airborne noise from mechanical equipment that impacts other issues such as building acoustics, privacy or environmental noise, with appropriate liaison with the Mechanical Consultant.

NOTE

Ambient noise levels significantly lower than the 'satisfactory' design sound level criteria may in fact be detrimental to speech privacy in office spaces etc. The constant 'broad band' noise associated with normal operation of ventilation systems often provides highly desirable 'masking noise', effectively improving the speech privacy achieved between spaces. The project Mechanical Engineering Consultant must advise the project Acoustic Consultant of private offices, interview rooms, or other spaces requiring 'speech privacy' where the duct-borne noise level is likely to be $\geq$ 5 dB lower than the 'satisfactory' level set out in Table 3A. (Refer to Section 8.0 – Speech Privacy).

Maintaining Acoustic Integrity of Construction Elements

In areas requiring acoustic isolation or speech privacy it is essential that the mechanical ductwork and air transfer systems do not downgrade the acoustic performance of the architectural barrier systems provided. All penetrations through the acoustic rated walls and ceilings are to be fully sealed or provided with appropriate acoustic attenuation treatment.

Of particular concern are:

Ceiling Return Air Systems*:* Where walls are not full height it is common for the ceiling system to be specified to achieve a particular acoustic barrier performance (Dncw / CAC), to control excessive room-to-room transmission via a ceiling void. It follows that the use of the ceiling void as a return air plenum is potentially problematic, as without proper detailing this arrangement can allow excessive flanking sound transmission through the ceiling space, over partition walls. This will significantly downgrade the sound transmission loss performance between areas. If a ceiling return air system is to be used, then acoustic treatment will be required to all ceiling penetrations. Return air grilles direct into the plenum are unlikely to be acceptable, and typically require full acoustic transfer boots or similar treatment.

Lineal Diffusers*:* Continuous lengths of lineal diffuser, which run right up to or across partition walls must not be used. Where lineal diffusers are required, they must be limited only to the length required for air transfer, and their full extent must be connected to a cushion head in the ceiling space above. Any area of linear grille not connected directly to a duct or boot must be effectively sealed 'airtight'.

Door Grilles: All types of door grilles significantly downgrade the acoustic performance of doors and must not be used in solid core doors to spaces requiring acoustic isolation / speech privacy. Where air relief is required, it must be via acoustically treated ductwork through the walls or ceiling, so as not to downgrade the acoustic integrity of these construction elements.

2.4.9 Hydraulic Noise

Objective – to ensure noise from hydraulic services is not considered intrusive and does not negatively impact on activity in a space.

Plumbing noise can be intrusive at low sound levels because of its informational content and ease of propagation via structure-borne paths. For an acceptable work environment it is essential that all plumbing noise sources be considered.

Planning is the key to effective control of plumbing noise. Identify all hydraulic noise sources in spaces adjacent to noise sensitive areas and consider potential hydraulic / structure-borne noise transmission.

Where planning cannot be used to control hydraulic noise, cavity walls, structural isolation of fittings / pipe work, acoustic lagging or bulkheads and other appropriate measures should be provided to prevent unwanted noise intrusion.

As a general guide, audible intrusion from hydraulic services should be no greater than the satisfactory 'design sound level' set out in AS/NZS 2107 (refer to Table 3A summary list in this brief). This does not mean hydraulic noise will not be audible, but that it should not be considered excessively intrusive.

For critical spaces such as recording studios and performance venues, the hydraulic design and detailing should be such that noise intrusion is not audible. This is likely to require planning to locate hydraulic fittings and service / waste pipes well away from the noise sensitive space.

2.4.10 Hearing Conversation

Objective – to ensure that the design of the facility supports the intent of legislation related to protection of employee hearing.

The requirements of the "Occupational Safety and Health Regulations, 1996" shall be met in full. These Regulations relate to all aspects of employee health and safety. Regulations 3.45 to 3.47, specifically address Hearing Conversation aspects of the work environment. To comply with the intent of the regulations, major design issues to be considered include:

- Workplaces are to be designed to minimise noise exposure to occupants. Wherever possible, noisy machines and activities should be remote or isolated from other work areas. Noisy equipment should be acoustically enclosed wherever practicable
- Consider the potential effects of reverberation, facility planning, and location of workstations relative to high noise plant, equipment and activity areas. Noisy work areas such as workshops must at least incorporate acoustically absorbent ceilings to assist in reducing the noise exposure of other people working nearby.
- Noise levels of new equipment should be considered as an integral part of equipment selection/purchasing procedures. A policy of selecting new plant and equipment on the basis of low noise operation should be considered.

2.4.11 Acoustic Isolation

Objectives

(a) to control unwanted room to room noise transfer from normal operational or activity noise (airborne noise transmission).

(b) to control unwanted noise intrusion from external / environmental noise sources.

The airborne sound insulation provided between various spaces and via the building elements shall be designed to ensure that the noise levels do not exceed the maximum "design sound levels" recommended in Australian Standard AS/NZS 2107 (refer to Table 3A in this brief).

The noise sources to be considered in terms of acoustic isolation include:

- Room to Room - internal noise sources from plant, services and activity noise
- Building Façade / Envelope - external environmental noise sources such as traffic, industry and externally located plant. (Intermittent noise from aircraft, rail and service bays should be considered separately).

Careful detailing of walls, windows, doors, floors and ceilings is required to ensure that the design performance of the construction is achieved and is not downgraded due to acoustic leakage or flanking transmission.

Room to Room "Airborne Sound Insulation"

As a guide, Table 7A sets out the required minimum airborne sound insulation values (Rw Design Ratings) between rooms. The design value typically appropriate for a particular scenario is determined by assessing the magnitude of activity noise in the 'source room' and the noise tolerance appropriate for the 'receiving room', as defined separately in Table 7B – "Room Classifications".

TABLE 7A - Design performance for "Airborne Sound Insulation" between rooms

Minimum Rw Design Rating	**Activity Noise in 'Source Room' *(see Table 7B)***				
Noise Tolerance *In Receiving Room* ***(see Table 7B)***		Low	Average	High	Very High
	High	**Rw 35**	**Rw 40**	**Rw 50**	**Rw 60**
	Medium	**Rw 40**	**Rw 45**	**Rw 55**	**Rw 60**
	Low	**Rw 45**	**Rw 50**	**Rw 60**	**Rw 60**
	Very Low	**Rw 50**	**Rw 55**	**Rw 60**	**Rw 65***

Where design ratings greater than Rw55 are required it is advisable to separate the rooms using acoustic buffer spaces such as corridors or storerooms. Where this is not possible significant construction solutions will be required.

NOTES:

(a) Source to receiver assessments must be conducted in both directions, and the higher of the two design ratings applied.

(b) Deviation from the design level of up to 2 points may be acceptable where a wall construction is known to provide suitable performance in a similar existing facility. (e.g. a total of 3 layers 13mm fire rated plasterboard on 76 mm studs and insulation with ≈ Rw 48 may be considered in lieu of Rw 50 between general purpose offices).

TABLE 7B – 'Room Classifications' to determine Airborne Sound Insulation

Type of Occupancy or Activity	Activity Noise (Source Room)	Noise Tolerance (Receiving Room)
EDUCATIONAL		
Audio Visual Areas	Average	Low
Cafeterias	High	High
Computer Rooms		
Teaching	Average	Low
Laboratories	Average	Medium
Conference Rooms	Average	Very Low
Flexible Teaching Spaces	Average	Low
Interview / Student support	Low	Very Low
Gallery Spaces	Low / Average	Medium
Gymnasiums	High #1	Medium
Laboratories		
Teaching	Average	Low
Working	Average	Medium
Seminar Rooms *(up to 50 seats)*	Average	Low
Lecture Theatres		
Without speech reinforcement	Average	Very Low
With speech reinforcement	High	Very Low
Libraries		
General Areas	Low	Medium
Reading Areas / Study Rooms	Low	Low
Stack Areas	Low	Medium
Toilets	High #2	High
Video Conference	Average	Very Low
MUSIC / PERFORMANCE		
Drama Studios	High #1	Low
Music Studio	Very High	Low
Dance Studio	Very High #1	Medium
Recording Studios #2	Very High	Very Low
Small Practice / Tutorial Room	Very High	Low
Ensemble Room	Very High	Very Low
Performance / Recital Space	Very High	Very Low
OFFICE ACCOMMODATION		
Board / Conference Rooms	Average	Very Low
General & Open Plan Offices	Average	Medium
Senior Private Offices (e.g. Head of Department)	Average	Very Low
Reception Areas	Average	Medium
Toilets	High #3	High
SERVICE AREAS		
Engineering Workshops	Very High	High
Plant Rooms	High #4	High
Undercover Carpark	High	High

NOTES

#1 - Control of potential impact noise sources requires special consideration.
#2 - Recording facilities require a project specific brief to be developed by the project Acoustic Consultant, depending on the standard of studio required.
#3 - Control of hydraulic services noise sources requires consideration.
#4 - Assessment of the expected reverberant sound pressure level within each plant room will be required in order to establish the extent of airborne acoustic insulation required to adjacent spaces (to achieve Design Sound Levels set out in Table 3A).

Some adjustment to the Activity Noise or Noise Tolerance for various spaces may have to be considered on a project-by-project basis, depending on the nature of the facility.

For example:
- Interview and counselling rooms generally accommodate only low voice levels. However, in the case of mental health training facilities much higher voice levels should be expected - hence, higher acoustic isolation provided.
- Specialist spaces such as 'Speech Therapy' rooms or those specifically for the hearing impaired should have 'Noise Tolerance' of *Very Low*.

- **Door and Internal Glazing**

  Doors and Internal Glazing
  In designing to achieve appropriate airborne sound insulation between a corridor and adjacent space or interconnected spaces, due recognition must be given to the limiting performance of doors and vision glazing.

  Doors
  In planning the location of doorways, recognition must be given to the resultant unavoidable acoustic weakness. Wherever possible the distance between doors to neighbouring spaces should be maximised, rather than directly side by side. Similarly, doors along corridors should be offset, to avoid situations where one door is directly opposite another. Also, planning arrangements must be such that doors to spaces requiring 'confidential' speech privacy do not open directly onto waiting areas or to workstations in close proximity to the door.

  Where doors are provided through acoustic rated walls, the following acoustic ratings should be provided for the construction elements.

  Teaching to Teaching
  Generally a Teaching-to-Teaching wall with interconnecting doors should be at least Rw 50. However, where a door makes up more than 1/4 of the dividing partition area, the wall rating can be reduced by 5 points below the design rating set out in Table 7A. The door must be solid core and incorporate effective fully adjustable acoustic seals, with a system design rating $\geq$ Rw 28.

  Teaching to Corridor
  Generally a Teaching-to-Corridor wall with access doors should be at least Rw 45. However, where a door makes up more than 1/4 of the dividing partition area, the wall rating can be reduced by 5 points below the design rating set out in Table 7A. The door must be solid core and incorporate fully adjustable acoustic seals, with a system design rating $\geq$ Rw 28.

  Office to Corridor
  General Purpose Office-to-Corridor walls with access door should be at least Rw 40. However, where a door makes up more than 1/3 of the dividing partition area, the wall rating can be reduced by 5 points below the design rating set out in Table 7A. The door must be solid core and incorporate fully adjustable acoustic seals, with a system design rating $\geq$ Rw 28.

  Head of Staff / Interview to Corridor or Lobby
  Spaces requiring confidential speech privacy such as Head of Department and Interview spaces require Rw 50 partition for walls accommodating the door. The

door must be solid core and incorporate fully adjustable acoustic seals, with a system design rating ≥ Rw 30. Doors opening directly onto waiting area or to corridors with dedicated seating areas are not appropriate.

Spaces with Very High Activity Noise or Very Low Tolerance to Noise.
Planning must allow for incorporation of acoustic lobbies or corridors to act as acoustic buffers. For example:

- Lecture Theatres must incorporate acoustic lobbies with ≥ Rw 40 design performance. The wall accommodating the doors must be at least Rw 50.
- Spaces designed for music / performance should also be accessed via an acoustic lobby or acoustically isolated corridor. The wall accommodating the doors must be at least Rw 50.
- High noise level Plant Rooms may require 'back-to-back' doors or acoustic lobbies with ≥ Rw 40 design performance where access is required from main corridor / circulation areas.

Internal Glazing
The requirement for visual access in not generally conducive to design for acoustic separation. However, it is recognised that where vision is provided through walls separating spaces, the expectation of acoustic separation is generally reduced and behaviour of building occupants is often modified to use lower voice levels etc.

Office to Corridor
It is relatively common for glazed partitions to be used for general purpose offices facing onto corridors and open plan work areas. However, where this is incorporated the overall airborne sound insulation of the construction will be limited to the order of Rw 30 to 35. This is because the design rating of 10 mm laminated glass is in the order of Rw 33. It follows that a high level of acoustic isolation can not be achieved, and speech privacy is likely to be reduced, particularly where a potential receiver position is close to the glass.

Teaching to Corridor
It is common for high level glazing to be used along the upper level of walls separating Teaching Spaces from to corridors. However, depending on the glass to wall ratio this may significantly reduce the design performance of the overall construction. Where high levels of airborne sound insulation are required, glazing may not be appropriate.

A case by case assessment of the likely 'Activity Noise' and 'Noise Tolerance' of the spaces may be required for specific scenarios - such as the suitability of fully glazed walls between Case Study to Breakout / Foyer type spaces. In some cases the requirement for view / visual connection may outweigh normal acoustic separation requirements.

Where it can not be clearly determined that single glazing will provided adequate acoustic isolation to meet user expectations, the glazing system be should be detailed in a manner that allows easy retro-fitting of a second pane of glass to form 'acoustic' double glazing. This requires at least 50 mm air gap between the layers of glass.

- **Flanking Transmission Paths**

Flanking Transmission Paths
The two most common forms of flanking sound transmission that can compromise the acoustic separation of spaces are; 1) room-to-room transmission via the ceiling space and 2) flanking via door grilles.

- **Room to Room via Ceiling**

  Various approaches to controlling flanking sound transmission may be considered but must take into account; the Rw rating of the dividing wall, the

Dncw rating of the ceiling system, and the extent of ceiling penetrations (including recessed light fittings) etc.

The acoustic insulation of the ceiling space must not compromise the design rating of the walls.

For spaces separated by higher performance walls (Rw $\geq$ 50), the most effective method of controlling flanking sound transmission via the ceiling space is to carry perimeter walls up to the underside of slab or roof over. (This design approach is then less dependent on selection of a barrier type ceiling system / detailing of penetrations).

Alternatively, provide loaded vinyl or other ceiling septum to work in conjunction with the acoustic barrier provided by the ceiling system. The overall level of acoustic insulation achieved by the combined ceiling and septum system must be comparable to the design rating of the wall.

For spaces separated by moderate performance walls (Rw 35 to 45), the selection of a ceiling system with appropriately high Dncw (CAC) rating, and incorporation of ceiling insulation over may be adequate (provided all ceiling penetrations are acoustically treated). The Acoustic Consultant is to advise on the likely acoustic insulation achieved by the ceiling system and any additional measures – specifically in relation to suitable control of flanking sound transmission.

- **Door Grilles**

  Mechanical System air transfer must not compromise the acoustic integrity of the wall, ceiling or septum systems – refer to Section 4.2 of this brief. Door grilles are a common cause of unwanted acoustic transfer.

- **Electrical Fittings**

  Recessed and vented light fittings in ceilings as well as back to back switches etc in walls can significantly downgrade the design rating of construction elements. Liaison with the Electrical Consultant will be required to resolve these potential acoustic weaknesses via planning or selection of appropriate fittings etc.

- **Junctions of Construction Elements**

  - **Wall to external glazing**

    Detailing of the connection between internal partition walls and the external walls / glazing is critical to maintain the required acoustic separation between spaces. The connection must not downgrade the performance of the dividing wall by allowing flanking sound transmission though acoustically weak materials / infill.

    Where this detail is not adequately addressed it is common for a significant acoustic weakness is to occur. Acoustic testing in various existing ECU facilities has identified this connection detail as a significant factor in reducing the potential acoustic insulation of dividing walls.

    An appropriate connection detail should comprise 2 parallel strips of 6 mm glass joining the end of the partitions to i) the external glazing, ii) windowsill and iii) head over the window. The strips of glass must be separated by an air space of at least 50mm. Silicone should be used for the butt joints, or use combination of silicone and proprietary glazing channels. Alternatively use 1.6 mm steel either side of 40 mm fibre insulation. Lightweight hollow vertical mullions must be fully concealed within this detail, and must not form part of the dividing construction. All joints must be airtight. Acoustic leakage is very common at this detail unless carefully resolved. Even very small gaps will compromise the acoustic integrity of the detailing.

- **Wall to ceiling**

  The junction of a partition wall to underside of ceiling is critical. It must basically be 'airtight'. This typically requires either; a) 'top plate' detailing that fits snugly between rebated tiles (aligned with the t-bar suspension grid), to the entire perimeter of each space, or b) flush faced tiles incorporating acoustic compressible seal along a flush top track.

  Alternatively, extent perimeter partition walls through the ceiling by at least 100 mm and fully seal the ceiling border to the to the perimeter walls.

- **Environmental Noise (Airborne Sound Insulation)**

  The existing acoustic environment at the proposed building site should be assessed at the earliest stages of the project, to determine relevant external design sound levels.

  The building envelope including walls, windows, roofing as well as ventilation systems must be designed to provide adequate airborne sound insulation to control noise intrusion from external noise sources including traffic, industry and externally located plant. Intrusion from normal external sources should not exceed the design sound levels set out in AS/NZS 2107 (refer to table 3A in this brief).

2.4.12 Speech Privacy

Objective – to provide appropriate levels of 'speech privacy' to selected spaces, to support the required range of activities.

Specific levels of Speech Privacy are typically required for spaces within administration and student services facilities, where confidentiality of discussions is required. In particular, Head of Department Offices and Interview Rooms often accommodate discussions of a confidential nature.

The method for predicting speech privacy is to be as per Australian Standard 2822 - 1985 'Acoustics - Methods of Assessing and Predicting Speech Privacy and Speech Intelligibility'.

The degree of speech privacy to be provided to various spaces is set out below.

Confidential Speech Privacy
Articulation Index (A.I.) not exceeding 0.05 for the specified voice level.

- Confidential Speech privacy should be provided to; Head of Department Offices, Interview and counselling rooms, and other rooms where strict privacy of conversations is integral to the use of the space.

Normal Speech Privacy
Articulation Index (A.I.) not exceeding 0.1 for the specified voice level.

- Normal Speech Privacy should be provided to; general private / cellular offices, staff studies, general-purpose conference and meeting rooms.

The design for speech privacy takes into account the following factors:

- Vocal Effort: i.e. - normal, raised, loud or shouting voice level,
- Privacy requirement: i.e. - normal or confidential privacy,
- Background noise level in the receiving space,
- Size of intervening partition,
- Size and acoustic absorption in the source room, and
- Size and acoustic absorption in the receiving room.

TABLE 8A - Definitions for vocal effort are

Vocal Effort	*Sound level at 1 metre*	*Description*
Normal	60 dB(A)	Speaking in normal office
Raised	66 dB(A)	Speaking in Conference Room Interjecting in small office Loud voiced person
Loud	72 dB(A)	Addressing a medium sized group Disagreement between persons
Shouting	78 dB(A)	Distraught person

Definitions for Confidential Privacy are:

Normal Speech Privacy is taken to mean that speech , although partly intelligible. is not intrusive. It assumes a noise-to-speech ratio of 9 dB and corresponds to an Articulation Index of approximately 0.10.

Confidential Speech Privacy is taken to mean that speech will not be intelligible, except when a person concentrates on hearing. It assumes a noise-to-speech ratio of 15 dB and corresponds to an Articulation Index of approximately 0.05.

When designing to achieve a specified level of speech privacy, all relevant sound transmission paths must be considered. Also, background noise levels used for the calculation of speech privacy should be based on the 'satisfactory' level specified in Australian Standard AS/NZS 2107. Where background noise levels in existing buildings are available, these noise levels may be used. However, consideration must also be given to scenarios where lower ambient noise levels may occur and thus may not provide normal masking noise. (For example – at the far end of long duct runs or in naturally ventilated facilities)

The recommended construction shall satisfy both the Acoustic Isolation requirements and the Speech Privacy requirement.

2.4.13 Reverberation Control

Objective – to ensure general reverberation is adequately controlled to suit the required use of the space

Specific levels of Speech Privacy are typically required for spaces within administration and student services facilities, where confidentiality of discussions is required. In particular, Head of Department Offices and Interview Rooms often accommodate discussions of a confidential nature.

The control of reverberation in spaces is normally carried out either for noise reduction within a room, or to create a specific acoustic environment. Reverberation Time (RT) within specified rooms shall not exceed the RT's recommended in the Australian Standard AS/NZS 2107 "Acoustics - Recommended Design Sound Levels and Reverberation Times for Building Interiors".

Table 9A (below) summarises a range of relevant Reverberation Time design criteria, based on AS/NZS 2107. These design levels apply to the mid frequency RT's including 500Hz, 1000Hz and 2000Hz. For spaces designed for clarity of speech, the lower frequencies may be up to 30% higher than the design RT. For larger volume spaces designed for music, the lower frequencies may be up to 50% higher than the design RT. This requires cases by case assessment.

TABLE 9A – RECOMMENDED REVERBERATION TIMES

Type of Occupancy or Activity	Recommended 'Reverberation Time' (T), sec
EDUCATIONAL	
Audio Visual Areas	0.6 to 0.8
Cafeterias	See Note #1
Computer Rooms	
Teaching	0.4 to 0.6
Laboratories	0.4 to 0.6
Conference Rooms	0.6 to 0.7
Corridors and Lobbies	0.6 to 0.8
Flexible Teaching Spaces	0.5 to 0.6
Interview / counselling rooms	0.3 to 0.6
Gallery Spaces	See Note #1
Gymnasiums	See Note #2
Laboratories	
Teaching	0.5 to 0.7
Working	0.6 to 0.8
Lecture / Seminar Rooms (up to 50 seats)	See Note #3
Lecture Theatres	
Without speech reinforcement	See Note #3
With speech reinforcement	See Note #3
Libraries	
General Areas	0.4 to 0.6
Reading Areas	0.4 to 0.6
Stack Areas	See Note #1
Toilets	NA
Video Conference	0.3 to 0.6
MUSIC / PERFORMANCE	
Drama Studios	See Note #3
Music Studio	See Note #3
Dance Studio	See Note #3
Recording Studios	See Note #3
Small Practice / Tutorial Room	0.7 to 0.9
Ensemble Room	See Note #3
Performance / Recital Space	See Note #3
OFFICE ACCOMMODATION	
Board / Conference Rooms	0.6 to 0.8
Corridors and Lobbies	0.4 to 0.6
Open Plan Offices	0.4 to 0.6
Cellular / Private Offices	0.6 to 0.8
Reception Areas	See Note #1
Toilets	NA
Undercover Carpark	NA
SERVICE AREAS	
Engineering Workshops	See Note #1
Plant Rooms	See Note #1
Undercover Carpark	NA

NOTES

1 Maximise extent of acoustic absorption as far as is practical, to control general reverberation. Plantroom lining is recommended to control the reverberant sound levels in the space, to reduce both occupational noise exposure and breakout to adjacent areas.

#2 The appropriate RT is volume dependent but can be 20 to 30% higher than Curve 1 of Appendix A in AS/NZS 2107

#3 The appropriate RT is volume dependent - Refer to AS/NZS 2107

2.4.14 Room Acoustics

Objective – to achieve room acoustic performance that supports the proposed use of the space, particularly with regards to clarity of speech communication.

Some spaces require specialist acoustic treatment in terms of Room Acoustic design. These rooms include:

Lecture Theatres
Large Conference / Seminar Rooms
Performance Venues

The acoustic design issues that shall be separately considered include:

- acoustic isolation,
- background noise.
- reverberation,
- speech intelligibility,
- sound reflection patterns

Generally spaces should be optimised for the projection of natural voice or un-amplified performance. However, where electro-acoustic systems are to be installed the acoustic environment must also take this into account.

A computer prediction model should be used to analyse relevant acoustic parameters such as Speech Transmission Index for relevant un-amplified presenter / source positions, and assess the space for potentially problematic reverberation characteristics or sound reflection patterns. This should be based on a three-dimensional model of the space, comprising surfaces with individually assigned absorption and scattering coefficients for each frequency band.

2.4.15 Vibration

Objective – to control transmission of vibration from plant and equipment to appropriate levels.

Dynamic elements of building services must incorporate suitable vibration isolation from the building structure to reduce transmitted vibration to below the "just perceptible" level as determined by the Reiher-Menistre scale of human perception of vibration.

The "just perceptible" level equates to 110 dB vibration velocity at any discrete frequency in the range 3 to 60 Hz.

2.4.16 Construction Noise

Set out below is a basic Specification section regarding the control of construction noise on university projects. A more detailed case specific version may need to be developed for non typical projects.

Control of Noise: Take practical precautions to minimise noise resulting from works within the Contract. Comply with guidelines as set out in Australian Standard AS 2436 - *Guide to Noise Control on Construction Maintenance and Demolition Sites.* In accordance with the Standard, the methods used to reduce noise emission from the site will include:

Substitution:	Where practicable quieter machinery or process are to be used;
Modification:	Engineered noise control is to be implemented on specific noisy items of equipment. This may include fitting of improved performance mufflers, screening of stationery noise sources, and other techniques as appropriate;
Siting of Equipment:	Locate high noise level equipment away from noise sensitive areas.

Maintenance: Ensure equipment on site is appropriately maintained so as to emit minimum noise.

Environmental Noise: Noise emission from the site is to comply with Regulation 13 of the Environmental Protection (Noise) Regulations 1997.

Noisy Equipment: The noise emission of all equipment on site must comply with Table D2 of AS 2436. The Superintendent may require the Contractor to provide a certificate of acoustic performance, produced by an approved Acoustic Consultant, indicating that the equipment meets the criteria as set out in Table D2, when tested in accordance with AS 2012.

Special Circumstances: On occasions for emergency reasons, the Superintendent may direct that all noise on the site ceases or be reduced. The Contractor shall direct his Sub contractors on site to meet this requirement.

Potential for this control measure will be highest during 'exam periods', where noise emission are found to be interfering with activity in adjacent facilities.

The 'exam periods' relevant to this project are:
(e.g. June xx to June xx 200_)
_____ to _____ 200_
_____ to _____ 200_
_____ to _____ 200_
_____ to _____ 200_

Noise Management Plan: The Contractor is to provide the University Project Manager with a construction program. In addition to this program, the Contractor is to advise both the Superintendent and University Project Manager of activities that are likely to result in high levels of noise emission to adjacent facilities, cross referenced to the construction program.

Of critical importance is the potential effect of noise during the stated 'exam periods'. A Noise Management Plan should be provided by the Contractor to the Superintendent, detailing specific noise control measures to be implemented during these periods. Noise intrusion into designated exam venues should not exceed LAmax 35 dB(A) whist exams are in progress.

Where noise emission are found to be resulting in unreasonable disruption to university activities, the Superintendent or University Project Manager may instruct the contractor to cease all noise from construction for a set period of time.

2.5 Design for Universal Access

2.5.1 Introduction

These checklists and notes are based on the Australian Standard AS 1428.1-2001, (*Design for Access and Mobility, Part 1 - General Requirements for Access – New Building Work*), AS 1428.2-1992. *(Part 2 - Enhanced and Additional Requirements - Buildings and Facilities), Disability (Access to Premises- Buildings) standards 2010* and on recommendations made by people with disabilities.

Consultants are required to ensure that their designs pay particular attention to the following areas of design for access affecting people with disabilities:

- Circulation spaces must not be violated by fixtures
- Constraints at doors, steps and turnstiles
- Grab rails (toilets, showers)
- Hand rails for ramps, passages and stairs
- Kerbs
- Landings

- Ramps (1:16 - 1:20), walkways (1:20)
- Ramp Gradients, Crossfalls
- Kick plates are required to base of critical use doors (main entries, corridors, toilets)
- Width of doors
- Lifts
- Stairways
- Toilet provisions (pans, basins, showers, mirrors, flushing button)
- Power outlets
- Carpark provisions

Where reference is made to a diagram it refers to that diagram in the relevant code.

Designers should remember that the term 'people with disabilities' is not restricted to wheelchair users. The term includes the following disability categories:

- walking problems
- balance problems
- vision impairment
- respiratory problems
- hearing problems
- restricted arm and hand grip problems
- variable physical strength capabilities (fatigue problems)
- communication problems (signage).

Consultants should role play building access by people with disabilities to ensure facilities provide adequate access from site boundary to carpark; carpark to building entry; entry to upper levels; access through lobby systems; use of toilet facilities. Reverse this path to check exit problems.

The intention of this document is to assist in the design and documentation of projects and to ensure that user group feedback for improving access for people with disabilities is included.

It remains the responsibility of the designer to become fully acquainted with full code requirements and to ensure that the statements in this document are correct **and current**.

2.5.2 Generally

It should be noted that the standard is a set of **minimum requirements**, although ECU strives to incorporate best practice within the design process so that the building could be considered a leading example. .

Designers must strive to achieve preferred requirements, but where this is not possible 'soft' answers between **minimum** and **preferred** may be acceptable subject to approval by the University Project Manager.

People with different degrees of disability may be using the building either independently or with an assistant. Consider both cases when checking designs

The People With Disabilities Code AS 1428.1 is linked to the legal requirements of the Building Code of Australia.

2.5.3 Reference Documents

Note that separate individual codes exist for items related to access for people with disabilities.

1172 - Water closet pans
1371 - Toilet seats

1735 - (Part 12) - Lift code
2208 - Glazing
2700 - Colour standards
2890 - Off street parking
2899 - Public information

2.5.4 Definitions

Shall : means mandatory
Should : means recommended
May : means optional

Circulation Space - unobstructed area, as designated to a minimum height of 2000mm. These spaces shall not be violated by fixtures.

Continuous Accessible Paths - check designs for continuous paths of travel (**both ways**) and eliminate constraints at doors, steps, turnstiles (see Introduction Notes).

Grabrails - check areas where a person may require steadying assistance (toilets and showers, for example).

Handrail - check areas where assistance can be given with the use of a handrail (ramps, passages, stairs).

Kerb - side barrier to trafficable surface. Check access paths from carparks to entries.

Kerb Ramps - check locations, maximum length 1530mm, with grades 1:12 or better.

Landing - flat surface with gradient not steeper than 1:40. (See detailed notes for landings).

Ramp - gradient 1:20 required with a maximum gradient permitted of 1.16 in extreme instances and only then after approval in writing by the Access Committee.

Step Ramp - (alternative to a step) Short ramp other than a kerb ramp. Maximum length 1530mm, gradient of 1:12 or better.

Walkway - maximum gradient 1:20.
Consider the use of walkways in lieu of ramps as these may be more effective and cheaper since handrails are not mandatory for walkways.

Consultants are to forward audit documents and a copy of the following checklist when Tender documents are completed.

2.5.5 Walkways, Ramps and Landings

Width [ ]
Unobstructed minimum width 1200mm (**1500mm** preferred by University) vertical clearance 2000mm.

As a guide, the following is to apply:

Low volume traffic : 1200mm wide (suitable in field tests).
Low/medium volume traffic : 1500 wide (likely passing).
Med/high volume traffic : 2000mm wide (frequent passing).

Walkways (determined by grade)
(a) Minimum gradient 1:20. [ ]

(b) Gradients 1:33 landings at 15 metres. [ ]
Gradients 1:20 landings at 9 metres.

Landings for intermediate grades by interpolation.
Grades flatter than 1:33 do not require landings.

Consider the use of layby areas at landings with a seat where ambulant people can sit and rest. Layby areas to be at maximum 50m apart.

Handrails should be installed in reasonably foreseeable risk areas.

(c) Gradient of walkways between landings to be constant. [ ]

(d) Where no handrail and kerb, or wall and handrail is provided the ground adjoining walkway is to extend horizontally for 1 metre each side of walkway. [ ]

(e) Space requirements for passing and turning circles in passages and walkways:
- Passing spaces are required every 20m where direct line of sight is not available.
- Turning spaces are required within 2m of the end of any passageway.
- Turning spaces are required every 20m in a continuous passage

Ramps

(a) The code maximum gradient of a ramp exceeding 1520mm long is 1:14 **but this is not to be used**. [ ]

If **walkway grades** are not possible a ramp grade of 1:16 may be permitted if approved by the University Project Manager.

(b) Landings to be provided at 9 metres. [ ]

(c) Where ramps have changes of direction and do not have landings then approach angles and grades should be checked against code table/figure 4 diagrams. Avoid these situations if possible. [ ]

(d) Gradient of ramps between landings to be constant. [ ]

(e) Ramps greater than 1:20 grade and landings shall be provided with profiled handrails (as per 28.6.1 both sides.) [ ]

(i) Check design of handrails against AS 1428.1. [ ]

(ii) If additional handrail required higher than 900mm then both are to be provided. [ ]

(iii) Handrails should not encroach into any horizontal circulation space requirement - e.g. around doors. [ ]

(f) Ramps and landings shall be provided with kerbs both sides, where clear ground (min. 1 metre wide) is not available, and kerbs are to be either: [ ]

(i) wall or rail kerb (preferred in order not to collect mud, leaves, etc.) with height not less than 65mm nor more than 75mm; or [ ]

(ii) kerb rails preferred because they allow less chance for mud, leaves, slime, etc., to accumulate. [ ]

(iii) achieve requirements of AS 1428.1, however, avoid kerbs in range 80mm to 145mm as footplates of wheel-chairs wedge on these kerbs and lift front wheels off the ground [ ]

resulting in the user becoming stuck.

(g) Check kerb and handrail relationship against AS 1428.1, however, a **100mm maximum kerb/handrail horizontal distance differential is required.** [ ]

Angles of Approach for Walkways, Ramps and Landings [ ]
Where changes of direction and grade are made then design in accordance with AS 1428.1 and associated table.

Use landings at these points.

Curved Ramps and Walkways [ ]
AS 1428.1 provides permissible gradient/radius requirements.

Landings, kerbs, handrails as for other ramps.

Crossfall not permitted. Code should be checked if curved ramps are to be used.

Camber and Crossfall in Ramps and Walkways [ ]
Cambers and cross falls are not allowed in internal ramps and walkways.

In outdoor conditions, walkways, ramps and landings must be designed so that water does not accumulate on surfaces. (1:40 cross fall permitted). (Refer AS 1428.2.)

Abutment of Surfaces [ ]
(Where walkways or ramps meet surfaces with a different gradient precise change of gradient must be evident by a sharp line and colour change in paving. A rounded hump is not acceptable at change in gradient.

Use 200mm wide tactile indicator strips on landings before ramp commences to aid people with vision impairment. Refer to AS 1428.1.

Kerb Ramps and Step Ramps

(a) To be: [ ]

(i) . as for AS 1428.1 code [ ]
. 1520mm maximum length
. 1330mm minimum (more preferred) access landing clearances from buildings.
. 1200mm minimum width.

(ii) Junction of surfaces at top and bottom of ramp to be as for ramp requirements notes. [ ]

(b) Two options are given in AS 1428.1 for location of kerb ramp near road corners. [ ]

Preference for location type (a)(i) because of:

- uniform crossfall (no camber, thus beneficial to visually impaired),
- safety right angled crossing of intersection (rather than oblique).

Landings

(a) **Minimum length landing 1200mm** [ ]
SUPP 1990 indicates a 1200mm long landing is adequate for low volume traffic.

Consideration should be given for wheelchair users and ambulant persons to rest at landings. Provision of a seat and wheelchair parking area in an intermediate landing/layby area should also be considered (where total length of ramp exceeds 50m).

Where volumes will require resting or passing of either wheelchairs or ambulant persons then landings should be 2400mm long.

(b) Where landings are near doorways: [ ]
- check circulation requirements for access to doors (AS 1428.1, but increase "L" dimension by 100mm and "W" dimensions by 50mm);
- check intrusion of handrails into circulation spaces against code requirement.

Tactile Indicators [ ]
Design of walkways to take into consideration navigational cues for the vision impaired. Tactile ground surface indicators, together with other environmental information to be provided according to AS 1428.4-2002.

2.5.6 Handrails and Grabrails

Handrails

(a) Circular handrail to be 38mm diam. [ ]

270 Degree access to uppermost portion of handrail (Full circular cross section preferred).

(b) No sharp edges to handrail. Minimum 5mm radius. [ ]

(c) Minimum height of handrail is 865mm and the maximum height of handrail to be 900mm. (Refer to AS 1428.1). [ ]

(d) End of handrail to extend for a minimum of 300mm, turned down 100mm or be returned to end post or wall. (AS 1428.2). [ ]

(e) Minimum 50mm clearance from side wall. (Refer to AS 1428.1). Minimum 600mm clearance above handrail. [ ]

(f) Continuous hand grip required on handrail. [ ]

(g) Colour contrast to background. [ ]

Grabrails

(a) Outside diameter to be 38mm. [ ]

(b) No exposed edges. [ ]

(c) Fastenings to be capable of withstanding 1100N force applied in any direction with no deformation or loosening to result. [ ]

(d) Grabrail clearance from wall to be in range 50mm min. to 60mm max. [ ]

No obstructions to occur within 600mm above top of grabrail.

Refer also clause 27.10(g).

2.5.7 Doorways and Circulation Spaces

Generally

(a) The principle pedestrian entrance to a building is required to be accessible. for people with disabilities. [ ]

At least 50% of all pedestrian entrances are to be accessible.

An accessible entrance must not be more than 50m away from the principle entrance.

(b) Signage at other public entries (not accessible by people with disabilities) to be provided to direct people to accessible entries. [ ]

Entrances also serve as emergency exits. Check that most entrances are suitable for entry and escape by people with disabilities.

(c) Where revolving doors or turnstiles are used alternative hinged or sliding door to be provided. [ ]

(d) Wheelchair footrests cause damage to the base of doors. Kick plate to be provided to accessible toilet doors and doors where significant wheelchair traffic is expected. [ ]

(e) Threshold ramps to have maximum rise of 35mm and length 280mm. Best if threshold can be eliminated. [ ]

(f) Provide automatic doors at the main entries of buildings. [ ]

(g) In libraries or buildings where shelving occurs, ensure there is a minimum 1200mm clear aisle space between shelving. [ ]

Clear Opening of Doorways

Minimum clear opening 850mm (Generally as for AS 1428.2).

(a) **Swing Doors** [ ]

Circulation spaces on both sides of each door are very important. Check against tables and diagrams AS 1428.1 but increase "L" dimension by 100mm and all "W" dimensions by 50mm.

Swing doors are preferred to sliding doors for acoustics, privacy, security.

(b) **Sliding Doors**

Refer to AS 1428.1 for circulation requirements each side of sliding doors [ ]

Circulation space on side opposite door face needs to be increased by dimension 't' Refer to AS 1428.1

Door Frames [ ]

To be a contrasting colour to doors (70% contrast).

Distance Between Doorways in Passages [ ]

Circulation access both ways through air locks and lobbies to be in accordance with AS 1428.1 which indicates distance as 1340mm (min.), however, this should be increased to 2000mm.

Door Glazing (Including Walls and Sidelights) [ ]

Check if hazardous situations exist where an ambulant or wheelchair user would need to be aware of a person or situation on the opposite side of the door.

Refer to AS 1428.1 for minimum glazing requirement.

Lower edge of glazing in doors to be not less than 300mm and not more than 1000mm above floor level. Upper edge of glazing to be NOT less than 1600mm above floor level. Edge of glazing to be 200mm from latch edge of door and width of glazing to be not less than 150mm wide (Refer AS 1428.2).

Frameless and Fully Glazed Doors shall be marked at a height of 900mm above floor level to provide protection against people walking into glass.

2.5.8 Lifts [ ]

See Code AS 1735.12

- Lifts to have audio, visual and tactile information. Ensure lift door closing speed complies with code. Ensure gap at floor between lift car and floor threshold complies with code.
- Full commercial sized lifts are acceptable as accessible lifts.
- Lifts that travel more than 12m need a minimum area of 1600mmx1400mm.
- Accessible controls.

2.5.9 Stairways

Generally

(a) To be in accordance with Building Code of Australia. [ ]

(b) Top or bottom step of a flight of steps shall not encroach into horizontal circulation space for people with disabilities - e.g. at doorways. [ ]

(c) Stairs should not have open risers. [ ]

(d) Spiral stairs are not permitted. [ ]

(e) Nosing of steps to have warning strips that are a contrasting colour to the material (50mm wide on tread and 25-50mm wide on riser). [ ]

(f) Stair treads to be 275 - 300mm effective width and risers to be 150mm to 165mm high (25mm maximum slope on riser is not included in effective width of tread). [ ]

(g) The floor surface of stairs to be a stable, slip resistant material. [ ]

Handrails

Handrails on both sides of stair to be in accordance with section 2.5.6.

(a) Heights and projections of handrail at landings to conform with AS 1428.2. [ ]

(b) Handrails to be continuous around landings. [ ]

(c) Where handrail terminates at top and bottom of stair it should extend: [ ]
300mm past riser at top of stair.
300mm plus one tread width from the riser at bottom step.
Provide tactile indicator domed button 150mm from end of handrail.

(d) Handrails must not encroach into circulation spaces nominated in code (i.e. landings and circulation spaces at doorways). [ ]

2.5.10 Sanitary Facilities

Water Closets

(a) Hand basin to be included with each water closet. Unisex toilets preferred but should not transverse areas reserved for one sex only. [ ]

Special closet pans are required (ie 'Caroma Leda 2000 Smart Flush) . Seat height to be460mm or less. Unisex toilets pans should be Caroma Cosmo Sovereign care site smart flush.

(b) Recessed or surface mounted cistern are both acceptable. Surface mounted cistern to be located as for AS 1428.2. Larger cistern button required (50mm diam). [ ]

(d) Full round securely fixed seat without flap is required. [ ]
Toilet seats should be heavy construction and flat, securely hinged to prevent sideways movement. Firm support is required when transferring from wheelchairs. Seats must have metal fixing. Caroma Pressalit 2000 is an acceptable type of seat.

(e) Flushing control to be a large button located 900mm above floor, on rear wall in an area starting 450 from room corner and extending out 500mm maximum. [ ]

(f) Location of toilet paper double roll controlled delivery dispenser (Refer to AS 1428.2). Bobrick B274 or similar approved to be used. [ ]

(g) Grabrails to be provided at rear and next to pan Refer to AS 1428.2. [ ]

Construction and fixing of grabrails to be as for AS 1428.2. Material to be stainless steel.

(h) Pan circulation space Refer to AS 1428.2 - Code requires space 2300mm long x 1900mm wide. [ ]

(i) Circulation space both sides of door in airlocks must comply with AS 1428.1. [ ]

(j) If sliding door used then circulation provisions to door handle access requirements increased by depth of wall plus gap to face of sliding door. Refer to AS 1428.1. [ ]

(k) Doors to water closets.

(i) Pivot or sliding doors acceptable (pivot doors preferred) [ ]

(ii) On projects exceeding 5,000m2 accessible toilet on main level to be fitted with automatic sliding door. [ ]

(iii) Emergency provision for latch release and removal of door in an emergency. [ ]

(iv) Vacant/engaged indicator bolt with large turn knob located 900mm above floor. [ ]

(v) If door closer used see Clause 28.11. 1-rising butt hinges preferred. [ ]

(vi) "D" handles preferred. Latch backset to be in range 35mm to 45mm [Clause 28.11.1(b)]. [ ]

(vii) Outward opening doors to have a hinge mechanism to hold door in closed position without the use of latch - AS 1428.2 [ ]

(l) Provide emergency call button to comply with AS2999 (linked to an attended service centre). [ ]

Hand Basins

(a) Basin or trough and fixtures to be in accordance with dimensional ranges shown in AS 1428.1. Lever handles [see Clause 28.11.3]. [ ]

(b) Waste pipes shall not encroach into knee space. Refer to AS 1428.1. Hot water to be delivered through a thermostatic mixing valve. [ ]

(c) Circulation space for wash basin to be as for AS 1428.2. [ ]

Washroom Fixtures and Fittings

(a) Full height mirror required in the range 450mm above floor level to 1850mm above floor level and min. 350mm wide. [ ]

(b) Provide one shelf 500mm long at nominal height 900mm above floor.

(c) Soap dispensers and paper towel dispensers to be installed at 900mm above floor. [ ]

(d) Provide an electric hand dryer in each toilet at 900mm above floor).

(e) Provide clothes hooks - Height range 900mm to 1100mm above floor level. Not less than 500mm from any internal corner. [ ]

(f) Allow for sanitary napkin disposal bins in all WC cubicles (restrained in brackets). [ ]

(g) Switches and general purpose power outlets (refer Clause 28.11.2). [ ]

Showers

(a) Size 2350mm x 1600mm circulation space to detail 13 and 14 of AS 1428.2. [ ]
Shower recess to be 1160mm x 1100mm.
Folding seat required one end open - in shower recess.
Shower seat to fold down, have a non-slip surface, self draining, rounded edges.
For fittings and general space requirements check against AS 1428.2.

Taps to conform to Code requirements and be:
lever type
have temperature controlled water
tap clearances from any obstruction to be a min. 50mm.
to be 900mm above floor.

Two clothes hooks to be provided within 600mm of shower seat.

A bench or seat outside shower area is also required for clothes to be accommodated.

(b) Weighted easy sliding shower curtain preferred to hinge doors. If doors used see conditions (a), (b) and (c) of Code. [ ]

No columns or support structure to encroach into circulation space.

(c) Grab rails to be fixed in shower all to detail 13 in AS 1428.2. [ ]
Size and fixings refer to AS 1428.1.

(d) Flexible shower hose and head to be installed on a shower head support grab rail. [ ]

(e) Soap holder required in zone (Refer to AS 1428.2). [ ]

Holder to be projecting type also acts as handgrip and should be capable of withstanding 1100N without failure.

(f) Floor and Waste Outlet [ ]
Floor to be self draining
No kerbs or stepdowns
Fall floor away from shower seat
Floor outlet to be located in centre of shower recess.

Combined Sanitary Facilities
See Code Appendix A (and Transparent Overlays) for illustrations of overlap provisions for circulation spaces. Vertical dimensions for circulation space is 2000mm above floor.

Fixture spaces are different from circulation spaces. Fixture spaces are NOT permitted to encroach into circulation spaces except where:

(a) A hand basin is near a doorway having a swinging door. [ ]
300mm ARC clearance provision. (Refer to AS 1428.1)

(b) A hand basin is near a sliding door. 1100mm Clearway is required [ ]
(Refer to AS 1428.1)

Drinking Outlet [ ]
One drinking outlet (refrigerated or not) is to be provided per floor to AS1428.2 in order to accommodate persons in a wheelchair. Refer unit installed in Building 23 Joondalup Campus as an acceptable standard.

2.5.11 Controls

Door Handles and Hardware

(a) Handles shall allow door to be unlocked with one hand. [ ]
Ambulant people need other hand to support mobility aid.
Lever handle preferred to knobs.
Hand should not slip from handle.
Knobs on bolts and snibs should not slip from hand (Recessed door pulls bad example).
Use 'D' pulls on sliding doors and toilet swing doors.

(b) Backset to handles to be in range 35mm to 45mm. [ ]

(c) Use rising butt hinges on toilet entry doors. [ ]

(d) Door Closers [ ]
Access for persons with disabilities is to be carefully considered when the use of door closers is contemplated. Where possible, alternate solutions are to be provided.
If used, Code requirements for opening force is to be met. Cam action closers are to be considered before rack and pinion closers.

(e) Location of door lock/opening controls. [ ]

(i) Turn type to be located 900mm above floor. [ ]

(ii) Touch type 900mm above floor and not less than 500mm from internal corner. [ ]

(iii) Bottom of 'D' handle to be no higher than 900mm above floor. [ ]

(ii) 'D' handles are to be used on sliding doors and to be not less than 60mm from door jamb. [ ]

Switches, General Power Outlets and Telephones [ ]
To be installed 900mm above floor, not less than 500mm from internal corner (Refer to AS 1428.1), and horizontally aligned with door handles. Security and taxi telephones to be installed 900mm from floor to u/s of phone.

Water Taps [ ]
Water taps to be operable by people with disabilities.

2.5.12 Signs

Statutory signage for accessible facilities shall comply with the Code (Refer to AS 1428.1). [ ]

2.5.13 Hearing Augmentation

Where a sound amplification system is provided, a listening system to aid hearing impaired people shall be installed or made available and shall cover at least 25% of the total area of the enclosed space. Provide suitable signs to indicate the availability of the system. [ ]

Refer to AS 1428.2.

2.5.14 Floor Surfaces

Floor surfaces in wet and dry locations shall comply with the requirements of AS 1428.1. [ ]

2.5.15 Carparking

(a) Refer Code AS 2890.1. [ ]

(b) Provide directional signage for people with disabilities from point of boundary entry to parking bays. [ ]

(c) Locate parking bays in close proximity to major campus pedestrian entries. [ ]

(d) Check that the gradients of parking bays comply with codes and are preferably to be at the same level as the entry to be used. [ ]

(e) Ensure that parking bays provided have a width of at least 3500mm but where bounded by walls the space to be 3800mm wide. [ ]

(f) Parking bays are to be marked with international symbols and signage. [ ]

(g) Where road crossings are necessary ensure that people with disabilities can cross directly to safe paths via kerb ramps. Wheelchairs using roadways as access (other than direct crossing) should be avoided. Access to kerb ramps must be kept clear of parked vehicles. [ ]

(h) Check that speed humps do not occur in paths of wheelchair users [ ]

who may by necessity have to use general car parking areas.

(i) It is not uncommon for wheelchair users to be set down near entries whilst an assistant parks a vehicle in a general car park and returns to be with the disabled person. [ ]

- Allow for safe short term set down parking.
- Allow for people with disabilities to be easily located under cover and preferably where pedestrian traffic is passing.

(j) Vertical clearance height at vehicle entry to parking bays to be 2500mm and internally within covered area at 2800mm. [ ]

(k) Ensure adequate lighting is available at accessible parking areas. (Minimum 20 Lux at car bay). [ ]

Refer AS 1428.2.

2.5.16 Public Counters

Public and Reception counters are to be planned and designed to enable full access and use to people with disabilities. [ ]

2.5.17 Student Accommodation Requirements

Storage [ ]
To be in accordance with AS1428.2 Clause 24.2.

Minimum clear floor space of 800mm x 1300mm providing either forward or parallel approach by a person in a wheelchair.

For forward reach unit wheelchair user storage to be at an accessible height within 380mm - 1120mm above floor (300mm wide shelf).

For forward reach wheelchair user over obstructions max. bench width to be 550mm.

For forward reach wheelchair user who are reaching over obstructions the max. bench width to be 550mm as indicated in AS1428.2.

For side reach wheelchair users shelves to be located in range 230mm - 1350mm above floor and shelving to b e 300mm wide.

To accommodate both ambulant and side reach wheelchair users, the common reach zone is 700mm - 1200mm above floor for 400mm wide shelves.

Ambulant reach zone is 500 - 1670mm above floor for shelves 400mm deep.

Corners of benches to be rounded.

Drawers or slide out wire baskets preferred to large open cupboards.

Cupboard/drawer handles to be “D” handles and to be contrasting colour to cupboards.

Worktops/Counters [ ]
To be at constant height.

Bench surface material to be heat resistant especially near cook top.

Work tops to be 30% lighter in colour than vertical surfaces.

Height of benches to be 850mm with clear height under of 820mm for distance of 1500mm to one section of bench (depth of this bench to be 550mm).

Sink [ ]
Sinks to be double bowl with maximum bowl depth to be 150mm.

Underside of sink bowl and exposed pipes to be insulated to avoid burns.

Clearances under sinks to be as shown in AS1428.2-1992.

Height to top of sink to be 850mm.

2.6 Specialist Facilities

2.6.1 Cleaner's Store

At least one cleaner's store (minimum 6m^2) per floor is to be provided in a building and is to contain:

- Cleaner's sink with hot and cold water (outlet to be single non-threaded type).
- A hanging rack for brooms, buckets and mops consisting of double pegs (to suit 6 items) on a back board.
- Floor drain at cleaner's sink ensuring this is located at the lowest point in floor.
- Provide 1.8m x 0.45m wide timber shelving with first shelf located 1.2m above floor level and second shelf 0.45m above first shelf (vacuum cleaners to be stored under shelving).

The room is to be a dedicated room for cleaners and not to be cluttered with pipes and cisterns that are associated with adjacent toilet areas.

Room is to be exhaust vented (operated by light switch control) with exhaust grille located above sink.

Preferred room dimensions are 2m x 3m.

2.6.2 Rest Room

A rest room is to be provided in accordance with Shops and Factories Act provisions.

2.6.3 Toilets

Student toilets, unisex toilet for people with disabilities (refer Section 27.0) and separate staff toilets are to be provided in each building in accordance with the BCA and shall be based on the expected population and gender mix of the building.

Toilets to be low maintenance areas complete with mirrors (in frames), soap dispensers (provided by ECU contractor), which are to be installed over basins in order that any drips fall into basin full height glazed ceramic wall tiles, terrazzo partitions, an electric hand dryer (two dryers provided where fixture count exceeds 3), coat hook/rubber buffer (to door of cubicles).

All female toilet cubicles to have a clear space of 250mm on one side of toilet pan (seat clearance) to accommodate a 655mm high x 320mm deep x 215mm wide sanitary napkin disposal unit.

A shelf or vanity bench is to be provided in all toilet basin areas.

Toilet paper holders to be Hygenex Jumbo Reserve (17.01.02) from Experro plastic dispenser (provided by ECU for installation by Contractor) except to toilets for people with disabilities where Bobrick B274 or similar controlled delivery dispensers are to be installed.

Provide GPO adjacent mirror.

Coat hooks/buffers to be provided to each cubicle door and to prevent doors opening and damaging cubicle partitions.

Toilet cisterns to be Caroma in duct cisterns.

2.6.4 Shower Facilities

Provide in each building where nominated a male and female shower facility together with bench seats, cubicle doors, hot and cold water, recessed soap holder, hooks (2), mirrors, shelves etc. Adequate space should be allowed for a small number of lockers. All showers are to be in cubicles with doors.

Provide graded floor in change room areas and matting in shower access area.

Provide area for staff to store clean clothes and change areas in situations where they are normally required to change clothes.

2.6.5 Courtyards and Indoor Planters

Light
Indoor or undercover plants must receive a minimum of 2000 lux of indirect natural light.

Water
One hose cock (20mm) with backflow preventor is to be installed to serve each courtyard, internal garden, balcony type planter box.

Drainage
Minimum of one 50mm diameter drain is required to service a surface area of 10 m^2 of internal garden or planter box. Each drain should be provided with a silt trap. All drains should have maximum fall to prevent silting and should have flushing connections.

Soil Depth
Minimum depth of 500m for plants to height of 1 metre. Maximum of 1 metre depth for plants of greater height.

Water Proofing
All planter boxes above ground shall be fully tanked internally.

2.6.6 Service and Storage Areas

Particular care is to be taken in the design of these areas to provide convenient access to Industrial Waste Bins and other rubbish containers while at the same time providing suitable visual screening. Adequate provision is to be made for the secure and ventilated storage of gas bottles where required.

2.6.7 Entrances

At least one entrance (as close as possible to parking area) to each building must have ramp access (for people with disabilities) with level landing outside entry doors.

Doors to be automatic opening, preferably sliding. Internal entry doors to accommodation leading off main foyers to be automatic. Refer Services, Electrical Section for specification of auto doors.

External stairs to all entrances must have "going" and "rise" in accordance with BCA but the tread must be no less than 300mm.

Use 38mm OD pipe handrail for both stairs and ramps with standard bends to be 100mm radius. Ensure brackets and balusters supporting handrails conform to requirements for persons with disabilities.

Provide adequate roof overhang or some form of external physical protection to entries.

At entry door install wall to wall indoor matting extending at least 1200mm into corridor.

Floor materials shall be non-slip low maintenance and require minimum cleaning.

Number each floor level starting from the basement as level 0 and ground being Level 1. Room number sequencing to be arranged clockwise from main entry with each number running in sequence down one side of the corridor and up the other. Refer Section 26.0 for detailed signage requirements.

2.6.8 Loading Docks

All loading docks are to have edges protected by a handrail (hinged where loading is carried out) to prevent people falling off the edge and provided with vehicle protection buffers to edge of loading docks.

Provide protective edging to ramps to prevent damage by vehicles.

Paving edge to be coloured differently to that of adjoining paving (to accommodate people with impaired vision).

2.6.9 Carparking

Car bays are to be:

- Minimum 2.5m wide x 5.5m long.
- Access drives to be 6m wide (2 way access drives)
- All end bays to be not less than 2.75m wide.
- Aisle bays to be not less than 3.0m wide x 6.7m long.
- Carpark pavement to be marked with messages and arrows in accordance with AS1742, Part 1-1975 (as amended).
- A car bay shall be marked along its length by unbroken lines not less than 75mm wide.
- Carpark lighting is to be kept 1.5m clear of canopy of existing fully developed trees and expected fully developed canopy of new or proposed trees.
- Carparking for persons with disabilities is to conform to AS2890.1 and amendments thereto.
- Footpaths running parallel to and against carpark kerbs are to be wide enough to suit the pedestrian traffic anticipated together with an additional 1000mm width of paving to accommodate over hanging parked vehicles. This 1000mm width of paving should preferably be of a different colour to the main path in order to signify that this is a different zone and not intended for pedestrian use.

2.6.10 Staff Lounges and Tea Rooms

All staff to be provided with tea room/breakout facilities in close proximity to workspace. Generally one per floor or business unit. Scale and type of services will be dependant on number of people served.

2.6.11 Waste and Recycling

Teaching and Non-Teaching Areas

- 120L yellow top sulo bin for comingled waste.
- 120L green top sulo bin for general waste
- 120L light blue sulo bin for paper waste.

Kitchen/Level

- 120L Yellow top Sulo Recycling Bin – with standardised signage clearly stating what goes in the bin
- Up to 20 persons maximum requires a 50L Green General waste Bin (under bench) – with standardised signage clearly stating what goes in the bin, in line with the waste principles/guideline for receptacles.
- Greater than 20 person using the kitchen, requires at least 120L yellow top recycle bin to be designed into the area, in line with the waste principles/guideline for receptacles.

Photocopying Areas

- 120L Blue Paper Recycling Bins and a 120L confidential blue paper bin should this be required.

Green Rooms

- A small dedicated room (4mx4m) or space dedicated to recycling of specialised items and environmental education that is clearly marked with a visual sign
- Located in a centralised area
- Provides a dedicated space for recycling of batteries, mobile phones, toner and printer cartridges.

2.6.12 Multi Access Room

Projects over 5,000m^2 are to be provided with a multi access room. Room to be provided with a baby change facility and a separate space with comfortable informal seating including power and data services. Door to room to be access controlled.

2.6.13 Laboratories

SECTION UNDER REVIEW, SUBJECT TO FURTHER NOTICE.

2.6.14 End of Trip Facilities

To provide adequate end of trip facilities in the way of showers, lockers and short and long term bike parking for the occupants of the building.

- Provision must be made for adequate change rooms to include separate male and female showers and lockers of adequate size (i.e. so clothes can be hung inside).
- Provision must be made for short term parking in the way of stainless steel U-Rails (refer Ausroads Standards – Guide to Traffic Engineering Practice Bicycles: Part 14 for dimensions).
- Provision must be made for long term secure parking in the way of a bike enclosure or compound that can be locked.
- All compounds of End of Trip Facilities (i.e. showers, lockers, and bike parking) need to be located in close proximity to one another in secure areas.