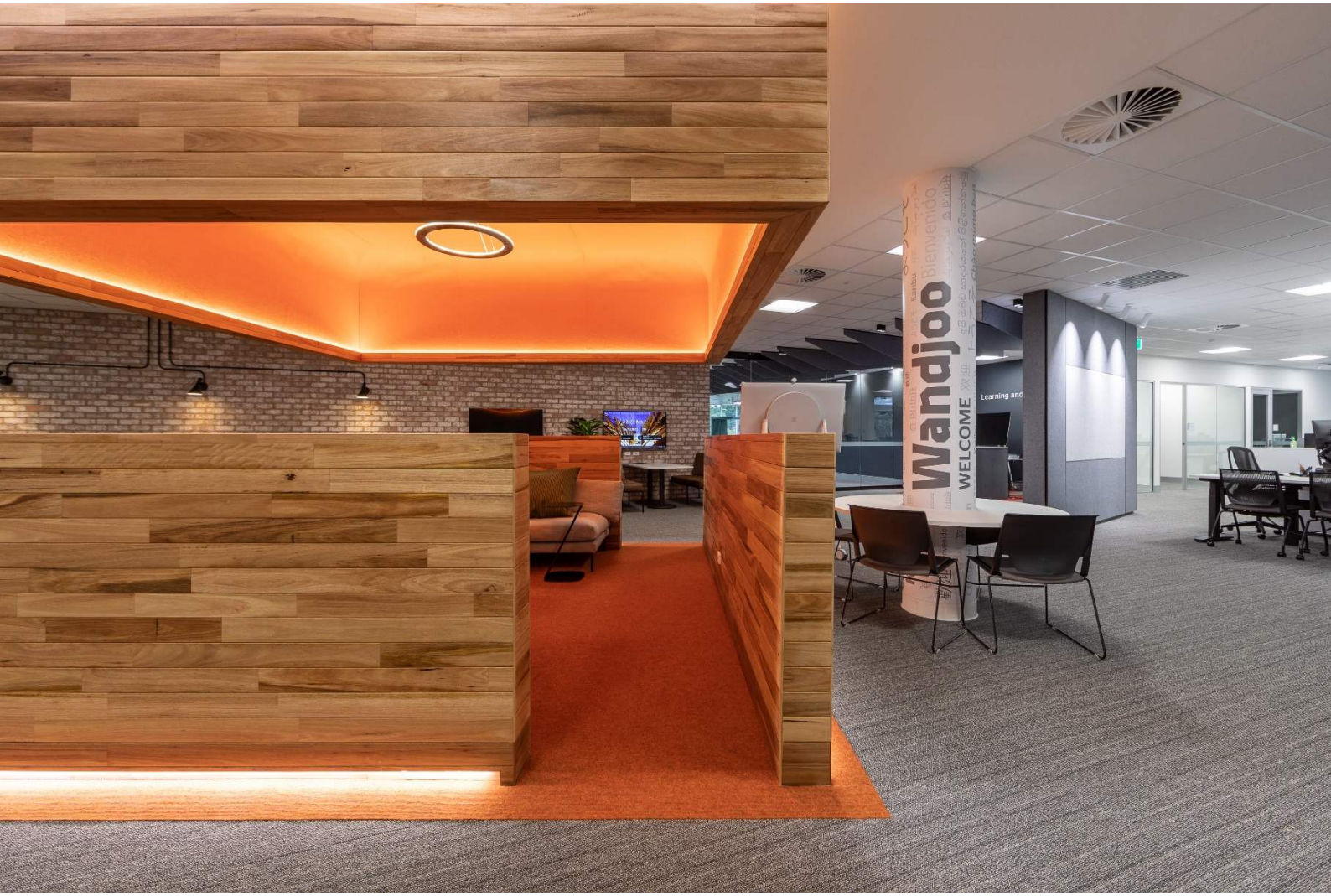
Edith Cowan University
Facilities and Campus Services

Planning and Design Guidelines

Contents



1.0 INTRODUCTION

These Planning and Design Guidelines ("Guidelines") establish the standards and objectives for the planning, design, documentation and construction of facilities for Edith Cowan University.

The Guidelines reinforce the University's objective to be at the forefront of tertiary education, providing learning opportunities for students supported by current technologies and contemporary facilities.

Consultants are encouraged to recommend solutions that exceed the standards, where the advantages improve:

- Education outcomes
- Precinct planning principles
- Safety in Design
- Constructability
- Fit for purpose
- Maintainability cost
- Time
- Quality
- Mitigation of University risk
- Environmental impacts

The Guidelines require conformity to all relevant Australian Standards, statutory building requirements and supplementary standards applicable to ECU projects. Where applicable these are referenced in the Guidelines.

Dependent on the type and scale of project, Consultants should liaise with the University and seek agreement as to which sections of this document are relevant.

This document should be read in conjunction with other relevant documentation made available by the Digital and Campus Services, including Campus Master Plans incorporating precinct planning. This information is available through the University's website at:

https://intranet.ecu.edu.au/staff/centres/facilities-and-services/our-services/campus-planning/master-planning

2.0 BUILDING DESIGN

2.1. CAMPUS MASTER PLANS

For each of its campuses, the University has prepared master plans and these will be available once approved through the Digital and Campus Services link on the University's website. The University's master plans provide information on:

- Environmental sustainability
- Interface with the wider community
- Movement and services corridors
- Form and space, including levels across campuses
- Steps for future development

The Consultant Team is required to thoroughly review the master plan information and consider as part of the planning and design process.

2.2. PRECINCT WIDE PLANNING

Generally, designs should actively respond to key urban design principles, when considering the design of a building within a wider precinct. These key principles could include, but not limited to, the following:

- Climate and site
- Interface with the public domain
- Context in relation to the precinct
- Architectural character
- Activation of building edges
- Safety, security and surveillance
- Access and egress (i.e. building users & maintenance)
- Campus wide services infrastructure
- Wayfinding
- Parking and pedestrian movements
- Acoustic considerations

The aforementioned principles are relevant to the University's Campus Master Plans and should be analysed throughout the building design process.

The Consultants are to clearly detail how the above considerations have been dealt with through and present as part of design reports at design approval gateways.

2.3. DESIGN APPROVAL PROCESS

The University has a step-by-step "gateway" process for design approvals. This process is to be followed to ensure that Digital and Campus Services and User Groups are involved during the design and their sign-off and acceptance of the design is provided. A typical process is summarised below as follows but may vary with the consent of Digital and Campus Services if the nature of the project warrants it:

Gateway 1 - Project Brief

Gateway 2 - Concept Design

Gateway 3 – Schematic Design

Gateway 4 – Design and Contract Documentation

Gateway 5 – Tender

Gateway 6 – Construction

Gateway 7 – Defects Liability

At each gateway the Consultants may be required to submit a design report to the University for review, comment and sign-off. In line with this submission, the Consultants may be required to present to University.

2.4. Delegation & Delegated Authority

As part of the design approval process, the Consultant Team will need to understand the University's Delegation and Authorities process and protocols.

Delegated authority is not provided to any member of the Consultant Team, unless advised in writing and approved by the University.

2.5. Safety in Design (SiD)

The University recognises the importance of planning and design of Projects being undertaken with the consideration of safe construction and maintenance practices. On this basis the Consultants are required to undertake Safety in Design (SiD) reviews throughout the planning and design process, identifying risks, mitigation strategies and latent issues for consideration by the Contractor during construction and the University following handover and building use. The outcomes of these reviews can be in the form of either reports or matrices and should be workshopped with the University as appropriate.

SiD reviews are to be undertaken throughout design phases, incorporated into "gateway" reports and evolve based on the level of design at respective milestones.

SiD reviews will be handed over to Contractors following Contract Award, integrated into their management plans and risk management process, for future updating and handover to the University for its internal facilities management processes.

For further information, the Consultants should refer to the relevant codes and practices to understand the requirements of safe design and obligations of the consultants.

2.6. Risk Management

The Consultants are required to be actively involved in the risk management process through planning and design. This may require:

- Attendance and contribution as part of risk management workshops with the University and other consultants
- Input into the project risk management process, identifying key risks and strategies to help mitigate and/or manage

2.7. PROJECT SPECIFICATIONS

As part of the preparation of Project Specifications by the Consultant Team, a review of the proposed Project Specifications against this document will be undertaken by the Consultant Team and presented as part of the Design Report prior to proceeding to tender.

Any departures from this document, noted within the Specifications will need to be approved by the University.

2.8. GENERAL BUILDING DESIGN

Generally,

- The design and construction of each building shall be economical in use of space.
- Materials must be of a quality commensurate with the building's purpose and longevity and consider future ease of maintenance.
- The placing of protruding building services and equipment on building facades and rooftops should be avoided wherever possible.
- Flexibility for future use of building spaces is to be considered an important design parameter and the probable effect on the Buildings and Maintenance requirements is to be assessed in relation to future change of use.
- Load bearing built elements that restrict future flexibility should be confined wherever possible to the building core or external walls leaving the interior open and uncluttered.
- Consideration must be given to the space allocation for services reticulation horizontal and vertical tunnels/ducts and ceiling voids to ensure ease of access for maintenance and future changes.
- 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. Where a building has concrete external walls, power and data conduits should be pre-installed where appropriate.
- Life cycle costs must be minimised as University buildings are to endure for at least 50 years. For life cycle costing analysis, the University recommends a 7% discount rate over a life of 20 years.
- Building design should consider the surrounding landscape and public realm, with the intent of integrating and activating these spaces as best as possible. This is dependent on the type of use of building.
- Intuitive wayfinding principles should be adopted wherever possible and not just rely on applied signage in aiding navigation around buildings and across campuses

2.9. 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. Ensure external façade design prevents or minimises the transfer of radiant heat to the interior and thereby affecting the useable space.

Internal roller blinds can be used for additional solar control but these should not be the primary method. Generally they should be manually controlled and allow a level sight through of which is best achieved with darker colours. A metallic backing should be considered to reflect any radiant heat from the glazing. Only in specialist circumstances on a case-by-case basis should blackout blinds and motorised blinds be considered.

2.10. WIND AROUND BUILDINGS

For an individual building or groups of buildings architects shall design to avoid problems of wind turbulence. Appropriate analysis / modelling should be undertaken to determine whether issues are present and how they are to be managed through design.

Design to ensure no wind tunnel /vacuum issues within ground floor lobby or lift risers which restrict use of entry doors or lift doors as well as noise transfer from wind in to building

2.11. SPACE PLANNING

2.11.1. KEY DESIGN PRINCIPLES

The following principles are intended to guide the design intent but not be a prescriptive direction.

- ECU aims to provide spaces for all users that are engaging, considered, fit for purpose, and created to inspire the occupants in whatever endeavour they are engaged in.
- Spaces should be as flexible as possible to ensure that future pedagogical and work practices can be accommodated without high refurbishment costs. Specialist spaces will be designed to meet the requirements of that school, but the principle of flexibility still needs to be considered.
- The design of spaces must always consider the requirements of a wide cross-section of physical abilities and cultural backgrounds, and produce environments that promote inclusivity, equity and diversity.
- Materials and finishes must be chosen that are commensurate with their intended use and of good quality whilst keeping in mind the project budget. The materials and finishes and design principles will be different if designing for a teaching environment, and public interface, or a back of house facility for example.
- Materials and systems should be chosen to minimise future maintenance and replacement costs over the course of their intended life span.
- Due consideration must be given to the acoustic requirements of the space

2.11.2. GUIDELINES

Like other Universities, ECU benchmarks against the Tertiary Education Facilities Management Association (TEFMA) guidelines (Edition 3). A copy can be provided by ECU for reference if required. The TEFMA guideline can be used to inform the design proposal but the requirements of the functional brief will also dictate the outcome to a degree. A review of the TEFMA standards and how they relate to the requirements of the University is currently underway.

When considering the application of TEFMA standards, be cognisant of the requirement to adhere to codes such as Australian Standards, The National Construction Code (NCC), the functions to be accommodated in the space, and the constraints of the building fabric.

2.11.3. PROFESSIONAL, ACADEMIC AND RESEARCH WORK SPACES

- Open plan workspaces are preferred when designing a contemporary workplace. An open plan environment offers space efficiencies, promotes the easy flow of communication and knowledge sharing, and it accommodates different ways of working such as autonomous, individual work, to collaborative work based on the immediate exchange of information and quick decision-making. Meeting rooms, focus rooms, collaboration and breakout areas, all promote flexible meeting opportunities and opportunities for quiet work. Flexibility is a key feature of this design, and the removal of physical walls and large storage areas will allow for the adaptable use of space. The needs of the workplace are evolving at a rapid rate and the workplace needs to be able to respond to these changes without a large cost or substantial disruption.
- As a benchmark, the goal for open plan workplace density is a maximum of 13 sqm per person and is based on Government Office Accommodation standards and common industry practice. This figure is calculated by simply dividing the total net usable area by the number of work points and includes all meeting rooms, breakout space, circulation and storage space. Specialist areas within the workspace which are considered over and above what is normally required of a workspace such a laboratory, are not included in this space density calculation. The density can be increased to accommodate various work functions, but this will ultimately be constrained by the building infrastructure and services, and by code requirements.

- FTE staff are to be allocated one desk at one campus only. If work is undertaken at another campus, then staff are required to utilise a bookable hot desk. The requirement for an assigned desk for part-time staff will need to be reviewed on a case-by-case basis.
- Sessional staff are required to use a bookable hot desk.
- Where facilities such as breakout rooms, meeting rooms, and stores are shared by multiple schools or centres, these can be accounted for in the space calculation on a pro rata basis.
- Private office space will sometimes be needed but these will be provided on a case-by-case basis. Other opportunities for private and quiet work needs to be provided where individual office space is not available.
- These standards are intended to be applied when fitting out new spaces and refurbishing existing, and when looking for space efficiencies.

2.11.4. Teaching and Learning Spaces

ECU is currently determining the required area of Teaching and Learning spaces and the associated capacity by referring to the TEFMA guidelines which can be viewed in the appendices – "*TEFMA Allocation and Design Standards by Room Type*". A review of these requirements is currently underway.

Additionally, the University has produced a set of Teaching Learning Space Standards. These standards list the technical requirements for all Teaching and Learning spaces. For more information refer to the appendices – "*210205 T&L Space Standards v3.1 UoF*"

Also refer to the appendices for "Teaching Learning and Student Service Spaces extract". This document gives a useful insight into the conceptual and pedagogical drivers behind the types of spaces that will now be required for Teaching and Learning areas. The pages set out ECU's current vision for how teaching, learning and service spaces would operate in the new City Campus currently under development. This vision will necessarily evolve in response to both the lead architects' experience and input, and the transformative work occurring under the University of the Future Project.

ECU is also using international benchmarks such as the "Learning Space Rating System". It is not publicly available but a copy can be provided by ECU if requested.

2.11.5. Specialist Spaces

These are spaces that are generally operationally managed by a school and have functions that separate them from general teaching spaces, such as laboratories and dance studios. The spatial requirements of these spaces will vary according to their function but for a general guide, refer to "TEFMA Allocation and Design Standards by Room Type" in the Appendices.

2.11.6. General Spaces

This encompasses a variety of spaces, some of which are referred to in the "TEFMA Allocation and Design Standards by Room Type" in the Appendices.

It also includes general circulation and gathering spaces, and areas defined as "Non-useable Floor Areas" such as services areas and ducts and toilets. Note that many of these areas are defined by code requirements.

3.0 SUSTAINABLE DESIGN

Section to be reviewed by consultant. Highlighted areas also under review

3.1. INTRODUCTION

The purpose of these Sustainability Guidelines is to provide guidance to designers in respect to Ecological Sustainable Design ("ESD"). ESD means to design buildings with longevity and minimal impact on the existing biodiversity and there are three key ways to achieve this:

a) Compliance with the six environmental performance indicators, see section 3.2.
b) 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.
c) Meeting the requirements for design documentation and review according to the process shown in section 3.3.

This document provides a step-by-step guide which will allow the design 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 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.

3.2. 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 CO2 concentration
Target: 700 ppm (average over 8-hour period)

Materials Intensity

Objective: To minimise the energy embodied in construction materials
Indicator: Embodied Energy (GJ/m^2) as calculated in accordance with Appendix 1 (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 1 (b)
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 CO2-e / m^2) to be calculated in accordance with Appendix 1 (c)
Target: To be established during the Concept Design phase [Nominally in the range 79-88T CO2-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 1 (d)
Target: To be established during the Concept Design phase
[Nominally in the range 0.20 - 0.25 L / day /m^2]

3.3. 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 Consultants 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 (incorporated into the Project Brief)

Step 3: Concept Design

Step 4: Schematic Design

Step 5: Detailed Design and Documentation

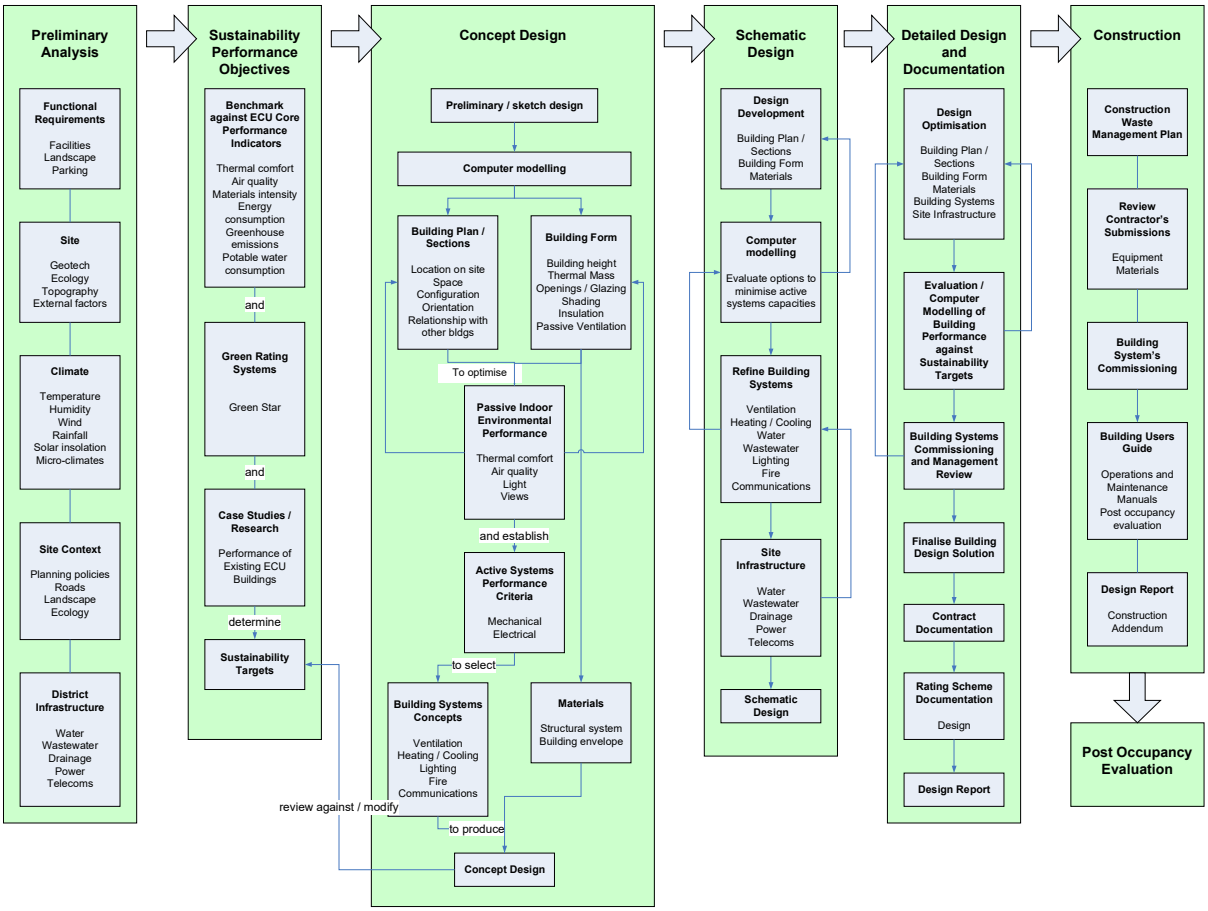
Step 6: Construction and Commissioning

Step 7: Post Occupancy Evaluation

The sustainability objectives are to be defined during the Briefing stage of the project, with clear indication of how each of the targets are to be reported against at each stage of the abovementioned process.

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

Figure 1: Flow chart showing the design process:



3.4. 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.

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, presence of rock material impacting structural design considerations

Environmental Conditions
Understanding of whether ground conditions pose a risk to health or the environment, resulting in landfill disposal requirements and importation of clean fill material from off-site sources

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

3.5. CLIMATE

It is ECU's objective to ensure that all buildings are designed to be responsive to the change in Perth's climate, which will require modelling of the design to evaluate performance against the sustainability indicators.

The climate analysis will include:

- Average temperatures rising by up to 2°C over the next 30 years. Hotter more humid climatic conditions.
- An assessment of the micro-climate at the site will be necessary to ensure that local factors are properly considered, thermal imagery will be required to identify hot spots in the building.
- Existing Infrastructure.

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
Maximise the use of rainfall and harvesting water if feasible, minimise the use of groundwater resources and scheme water. ECU encourages designers to investigate the option of recycling water within buildings.

Wastewater
Ensure wastewater infrastructure does not pollute or create contamination to wastewater 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, including integration into landscape design.

Power
Incorporate renewable energy options into building design as a way of reducing carbon emissions and at least 5% of the total power usage with photovoltaic technology.

Telecoms
Communications, building control potential.

3.6. ESTABLISHMENT OF SUSTAINABILITY TARGETS

The results of the preliminary analysis provide an initial evaluation of the constraints and opportunities to meet and inform ECU's core sustainability performance objectives. This information should be considered in conjunction with:

- Performance data from other similar 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 Australia or overseas.

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 Consultant team and ECU and be documented.

Targets will be set based on both environmental performance and project cost, including the impacts on project quality outcomes. 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. Initial advice should be sought from the appropriate consultant to set interim targets based on the specific building type.

3.6.1. Concept Design

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

3.6.2. 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 Engineering input as required.

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

3.6.3. 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.

3.6.4. 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.

3.6.5. Finalising the Concept

A workshop will be held with ECU just prior to completion of the Concept Design phase. In this workshop the Consultant 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 Consultant 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, quality and cost considerations.

3.7. Schematic Design

3.7.1. Design Development

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

3.7.2. 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.

3.7.3. 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.

3.7.4. Finalising Schematic Design

A workshop will be held with ECU just prior to completion of the Schematic Design phase. In this workshop the Consultants 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 Consultants 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, quality and cost considerations

3.8. DETAILED DESIGN AND DOCUMENTATION

3.8.1. 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.

3.8.2. 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.

3.8.3. 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. This will stipulate the requirements of the Contractor to achieve sustainability targets during construction.

3.8.4. 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.

3.8.5. 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.

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.

3.9. CONSTRUCTION AND COMMISSIONING

3.9.1. CONSTRUCTION MANAGEMENT

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

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

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

The Building Users Guide will also include a section on the measures that will be undertaken at post-occupancy to evaluate the performance of the building as set out below.

3.9.3. SUSTAINABILITY REPORT

An addendum to the sustainability report will be prepared at the time of practical completion, which considers any modifications to the design arising from construction or clarifications necessary following commissioning and building tuning. This is to be prepared in conjunction between the Consultant Team and Contractor.

3.10. 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

SUSTAINABILITY APPENDIX

CALCULATION OF EMBODIED ENERGY

Embodied Energy Calculation

An example of a calculation used to determine embodied energy can be found at

http://thegreenestbuilding.org/

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 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 target embodied energy figures.

Accordingly it is envisaged that targets will be set because 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/m^2 for an educational facility.

Figure 2 – Embodied Energy

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

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 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/m^2/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 modelling in accordance with the final and current version of the Green Star – Education v1 Energy Calculator.

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.

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.

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.

4.0 ACOUSTIC REQUIREMENTS

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

To be reviewed by acoustic consultant with an eye on different future acoustic requirements brought on by access to new technologies and different ways of presenting information both in teaching and public spaces

4.1. 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 like the Rw value, except those values are established via field measurements. It is recognised that normal building tolerances and flanking transmission paths influence 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 period, which is equivalent in total sound energy to a variable sound level over the same 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.

4.2. COMPLIANCE WITH CODES AND STANDARDS

Unless otherwise required, the consultant shall execute all work undertaken in accordance with the relevant Australian Standards, National Construction Codes, Acts, etc. and the National Construction 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) based on the functional use of the building and surrounding facilities / spaces.

4.3. Implementation for Existing Facilities

It is recognised that implementation of all acoustic requirements may not be possible in retrofit / refurbishment 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, dependent on the usage and scale of works.

4.4. 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 or external activities (i.e. public spaces, retail areas, areas subject to heavy foot traffic).
- Noise emission from mechanical equipment and plant rooms, including lift motor rooms, chillers / condensers, air handling plant, fume / dust extractors, pumps & tanks, 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.

4.5. Environmental Regulations (Noise)

Objective – To control noise emissions from facilities to meet the requirements of the Environmental Protection (Noise) Regulations 1997 r 5, 7-9, 11-14A, 14, 15, 16, 16AA, 16BA, 17, 18, 18B, 19B; sched 2, (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 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.

4.6. 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 because 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
- Pedestrian traffic / public space use
- 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 10 of this Acoustic Brief. This intention is that noise intrusion because 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 1 (below). For Offices and Flexible Learning Spaces, levels up to 5dB above the stated 'satisfactory' criteria are likely to be acceptable.

Table 1 sets out a summary of relevant 'design sound levels and reverberation times for different areas of occupancy in buildings', based on AS/NZS 2107:2016 "Acoustics - Recommended Design Sound Levels and Reverberation Times for Building Interiors".

Table 1 – *Recommended internal noise levels and reverberation times*

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)	<50 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	30 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-*	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

* The appropriate reverberation time shall be influenced by the use, volume and geometry of the space. Guidance from an acoustical engineer should be sought.

** Reverberation should be minimised for noise control

Note that rain noise is excluded. For rain noise, the noise level at a rainfall of 25mm/hr should not exceed the upper extent of the noise level range in Table A by more than 5 dBA.

4.7. MECHANICAL ACOUSTICS

Objectives

- To ensure noise from mechanical equipment is not considered intrusive and does not negatively impact on activity in a space.
- 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 □ 5 dB lower than the 'satisfactory' level set out in Table 3. (Refer to Section 4.11 – 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.

4.8. 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 3 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.

4.9. 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 "Work Health and Safety (General) Regulations 2022" shall be met in full. These Regulations relate to all aspects of employee health and safety. Regulations 4.1, specifically address "exposure standard for noise". 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 based on low noise operation should be considered.

4.10. ACOUSTIC ISOLATION

Objectives

- To control unwanted room to room noise transfer from normal operational or activity noise (airborne noise transmission).
- 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 3 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 2 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 3 – "Room Classifications".

Table 2 - *Design Performance for "Airborne Sound Insulation" Between Rooms*

Minimum Rw Design Rating	**Activity Noise in 'Source Room' *(see Table 3)***				
Noise Tolerance *In Receiving Room (see Table 3)*		Low	Average	High	Very
	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	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:

- Source to receiver assessments must be conducted in both directions, and the higher of the two design ratings applied.
- 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 3 – '*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

Type of Occupancy or Activity	Activity Noise (Source Room)	Noise Tolerance (Receiving Room)
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	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 to establish the extent of airborne acoustic insulation required to adjacent spaces (to achieve Design Sound Levels set out in Table 2).

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
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 near 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 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 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 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 cannot 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 cannot be clearly determined that single glazing will provide adequate acoustic isolation to meet user expectations, the glazing system should be detailed in a manner that allows easy retrofitting 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
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 consider; 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 □ 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 21 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 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; i) 'top plate' detailing that fits snugly between rebated tiles (aligned with the t-bar suspension grid), to the entire perimeter of each space, or ii) 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, and 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 3 in this brief).

4.11. 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. 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 AS2822 - 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 considers 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 4 - *Definitions for Vocal Effort*

Vocal Effort	Sound level at 1 metre	Description
Normal	60 dB(A)	Speaking in normal office
Raised	66 dB(A)	Speaking in Conference Room
Loud	72 dB(A)	Addressing a medium sized group
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.

4.12. 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. 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 5 (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 5 – *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

Type of Occupancy or Activity	Recommended 'Reverberation Time' (T), sec
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.

4.13. 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 finished and furnished space, comprising surfaces with individually assigned absorption and scattering coefficients for each frequency band.

4.14. 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.

4.15. 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 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 to emit minimum noise.

Environmental Noise: Noise emission from the site is to comply with the Environmental Protection (Noise) Regulations 1997 r 5, 7-9, 11-14A, 14, 15, 16, 16AA, 16BA, 17, 18, 18B, 19B; sched 2.

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 ECU Project Manager with a construction program. In addition to this program, the Contractor is to advise both the Superintendent and ECU 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 ECU Project Manager may instruct the contractor to cease all noise from construction for a set period.

5.0 DESIGN FOR ACCESS AND INCLUSION

5.1. INTRODUCTION

ECU is an inclusive university that values diversity and aims to create for students, staff and the broader community an environment free from discrimination. ECU is committed to increasing access and providing opportunities for students who face barriers to higher education. A whole-of-university approach – with multiple areas responsible for the plan outcomes – has been taken to encourage and support prospective and current students, as well as staff and the broader community, to reach their potential.

ECU is committed to inclusive course design and delivery which gives everyone the opportunity to succeed. Clear communication and flexibility are essential elements of inclusive teaching and assessment practices. The Disability Services Act (1993) defines 'disability' as meaning a disability which:

- Is attributable to an intellectual, psychiatric, cognitive, neurological, sensory or physical impairment or a combination of those impairments;
- Is permanent or likely to be permanent;
- May or may not be of a chronic or episodic nature;
- Results in substantially reduced capacity of the person for communication, social interaction, learning or mobility and a need for continuing support services.

Ensure that code requirements are met as a minimum with particular attention made to AS 1428.1-2009, (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), and further attention taken from the Disability (Access to Premises - Buildings) standards 2010 and on recommendations made by people with disabilities.

It should be noted that the standards are 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.

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

Consultants are required to ensure that their designs pay particular attention to the following areas (but not limited to) of design for access affecting people with disabilities:

- Circulation spaces must not be encroached by fixtures
- Constraints at doors, steps and turnstiles
- Grab rails (toilets, showers)
- Handrails 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

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

- Walking impairment
- Balance disorders
- Vision impairment
- Respiratory disorders
- Hearing impairment
- Restricted arm and hand grip impairment
- Variable physical strength capabilities (fatigue problems)
- Communication difficulties (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 and use of toilet facilities. Reverse this path to check exit problems.

5.2. REFERENCE DOCUMENTS

Note that separate individual codes exist for items related to access for persons with disability.

- AS 1172 - Water closet pans
- AS 1371 - Toilet seats and fittings
- AS1735-1999 - (Part 12) – Facilitates for persons with disabilities
- AS/NZS 2208 – Safety glazing materials in buildings
- AS 2700 - Colour standards for general purposes
- AS/ NZS 2890- 2009 – (Part 6) Off- street parking for people with disabilities
- AS 2899 - Public information symbol signs
- National Construction Code Series, National Construction Code of Australia, Volume 1

Refer to ECU Equity, Diversity and Inclusion for more general information on ECU's process.

6.0 SPECIALIST FACILITIES

6.1. CLEANER'S STORE

At least one cleaner's store (minimum 6m²) 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).
- Suitable hanging racks and shelving for the items briefed. Stainless steel fittings preferred. If cabinet work is required, then board must be High Moisture Resistant as a minimum and not to be places on the floor.
- Floor drain at cleaner's sink ensuring this is located at the lowest point in floor.

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.

6.2. TOILETS

Student toilets, unisex toilet for people with disabilities and staff toilets are to be provided in each building in accordance with the NCC and shall be based on the expected population and gender mix of the building. Confirm with ECU the required classification of toilet facilities to be provided.

- Toilets to be low maintenance areas complete with mirrors (in frames),
- Soap dispensers (provided by ECU contractor) are to be installed over basins in order that any drips fall into basin or vanity top. Exceptions to this are where Australian Standards or NCC state different.
- Wall and floor tiles to be full height and fully vitrified.
- Use Mitsubishi Jet Towel electric hand dryer or equal approved
- Coat hook and rubber buffer to door of cubicles.
- The male urinals are to be waterless to be sourced from the ECU supplier - Urimat Australia or equal approved.
- All female toilet cubicles to allow for a sanitary napkin disposal unit.
- A shelf or vanity bench is to be provided in all toilet basin areas.
- Toilet paper holders to be provided by ECU for installation by Contractor except to toilets for people with disabilities. These will need to be supplied to code by the contractor. Seek approval from ECU for the make and model.
- Toilet cisterns to be Caroma or equivalent in-duct cisterns.
- Ensure access to hydraulic pipework valves servicing bathrooms.

6.3. COURTYARDS AND INDOOR PLANTERS

Temperature
Increase the canopy cover of plants in open areas to reduce hotspots. Refer to the landscape Guidelines for plant species.

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

Water
One hose cock (20mm) with backflow preventer 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 m² 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.

6.4. Service and Storage Areas

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.

6.5. 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.
- External stairs to all entrances must have "going" and "rise" in accordance with Australian Standards.
- Provide adequate roof overhang or some form of external physical protection to entries.
- At entry door install wall to wall indoor matting extending into corridor. All external doors to be fitted with appropriate weather seals to prevent water ingress.
- Floor materials shall be non-slip low maintenance and require minimum cleaning.

6.6. 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 and guard rails 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).

6.7. 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 2014 (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 to signify that this is a different zone and not intended for pedestrian use.

6.8. PARENTING ROOM

ECU is committed to strengthen its work with, and support for, their diverse students, staff, families, communities, and partners. The *ECU Strategic Plan 2022 – 2026 Towards the University of the Future* sets the shared vision and goals and aims to foster an environment where everyone feels welcome, respected, and supported to fully participate in their studies and employment. The *Equity and Inclusion Plan* builds on ECU's previous work in equity and inclusion, and is informed by extensive student and staff consultation. In December 2018, ECU was one of the first 15 institutions Nationally to achieve the Athena SWAN Bronze Institutional Award. Athena SWAN is an accreditation framework based on ten key principles which commit to creating gender inclusive workplaces. The Bronze Award recognises institutions who understand the current state of gender equity in science, technology, engineering, maths and medicine (STEMM) disciplines.

One of the actions as part of our commitment to gender equality is to provide Athena SWAN Parenting Rooms across all ECU campuses. The importance of parenting room/baby-care rooms at ECU is to provide a facility for carers to attend to need of their children while attending any ECU campus. All seven of the ECU Athena SWAN parenting rooms at the Joondalup (including Edith Cowan College), Mount Lawley and Bunbury Campuses are rated 5-stars from *Australian Breastfeeding Association*. When designing a parenting room the University is guides by the Australian Breastfeeding Association *Star Rating Guidelines*.

- The uses of parenting rooms are for such reasons as:
- Breastfeeding/expressing milk
- Heating and cooling of milk
- Feeding of solid food to older infants/toddlers
- Changing nappies

- The parenting rooms should be designed as to be:
- Easily accessible for staff and students
- Be close by to toilet facilities
- Adequate size - Have a wide enough room opening and access to allow a pram to enter easily and be moved around

As a minimum, equipped with items such as:

- Fridge
- Microwave
- ZIP Tap (hot and cold regulated water)
- Facilities for hand washing (including soap) and washing of equipment; and
- Hand drying facilities (at a minimum paper towel)
- Separate kitchen area and bench space to baby change facilities
- Movable or comfortable chairs
- Have power points
- Appropriate garbage disposal for nappies and other child related items

Other suggestions of items would include:

- Highchair
- Privacy Screen for when more than one person is using the room
- Provision of hand sanitiser
- Provision of bay wipes/antibacterial wipes for baby-change facilities
- Play area and toys for older children who may be accompanying parent to parenting rooms

Parenting room should be provided across all ECU campuses. When designing parenting rooms *athenaswanaustralia@ecu.edu.au* should be consulted in the process.

6.9. LABORATORIES

Specific design requirements will be required where laboratories are to be included.

6.10. MULTI FAITH ROOM

Text to be added

6.11. MUSSALLAH

Text to be added

6.12. END OF TRIP FACILITIES

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

- Provision must be made for adequate change rooms to include appropriate change areas, showers, and lockers of adequate size (i.e. so clothes can be hung inside).
- Provision must be made for short term bike parking.
- 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 near one another in secure areas.
- Considerations needs to be made to include incorporation of drying room facilities.

7.0 BUILDING FABRIC

7.1. GENERAL

Design of building fabric and selection of materials to satisfy the following criteria:

- Fitness of purpose.
- Flexibility.
- Robustness.
- Life cycle cost.
- Fits ECU sustainability objectives.
- Thermal Performance.

7.2. EXTERNAL FABRIC

7.2.1. STRUCTURE - CONSTRUCTABILITY

- Buildings with poured in situ concrete external walls shall be designed with particular care and consideration given to the possible future effects of shrinkage and cracking which may lead to corrosion of reinforcement and eventual spalling of concrete. Any such designs will be critically examined, and structural guarantees will be required.
- Provide adequate control joints in all masonry walls. Joints to be thoroughly sealed to prevent water entry.
- Ensure damp proof course (DPC) are provided to cavity masonry at floors and flashings to heads/sides of openings. Ensure drainage through weep holes at all damp-proof course (DPC) DPC flashings.
- Ensure cavities and ties are clean at completion of construction.
- Provide vertical flashings between columns in cavities and the external masonry leaf.
- Where possible, building materials should be RF transparent for Wi-Fi conductivity.

7.2.2. ROOFING

- Design of roofs to satisfy essential requirement to keep out the weather, and effectively drain away stormwater. Complex roof forms which result in risk of leakage are to be avoided.
- Membrane roofing/tanking, etc. not to be used without prior approval.
- Gutter design. Internal gutters or box gutters are not to be used without prior approval. Gutters must relive to the outside of the building and not track internally through the building

7.2.3. WALL LINING

- Limit use of materials to those which do not require periodic maintenance.
- Use of painted finishes to external elements is discouraged and is not to be used without prior approval.
- Any lightweight materials which are susceptible to mechanical damage shall not be used within 3 metres of ground level.
- Design for thermal buffering/ Insulation.
- All wall finishes to be sealed with non-sacrificial type anti-graffiti coating to a height accessible from ground level (2.5m). Care to be taken in the “designing in” of the boundary of coating. External walls shall be either concrete or concrete masonry.

7.2.4. APPLIED FINISHES

Text to be added

7.2.5. External Soffit Lining

- Limit use of materials which require periodic maintenance.
- Screw fixings which embed into the material (fibre cement) being fixed to be avoided where depth of embedment cannot be reliably controlled.
- Design of support structure and fixings for soffit lining will require input from a Structural Engineer.

7.2.6. External Windows and Doors

- Design and location of windows is to provide natural lighting and outlook while at the same time does not introduce glare and thermal load to the interior. Openings exposed to full sun are to be avoided particularly on the East and West elevations.
- Allow for adequate access for cleaning of windows either from elevated work platforms or permanent gangways. Where access to these gangways is from the inside, doors shall be keyed to the University service master key system.
- When accessing external perimeter walkways, it is not to be via a window but a door at floor level.
- All external windows shall be designed in accordance with all relevant codes,
- Are to be in common or open plan spaces and not within single offices.
- Refer Electrical Services and Security and Traffic Services for the provision of automatic doors and the securing of the external perimeter

7.2.7. Sunscreen and External Attachments

- Any external attachment to a building is to be designed by a Structural Engineer.
- In general, the durability of any attachment must match that of the external fabric. Any elements (light fittings, signage etc.) which require applied coating for durability must be designed to be able to be maintained and accessible
- Consideration must be given to protecting the façade or building perimeter to prevent fouling from birds.

7.2.8. Access for Periodic Maintenance

- Any element of the external fabric of a building which requires periodic access for maintenance is to be provided with safe access. Elements include windows, gutters, roofs, equipment, light fittings etc. Demonstrate design strategies to achieve this end.
- The window system should be designed to ensure external face of glazing is capable of being cleaned wholly from within the building without infringing the requirements of regulatory authorities. Where this is not possible, provide approved external walkways complete with fall arrester system.
- Eyebolt systems safety hooks for cleaning windows may be required where the window opening is large enough to allow a person to accidentally fall out. This is to be determined in consultation with the Digital and Campus Services Department.
- -When planting around the perimeter of a building due consideration must be given to allowing access to services, for ongoing maintenance and cleaning, and the potential for root damage to the building structure.
- Glass must be easily removed and replaced after breakage. All window types must cater for this requirement and be designed and installed accordingly.
- All metal finishes shall be anodised aluminium for low maintenance purposes. Colour shall be approved by the ECU Project Manager.

Refer to "Design Life Provisions for Architectural Elements" in the Appendices for a guide to what ECU expects in terms of the lifespan of architectural elements.

7.3. INTERNAL WALLS, PARTITIONS AND FINISHES

7.3.1. FLEXIBILITY

Buildings shall be designed for total flexibility internally with respect to useable floor areas. Load bearing walls shall be minimised and restricted to areas such as the building exterior, core for stairwells, lift shaft and toilets. All other internal walls and partitions shall be non-load bearing and preferably fully demountable within the limits of economical design. To ensure building flexibility framed construction is preferred to load bearing masonry for buildings other than for domestic type of use. Additionally, avoid where possible the reticulate of services through structural walls, columns and slabs which limit the future expansion of services, are difficult to access, or compromise the ability to make future construction changes which may interfere with those services. Walls to have required control joints which coincide with floor expansion joints.

7.3.2. MATERIALS (INCLUDING SKIRTINGS)

Partitions and internal walls may be of plasterboard on metal stud, concrete masonry, or equivalent as required by the application. Finish must be low maintenance and easily cleanable.

Protection of external corners, where appropriate, to be considered. Skirtings are essential to prevent damage to base of walls from cleaning equipment. Where damage from furniture is considered a high risk, use of chair rails and the like to be considered.

7.3.3. APPLIED WALL FINISHES

Text to be added

7.3.4. INTERNAL PAINT FINISHES

Text to be added including reference to preferred common paint colours

7.4. FLOOR AND FLOOR FINISHES

7.4.1. DESIGN

Floor slabs shall be designed for the most economical construction and flexibility of use with due consideration to long term deflections and the need to provide for penetrations both initially and during the building's life. The need to core holes up to 200mm diameter or to provide penetrations up to 1200mm square in selected areas at a later date should be considered during design.

7.4.2. FLOOR LOADS

All buildings shall be designed for floor loadings generally in accordance with those specified by AS1170. Floor loading should accommodate provision for use of EWP units to access internal areas within the building where equipment or building fabric requires future maintenance. Also consider doorways and access paths to accommodate EWP/boom lift.

Library stack areas shall be designed to suit compactus loading. Floor loads for special areas shall be determined in consultation with users.

Provision shall be made for the installation of compactus shelving in all general office areas and in other areas specifically nominated in the brief.

7.4.3. Termite Control

Anti-termite treatment shall be provided to all buildings either at the beginning or after completion of the contract. All workmanship and materials shall conform to the requirements of AS2057A-1986 and subsequent amendments for soil treatment for the protection of buildings against subterranean termites. All necessary safety precautions shall be taken to protect workmen and others from poisoning.

7.4.4. Floor Mats

Suitable commercially rated entry mats shall be provided internally in mat recesses at each external access to the building.

7.4.5. Floor Finishes

Floor materials shall be low maintenance and require minimum cleaning. All flooring material will be non-slip with special care being taken in material selection for wet areas.

Standardisation of type, pattern and colour is advantageous for future renovation and addition. Refer to ECU for advice on current preferred options for general teaching and administrative areas. Where there is a briefed requirement for the space to have floor coverings that are outside of these general areas and need to make more of a statement in areas such as receptions for example, then these will be approved by the ECU Project Manager.

Designers are to be cognisant that most University spaces are very high traffic and so the composition, colour, pattern and type must all take this into account to reduce or eliminate soiling, tracking and general marking.

Carpet
Commercial grade carpet tiles with anti-static properties are to be used where a carpet finish is briefed. Broadloom carpet is not to be used.

Resilient Sheet and Tile Materials
Choice of vinyl floor finish to suit the application. In general finish to be non-slip and easily cleaned. In chemical laboratory areas finish to be chemical resistant with fully welded joints. In computer labs, comms and server rooms, or areas with high density of electronic equipment, finish to be antistatic.

Tiles
Tiles are required to have the correct slip rating for the application and are to be non-porous. Glazed ceramic tiles are not to be used for floors and are not preferred in general. Fully vitrified tiles are preferred.

The choice of grout will depend on the application but consideration must be given to opportunity for soiling and movement. Larger format tiles are preferred for floors in places such as bathrooms and kitchens where the soiling of grout might be an issue.

Appropriate expansion joints shall be provided when required.

Where floor tiles are used in areas susceptible to drink/fats/grease type soiling, then tiles are to be 100% non-porous, non-slip in line to code requirements, and easy to clean.

Concrete Finish
Exposed concrete floor finishes shall be sealed for dust and cracking.

Other Floor Finishes
All other floor finish types are to be approved by the University

Floor Penetrations
All floor penetrations shall be sealed and comply with fire stopping requirements.

Floor wastes shall be provided within all wet areas and adequate falls in the floor to these outlets are to be provided. No ponding in wet areas will be permitted.

Colour

Colour of all floor finishes shall form part of the overall colour scheme for the building and shall be selected in consultation with the ECU Project Manager.

7.5. CEILINGS AND CEILING FINISHES

Choice of ceiling type and finish to suit the application.

In general ceilings are to have the appropriate acoustic properties and provide easy access for services contained within ceiling spaces. Where accessibility is a requirement, it is essential that ceiling panels can be removed and replaced without damage to the panels.

Where fire isolation or acoustic isolation is a requirement painted flush plasterboard is acceptable. Where access to ceiling voids is required when using this type of surface, proprietary manholes which do not compromise fire and or acoustic properties of the ceiling are to be used.

When putting forward ceiling tile types for approval by the University, consideration must be given to existing types in the building and if efficiencies can be achieved by specifying the same.

7.6. FURNITURE

7.6.1. BUILT-IN FURNITURE

This should be limited where possible to items that reticulated with cabling such as power and data, or services in areas such as kitchens. Fixed joinery may also be necessary for the design intent to be realised in some areas but generally, the aim is to create flexible areas that can be reconfigured without excessive costs being incurred.

Special finishes which are difficult to replace or require long lead times to procure shall be avoided where possible.

7.6.2. LOOSE FURNITURE

Loose furniture to be selected and procured through Digital and Campus Services as per the ECU Furniture Guideline (currently under development).

Consideration must be made to circulation space, access and egress, National Construction Codes, suitability, appropriateness and warranties when selecting furniture for a space.

7.6.3. WHITEBOARDS AND PIN BOARDS

Refer to the Teaching and Learning Space Standards for information on the application of whiteboards and pinboards.

7.7. CURTAINS AND BLINDS

Generally curtains are not to be fitted to external glazing for the purposes of solar control. Their application will generally be limited to spaces where they might be used for a performance or where options for acoustic attenuation are limited and a curtain proves to be the best option. All fabrics utilised in Public Building designated areas are to be flame retardant quality -complying with the relevant standard.

In general, windows to office areas are to be provided with blinds with manual control. Internal roller blinds can be used for additional solar control but these should not be the primary method. Generally they should be manually controlled and allow a level sight through of which is best achieved with darker colours. A metallic backing should be considered to reflect any radiant heat from the glazing. Only in specialist circumstances on a case-by-case basis should blackout blinds and motorised blinds be considered.

Consideration also needs to be given to how blinds are seen from outside when in use. They have the potential to create an untidy façade when viewed from outside and there may be some circumstances when this may not be desirable.

7.8. SPECIAL EQUIPMENT

In general equipment which is to be built-in is to be included in the contract. Fume cupboards; biological safety cabinets; compressors and the like fit into this category. Selection of equipment will be to stakeholder brief.

Equipment which is to be provided by users is to be identified during the briefing process and adequate space and servicing requirements provided for in the contract.

7.9. DOOR HARDWARE AND LOCKS

7.9.1. LOCKS

The University requires a consistency of type of door hardware throughout its facilities.

Door Locks
Shall be Abloy Protec 570 oval cylinder (CY504N) or Abloy Protec 201 round cylinder (CY414N) Series and keyed to the University's Grand Master Key system. Locks shall be mounted such that strike is 900mm above finished floor level. No locks are to be mounted in the bottom rails of doors.

A complete lock and hardware schedule shall be prepared by the Consultant Architect and a keying schedule will be prepared by the ECU Project Manager.

All external and internal fire hose/extinguisher cabinets shall be fitted with “D” handles and roller catches only.

Table 7 - *Lock Characteristic Table*

Location	Lock Type	Remarks
Staff Offices General Staff Areas	CY504N	When not locked may be opened by inside or outside handles. Snib locking to inside cylinder and key lock to outside. Lever handles both sides.
Lecture Theatres Lecture Rooms Seminar/Tutorial Rooms Laboratories	CY504N	Cylinder lock to outside. Lever handles both sides. When locked by key, outside handle inoperative but inside handle always free to open door.
Exit Doors	CY504N	Opening Out. Key from outside retracts latchbolt. Key on inside locks outside handle. Inside handle always free.
Services Cupboards, Plumbing Ducts	CY504N or CY414N	Nightlatch with pull handle externally. Turn snib on inside opens door.
Plantrooms, Electrical Switchrooms, Lift Motor Rooms.	CY504N or CY414n	Key on outside retracts latchbolt. Inside handle always free.

Location	Lock Type	Remarks
Stores	CY504N	Key on outside retracts latchbolt. Inside handle always free.
AV Cabinet or Lectern	Metalux 60068 or Hafele 0068	

7.9.2. KEYS

The University maintains a *Protection and Security of People and Physical Assets Policy* which is administered by the Security and Traffic Services Manager.

Lead Consultant to develop a key schedule in conjunction with Security and Traffic Services Manager and the ECU Project Manager.

Key Schedule to:

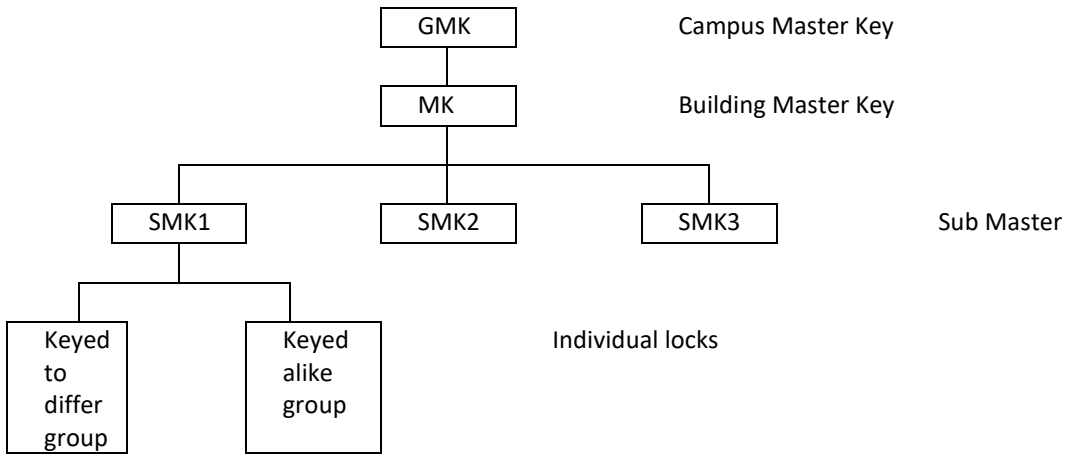
- Follow hierarchy set out in this Planning and Design Guideline.
- Sub mastering to follow compartments identified in the Security Plan.

Note – key override is to be provided to access points fitted with electronic access control.

- Lock cylinders and keys to new works will be Abloy Protec. If works are within an area covered by the old Lockwood system, advice on system selection is to be sought from the ECU Project Manager.
- Key scheduling will be carried out by the University. Keys from the manufacturer are to be delivered direct to the Security and Traffic Services Manager. If key locking is required in the construction process, construction keying is to be utilised.
- All buildings to be keyed differently and to be numerically identified.
- Where more than 6 keys need to be issued for a single door the use of card-controlled access is to be considered.

7.9.3. BUILDING KEYING SYSTEM

Figure 3



7.9.4. SERVICE KEYING SYSTEM (BUILDING FABRIC.)

Figure 4 – Joondalup

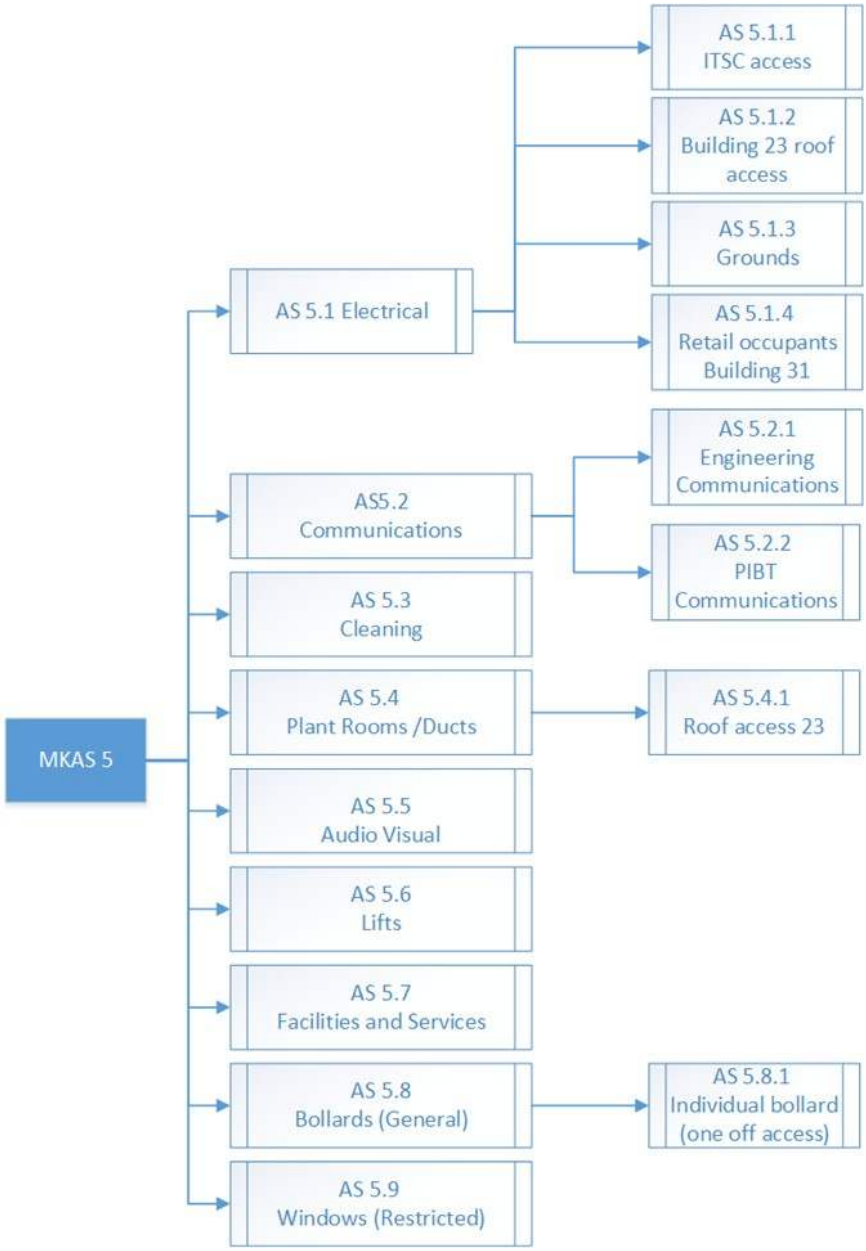
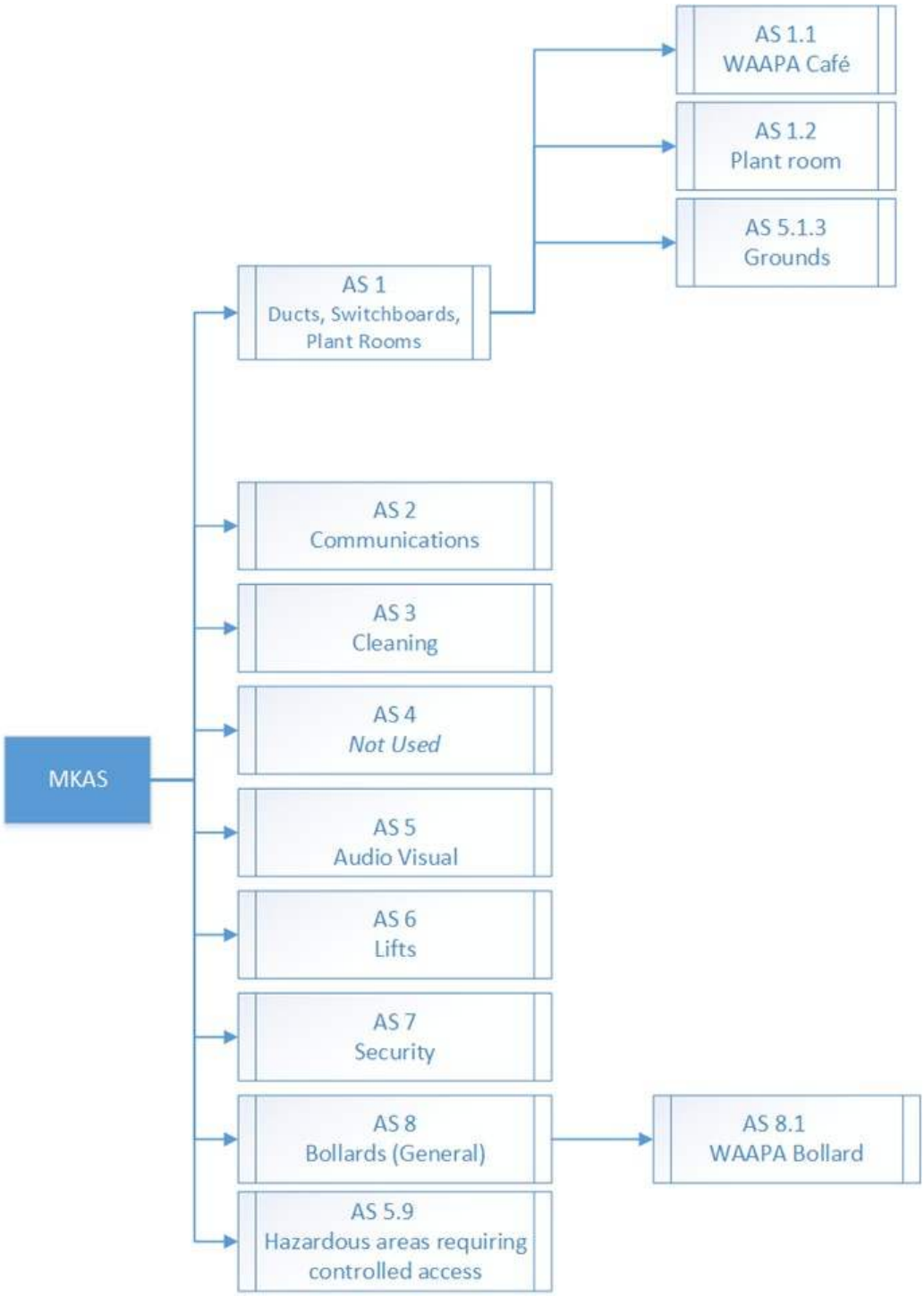


Figure 5 – Mt Lawley and South West



7.9.5. Key Stamping Policy

All keys and cylinders shall be stamped to the following format.

Campus ID	**Building No**	**Sub Master**	**Individual Lock**	**(issue)**
5	21	3	12	(2)

7.9.6. Door Furniture

This clause is to be read in conjunction with section on Design for Persons with Disabilities

- Lock furniture shall be Lockwood 1800, 2800 Series satin chrome finish or to match existing. Furniture selection is to comply with Australian Standards for Accessibility
- Engraved push pull plates are to be provided where required.
- 2mm stainless steel kick plates are to be provided in areas of high wheelchair or trolley traffic is expected.
- In confined spaces such as toilet cubicles, furniture to be selected to allow door to be removed in an emergency.
- To provide easier control for people with disabilities all cubicle doors to toilets/showers are to be fitted with Lane M.I.B. (Mortice Indicator Bolt) with extended handle.
- All doors which may, during operation, damage adjoining finishes shall be fitted with effective door stops. Fitting of doorstops is not to compromise required clear opening dimension.
- Acoustic door seals are to be provided where acoustic isolation is required.

7.9.7. Door Closer

Shall be provided to entrance doors, external doors, lecture theatre doors, plant rooms, toilets, air locks and fire doors. Type shall be “cam” action type approved by the University. Hold open controls are not to be used for security doors or operable leaves in air-conditioned spaces unless otherwise directed. Door closers shall be provided to doors which are at the perimeter of an air-conditioned zone and must be capable of complying with NCC and Australian Standards requirements on door opening force to suit persons with disabilities.

7.9.8. Push/Pull Plates and Handles

Shall be provided where required.

7.9.9. Hold-Open Devices

Electromagnetic hold open devices shall be provided to all fire-doors in high traffic areas which shall automatically release the door, allowing closure, in the event of any fire or smoke alarm activated at the Fire Indicator Board.

7.9.10. Toilet Cubicle Latch Sets

To provide easier control for people with disabilities all cubicle doors to toilets/showers are to be fitted with Lane M.I.B. (Mortice Indicator Bolt) with extended handle

8.0 SIGNAGE

All ECU signage should be implemented as per the ECU Wayfinding and Signage Manual located at:

https://secure.ecu.edu.au/fas /procedures/listing.php?dvid=6

Whilst the current guidelines do not include digital signage this is something that should be developed/considered for future signage.

8.1. SIGNAGE TYPES

Signage is divided into the following categories:

Directional. Signage which guides people from the campus boundary to a particular building front door.

Destination. Signage which guides people from the front door of a building to a particular occupant or facility.

Statutory. The contractor shall supply and install all statutory signage in accordance with the requirements of the NCC.

8.2. ROOM NUMBERING SYSTEM

Room numbering should be implemented as per the ECU Work Instruction 'Floor and Room Numbering Process'. Room numbers will be allocated by the ECU Planning team and issued as required.

8.3. BRAILLE AND TACTILE SIGNAGE

Braille and tactile signage shall be used where required by the NCC.

9.0 WASTE MANAGEMENT PLAN

9.1. UNCLEARED LAND AT ECU

An environmental assessment of the site to be undertaken by a third party as nominated by the ECU Project Manager. At least one annual assessment must be undertaken in spring and will include photo evidence of flora and fauna on site. The completed assessment must be reviewed by the ECU Project Manager. The assessment must include:

- Significant trees and areas of significant value to be maintained.
- Identification of nesting sites and the potential for relocating nesting sites.
- Grass trees suitable for retention and incorporation into the landscape design.
- Flora suitable for transplantation.
- AS4970-2009 must be considered in the assessment.
- Environmental risk assessment must be completed.
- Identification of fauna.

The environmental assessment must be integrated into the building design process to ensure that flora to be retained is incorporated with the design of the building.

The site should be checked prior to clearing to ensure there are no protected species such as orchids or animals such as bobtails, snakes, lizards or birds living on that site.

The topsoil is rich in nutrients, organic matter, micro-organisms and could be used in post construction in garden beds and the topsoil contains a rich supply of seeds that will germinate.

Where trees cannot be retained, they should be milled and/or mulched. The mulch is be used on ECU grounds and in the case of milling timber must be used in the building site.

The development process must be documented for historical purposes.

ECU sites for clearing must be directly linked to the masterplan.

- The contractor must implement a Waste Management Plan (WMP) – this must identify the different types of waste to be produced and waste management and minimisation strategies. The WMP must take into consideration the other waste criteria;
- A 60% (by mass) of all construction and demolition waste is to be re-used or recycled (based on the green star rating tool);
- Waste produced in the construction phase must be documented and recorded to be reported quarterly to ECU for the life of the project.

9.2. IN-BUILDINGS-REQUIREMENTS

A dedicated storage space for recycling that facilitates the recycling of general waste, comingled recyclables, paper/cardboard, organic waste and confidential paper waste used within the building:

- Waste stations for comingle and general waste – see standard waste station section below and paper/cardboard bins to be supplied by ECU (extra requirements on request).
- All signage to be supplied by ECU – see standard signage section below.
- All recycling bins must be able to handle the recyclable waste produced for the allocated catchment area for one day.
- Comingled bins, general waste and organic bins are to be in all kitchen areas.
- Comingle bins, general waste and confidential bins are to be in central locations in all large non-teaching areas.

- Comingle bins, general waste and confidential bins are to be in corridor locations near to individual offices.
- Comingle bins and general waste bins are to be in corridor locations near to teaching spaces and throughout the building were required i.e. Foyers and entrances.
- Paper/Cardboard bins and Confidential bins to be located next to or near allocated photocopy areas.
- All waste stations must be able to have a bin liner placed in them.
- All waste stations must be placed in practical, visible, high use areas.
- Number and placement of waste stations to be determined by design consultant.
- Accessibility for collections needs to be considered when designing waste station areas and the path of travel for moving bins form the storage area to the identified collection point.

9.3. Suggested Designs for the Different Areas

For Kitchen areas:

- For areas of smaller volume – 50L bin as pull-out draw under the kitchen bench for general waste and comingled waste.
- For areas of larger volume there are two options: the standalone bins are dependent upon number of people use the area
  - 50L bin as a pull-out drawer for general and comingle waste and 100L standalone waste station, OR
  - 50L bin as a pull-out drawer for general and comingle waste and 2 x 50L standalone waste stations.

For other teaching and non-teaching areas:

An area will need to be provided for a 50/100L waste station for comingled waste and 120L light blue sulo bin for paper waste.

9.4. Other Bin Requirements

An area will need to be provided for the following bins within buildings:

- Printer and toner cartridges – to be supplied by ECU.
- Mobile phone and batteries – to be supplied by ECU on request.

Standardised Signage

- Internal waste stations have the standard signage applied where possible;
- All waste stations are to have the relevant signage as per below:

General Waste Signage

Comingled Recyclables Signage

Paper Recycling Signage

Joondalup Recycling Station

Mt Lawley and South West Recycling Station

External Bin Requirements -

Please see below the required enclosures for waste bins that are located outside of buildings (manufacturer of waste enclosures is Commercial Systems Australia Pty Ltd):

- 120L/240L stainless steel enclosure for yellow top sulo bin for comingled waste.
- 120L/240L stainless steel enclosure red top sulo bin for general waste.

All external bins are to display the standard signage as above where possible.

10.0 BUILDING SERVICES

General
Designers interpreting these guidelines are to understand that changes to technology and policy may outpace the content of these guidelines. Contractors either tendering or working on projects at Edith Cowan University must be approved by the ECU Project Manager and or already be an approved supplier on the University Procurement Panel.

Specification
The content of these guidelines must be fully integrated into consultant specifications. The practice of appending these guidelines to generic specifications will not be accepted. Generic specifications, if used, must be edited to eliminate any conflict with the content of these standards.

Surveyed "As Constructed" In Ground Services
All in ground services are to be surveyed by a surveyor picking up location, inverts at critical intervals and levels of tops of pits.

Information is currently aligned to GDA94 Coordinates to allow insertion into the University Master Site Services Plan. It is the intention of the University to move to GDA2020 at some point. Check with the University on which is the current preferred coordinate system.

10.1. ACCESS AND MAINTENANCE

Maintenance of the University's facilities is funded from its recurrent resources. It is therefore imperative to ensure that all facilities are constructed bearing in mind life cycle costs and maintainability.

Designs will be rejected which make inadequate provision for:

- Servicing and maintenance;
- Easy removal and replacement of plant and equipment;
- Access;
- Durability;
- Those which opt for minimising capital cost at the expense of on-going maintenance.

10.1.1. OPERATING AND MAINTENANCE MANUALS

O+M manuals are only be provided in electronic format. The exact requirements under each section listed below will be provided as a template once completed.

- Introduction and Scope of Work
- Project Specification
- Emergencies and project teams Contact Numbers
- Equipment and suppliers list
- Technical Schedules
- Maintenance procedures and instructions
- Operations data
- Commissioning and testing data
- Warranties and Certificates
- As Built Drawings (In AutoCAD and PDF Formats)

If a project is being documented in BIM, all As-Constructed drawings still need to be supplied in an AutoCAD format together with the original BIM.

10.1.2. Access for Engineering Services

Simple maintenance procedures throughout the buildings are vital and shall be reviewed with the University before going to tender.

The design and construction materials shall reflect low maintenance considerations. All fabric, structural and service components shall be readily accessible and shall not be labour intensive at the repair stage.

Consultants shall ensure that they indicate:

- how each item of plant is to be installed initially;
- how the University's routine service personnel will access each plant item;
- the method to be used in changing the largest item of plant in any plantroom or plant area.

"Adequate access" for routine servicing means the sufficient space for a plant mechanic, irrespective of working age, to reach all items requiring routine service safely and without undue stress.

Any equipment installed in a trafficable ceiling space or on the roof, shall have a permanently fixed ladder and easily opened trap door. The design and location shall be approved by the ECU Project Manager.

Mechanical and Electrical Plant and equipment, particularly those requiring manual operation such as electrical control panels, or routine maintenance such as pump, fans, etc. shall have safe and comfortable access. A "loose" fit is essential to enable work to be carried out around them.

The Project Architect shall ensure that there is co-ordination between the Structural Engineers and Service Engineers to allow incoming underground services, in the form of pipes and cables, to pass through the building footings.

Adequate spare conduits to allow for future growth of services shall be allowed. Such things as electrical and telephone cables may be too big and heavy to be pulled around conduit bends; straight access, without bends or obstructions, shall be provided.

10.1.3. Plant Rooms

The Project Architect shall request from consultants the range of sizes for all items of mechanical and electrical plant. The Architect shall ensure that the final selection of mechanical and electrical equipment will not require additional space.

The Project Architect and Consultants shall ensure that the plant room layout at the design stage provides for future expansion.

Direct access from corridors to roof areas, plant rooms, tunnels, etc. shall be provided where possible to enable the independent control of these areas by Operations Branch.

Plant rooms shall be located convenient to the most direct point of vehicular access which can be achieved without the introduction of extensive service road connections.

It is preferred that plant rooms be located at roof top or basement level rather than in the body of the building. Provision shall be made in elevated plant rooms for hatches and lifting equipment to facilitate conveyance of equipment to ground. Where plant rooms are built in tier fashion within the building, access ladders shall be provided between levels within the plant room.

Plant room floors shall be graded to floor outlets to permit hosing down of floor. Floor surfaces are to be sealed against spillages and flooding by bunding or other approved methods and painted with paving paint.

All pipework penetrations to be bunded.

Plant rooms shall be designed so that the noise level measured with all the equipment operating under full load will not exceed the current exposure standard less 3dbA. Where this cannot be achieved, the Project Manager shall be consulted.

Plantrooms floors shall be designed to be washed down for maintenance and cleaning and shall be provided with water taps.

11.0 MECHANICAL SERVICES, HEATING, VENTILATION AND AIR CONDITIONING

11.1. GENERAL

This section of the Design Standards outlines the University's minimum requirements for air conditioning and ventilation systems for both new buildings and buildings being refurbished.

The following functional requirements are to be given special design consideration:

- Energy efficiency.
- Simplicity of design, particularly in relation to controls.
- Accessibility, ease of operation, simple maintenance, combined with minimal maintenance frequency.
- Whenever possible, life cycle cost analysis shall govern the selection of systems and equipment and the University may call for calculations on competing systems.
- Chilled water systems are preferred in areas that are near existing or planned chilled water reticulation systems. It is accepted that chilled water systems may initially require a higher capital cost than DX systems, but, on a life cycle cost analysis, may be preferable.
- Allowance for adequate space for installation and maintenance of machinery whether it be in designated plantroom, ceiling spaces or otherwise. Lack of space is not considered an acceptable constraint on mechanical design.
- Compliance with all statutory requirements including the Registration of all Plant and Equipment that require registration with the appropriate Government Regulator that is administering the Work Health and Safety Act.
- Compliance with AS3000. All required test results including earth looping impedance testing shall be issued with “As Constructed” documentation.

All staff studies are to be provided with an air conditioning system conforming to the following:

- Staff occupy their offices approximately 15 hours per week.
- System must have economy cycle where systems are greater than 20KW(R).
- Proposed system must be low maintenance and energy efficient.
- Sensors are to be located 1200-1500mm from the outside wall and on the room dividing wall where the whiteboard/pin board is located.

11.2. PREFERRED CONTRACTORS

Contractors either tendering or working on projects at Edith Cowan University must be approved by the Manager, Technical Services (Buildings and Maintenance).

11.3. SUSTAINABILITY

All utility consumption is to be metered and data from meters presented in a form to allow comparison against historical data to enable fine tuning of systems to achieve maximum efficiency. Current strategy is to aggregate all utility meter data under the BMS system.

Metering proposal to be approved by the Manager, Technical Services (Buildings and Maintenance) prior to implementation. Data gathering and reporting systems must be fully operational before practical completion.

11.4. DESIGN CONDITIONS

Careful consideration should be given to the design conditions for various areas.

External Design Conditions Summer

a) Teaching Areas 37°C DB
24°C WB

b) Office & Research Areas 36°C DB
24°C WB

External Design Condition Winter

a) 7°C – Noncritical applications
b) 4°C – Critical applications

11.5. PERFORMANCE STANDARDS

Air conditioning plant shall be designed to maintain the following internal design conditions:

Internal Design Conditions Summer

22.5°C DB +/ 1.5°C
55% RH +/ 5% RH
unless specifically nominated otherwise.

Internal Design Conditions Winter

Internal Winter Design Conditions shall be:
22.5°C +/ 1.5°C

11.6. ROOM OCCUPANCY NUMBER

Can be taken to be approximately equal to those shown below:

- General Office 5.0m²/person
- Library Reading Rooms 2.5m²/person
- Laboratory Undergraduate (lst Year) 3.7m²/person
- Laboratory Undergraduate (other years) 4.7m²/person
- Laboratory Postgraduate 12.0m²/person
- Seminar Rooms 2.0m²/person
- Lecture Theatres 1.1m²/person
- Lecture Classrooms 2.0m²/person

Note that Lab will be variable, and the utilisation of some labs will be low. Configure for energy efficiency.

Where room usage and corresponding population levels are not listed, forward a request to ECU for the relevant information. Where this information is not available, conform to AS1668 Part 2 as nominated by the NCC.

11.7. EQUIPMENT LOADS

Equipment loads can be approximately equal to those shown below and are subject to confirmation by the ECU Project Manager.

- General Office 10 W/m²

- Laboratories 30 W/m² To be individually determined
- Computer Terminal Rooms 100 W/m² To be individually determined

Where equipment loads have not been identified for a particular area, forward a request to ECU for the relevant information.

Pull down time for spaces with high and /or variable occupancy profiles shall be demonstrated by the design Engineer to the satisfaction of the Manager, Technical Services (Buildings and Maintenance). Designers shall demonstrate that the rooms design temperatures are stabilised after predetermined time in minutes after the room becomes fully occupied (From an Unoccupied State).

11.8. Fresh Air Rates

Shall be in accordance with AS 1668 Part 2 as nominated by the NCC.

11.9. Ventilation Requirements

Shall be in accordance with AS 1668 Part 2 as nominated by the NCC.

In reference to toilet exhaust systems, exhaust air flow rates shall be calculated to meet the minimum requirements of AS1668 Part 2 and the Health Act. Note that where a toilet exhaust system serves more than one compartment (WC), then duty/standby exhaust fans, complete with run/fault lights and automatic change over on fault, are required as stipulated by the Health Act.

11.10. Ventilation in Photographic Darkroom Areas

All fumes are to be extracted at source and systems are not to exhaust fumes by extracting past operator's breathing zone.

- For Ilfospeed fixers or similar not less than 15 air changes/hour for mixing and processing areas.
- For Ilfospeed Multigrade Developer or similar not less than 15 air changes/hour for mixing and processing areas.
- For Hypain Rapid Fixer or similar not less than 15 air changes/hour for mixing and processing areas.

For any product containing:

- Hydroquinone or Sodium Formaldehyde Bisulphite provide 10 air changes per hour.
- Methylaminophenol Sulphate (such as Kodak Dektol Developer) provide 10 air changes per hour.
- -Acetic acid (such as Kodak Acetic Acid 28%, Kodak Indicator stop bath) provide 10 air changes/hour. Local exhaust required.
- Tricholoroethane (such as Kodak Film Cleaner) allow 10 air changes per hour general room ventilation.

Local exhaust required where the following are used:

- Ethoxyethanol, Hydroxylamine Sulphate, pPhenyleneDiamene, Tertiary Bulylamine Borane, Selenium Oxide, Platinum Chloride, Potassium Oxalate, Potassium Sulphide, Potassium Permangenate, Potassium Cyanide, Potassium Dichromate, Ammonia, Mercuric Chloride, Acetic Acids, Catechin.

Minor exhaust systems from photocopiers and printers, kitchenettes and the like shall be ducted to outside the building. Discharging to return air ceiling voids is not permitted.

11.11. Fire & Smoke Control

Shall be in accordance with AS 1668 Part 1 , as nominated by the National Construction Code of Australia and/or as approved fire engineered performance solutions Certification and commissioning documentation, maintenance and testing procedures are all to be included in the operating and maintenance manuals. Fire/smoke separation to be clearly indicated in documentation.

11.12. Humidity Control

Humidity control will not be provided unless specifically called for or where special circumstances dictate. Where special conditions are required, these will be nominated by the user and agreed by the ECU Project Manager.

11.13. Chilled Water Temperatures

For design purposes the following chilled water temperatures are to be used:

Supply Water Temperature 7.0°C

Return Water Temperature 14.0°C

Leaving chilled water temperature set point shall be re-scheduled from 7.0°C to 12.0°C based on outside air temperature. Refer to Air Conditioning Control Functionality.

Special attention must be paid when modifying or extending an existing chilled water system with respect to the impact on the existing plant capacity, distribution system and controls. The designer shall review the design parameters of all equipment on that system to ensure design chilled water temperatures and flow rates are normalized to meet the current design standard for the site and that the piping and valve configurations for the system are in accordance with the design intent of the system.

11.14. Heating Water Temperatures

For design purposes the following heating water temperatures are to be used:

Supply Water Temperature 75.0°C

Return Water Temperature 55.0°C

Leaving heating water temperature set point shall be re-scheduled from 75.00C to 55.0 0C based on of outside air temperature. Refer to Air Conditioning Control Functionality.

Special attention must be paid when modifying or extending an existing heating water system with respect to the impact on the existing plant capacity, distribution system and controls. The designer shall review the design parameters of all equipment on that system to ensure design heating water temperatures and flow rates are normalized to meet the current design standard for the site and that the piping and valve configurations for the system are in accordance with the design intent of the system.

11.15. Condenser Water Temperatures

For design purposes the following condenser cooling water temperatures are to be used:

Supply Water Temperature 29.5°C

Return Water Temperature 35.0°C

Leaving condenser water temperature set point from the cooling tower shall be re-scheduled from 29.50C to 21.5°C based on a combination of outside air temperature, time of day and charge mode of chilled water storage tank. Refer to Air Conditioning Control Functionality, Section 21.26.

11.16. Noise and Vibration Control

The system shall be designed to minimise the transmission of noise and vibration from air-conditioning and mechanical equipment (all in accordance with the relevant Australian Standard and noise levels listed below). Sound attenuators and/or internally lined duct work shall be installed where necessary to minimise the transmission of fan noise. Ensure the acoustic Engineer's recommendations are specified in the Mechanical Services Specification

Care should be taken to minimise transmission of vibration to the structure from mechanical equipment. Where reciprocating or rotating equipment is installed, these shall be isolated from the structure by vibration isolators. Reciprocating or rotating equipment shall be mounted on inertia bases weighing not less than 1.5 times the weight of the equipment. The maximum allowable noise levels shall be in accordance with the acoustic engineer's report, or as scheduled below where such report is unavailable:

- General Offices NR 35-40
- Laboratories NR 35-40
- Lecture Theatres NR 25-30
- Seminar Rooms/Classrooms NR 30-35
- Individual Offices NR 35-40
- Library NR 35

11.17. Air Handling Systems

Airconditioning shall normally be provided using air handling equipment using chilled water supplied from the University's Central Chiller Plant. Direct expansion (DX) refrigeration systems shall not be used unless it can be demonstrated that required conditions cannot be achieved by use of chilled water. The use of direct expansion, window mounted or through the wall room air conditioners (RACs) is prohibited except in transportable buildings or other locations approved by the ECU Project Manager.

- Fresh air systems are preferred, CO2 concentration levels vs heat reclaim
- AHU to handle smaller zones for after-hours use and zone arrangements.

To achieve better control over operation, unitary type air-handling systems serving a single room or small number of similar rooms are preferred over large central station air handling systems. Air handling systems serving more than one floor shall not be used, alternatives may be permitted, subject to demonstration by the designers that suitable grouping of similar thermal zoning and occupancy profiles is achieved, and that afterhours functionality for individual functional spaces is achieved, additionally, multizone constant volume reheat systems shall not be used.

Floor mounted console style chilled water FCU's shall not be used.

All air conditioning systems shall have adequate fresh air (in accordance with current Code requirements of AS 1668 Part 2) drawn from outside the building at locations well away from discharges from cooling towers, fume exhausts, traffic, cooking areas, chemical storage areas (in accordance with current Code requirements of AS 3666).

The minimum and maximum outside air dampers shall be motorised.

Air conditioning equipment and ducts must be placed in such a way to minimise adverse impact to AV equipment. Where long or ultra-short throw projectors are used, please confer with the IT Collaboration team to ensure that no vibration or direct airflow causes image shake or distortion.

All air handling systems to be of Fan Coil Industries, G.J Walker Air Handling Systems, Airwise Engineering, Carrier manufacture or approved equivalent.

Ensure access is easy and safe to all major components, including motors, fans and coils Provide lifting points (especially to fan motors) as required to prevent damage to the equipment. Ensure there is adequate physical access in the plantrooms to manoeuvre equipment and carry out maintenance. Access to fire dampers shall be provided.

Air flow switches to be piped across the suction and discharge sides of fans in air handling systems.

Where appropriate, air handling systems shall be configured to allow for economy cycle, warm up cycle and night purge control routines to minimize energy consumption. Base heating shall be via heating water coils located in either the air handler or zone ductwork, depending on the system design. Electric duct heaters at VAV boxes shall be provided for trim heating. To obtain approval to use heating water pipework to VAV, the consultant will need to prove the economic/running cost viability.

The use of fan assisted constant volume VAV boxes may be used as an alternative to maintain minimum airflow rates to centre zones and to make use of secondary air as “free” heating, provided that the energy savings can be justified over the increase in cost and maintenance. Similarly, the use of variable volume fan assisted VAV boxes with electric reheat may be used on perimeter zones, provided that the energy savings can be justified over the increase in cost and maintenance. Cost justification in writing will be required to be submitted to ECU’s Manager, Technical Services (Buildings and Maintenance) where fan assist VAV boxes are proposed.

N+1 Air conditioning to be provided with Chilled water system for the duty system and Direct Expansion system for the backup for critical areas, data rooms, PABX rooms and the like.

11.18. CHILLED WATER SYSTEMS

Joondalup Campus

The existing chilled water system has the following characteristics:

- Central chilled water plant located in Plantroom 2 in Building 16, consists of 3 off water-cooled chillers and 1 off 2.2 million litre chilled water storage tank
- The chilled water storage is discharged during the day as a “phantom” chiller to reduce peak demand. The storage tank is charged by the chillers at night utilising the digital control system
- The chilled water storage tank stores chilled water at approximately 5.0 0C and mixes it with return water as required to achieve desired supply water temperature set point
- Another central chilled water plantroom is in building 24 consists of 2 off water cooler chillers.
- Chilled water supply temperature is reset from 7.0 0C to 12.0 0C, based on variation of outside temperature
- The chilled water systems are a decoupled primary water systems at the central plants with secondary variable speed pumps utilised for chilled water distribution to the Campus
- A reticulated chilled water distribution system across the campus serving most buildings utilising a two-way control valve arrangement with 3-way valves on index legs

The secondary chilled water pumps are controlled via differential pressure sensors located in Buildings 1, 2, 8, 16, 18, 19, 21, 22, 23, 24, 31, 32 and 34. Consideration for an additional differential pressure sensor to form part of the chiller plant control logic shall be assessed for each new building.

A cooling call is generated from each building which enables the chilled water plants. The cooling call is typically generated via any chilled water valve that opens more than 70% and the cooling call is disabled when all chilled water valves for that building is closed less than 20%

The chilled water system utilises a pressurised expansion tank located in Building 16. The original site chilled water header tank located in Building 18 is isolated now that the thermal storage facility has been installed.

The chilled water plant in building 16 utilises the Schneider INET Building Management Control System which interfaces with the Andover and the Struxureware Building Operation Building Management Control System (BMCS), the chilled water plant in building 24 utilises the Andover Continuum Building Management Control system (BMCS).

There is a smaller chilled water plant located in Building No 4 which is used as a back-up for Building 4, 5 & 6 and 30, if chilled water conditions are lost from the central plant. The chiller and dedicated boiler plant are in lower-level plantroom in building 4. The expansion tank for this chilled water system is in Building 6 air handling plantroom. This chiller and boiler plant operates under an Andover control System.

Building 15 has an air-cooled chiller on the roof of this building supplemented by the Chilled water supply from the campus ring main

All new buildings Chilled water supply for cooling shall be provided from the Campus existing Chilled water ring main, the designer must comply with the existing Campus Chilled Water master plan and design principles and consult with the University's Managers, Technical Services (Buildings and Maintenance) for any proposed system. The designer must check the existing Chilled water plantrooms capacities and establish if there is a need to increase these centralised capacities in line with the Chilled water master plan when designing a system for any new buildings.

Mt Lawley Campus

The existing chilled water systems have the following characteristics:

- Central chilled water plant located in Plantroom 6 in Building 19 consists of 3 off water-cooled chillers with a fourth chiller located in Building No 3, Plantroom No 1
- There is another stand-alone chilled water plant - (Trane Chiller in Plantroom 4) Serving Part Building 1
- Chilled water supply temperature is reset from 7.0 0C to 12.0 0C, based on variation of outside temperature
- The chilled water system is a decoupled primary water system at the central plant with secondary variable speed pumps utilised for chilled water distribution to the Campus
- A reticulated chilled water distribution system across the campus serving most buildings utilising a two-way control valve arrangement with 3-way valves on index legs
- The secondary chilled water pumps are controlled via differential pressure sensors located in Buildings 3 (Plantroom 2 tunnel) Building 1 and 8.
- A cooling call is generated from each building enables the chilled water plant. The cooling call is typically generated via any chilled water valve that opens more than 70% and the cooling call is disabled when all chilled water valves for that building is closed less than 20%
- The chilled water system utilises an expansion tank located in Building 19 Plantroom 6 in the cooling tower compound.
- The chilled water plant utilises the Schneider INET Building Management Control System which interfaces with the Andover Continuum and the Struxureware Building Operation Building Management Control System (BMCS).

If a new building is being planned to run off any of the existing chilled water systems, the designer shall review that system in its entirety to ensure that the existing pipe sizes can deliver the design flow rates, existing pump heads and capacities are not affected, the existing chillers have the capacity, existing expansion tanks are suitable

in height and size and that the new control system interfaces with the existing control system for the plant. Consideration for an additional differential pressure sensor to form part of the chiller plant control logic shall be assessed for each new building.

South West Campus

The South West Campus buildings are serviced by various ducted split and packaged direct expansion (DX) air conditioning systems.

11.19. HEATING WATER SYSTEMS

Joondalup Campus

The existing heating water systems have the following characteristics:

- Two boilers in Building 1B plantroom provide for space heating requirements to Buildings 1 and 2.
- One boiler in Building 4 Plantroom 1 provides for space heating requirements to Buildings 4, 5, 6 and 30.
- A single boiler located in Building 8 and one in Building 8A provide for space heating requirements to each building.
- A single boiler provides space heating requirements in Building 17.
- A single boiler provides space heating requirements in Building 18
- A single boiler provides space heating requirements in Building 23.
- A single boiler provides space heating requirements in Building 19.
- A single boiler provides space heating requirements in building 31
- A single boiler provides space heating requirements in building 21
- A single boiler provides space heating requirements in building 32
- Two boilers provide space heating requirements in building 34.
- Two boilers provide space heating requirements in building 15.
- Coil control valve arrangement is based on a two-way valve system with system differential pressure controlled by a single bypass valve located in each plant room.

Mt Lawley Campus

The existing heating water systems have the following characteristics:

- A boiler located in Plantroom 7B of Building 1 provides for space heating requirements to part of the eastern end of building 1 while a boiler located in Plantroom 3 Building 4 provides space heating to the remainder of Building 1.
- Two boilers in Building 3 Plantroom 1 provides for space heating requirements to Buildings 3, 5 and 6.
- A single boiler located in Plantroom 5 of Building 12 provides for space heating requirements to Building 8 and 12 and domestic hot water to Buildings 12, 14 and 15.
- Two boilers in Building 19 Plantroom 6 provides for space heating requirements to Buildings 13, 16, 17 and 18.
- A single boiler located in Building 15 provides for space heating to Building 15.
- A single boiler provides for space heating requirements in building 10

Coil control valve arrangement is based on a two-way valve system with system differential pressure controlled by a single bypass valve located in each plantroom.

If a new building is being planned to run off any of the existing heating water systems, the designer shall review that system in its entirety to ensure that the existing pipe sizes can deliver the design flow rates, existing pump heads and capacities are not affected, the existing boiler have the capacity, existing expansion tanks are suitable

in height and size and that the new control system interfaces with the existing control system for the plant. Consideration for an additional differential pressure sensor to form part of the boiler plant control logic shall be assessed for each new building.

South West Campus

The South West Campus buildings are serviced by various ducted split and packaged direct expansion (DX) air conditioning systems.

11.20. DUCTWORK AND REGISTERS

In general, low velocity systems are preferred. Ductwork shall be designed to limit duct air velocities to a maximum of 6.5 m/s for constant volume air conditioning systems and exhaust ventilation systems. However main riser ducts shall be capable of handling an increase of 15% in air quantity. Fans and motors should be selected with this in mind.

Where variable Air Volume systems are deemed appropriate to provide zoning flexibility, then ductwork shall be designed to limit air velocities to 10.5 m/s in riser ducts and a maximum of 8.5 m/s at VAV box inlets. Static regain should be utilised wherever possible in sizing the ductwork.

Main distribution ductwork shall be galvanised sheet metal ductwork, thermally and acoustically insulated as required to suit the application. The use of fibre glass insulation will not be accepted on all rigid and flexible ductwork. Where alternatives are available, they shall be used upon ECU's approval.

All flexible ductwork used for supply air or return air shall be externally insulted to reduce heat transfer. Flexible ductwork shall be in accordance with AS 1668 Part 1 and shall have early fire hazard properties not exceeding the following indices when tested in accordance with AS 1530 Part 3 and AS 4254:

Spread of Flame	0
Smoke Developed	3

Heater bank linings shall be in accordance with AS 1668 and be constructed from "Harditherm 700" or approved equivalent.

Ceiling diffusers shall be of the square louvre faced type for typical applications and shall be of Variflow, Harts, Dragon or other approved manufacture. Circular Krantz diffusers are acceptable however correct engineering and selection as prescribed by Krantz PTY LTD is to be adhered too. Additionally, where motorized Krantz diffusers are installed, access to the diffuser motor for servicing is to be provided to the acceptance of ECU. Ceiling diffusers shall be retained in position by a threaded screw/bolt arrangement. Where it is proposed to use an alternative arrangement, approval from ECU's Manager, Technical Services (Buildings and Maintenance) is required. All diffusers shall incorporate insulated cushion heads with flexible ductwork to spigot take-off from main distribution duct, to allow easy relocation of diffusers as required. Where diffusers are in roof spaces, the back surface of the diffuser exposed to the roof space shall also be insulated to prevent condensation on the diffuser. The insulation shall be glued with a suitable adhesive to prevent lifting of the insulation. All raw edges of the insulation shall be sealed.

Wall registers shall be of the adjustable blade type. Front set of blades are to be horizontal. Maximum blade spacing shall be 20mm.

Toilet exhaust grilles shall be of disc or egg crate type.

Return air/relief air grilles to be egg crate, half chevron or full chevron type.

11.21. PIPING, VALVES AND FITTINGS

In general, chilled water, heating water and condenser water lines within buildings shall be of Type B Copper. Underground pipework shall be suitably protected copper type B and or ABS laid direct in the ground unless laid near heating water pipework. Pipe installed underground at a depth of less than 1200mm shall be insulated type B copper pipe. Galvanised pipe or other material shall not be used unless approved by ECU's Manager, Technical Services (Buildings and Maintenance).

Chilled water and heating water underground mains are to be located under paving unless funds allow their location in culvert ducts or covered way ceilings.

Transition from one material to another should be made adjacent to the buildings in a pit which is always readily accessible. Valves shall be of approved manufacture and shall be in easily accessible positions.

Valves shall be of the type to suit the application, but generally be as scheduled below:

Isolation
- Ball valves to 40 mm diameter
- Wafer type butterfly from 50 mm to 500 mm diameter
- Gate valves from 300 mm diameter

Throttling plus Isolation
- Double regulating valves from 15 mm to 65 mm diameter (for bypass legs across coils at index runs only)
- Wafer type butterfly valves from 50 mm to 300 mm diameter

Modulating Control Valves
- Belimo Pressure Independent Characterised Control Valves (PICC valves) only (with manual over-ride capability)

Stabilising Differential Pressure Valves (for each building only)
- Tour & Andersson

Non-Return Valves
- Swing Check Valves

Gauge Cocks
- Ball Valves

Pressure / Temperature Test Points
- Binder Double Seal Type

Belimo Pressurised Independent Characterised Control valves with associated strainers shall be used for all water balancing and control of cooling and heating coils and the like, in lieu of the traditional double regulating valves. All valves shall be labelled and clearly identify their flow control setting. Stabilising Differential Pressure valves shall be used for all branches take off from mains serving each building to provide a second tier of automatic balancing for both the chilled water and heating water systems.

Ensure valves and fittings are adequately spaced and distanced from bends and the like, in accordance with manufacturer's recommendations. This is particularly relevant for the installation of Pressurised Independent Characterised Control valves, throttling valves and pressure / temperature test points. Ensure that pressure / temperature test points are located across individual coils and individual control valves without bends or other fittings in between apparatuses.

All headers are to be provided with at least one spare flanged and valved connection for future use. Typically, headers should be sized for the future capacity of the plant or at least one size larger than the main distribution pipe leaving the plantroom.

Ensure layout of pipework in plantrooms does not interfere with direct route of removal of equipment within plantrooms.

Where pipes pass through floors or walls, sleeves shall be specified and filled with appropriate sealant to suit application. Provide facia plated where exposed to view.

All risers shall be provided with dirt legs and drains at the bottom. Each level of pipework shall be isolated and provided with drains at the low point of each branch and at the riser.

All bolts, studs to valves, water boxes and equipment especially exposed to wet conditions are to have threads coated in nickel anti-seize.

Any variation of valve types / applications from the above shall be notified in writing to ECU Architectural and Buildings and Services Branches of ECU prior to ordering of equipment.

Where existing chilled / heating water system is to be extended, the consultant shall check and verify the capacity of the existing piping mains and plant to ensure that they are capable of meeting current and future demands. The consultant shall advise both the Architectural Branch and the Buildings and Services Branch of ECU of the current and future system characteristics.

Consider adding further filtration requirement. PICC valves (particularly small valves on smaller FCU systems) can be susceptible to becoming clogged if there is any sediment/impurity in the chilled/heating water system.

11.22. Insulation to Pipework

Pipework insulation to comply with the appropriate and applicable Australian Standards and Buildings Code of Australia. Insulation for valves, flanges and fittings shall be arranged for easy removal for maintenance purposes and shall be provided with hinged and clipped casings. All exposed pipework which is insulated shall be metal sheathed in plant rooms, ducts and where exposed and sisalation wrapped where concealed. Metal straps shall be provided to both metal sheathing and sisalation. Sisalation shall be continuous over all wooden insulation blocks at hangers. Blocks shall be turned from solid timber.

11.23. Underground Services

All underground services including pipe work, conduits etc. shall be laid in sand and shall be identified by laying continuous PVC marker tape not less than 300mm above the pipe. The marker tape shall be colour coded, magnetic and be printed with the identification of the contents of the pipe and/or conduits. At ends of straight lengths of pipes, provide permanent concrete or cast-iron markers located at ground level.

All pits laid in paving are to be trafficable to standard commensurate with their location. For example, heavy duty covers are required in service access routes

All bolts, studs to valves, water boxes and equipment especially exposed to wet conditions are to have threads coated in nickel anti-seize.

11.24. PLANT AND EQUIPMENT

Pumps

Unless it can be demonstrated that an alternative pump configuration is more suitable for a given application, 50mm suction and over shall be “Back End Pull Out Type”. Under 50mm Suction shall be “Vertical Split End Type”. Close coupled pumps shall not be used unless approved by the Manager, Technical Services (Buildings and Maintenance). Impellers shall be bronze; casing above 25mm: gunmetal, below 25mm: bronze; shafts shall be stainless steel. All seals shall be mechanical seals. Pumps shall be KSB, Grundfos or approved equivalent

Motors

Shall be totally enclosed fan cooled and normally be limited to 1450 rpm maximum. Motors for variable speed to be selected for sufficient dissipation of localised motor heat when running at low speed. High efficiency motors shall be specified.

Motors over 4.0 kW are to be soft start.

Fans

Where they are centrifugal fans, they are to be of approved manufacture with backward curved aerofoil shaped blades. Air flow switches are to be piped across the suction and discharge ends of fans

Variable Speed Drives

Variable Speed Drives (VSD) shall be of Danfoss, ABB or Zenner manufacture or approved equal.

Installation of VSD’s shall be in accordance with current standards as provided by Standards Australia and relevant legislation.

VSD shall have a mains supply isolation contactor installed before the VSD. The contactor shall, at all times, be sized sufficiently to allow the controlled motor to operate Direct On-line (DOL) should the VSD be removed for service. The intent is to allow conversion to DOL operation as a contingency in instances where failure of a VSD occurs and it is necessary to keep the facility in service. In such instances, temporary “soft starting” may be required where motor size does not allow DOL starting, however it is important that the isolation contactor is of sufficient size to operate in conjunction with soft starting.

Edith Cowan University’s Building Automation Systems shall control the VSD. The BMS shall provide a minimum input/output (I/O) interface to the VSD as follows:

- One Analogue Output to ramp the VSD proportionally (0 – 10 vdc)
- One Digital Output to provide Isolation Contactor Enable (24 vac)
- One Digital Input providing the BMS with VSD fault status (Dry Contacts)

DDC control wiring shall be such that the VSD can be enabled/disabled via a “Manual/Off/Auto” switch located on the Mechanical Services switchboard. The VSD can be further controlled on the VSD by use of local control functionality.

The DDC enable input on the VSD shall be provided with a “bridge” (where required) to give a permanent enable on the VSD.

The DCC enable signal shall not be removed until after the analogue output signal to the VSD is equal to or less than a value of 0% and a minimum time has elapsed that is equal to or greater than the ramp down time as set on the VSD plus 15 seconds.

Should the VSD experience a fault condition, the VSD diagnostic display shall be retained so that it can be interrogated for fault finding purposes.

Roof Mounted Exhaust Fans
Roof mounted exhaust fans shall be direct drive type and utilise speed controllers or variable speed drives as required depending on the fan motor size. The use of belt driven fans is not the preferred option. If a belt driven fan is proposed, then it shall be subject to approval by ECU.

Fume Cupboards Flues
Roof mounted PVC fume cupboards flues to be fitted with bird spikes to prevent the birds from entering the flues.

Heater Banks

Heater banks may be electric but only to be used where other alternatives are cost prohibitive. Utilise pulse width modulation for the staging of the heater banks as described under Controls

Filters
Shall be SW Hart, Email or other approved equal and conform to the minimum filter efficiencies as outlined in AS 1668 Part 2 and as a minimum, achieve 20% efficiency using Dust Test No 1 as per AS1132.5. The following is a guide to the type of filters to be specified:

Air handling plant above 3,000 L/s	Pyracube, Four Peak or deep bed type
Air handling plant under 3,000 L/s	V- Form extended media throwaway type
Grease filters	Email type GW
Dry media filters	Shall be of the disposable type.

Outside air intakes for large air handling systems shall be provided with pre filters located behind the plant room air intake grille. Prefilters shall be of Email SP panel type filter with KO type media or approved equivalent, to achieve a minimum of 75 % efficiency at AS1132 Dust Test No 4.

Magnahelic gauges shall be provided to sense filter bank pressure drop. Engraved labels secured adjacent to magnahelic gauges shall state the pressure at which filters shall be cleaned/replaced.

VAV Boxes
VAV boxes shall be Celmec, Johnson or approved equivalent. Depending on the design, variable volume boxes utilising a single primary air system is preferred. Subject to justification to and approval by ECU, the use of series or parallel type fan assisted VAV boxes may be considered. Where fan assisted VAV boxes are utilised, they shall incorporate a fan air flow or pressure switch which shall be suitable for low air pressure at minimum airflow. The airflow / pressure switch shall be interlocked with any electric trim duct heaters.

The size of each VAV box shall be selected to suit the design minimum / maximum airflows and control ranges of the box, in accordance with manufacturers recommendations. Test certificates indicating performance testing and QAQC checks shall be included in the Operating & Maintenance Manuals.

Chiller Sets
Chillers to be Water cooled and to be Trane, York ,Luke or approved manufacturer. Magnetic bearing centrifugal chillers are the preferred option for the base load chillers and helical screw type chillers are the preferred option for the low load.

Chiller condenser vessel tubesheets shall preferably be constructed from stainless steel. Where mild steel tubesheets are supplied with new chillers, the tubesheet shall be treated with a protective coating such as “Corocoate” or like epoxy coating. Cathodic protection shall be provided with the application of sacrificial anodes in condenser end caps as a minimum along with “Best Practice” application of anti-corrosion water inhibitor treatment.

Treatment of tubesheets and cathodic protection type, along with maintenance requirements, shall be documented in plant “Operation and Maintenance Manuals”.

Chiller ancillary electrical components such as contactors, contact sets, coils and relays etc., shall be freely available "off the shelf" in Australia. In turn, power and control circuit voltage must be of a standard that allows the procurement of "off the shelf" replacement component parts within Australia.

Chillers shall incorporate control modules, such as BacNet, that allow chiller plant management and monitoring. Control functions shall include chilled water reset, chilled water throttling valve control, chilled water bypass control and condenser water reset and / or condenser water throttling valve / bypass valve control.

Where BacNet or other high-level interface is provided, the control system shall be configured to:

- Monitor refrigerant temperatures and pressures
- Monitor % compressor loading
- Monitor compressor Amps and run times
- Allow variation of % load limit
- Identify low level and high-level alarms such that on failure of one compressor, the compressor is rotated to lag position, allowing the chiller to continue operation until a major fault isolates that chiller.

Chiller enable, chilled water reset and any other critical command from the BMCS to the chiller shall be hard wired, all BACnet or HLI is to be utilised for monitoring only. The cooling capacity selected for the chiller shall consider the staging capacity of the chiller plant to ensure a sequential and lineal grade of capacity increase and decrease. The make and model of the chiller/s to be specified shall consider COP's at part load, varying chilled water supply temperatures and varying condenser water temperatures. Life cycle costing of operating and maintenance profiles over 20 years shall be forwarded to ECU for verification prior to the consultant issuing tender specification.

Where water cooled type chillers are to be provided, particularly helical screw type chillers, regardless of if they are lead or lag, they shall incorporate condenser water throttling / control for cold condenser water starts, in accordance with manufacturer's recommendation.

Cooling Towers

Cooling towers shall be constructed of fibreglass or non-corrosive material and be in accordance with AS3666. Cooling tower sumps and condenser water take-off pipe assemblies shall be of fibreglass or non-corrosive material and shall be completely free draining. That is, build-up of sediment because of general maintenance and cleaning of towers, cannot occur. Cooling tower construction shall allow all wet surfaces to be exposed to chemicals associated with water treatment at all times. Cooling tower construction shall not allow the development of bio-film barriers that will affect water treatment effectiveness. Where new cooling towers are provided, they shall incorporate an automatic type flushing system to the approval of ECU.

Water treatment of condenser cooling water systems shall be in accordance with AS3666 and shall further provide the following as a minimum:

- Monthly Legionella testing;
- Automatic dosing of chemicals associated with protection against corrosion;
- Automatic dosing of biocides associated with microbial control. Additionally, automatic dosing shall be setup to provide for rotation of biocides. Biocide chemicals shall be injected into the condenser water entering side of chiller condensers. All condensers, pipework and cooling tower wetted surfaces shall be treated by biocides including potential "dead-legs" such as condenser bypass pipework;
- Where a BMS is available within a condenser water system plantroom, automatic time scheduling of biocide dosing shall be achieved via the BMS.

The selection of a cooling tower shall be undertaken in conjunction with the selection of the associated chiller to ensure COP's at design and part load conditions are achieved. Cooling tower fans should incorporate variable speed drives, suitably controlled to maintain design condenser water temperature to each cooling tower basin.

Cooling towers shall be of B.A.C. (Baltimore Aircoil) manufacture or approved equal. Disposal of cooling tower wastewater is to be to approval of ECU. ECU sustainability objectives require the consideration of reuse of wastewater. The option of discharge to sewer as trade waste must be maintained.

Air Cooled Condensers
Where air cooled condensers are proposed, they should preferably be of the vertical air flow type with air drawing through the coil.

Pressure Vessels
All equipment supplied to the University that contains pressure vessels shall be registered in accordance with relevant Australian Standards, legislation and WorkSafe WA.

In addition to statutory requirements, copies of registration certificates and inspection reports/datasheets shall be included in "Operation and Maintenance" manuals with a separate copy issued to ECU's Manager, Technical Services (Buildings and Maintenance).

Examples of equipment that contain pressure vessels that may be required to be registered include, but are not limited to the following:

- Chillers – evaporator and condenser vessels;
- Boilers;
- Air compressors; and
- Vacuum systems.

Inspection, certification and maintenance requirements of pressure vessel shall be detailed in "Operation and Maintenance" manuals.

All Belt Driven Equipment
All installations utilising exhaust fans shall be direct drive. Where installations have no option but to require belt drive means, the installation shall have a minimum of two vee belts and pulleys shall be equivalent to Taperlock.

Air Handling Plant
Refer filters, motors and fans under items 11.15 and 11.22. Air handling plant associated with variable air volume boxes shall incorporate variable speed drives to control supply air fan speed to suit static pressure set point.

Coil velocity shall be limited to:

- 2.2 m/s cooling
- 3.0 m/s heating

The use of return / relief air fans should be avoided if possible, depending on the configuration of the air handling plant and air distribution system. The use of return / relief air fans limits the use of economy cycle in trying to modulate to achieve leaving air temperature set point. The use of dissimilar return / relief and supply air fans, as in centrifugal and axial type fans, is also discouraged due to the different pressure / airflow performances of the fans, particularly on variable air volume systems where both fans incorporate variable speed drives.

Air handling units shall incorporate a motorised minimum outside air damper which shall close on warm up cycle. Economy cycle damper which could also be utilised in night purge control routine should also be provided where appropriate.

All sensors and relief dampers locations are to clearly show on the Building Management and Control systems (BMCS) graphics

All related DDC points on a related system must be located on the same physical controller e.g. a heating water system differential pressure must be on the same controller as the heating water bypass valve.

Heating Water Boilers

Shall be forced draught type.

Evaporative Coolers
Shall be constructed of aluminium like "Bonaire" or approved equivalent.

Plantroom Floor Waste Charging System
A solenoid valve to be provided to charge the plantroom floor wastes. These solenoid valves are to be controlled to come on once a week by the Building Management System.

11.25. INSTRUMENTS

All instruments shall be calibrated to read in the S.I. system of units. Dial gauges shall be 100mm minimum diameter and shall be installed to allow the gauge to be zeroed when not in use. The range of the instrument shall be suitable for the application i.e. normal operating point equal to 80% of full-scale deflection.

11.26. AIR CONDITIONING ELECTRICAL SYSTEM

Switchboards and Motor Control Centres shall normally be of type tested construction.

Permanent, clearly legible traffolyte labels shall be fixed to all internal and external controls.

Fire Alarm relays shall be provided in accordance with the requirements of AS 1668 and AS 1670 as applicable.

25% spare capacity shall apply to both electrical capacity (in submains, main switches etc.) as well as spare physical space in switchboards. Physical expansion space shall be provided in both the LV (power) and ELV (controls) sections of boards.

High and low voltage cable and controls (DDC) shall be separated within cubicles in accordance with AS 3000.

A minimum of three (3) fuses of each size and type shall be specified as spares and shall be secured in holding clips on the inside of Switchboard Cubicle Doors.

Hours run meters shall be provided on all items of equipment which are duplicated or run in parallel, and where else considered necessary, unless controlled by a direct digital control system, in which case the control system shall record operating hours. Strategy for measuring and tracking energy use by mechanical services systems will require greater detail.

Provision shall be made to override local start stop controls by means of BMS control where specified.

Polyphase Kilowatt Hour Meters shall be provided to main A/C Switchboards to meter the consumption of the switchboard and all its sub boards. Where sub-metering of mechanical service switchboards is being picked up under the Electrical Services element, this requirement is not applicable.

All cables shall be run on a cable tray and terminated strips. Cables shall be identified by numbered ferrules at each termination.

Heater banks shall be controlled by BMS, irrespective of air conditioning controls, for energy load shedding.

Heater protection thermostats complete with fault lights (visible from within the occupied space) shall be provided to all heaters including those associated with VAV boxes. Air flow switches shall be incorporated in all heated air systems.

Electrical drawings shall be prepared with Circuit Reference Numbers to indicate the number of contacts and their location.

11.27. IDENTIFICATION OF EQUIPMENT

All items of equipment shall be identified with engraved trefelite labels, in accordance with the University's Computerised Maintenance Management System QFM Coding structure. Contact the Buildings and Services Branch for details. Thermometer bulbs, pressure gauge tapings and remote sensing points shall be labelled to indicate their function.

11.28. IDENTIFICATION OF PIPEWORK

All pipes shall be identified in accordance with AS 1345 1972 for the Identification of Piping, Conduits and Ducts and AS 1318, Industrial Accident Prevention Signs. "Safetyman" adhesive labels are an acceptable method for identification of pipework. Flow direction arrows shall be provided to all pipework. All exposed pipework in plant rooms and risers and wherever else exposed to view shall be fully painted in accordance with the University's "Colour Schedule for Plant and Equipment" (Section 24.0). Colours standards shall be in accordance with AS 2700.

11.29. FUTURE AIR CONDITIONING

All buildings are to be designed to have sufficient capacity to allow for extension or expansion of the air conditioning systems within the building design for future buildings proposed for the site. The designer should reference the master plan and discuss the options with ECU to consolidate the design intent. All chilled water and heating pipe systems to each building shall, as a minimum, be designed to have 20% spare capacity throughout.

11.30. BUILDING MANAGEMENT SYSTEM (BMS)

The University's buildings are controlled and monitored through an Andover Continuum or TAC INET system with Schneider Struxureware Building Operation located in the Maintenance office with Data Gathering Panels (DGPs) in each building. The Contract shall allow for the supply and installation of a system in the building connected back to the CPU by the University's ethernet communications network and to any relevant points in the building to be determined in conjunction with the University. The new Building Management and Control Systems (BMCS) shall be Schneider Struxureware Building Operation.

It is the intent of the University to utilize the Buildings Management System (BMS) in the future as the main access platform to other Buildings Services Systems such as Lighting, Power Management, Energy Metering and Management, Regulatory Compliance and other Systems that can be easily integrated within the BMS.

Interconnection between DGPs within the building and between buildings shall be DEKORON cable 1.5mm², twin, terminated through a lightning protector at the DGP.

Power to the DGPs shall be 240V/24V with capacity to operate the maximum relays controlled by the DGP. All controls emanating from the DGP to external devices shall be 24V A.C. originating from a 240V/24V transformer mounted within the DGP cabinet or in external switchboards and switched by the internal relays within the DGPs.

Relays shall be IZUMI, RY4S, and 24V D.C. Typical control drawings are available from Asset Planning Branch.

Programming of system shall be part of the contract and group point numbering shall be determined in conjunction with ECU's Buildings and Services Branch. Provision for system graphics to also be included in accordance with current methodology.

MAC addresses, port and switch information is to be provided to ITSC for all BMS equipment at the earliest possible juncture. The provisioning of VLAN's and the relevant switch port information will then be given back to Facilities to ensure timely commissioning of all BMS equipment.

The BMCS contractor to provide the University with all the details of the controls network devices including MAC addresses. The University will issue the IP addresses for these devices.

All the BMCS and mechanical services switchboards to have 25% spare capacity for future expansion, the spare capacity shall include but limited to Hardware, software and spare DDC points capability.

The contract shall provide for not less than eight hours instruction on the system operation and programming (depending on size of project) to staff of University. Allow for maintenance period to cover cost of call outs and maintenance for 12 months.

It is the intent of the University to utilize the Buildings Management System (BMS) in the future as the main access platform to other Buildings Services Systems such as lighting, Power Management, Energy Metering and Management, Regulatory Compliance and other Systems that can be easily integrated within the BMS.

Consideration to be given to the use of data collection and Artificial Intelligence within the Building Management System for the management and improving the controls strategies and the predictive maintenance of the system.

11.31. Air Conditioning Controls – General

- Refrigeration plant shall be fully automatic and shall normally respond to a call for cooling from the air handling unit.
- Local exhaust fans (other than toilet exhaust) shall be provided with local manual controls.
- External and/or remote temperature and pressure sensors and recorders should be specified on any installation of 100 kW or over.
- Provision should be made on all controls and sensors for connection to a Central Control and Monitoring System (BMS) – Schneider Struxureware Building Operation.
- Control and monitoring systems for air conditioning plant shall be determined in consultation with staff of ECU's Buildings and Services Branch prior to finalisation of specification.

11.32. Air Conditioning Control Functionality

Occupied (Master) Setpoint

Occupied Setpoint is an internal numeric point which floats over a temperature range of 22.5°C to 23°C and is established once on each air handling/fan coil unit. The Occupied Setpoint represents the room or space temperature Setpoint under active push button control. The floating Occupied Setpoint is reset according to ambient temperature in accordance with the following parameters:

- If the ambient temperature is below 17°C then OSP = 22.5°C
- If the ambient temperature is above 25°C then OSP = 23.0°C
- When the ambient temperature is between 17°C and 25°C, OSP will be proportional between 22.5°C and 23°C

Mode	Set point
Occupied Set-Point	22.5°C
Setback Cool Mode	OSP + 2°C
Setback Heat Mode	OSP – 2°C

- Where a globalised campus Master (Occupied) Setpoint is already established providing alternative functionality relating to previous approaches in control strategy, the above approach will take precedence. To this end, the control strategy shall be updated to reflect current control requirements.

Air Conditioning Run Times

Air conditioning systems shall be time scheduled to operate in core hours. Core hours for the purpose of air conditioning run times is from 8:00am to 5:30pm Monday to Friday.

Once air conditioning units start in core hours, systems shall operate in a "setback mode". Setback shall be in accordance with the following parameters:

Setback cool mode = OSP + 1.5°C = SBCSP

Setback heat mode = OSP – 2.5°C = SBHSP

Upon the occupant activating an A/C push button, the active zone shall revert to "occupied mode". "Occupied mode" shall provide system control to Occupied Setpoint. In core hours, occupied mode shall be for a duration of four (4) hours. Outside of core hours, an initial activation of the A/C push button shall start the air conditioning system with the active zone operating in "occupied mode" while inactive zones operate in "setback mode". Out of hours run time is for a duration of two (2) hours.

A/C push button control stations shall utilise a "rocker" style switch (not depression type as used previously) and shall incorporate a green neon indicator light that provides the occupant with an indication of air conditioning status and that the zone is active. All inactive zones shall remain in "setback mode". The push button control logic shall be set up where the push button must be depressed for a period of no longer than 3 seconds to enable occupied mode. A further 30 seconds needs to elapse before the bush button can be depressed for a period of no longer than 3 seconds to enable setback mode in core hours and turn the AHU/FCU off in an "out of hours" condition.

Where there is a group of staff studies, the A/C push button control station shall be located most conveniently in the main access way at 900mm above floor level. Where tutorials or classrooms are encountered, separate push button control stations for each area located adjacent to the light switch shall be provided.

Some areas, such as Auditoriums, Theatres and the like, do not operate on core hours. The air conditioning plant is initiated when the push button is activated and then controls as required to achieve OSP. However, if the area is not occupied and the room temperature exceeds 28.0 0C or is lower than 19.0 0C, then the air conditioning plant shall start automatically and run until the room temperature falls below 26.0 0C or rises above 20.0 0C.

There is existing air handling plant that, due to their configuration, does not follow the above control logic to the letter. If there are modifications to an existing air handling or distribution system, the designer shall identify the control logic employed and modify as required, subject to ECU approval, to provide a plant that operates effectively and is energy efficient. The control logic finally employed should be similar in intent to the design intent of the control logic described herein.

Room Sensing

Normal location of sensors for room temperature sensing shall be:

- For perimeter zones, 1500 – 2000 mm from the outside wall, 1500mm to 1700mm above the floor, out of direct sunlight and adjacent return air path if possible
- For internal zones, 1500mm to 1700mm above the floor and adjacent return air path

VAV Operation

VAV operation shall be in accordance with control functionality for occupied and setback modes as outlined under section titled "Air Conditioning Run Times". This means that only the VAV in the activated push button area is to commence full control function - all other VAV's are to remain in setback mode as indicated.

Where more than one VAV Box service a common area a common push button is to be installed and programmed to start all the VAV Boxes serving that area.

VAV electric re-heat shall be enabled and allowed to operate to maintain OSP or SBSP whenever the following calculation below is true.

- SAF Status = On & (SAT < RAT)
- SAF Status = On & (RT < OSP or SBOSP)
- SAF = Supply Air Fan
- SAT = Supply Air Temperature
- RAT = Return Air Temperature
- RT = Room Temperature
- OSP = Occupied Set Point for occupied
- SBSP = Set Back Set Point for unoccupied mode

Note: Refer to item (v) in Warm Up Section under the heading of "Note" for VAV operation during warm-up mode.

VAV heater banks shall have a mains power supply isolation contactor located in the air conditioning unit plantroom mechanical services switchboard that is energised based on fan status that is derived from an air flow switch located in the supply air duct.

VAV heater bank trip indication shall be by way of monitoring a hardwired status point typically associated with the heater isolation contactor/relay and is to be displayed on the BMS graphic page for VAV boxes.

Economy Cycle Operation

AHU start up
- On AHU start-up hold chilled and heating water valves closed for 2 minutes.
- Check for viability of economy by
- OA < RA and SA > SA_SP and Enthalpy < 48 for economy cool
- OA > RA and SA < SA_SP for economy heat

If economy is viable modulate economy dampers to control supply air temperature to supply air temperature set point. (Hold chilled and heating water valves closed)

If on economy cool
Where economy dampers = 100% and SA > SA_SP for a period greater than 2 minutes, then modulate CHWV to maintain supply air temperature. (Economy not able to meet demand)

If OA > RA or Enthalpy > 52 then close economy dampers. Modulate the Chilled Water Valves to maintain supply air temperature. (Economy is no longer viable).

While AHU is running when no economy is in use, check for cooling economy viability by OA < RA and Enthalpy < 48 for economy cool. Where this is true, open economy dampers to 100%. Continue to modulate CHWV until valve = 0%. Then modulate economy to maintain supply air temperature.

If on economy heat
Where economy dampers = 100% and SA < SA_SP for a period greater than 2 minutes, then modulate HWV to maintain supply air temperature. (Economy not able to meet demand)

If OA < RA then close economy dampers. Modulate Heating Water Valves to maintain supply air temperature. (Economy no longer viable).

While AHU is running when no economy is in use, check for heating economy viability by OA > RA for economy heat. Where this is true, Open economy dampers to 100%. Continue to modulate HWV until valve = 0%. Then modulate economy to maintain supply air temperature.

Variables
Where SA temperature is not used replace SA and SA_SP with chilled and heating water control points (e.g. Room temperature and room temperature set point)

Where OA > SA_SP -0.5 and OA < SA_SP +0.5 and Enthalpy < 48 then Economy = 100% (OA is very close to SA_SP so economy is used to provide 100% fresh air).

- OA = outside air temperature
- RA = return air temperature
- SA = supply air temperature
- SA_SP = supply air temperature set point
- CHWV = chilled water valve
- HWV = heating water valve

Note: Enthalpy is not used for heating

Night Purge
Night purge shall be incorporated and initiated when:

- The air handling system incorporates an economy cycle and does not operate 24 hours a day
- The average space temperature for all zones exceeds 24.0°C
- Outside air temperature less than 22.0°C
- Outside air enthalpy less than 52 kj/kg
- Time of day between midnight and core hours start time

Night purge shall be terminated on commencement of core hours of operation when outside air temperature greater than return air temperature or outside air enthalpy exceeds 52 kj/kg. During night purge operations, all VAV boxes shall open to 100% design airflow until OSP + 2.0°C is achieved, whereupon the night purge cycle shall terminate

Early Morning Warm Up Operation

Initiation
Warm up cycle will not be initiated unless the average room temperature is less than 20.0°C, outside air temperature is less than 14.0ºC and time of day is less than two hours before core hours (i.e. Monday to Friday). This is illustrated in the following equation.

(ART < 20°C) & (0AT * 14°C) & (TOD = Core Hours Start < 2 hours). Where:

- ART = Average Room Temperature
- SAF = Supply Air Fan
- OAT = Outside Air Temperature
- TOD = Time of Day

The warmup cycle shall be enabled two hours before core hours commences, subject to operating parameters being met. When the warmup cycle is enabled the heating water valve will modulate to maintain a supply air temperature of 35.0°C. This will be held until the average of all room temperatures is equal to OSP – 1.0°C or Core Hours commence.

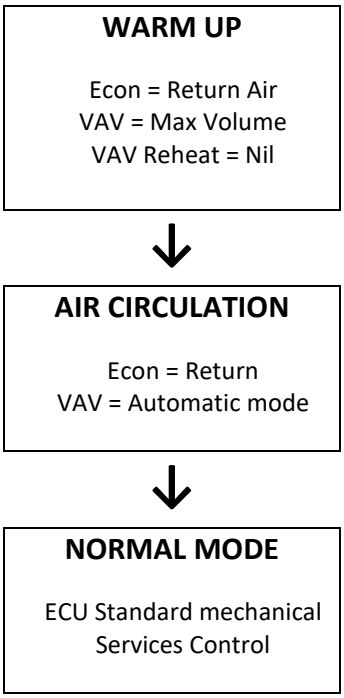
i.e. cold morning OSP = 22.5°C - 1 .0 0C = 21.5°C

Note:

1) 22.5°C – 1.0°C is needed to overcome building inertia. This control logic is aimed at being both energy efficient (i.e. not overheating the space) and mindful of reducing operating costs (i.e. minimising the need for electricity consumption during on-peak periods) as the central heating is typically a gas boiler with no on peak periods, it is prudent to maintain the operation of the warmup cycle until specified conditions are achieved. Variation of parameters for activation and termination of warm up cycle may be required to suit building characteristics and plant performances over varying ambient conditions.

2) The economy cycle will need to de-energise while warm up is in operation.
3) The minimum outside air will need to be closed off and in the case of air quality control, will need to be overridden to move to its closed position.
4) During warm up, an AHU localised point will be recognised by each VAV so that the VAV will drive to its maximum design volume (i.e. reverse acting mode) and lock out any VAV re-heat.
5) The duration of the warmup cycle is nominal only.
6) After the warmup cycle has terminated, a period of 15 minutes (variable) air circulation is required before ECU standard mechanical services control is enabled. The air handling unit shall continue to operate until core hours of operation are initiated however, the minimum outside air damper would open to preset (normal open) position, the VAV boxes would return to normal control of airflow and the leaving supply air temperature would be reset to normal operation. The outside air economy dampers would be held closed 100%
7) If the warmup cycle is terminated prior to 7.30 AM, the air handling unit shall be switched off until either the parameters for warm up cycle allow it to be enabled or core hours of operation were reached.
8) Ensure that the warmup cycle utilises the gas boilers and central heating water systems in lieu of electric reheat.
9) Consideration should also be given to day warm up cycle routines where the building or air handling systems experience a cold thermal change during the day.

The warmup sequence is illustrated below in Figure 8:



Day Warm Up Operation

The day warm up cycle is enabled from the following parameters:

Enabled	Disabled
Average Room Temperature < OSP – 1.5 ^{0}K **or**	Average room temperature > OSP -1.0 ^{0}K
All AHU VAV heater positions >50%	Outside core hours (0800 – 1730)

Core hours (0800 – 1730)	Monday to Friday
Days of week is Monday to Friday	

Whilst the daytime warm up cycle is enabled, the operation of the VAV boxes is then reversed such that it will control to maximum air volume as the temperature in the room falls below the heating set point and will control to minimum air volume as the room temperature rises above the heating set point.

WARM UP

S/A = 32.0 ^{0}C

Econ = Return Air

Min O/A = Open

VAV Airflow = Reverse

VAV Reheat = Nil

Once warm up cycle is disabled a period of 15 minutes is elapsed to allow for the air circulation. During the air circulation cycle the supply air temperature resumes normal control, the economy cycle dampers remain in full return air mode, the minimum outside air dampers operate and VAV boxes operate as below:

Early Morning Air Circulation	**Day Time Air Circulation**
S/A = Normal Control	S/A = Normal Control
Econ = Return Air	Econ = Return Air
Min O/A = Open	Min O/A = Open
VAV Airflow = Automatic	VAV Airflow = Reverse
VAV Reheat = Nil	VAV Reheat = Nil
P/R SAF = Normal	

AHU Static Pressure Control

Air handling unit air volume will be controlled by sensing system static air pressure with the sensor located at a distance 60% downstream of the AHU in the supply air duct index leg. The static pressure sensors locations are to be shown on the Building Management and Control System Graphics, sensors must be in locations that can be accessed for future maintenance. (Variations to this will need special arrangement through ECU Buildings and Services Branch). The static air pressure will be maintained by modulating a variable speed drive controlling the AHU supply air fan motor speed.

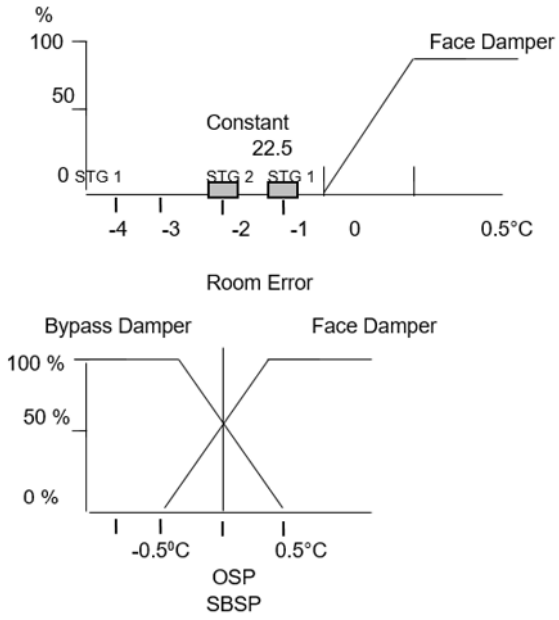
The static pressure set point shall be determined in conjunction with the consultant and the commissioning personnel such that the static pressure set point shall be measured at simulated diversified airflow for the air distribution system.

Chilled and Heating water pressure transducers shall be provided with isolation and bypass valves, binder points to be installed near the transducers to allow commissioning, calibration, replacement and zeroing of the transducer.

AHU Zone Control (Face & Bypass)
Face / Bypass control achieved by taking the highest average value of any space temperature sensor on that zone and comparing to OSP for each zone sensor to determine set point deviation

Deviation of Room Temperature against OSP / SBSP

Supply Air Temperature Cooling and Heating Reset
The chilled and heating water valves will be modulated to maintain supply air temperature sensed by a supply air temperature sensor according to the reset schedule as illustrated below. Room error referred to is obtained by utilising the highest average of zone temperatures compared to the master set point (or room set point) in occupied mode or the "setback mode" set point when no zones are active. If operating in the unoccupied mode and the after-hour's push button was activated for one or more VAV boxes or areas, then the highest average room error would be calculated using only the activated VAV boxes or areas, with the unoccupied areas excluded from the calculation.



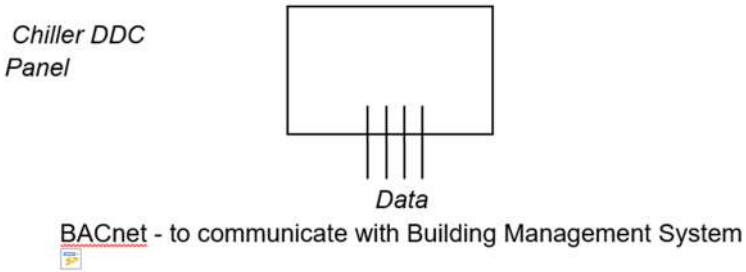
An example of the calculation of the highest average is provided as follows:

VAV No	SP	Actual Temp	Occupied / Unoccupied
1.1	23.0	23.8	Occupied
1.2	23.3	25.0	Occupied
1.3	23.0	25.5	Unoccupied
1.4	23.0	23.7	Occupied

Calculated Average Room Error = (0.8+1.7+0.7)/3 = 1.06°C

Calculated Highest Average Room Error = (1.7+1.06)/2 = 1.38°C

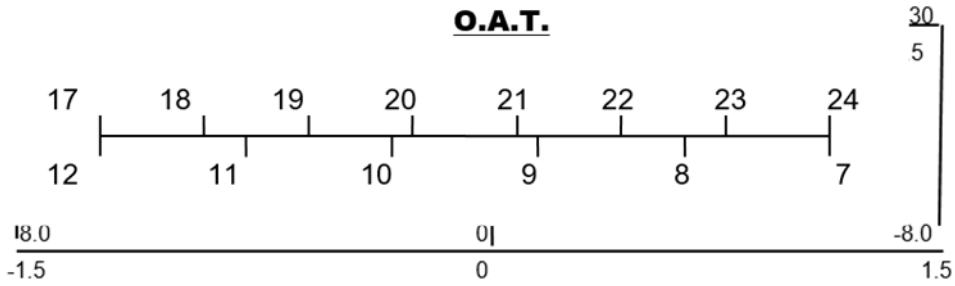
A - OUTSIDE AIR TEMP



B - SUPPLY AIR RESET = 22.5 + (A + B)

Toilet Exhaust Control
Toilet exhaust fan will operate during core hours plus 1 hour or whenever toilet zoned AHU is running plus one hour. The duty / standby fans shall be step start controlled based on accumulated run hours for each fan.

Chiller Control



ROOM ERROR (OSP or SBSP)

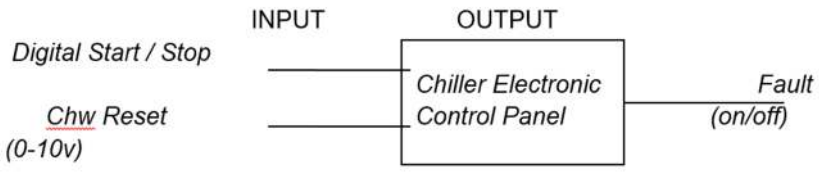
Interface and Reset
The chiller selected by ECU will have either an electronic control panel or a full direct digital control panel.

Electronic Control Panel
Control interface to Edith Cowan University's Building Management System where an electronic control panel is used will be as indicated below.

Direct Digital Control Panel
Control interface to ECU's Building Management System where a direct digital control system is used will be as indicated below.

Chilled Water Control

Chilled Water Temperature Reset
The chilled water system is to be provided with setpoint reset according to the schedule below.



Chilled Water Temperature Setpoint

The staging up of the chillers on return chilled water temperature shall have the staging set points offset to match the variation in leaving chilled water temperature setpoint such that, for example, set points of 7.0 0C / 14.0 0C would change to 10.0 0C / 17.0 0C.

Condenser Water Reset
Provide condenser water temperature reset for screw type chillers based on the following parameters:

Outside Air Temperature

Condenser Water Supply Temperature

Chilled Water Set Point

Condenser Water Supply Temperature

Use highest of the two values above.

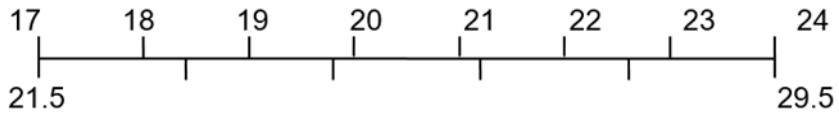
Screw chillers shall incorporate condenser water flow control, either via the use of throttling valves or variable speed pump operating controlled by refrigerant differential pressure sensor, in accordance with manufacturer's recommendations.

Reciprocating chiller sets shall incorporate condenser water bypass in accordance with manufacturer's recommendations. Unless centrifugal chillers are to be utilised for lead start, these chillers would not require condenser water throttling control. However, where a chiller plant has more than 2 chillers, and depending on the configuration of the condenser water pipework, condenser water throttling valves or automatic regulating valves may be necessary to limit excess condenser water flow through each vessel.

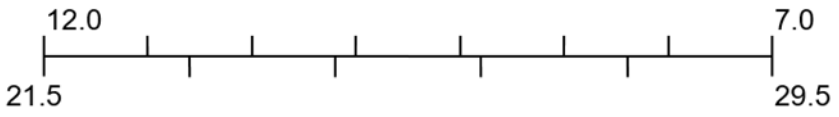
In resetting condenser water supply temperature set point, the operation and staging of the cooling tower / fans must follow suit. Utilise free cooling across all cooling towers where possible.

Chilled Water Differential Pressure Control

Where a de-coupled chilled water system is in use, the chilled water system differential pressure will be maintained by a variable speed drive attached to the secondary chilled water pump. The variable speed drive will respond to variations in system pressure as read by a differential pressure transmitter. The transmitter is to be installed at a point approximately 60% downstream of the chilled water pump in the index leg of the chilled water system.

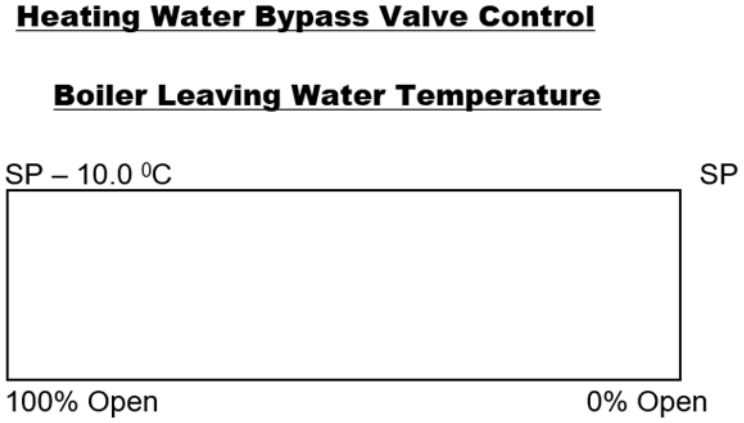


Where the system is not de-coupled, chilled water system differential pressure will be maintained by a bypass valve which will respond to variations in system pressure as read by a differential pressure transmitter across the chiller vessel. The transmitter shall measure differential pressure across the chiller to ensure minimum chilled water flow rates are maintained while providing full flow out into the field as required.



With respect to the Joondalup campus, the operating pressure and pressure range for valves to the expansion tank and system differential pressure have been set against the Science and Health Building No 19, which represent the index leg of the system, including the static head exerted on the system.

For all new projects on Joondalup Campus, it is important that the engineer checks and ensures that the static head of new buildings does not exceed that of the Science and Health Building. This will generally be achieved by



locating chilled water plant on levels below the Science and Health plant room levels. In the event the levels of Science and Health Building plant are exceeded the engineer is to check and calculate all system pressures which may then require some adjustments to be made to the pressure settings relevant to the thermal storage system and expansion tank in the central plant room.

Heating Water Control

Heating Water Temperature Reset
The heating water system is to be provided with setpoint reset according to the schedule in below.

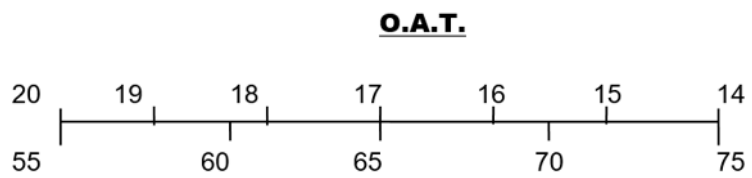
Heating Water Temperature Setpoint

Heating Water Differential Pressure Control
The heating water system will have a Bypass Valve that is to maintain the boiler water temperature as illustrated below.

Bypass Valve Position

The boiler operation shall be interlocked with a heating water flow switch, to be located on the leaving water side of the boiler, suitably calibrated to de-energise the boiler at minimum flow rate.

Heating Water over Pressurisation
The bypass valve will be programmed to open in accordance with the schedule illustrated below, should over pressurisation of the system occur.



Heating Water System Differential Pressure

11.33. LOAD SHEDDING

Where load shedding control sequences are utilised, they shall be incorporated where site maximum demand is monitored. Load shedding shall have the following priorities:

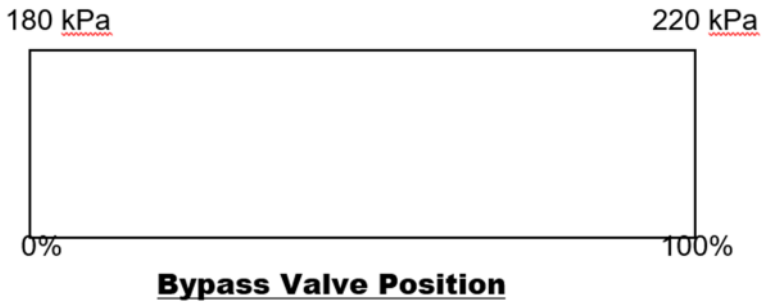
- Increase of chilled water supply temperature from 7.0 0C to 8.0 0C
- Increase in OSP and SBSP by 1.0 0C
- Isolation of operation of all electric duct heaters

11.34. ENERGY MANAGEMENT

At preliminary design stage, subject to the extent of works to be carried out, but where new plant is proposed to be installed, and as part of the life cycle costing of the selected plant, the consultant shall advise the ECU Project Manager Buildings of the estimated energy consumption profiles over a 12-month period and the energy modelling scenarios. The consultant is to identify, nominate and / or investigate all scenarios for limiting energy consumption and greenhouse gas emissions.

The consultant shall be responsible for monitoring the operation and control of the air conditioning plant for a period of 24 months after practical completion. This work shall form part of the consultants brief for the design and documentation of the project. This shall include regular site visits or remote dial in to the site to observe operation and performance of plant, make modifications to the control logic of the plant and equipment to improve efficiency and reduce operating costs. The consultant shall instruct the contractor to make all necessary changes at no cost to ECU, as required to achieve efficient operation of the plant. The consultant shall submit energy consumption profiles and sign off on the operation and control of the plant and equipment every 3 months, to the approval of ECU.

The consultant shall also specify energy monitoring equipment to be provided for all forms of energy consumed for the building. This shall be achieved via monitoring points on the digital control system. This shall include, but not be limited to:



- Ambient temperature
- Chilled water consumption (entering water temperature, leaving water temperature, chilled water flow rate)
- Heating water consumption (entering water temperature, leaving water temperature, heating water flow rate)
- Gas consumption
- Electricity consumption
- Hot water consumption
- Energy consumption / production from miscellaneous sources such as bore water, geothermal, solar hot water, wind, photovoltaic, etc.

The consultant shall specify all necessary metering equipment necessary to develop an energy consumption profile for each building. Where the control logic or equipment parameters have been altered, the consultant shall ensure that the Operating and Maintenance Manuals are upgraded accordingly.

11.35. Gas Meters/BMS Connection

All wiring connected to all gas meters to be installed as per Standards Association of Australia requirements for electrical circuits in a Zone 2 environment. Protection is required to enable the circuits to be rated intrinsically safe.

11.36. Practical Completion

The consultant is encouraged to discuss the design and development of the mechanical services and the selection of equipment with ECU's Manager, Technical Services (Buildings and Maintenance), at an early stage of the project to ensure that the systems proposed meet with ECU approval.

Prior to issuing out to tender, the consultant shall issue to ECU's Manager, Technical Services (Buildings and Maintenance), one set of preliminary tender drawings and specifications for review and comment.

At practical completion, the consultant shall forward all commissioning data to ECU's Manager, Technical Services (Buildings and Maintenance), for approval. The consultant shall also co-ordinate the defects inspection to be carried out with a representative of the consultant, the contractor, ECU's Project Manager and ECU's Buildings and Maintenance branch.

11.37. Defects Warranty Period

The consultant and contractor shall ensure that all new plant and equipment is serviced monthly for a period of 12 months after practical completion and that maintenance service sheets for all items of equipment are reviewed by the consultant before being forwarded to ECU for their verification.

At the end of the 12 months defects warranty period, a final inspection shall be carried out by the consultant, contractor, ECU's Manager, Technical Services (Buildings and Maintenance) and ECU representatives. A copy of all service sheets shall be forwarded to the ECU's Manager, Technical Services (Buildings and Maintenance) for their records.

After the defects warranty period, the consultant will continue monitoring the operation and performance of the air conditioning plant and initiate improvements and modification as required up to the end of the 24-month energy-reporting period that commences from practical completion to the approval of ECU's Project Manager. ECU's Manager, Technical Services (Buildings and Maintenance) shall also be advised of any changes to the operation of the plant and equipment and the Operating & Maintenance manuals shall be upgraded accordingly, on a regular basis.

12.0 HYDRAULIC SERVICES

12.1. PREFERRED CONTRACTORS

Contractors either tendering or working on projects at Edith Cowan University must be approved by the ECU Project Manager and or already be an approved supplier on the University Procurement Panel.

12.2. PIPED PRESSURE SERVICES

12.2.1. GENERAL

This section of the standards outlines the minimum requirements for the following pressure services:

- Cold water;
- Hot water;
- Natural gas;
- Reverse Osmosis Water System
- LP Gas (liquefied petroleum gas);
- Specialist gases e.g. nitrogen, oxygen, CO^2, etc.;
- Compressed air;
- Vacuum.

In general, each riser shall be fitted with isolating valves at the bottom (or top in cases of down feeds) and each multi storey circulating stack shall be isolated at top and bottom as appropriate. Branch lines serving an outlet or groups of outlets shall be provided with isolating valves at the riser. To laboratories and ducts to ablution blocks there is to be a main isolating valve. In all cases, isolating valves shall be readily accessible in ducts or valve boxes. For water supplies, compressed air and natural gas, ring main distribution systems should be used wherever possible and these rings should be broken down into minimum of three sections per ring by clearly marked isolating valves in the ring system. In the case where a building is supplied by a ring main, then the main shall be capable of being isolated on either side of the tee-off position. Isolation valves are to be clearly identified on As Constructed drawings, for clarity it may be necessary to include a schematic layout.

All pressure pipework shall be tested to a minimum pressure of not less than 50% above Manufacturer's design working pressure for the pipe or twice the working pressure whichever is the greater when no other relevant Australian testing standard exists. Allow to isolate fixtures during pressure testing.

12.2.2. WATER SUPPLY

Materials

Pipework. Reticulation within buildings shall be seamless tested copper tube type "B" as described in Australian Standard AS1432.

Fittings. Shall be press fit systems and or silver soldered capillary fittings, taper/taper threaded inhibited brass fittings, flared fittings, inhibited brass fittings or flanged connections. For connections to fixtures and fittings use flared and/or brass barrel unions for up to and including 50mm diameters. Flanges to be used for sizes above 50mm diameters Silver solder shall contain at least 15% silver in all instances.

Valves.

All valves shall be suitable for Perth water regarding dezincification. Isolating valves may be dezincification inhibited bronze gate valves or stop cocks up to and including 50mm diameter. For sizes larger than 50mm diameter, flanged valves are to be used with flanges and valve body designed for the test pressure of the service. Balance valves shall be globe valves. All valves to be suitable for pressure testing of both body flanges and disc to 2100 kPa.

(Valves 80mm diameter and larger may be cast iron or steel body, bronze trimmed with DR stem.).

Butterfly valves are acceptable for isolating purposes only and are to be stud fitted (between flange models are not acceptable). Spindle to be stainless steel and seals to be rubber or plastic appropriate to fluid being transported, likewise valve discs are to be stainless steel, brass, aluminium or aluminium bronze as recommended by the valve manufacturer for fluid being transported. Ball valves are permitted.

Taps.
Taps shall be of brass construction with jumper valves except where lever action valves are used and these are to be fitted with 90° or 180° ceramic seats. Handles shall be brass or ceramic vandal proof. All standard taps, outlets and fittings shall be of approved manufacture.

Cold Water
Branch lines shall be of the following minimum sizes to domestic type outlets, unless the occupancy or use is such that normal diversity factors are not appropriate:

Serving one outlet	-	15mm min. does not exceed 10m
Serving three outlets	-	20mm min.
Serving seven outlets	-	25mm min.
Above seven outlets	-	as required.

All external hose cocks to have a minimum branch size of 20mm and where branch serves more than one hose cock it is to be appropriately sized to suit the low diversity factor.

Direct mains water connected external wall mounted, or hot dipped galvanised steel post mounted, 20mm polished brass hose cocks on 50mm flanged polish brass extensions for washing down shall be located around the external surfaces of all buildings. Hose cocks shall be located approximately 600mm above ground and positioned such that a 20-metre length of 15mm nominal bore garden hose can be fitted to the hose cocks for the washing down of all external surfaces and windows of the building, i.e. Maximum spacing of hose cocks to be 35 to 40 metres centre to centre. All such hose cocks shall be fitted with lockable polished brass backflow prevention hose connectors.

Minimum outlet running pressure shall be 100 kPa. Where this pressure is not available, the above minimum pipe sizing is to be reconsidered.

Hot Water
Hot water services shall be minimum of 15mm N.D. up to 10m to individual outlets, local electric units are acceptable under some conditions where the number of outlets is small, however when electric water heaters are used, their size and location is to be brought to ECU Project Manager's notice prior to the design being completed.

In general, the hot water supply should be centralised using several natural gas fired Mains Pressure HWS in parallel with an insulated flow and return system incorporating a circulating pump plus a manual change over stand by pump.

Dead legs should be restricted to 10m maximum except to cleaners' rooms where the dead leg may be up to 20m.

Hot Water Points. In addition to areas specifically mentioned, hot water shall be provided to the following areas:

Showers
Showers as directed will have the water outlets to be positioned on side walls. These outlets are not to discharge towards the change area of the cubicle. Thermostatic temperature control mixing valves and lever action taps to be fitted in facilities for people with disabilities and childcare areas.

Staff Room Kitchen / Breakout space
Hot water service shall be provided to kitchen and teas areas. Appropriately sized boiling/ chilled water units to match staff numbers are required for tea making. A centralised hot water filtered system for staff drinking is preferable to maintain capacity, given independent units often fail to meet demand. Independent chilled cold-water units to be provided in staff rooms and kitchens.

Toilet Hand Basins
Are not to be provided with hot water unless specifically called for in the brief. Where required they are to have one or three tap hole mixer sets. Individual hot and cold-water bib cocks are not acceptable.

Basins for Persons with Disabilities
To cubicles for persons with disabilities, basins are to be provided with controlled temperature water and lever action taps with mixer sets. Controlled temperature adjustable valves to be located above 2100mm above floor level.

Cleaners' Sinks
Are to be provided with hot water with mixed outlet and aerator (located maximum 450mm above sink).

Hot water units must be in easily accessible locations for maintenance and access must not be compromised by location of other services, etc.

Minimum outlet pressure shall be equivalent to cold water.

Insulation of Hot Water Lines

All hot water lines shall be insulated in material appropriate to the project and circulating loops shall be fitted with Mechanical thermostatic control valves to maintain temperature at all points in the flow loop with a minimum flow. The use of pre insulated copper pipe is permitted up to 15mm diameter only. Hair, felt and paper insulation shall not be used. Sectional insulation such as Ensolex or Armaflex may be used up to the appropriate temperature rating. For hot water distribution, ring mains shall be insulated with 25mm thick sectional fibreglass (or the equivalent thermal rating using multiple layers of Ensolex or Armaflex) aluminium wrapped and taped. Where exposed to view or subject to damage and in all plant rooms and ducts, pipe insulation shall be sheathed in 0.9mm aluminium.

12.2.3. Reverse Osmosis Water System CARL

A commercial reverse osmosis plant "Millipore" or similar approved should be used.

Reticulation shall be by means of ABS, polythene or PVC piping, the choice of reticulation material being confirmed with the users prior to design commencing.

12.2.4. Natural Gas

Pipework external to buildings to be approved yellow colour coded PVC, type 2 class 100 to AS1464 or polyethylene or similar approved plastic pipe. Isolating valves may be gate, quarter turn ball or studded butterfly. Pipework (internal to the building) shall be seamless tested copper tube as described for water supply and sized as required for loads but not less than 6mm diameter for up to 1m (serving individual laboratory outlets) and not less than 15mm diameter elsewhere.

All joints shall be silver soldered as for cold water. Isolation valves within buildings shall be of the Diaphragm or quarter turn ball valve type and each laboratory, kitchen area, plant room, etc., will be fitted with main isolating valve conveniently located for emergency access. All rooms with gas fittings or fixtures are to be provided with an emergency shut off button located adjacent to entry. A gas meter shall be provided to the building main supply.

12.2.5. LPG

LPG shall be copper pipework throughout all as described for natural gas with pipe sizes adapted appropriate to the higher calorific value of the LPG.

12.2.6. Inert Gases

Inert gases such as nitrogen should be supplied from the bottles located within a ventilated storage space which is easily accessible to the service road.

Cylinders shall be supported in racks and shall be manifolded with non-return valves in such a way that any cylinder can be removed and still allow the effective operation of the remainder of the bank.

There is to be rack storage space for standby bottles.

A pressure relief valve and pressure gauge should be fitted to the low-pressure manifold, relief to discharge to atmosphere clear of all walkways, building openings, etc.

Pipe work shall be copper and shall be silver soldered, all as described under water services. Isolation valves may be diaphragm, quarter turn ball, and globe or needle type.

12.2.7. Oxygen

Oxygen shall be supplied from bottles located within an easily accessible, secured, well ventilated storage space (accessible to delivery dock). Cylinders shall be manifolded with non-return valves in such a way that any cylinder can be removed and still allow the effective operation of the remainder of the bank.

A pressure relief valve and pressure gauge should be fitted to the low-pressure manifold, relief to discharge to atmosphere clear of all walkways, building openings, etc.

Pipe work shall be copper and shall be silver soldered as described under cold water. Pipework to be fully degreased prior to installation. Isolation valves may be diaphragm, quarter turn ball, and globe or needle type. Oxygen lines shall be adequately drained and kept at least 150mm clear of pipes carrying gas.

12.2.8. Compressed Air

Compressed air shall be supplied from air compressors within the building. Compressors shall be oil free of Broomwade manufacture (or other approved equal), liquid ring or screw to suit University service requirements.

They shall be mounted together with their motor on an integral steel base and shall be effectively isolated from the structure. Tank mounted compressors are also acceptable.

The compressor shall be effectively silenced. Air cleaners shall be substantially mounted. Unless otherwise called for, compressed air shall be supplied at 200 kPa at the bench outlet (confirm requirements with Client Department).

Pipe work shall be copper and shall be silver soldered all as described for cold water and shall grade to automatic drains with collection tundishes. Isolation valves shall be of the Diaphragm, quarter turn ball, and globe or needle type.

An air receiver shall be provided to limit the number of starts per hour of the compressors. The receiver shall be provided with all necessary gauges, safety valves, pressure stats and automatic drain for automatic operation. The compressed air system shall be complete with "mains to system" air regulators. At the base of all risers and low points in the distribution system fit water traps having automatic discharges like Spirax, Norgen or SMC and complete with collection tundishes.

12.2.9. Vacuum

Vacuum shall be supplied by means of vacuum pumps within the building. Vacuum pumps shall be Nash or Dynavac or equivalent manufacture, water ring pump capable of passing fluids from the system without damage to the pump, fitted with bacteria filters where appropriate.

Vacuum pumps shall be mounted together with their motor on an integral steel base mounted on an inertia base equal to 1.5 times the weight of the vacuum pump and its ancillaries and shall be effectively isolated from the structure. Water seals with safety interlocks shall be provided to each pump.

Pipe work shall be solvent joint Class 18 PVC pressure pipe or Type "B" copper depending on service. Plugged tees shall be used in place of bends to allow for cleaning of piping, however at the base of all droppers and at the low points in graded horizontal pipework fit glass removable catch pots with full pipe diameter inlet valves. Isolating valves shall be of the Diaphragm or quarter turn ball type.

A vacuum tank shall be provided to limit the number of starts per hour of the vacuum pump(s). The tank shall be provided with all necessary gauges, safety valves, pressure stats for automatic operation.

12.3. PIPEWORK

All pipe work to grade to liquid collection catch pots.

12.3.1. IDENTIFICATION OF PIPE WORK

All pipe work shall be identified with their names and colour codes as listed in Section 24.6.

The ground colour shall be applied over the full length of the pipeline or over a length of pipeline of not less than 450mm where adhesive labels are used. The location of identification marking shall be at intervals of not more than 3m (not less than 1 per floor in vertical pipework) and preferably adjacent to branches, junctions, valves, walls and control points. Such markings shall be placed so that they are easily seen from all approaches.

Service labels where applied shall be over a length of not less than 200mm at locations and intervals as specified for ground colours.

The direction of the flow shall be indicated by an arrow adjacent to each service label. An approved adhesive label shall be used for identification and indication of the direction of flow of pipework.

12.3.2. UNDERGROUND PIPE WORK

All underground pipework shall have a minimum of 600mm cover to topmost surface of pipe or pipes. Pipes shall be buried in sand with a minimum of 150mm sand above, to side and below (or on a bed of crushed diorite where base of trench is clay or rock) pipe. Pipes shall be laid in a horizontal plane and not one above each other.

Rubber ringed jointed pipe work is not permitted under buildings or within 3m of building perimeter or external columns. All rubber ringed jointed pipework to be fitted with concrete anchor blocks in accordance with pipe manufacturer's requirements sized to reflect test pressure.

All underground pipe work shall be identified by laying continuous PVC marker tape not less than 300mm above the pipe. The marker tape shall be colour coded, magnetic and be printed with the identification of the pipe contents.

All external hose cocks shall be capable of isolation for servicing either individually or in groups. Valvebox lids are to be hot dipped galvanised hinged cast iron lid and frame set on pressed bricks and cement mortar and are to be identified and colour coded to reflect service involved.

12.4. PUMPS

Where required to achieve nominated pressures or flows

12.4.1. GENERAL

Pumps complete with switch and control gear should preferably be provided and installed by the Hydraulics Services Sub Contractor to ensure correct installation and control. Pumps shall be of an approved centrifugal either multistage or back end pull out type. All seals shall be mechanical seals.

12.4.2. COLD WATER BOOSTER PUMPS.

A minimum of Dual cold-water pumps shall be provided. One pump shall be capable of providing the flow and pressure required. The other pump shall act as standby; however control circuits are to enable pumps to run together during periods of concentrated load. Facilities shall exist for manual changeover for duty and standby pumps together with individual manual test stop/start switches to all pumps. Hours run meters shall be provided for each pump. Pressure gauges of the bourdon tube type, nominal 100mm face, with inlet union and isolating valves for servicing shall be provided on each side of the pumps. Pumps shall be activated by a drop in system pressure. A system pressure tank or tanks shall be provided with gauges fitted to tank input to enable checking of pressure system.

12.4.3. HOT WATER PUMPS

Where a central system is installed, hot water circulating pumps shall be provided in the hot water loops to minimise dead legs.

Thermostatic and timeclock control functionality should be included and connected to the BMS to enable pump faults and temperatures to be recognised and monitored.

The hot water circulating pump shall be installed in the return water loop. Care shall be taken to ensure that pressure in the hot water circuit is not greater than the pressure in the cold water main. Pumps shall be of the "in line" type with totally enclosed motor. Pump casings shall be bronze with stainless steel or bronze impellers and stainless-steel shafts and mechanical seals.

Circulating pumps to be single phase 250V with one metre of flex and 3 pin GPO plug. GPOs to be mounted in tandem with individual switching. Pumps to be individually isolated and fitted with unions so they are readily removable for servicing.

12.5. INSPECTION AND TESTING

General

Contracts shall provide to carry out all commissioning of equipment and required tests including the payment of fees, provision of labour and test equipment. All tests shall be carried out to the applicable Australian Standard, the requirements of any Act or Authority having jurisdiction or these Standards as set out in this specification, whichever is the greatest.

No piping work, fixtures or equipment shall be concealed or covered by any means before they have been pressure tested, flow tested and inspected by the Superintendent. All works shall be completely installed and tested as required by this Section and the Code requirements and shall be leak tight before inspection of the works is requested. Tests shall be repeated to the satisfaction of the authorities having jurisdiction.

All defects shall be remedied immediately and the tests reapplied to the satisfaction of the Superintendent and the Authorities.

At least 72 hours' notice shall be given prior to the carrying out of tests. Where construction vehicles or similar equipment is used on the site allowance shall be made for retesting pipelines under concrete slabs on ground immediately prior to placing membrane and reinforcing steel or in the case of roadways, builder's tracks, etc., immediately prior to practical completion.

Test Pressures
Gravity pipelines including soils, waste and vent piping shall be tested to maximum flood conditions for three hours.

Water supply pipelines including Fire Mains and Services: 2.1mPa for twelve (12) hours and generally kept charged thereafter.

Drainage Rising Mains: 1 mPa for 3 hours or 1.5 times pipe manufacturer's designed maximum operating pressure for 3 hours, whichever is the greater pressure.

Fire Hydrants and Fire Hose Reels shall be tested for pressure of flow as required by the Fire Brigade. Such tests to be witnessed by the Hydraulics Engineer.

Fixtures to be filled to spill level with water after installation and visually checked for leaks.

Internal downpipes to be hydrostatically tested to the maximum head possible for a minimum of 24 hours.

Pipework for gases shall be tested in accordance with the relevant code or standard or twice the working pressure or 1.5 times the pipe manufacturers' maximum recommended working pressure, whichever is the greater.

Gravity sewers shall be water tested as for (1) above, but with maximum hydraulic pressure plus 2m or air tested to 50kPa (both tests being conducted for a minimum of 3 hours).

12.6. SANITARY PLUMBING

Materials
Shall be U.P.V.C., cast iron, copper, stainless steel or brass subject to:

- The effluent being discharged (urinals shall not discharge into copper soil drains, sewerage effluent rising mains shall be PVC or similar approved plastic material).
- Australian Standard AS 3500, National Construction Code of Australia and Water Corporation Bylaws.

Pipe work
Shall be concealed where possible in accessible ducts and ceiling spaces.

Plumbing Ducts, Access Panels, False Ceilings etc.
Architectural drawings shall be checked to ensure all sizes and clearances etc. to conform to the Authorities' minimum requirements.

Design
Design of sanitary plumbing is to be in accordance with the Water Corporation Bylaws and AS 3500.

No toilets or waste facilities shall be provided below the level of main sewer lines.

Trade Waste
Generally, all waste lines from laboratories shall be U.P.V.C. unless the effluent is incompatible. Underground drainage shall be U.P.V.C. with solvent joints. Neutralising traps shall be installed if required by regulations. Grease traps shall be installed from all commercial kitchen areas. Trade Waste pits should be labelled with appropriate signage prescribed by the University and easily accessible for emptying and removal of waste. All

trade waste installations shall be subject to Health Department & Water Corporation approval. Water Corporation approval is required prior to construction commencing.

Sewer Drainage

Design
Generally, the drainage system shall be designed in accordance with the W.A. Sewerage and Water Supply Regulations and AS 3500.

Materials
Shall be U.P.V.C. pipes and fittings complete with solvent joint where minimum required cover is available. Otherwise mechanically jointed cast iron or reinforced concrete encased vitrified clay pipe with neoprene rings shall be used.

Pipe Sizing
To minimum Authority requirements.

Filled Ground
Where pipes are laid in filled ground the use of a concrete mat, crushed rock bed in lieu of pier and beams is to be investigated and discussed with the University.

Inspection Chambers
Shall be pressed clay bricks in cement mortar installed in accordance with Local Authority requirements. Gas airtight covers to be used throughout. Medium duty covers shall be used externally except in roadway (where heavy-duty circular covers are to be used). Light duty covers shall be used internally. Brass edged covers are to be used where particular floor or paving finishes are to be used.

12.7. STORMWATER DRAINAGE

Design
Calculations from Moores Tables N = .013.

Pipe Sizing
Flooding frequency shall be decided for each project after considering the damage or inconvenience flooding would cause.

For building drainage	once in 50 years;
For site works	once in 20 years.

Assessment of possible damage implication to be undertaken.

Materials
Tested soil weight U.P.V.C. or V.C.P. for 100 and 150 diameters. R.C.P. for 225 diameter and over (class to be consistent with traffic loads).

Inspection Pits
Inspection pits should be constructed at major changes of direction and junctions. Precast pits with silt traps external to buildings. Stamp S W into covers. Medium duty covers shall be used externally, and light duty covers shall be used internally. Brass edged covers are to be used where particular floor or paving finishes are to be used.

In paved areas, lids are to be buried but manhole covers and/or grates are to be visible at paving level and appropriately labelled.

Fittings
Generally, sumps with silt traps shall be located to avoid the use of pits or fittings. Overflow gutters or sumps to be provided on drains from downpipes.

Discharge
All stormwater lines shall discharge directly into the closest existing pits, lines or soakwells. The route point of outlet, and method of discharge is to be approved by the University. Provide a means of dispersal and water energy reduction.

Agricultural Drains
Shall be 100mm diameter (min) slotted tested UPVC pipe and fittings with lines extended to surface and fitted with brass clear outs in finished paving. Alternatively, Nylex or similar approved strip drain can be used.

Soak wells

Shall be culvert pipes classes S, X or Y depending on traffic loads. Tops to soak well to have removable manhole covers and 100mm diameter sighting and inspection access openings extended up to ground level.

Soak wells with slotted walls are to be wrapped with geo fabric to prevent sand from collapsing into well. Tops and manhole covers are to suit traffic loads.

12.8. BACKFLOW PREVENTION

All mains water services to new or altered existing buildings will be fitted with Backflow Prevention Equipment in conformity with the requirements of AS 3500 and the Water Corporation of W.A. regulations.

The basic design and installation criteria to be applied to the backflow prevention equipment are that of "containment" generally as described below:

The individual non-potable water supply connections to buildings are to be isolated from the mains water distribution network of the campus by installing in the buildings connection main an approved Reduced Pressure Zone backflow prevention device (an RPZ valve). The RPZ's are to be installed to form containment zones for the buildings concerned.

The protection of the individual internal services of a building which is within a containment zone formed by the fitting of an RPZ valve in the incoming supply is not necessary, except for those services supplying items of equipment whose usages are specifically listed as requiring consideration under AS 3500. However, all laboratory taps, and mixed water outlets, including those in Fume Cupboards, are to be fitted on their outlets with high operating temperature approved DR. C.P. brass dual check valves with 316 S.S. springs. Dual check valves are to be fixed tightly to the outlets to prevent accidental removal by staff or students and "non-potable" water warning sign is to be mounted adjoining all such outlets.

All potable water outlets are to be supplied directly from the campus mains water distribution network, i.e. from the upstream side of the "containment RPZ" valve.

Whilst only a single RPZ valve is to be installed in each water service between the internal distribution mains of the campus and those of the building, pipework and isolating valves for a duplicate RPZ valve set will be installed. Prior to Practical Completion, the contractor is to supply to the University, for stocking purposes, a second separate tested approved stand-by RPZ valve of identical size and model to that installed. The stand-by RPZ valves to be held by the University for use in the event of a service emergency.

To conform to AS 3500 it is necessary to fit all RPZ's above the surrounding ground or surface level with their discharge orifices being at least 300mm above the ground or surface. Generally the RPZ valves are to be fixed unobtrusively on standoff brackets to the external face of the wall of the building to which they are protecting.

Labelling of all internal water service pipework shall be carried out, however, it is difficult and expensive to label external buried pipes whose service duty changes from Potable to Non-Potable water due to the fitting of backflow prevention devices. To overcome the difficulties and costs associated all isolating valves on all external

Non-Potable services are to be painted bright purple, whilst all new service pipework will be sleeved or wrapped in bright purple wrap to alert tradespersons that the service they are isolating, or connecting to, is a non-potable service.

The existing inverted hose cocks and garden strip sprinklers around the existing or new buildings which are connected to mains water are to be connected via RPZ valves whilst above ground wash down hose cocks connected to mains water are to be installed as per hydraulic services briefing note for external hose cocks, no new inverted hose cocks will be installed.

A separate allowance is to be made for the installation and fitting of water meters to all potable and non-potable water services directly feeding buildings.

A recording and maintenance schedule following the system set out by the Water Corporation for recording the need to test and service all testable devices and setting out the results of all testing and servicing shall be formulated and activated.

12.9. FIXTURES

General
Selection of fixtures to satisfy the following criteria:

- Ease of maintenance
- Availability to allow quick replacement of components.
- Standardisation across the campus where possible.
- Satisfy University sustainability objectives.

Where fixtures vary from University standard samples to be provided and approval to be sought from the ECU Project Manager.

12.9.1. FIXTURES

Cisterns
Half and full flush cisterns to be used. Care to be taken in the design of drainage from fittings served by low flush cisterns to avoid frequent blockages.

Recessed cisterns located in ducts are required except in staff toilet areas but only when so approved by the Project Manager.

Waterless Urinals
Current standard utilised by the University is the Urimat product or equivalent. Ceramic material preferred given plastic units crack and wear unreasonably quickly. Prior to specification check University service agreements for these fixtures.

Taps
The University objective is to save water by the elimination of waste. Taps to be selected for low flow.

Frequent failure of nylon operating pins to ceramic discs has been experienced with taps from one manufacturer. Care should be taken with tap selection.

Taps are to be fitted with flow restrictors with the following general flow rates limits:

- Taps general 3-5l/min is equivalent to a 5-star WELS Water Efficiency Labelling Standards) rating
- Showers 6.5.0 l/min is the equivalent to a 4-star WELS (Water Efficiency Labelling Standards) rating
- Flow restrictors to be hydromisers or approved equivalent.
- Chilled Water Drinking Fountains

Provision of appropriately located f Chilled Water Drinking Fountains should be made available, to enable people to fill bottles. Each unit is to suit people with disabilities. Refer Australian Drinking Water Guidelines. Each unit to be fitted with an accessible isolation valve. Chilled drinking water fountains should wherever possible include leak detection.

12.10. TANKS AND HOT WATER SYSTEMS

12.10.1. TANKS

General

In general, buildings other than laboratory buildings shall be supplied from mains pressure. Where water pressure is insufficient, tanks and booster pumps shall be specified. In laboratory buildings all laboratory fittings shall be supplied through a buffer storage tank of suitable capacity fitted with discharge pressurising pumps. All laboratory water outlets to be labelled "non-potable". Other fittings within the laboratory building shall be fed from the mains. All tanks shall be fitted with a strainer to the inlet.

Cold Water

Cold water tanks shall be appropriate to the projects. Tanks shall be welded, 1.2mm, type 316 stainless steel or fibreglass, circular, corrugated. Minimum tank size shall be of suitable capacity but in no case shall the stored volume plus makeup be less than 50 litres per hour per fixture. The tank shall have a lid complete with access manhole and internal/external ladder. Internal ladder to be in stainless steel. Tanks to be fitted with full height transparent indicator tube.

Demineralised Water

Demineralised water tanks shall have a minimum capacity of 2000 litres and shall be welded, 1.2mm, type 316 stainless steel or fibreglass circular, corrugated. Tanks shall have a lid complete with access manhole and if necessary internal and external ladder, all in stainless steel.

Hot Water

Mains pressure electric units if used shall be "Rheemglass/Zip" or equivalent. Preferably hot water to be mains pressure natural gas pressure fired units either "Rheemglass" or mains pressure Calorifier type or equivalent.

Overflows

Overflows shall be capable of discharging the full inlet water quantity. Copper safety trays shall be provided to all tanks and hot water units and tanks shall be mounted on painted jarrah bearers within the tray.

Alarms

All tanks shall be provided with high, low and extra low-level alarms. Float switches shall be of Mobrey or Flyght manufacture or equivalent. In addition, a pressure switch shall be provided to sound an alarm should the system pressure fail. Both tank and pressure alarms are to be connected via a Data Gathering Panel to the BMS. Pressure pumps shall be de energised when the extra low-level alarm is actuated.

Solar Hot Water Systems

Consideration shall be given to the installation of electrically boosted "solar" hot water units. In all cases the consultant should check that the flows and temperatures available are suitable to the application.

12.10.2. ELECTRIC HOT WATER SYSTEMS

Hot water may be provided by single or multiple electric hot water units of Rheem/Zip or equivalent. Mains Pressure glass lined type with 3.6 kW elements. Sufficient capacity and storage shall be provided to enable supply of hot water for a minimum of four (4) hours when heating elements are shed for energy management by the BMS. Provide electric control systems to enable load shedding via BMS of all electric elements (see Section 21.33).

Where demand is large then gas heating is to be used.

12.11. WATER METERS

Provide water meters to master supply of all buildings. Strategy for metering and managing of consumption of hydraulic services to be established. It is intended that all meter data to be accessed electronically to negate need to read meters manually and integrated in to BMS system

12.12. BMS CONTROL POINTS

Allow for the following alarms, controls and monitoring points to be connected to the BMS via a DDC in the building:

- Electric Hot Water heaters for load shedding
- Cold Water Tank - high, low and extra low-level alarms
- Demineralised Water Tank - high and low alarms
- Fire Main - low water pressure alarm
- Booster Pump(s) alarms - failure
- Fire Pump Alarm - failure and run
- Compressed air alarms - compressor overload
- Low oil pressure
- Low air pressure
- Vacuum alarms- overload
- High vacuum
- Water seal failure
- Hot water circulating pumps - failure.
- Water fountains
- Hot and cold chilled water units

13.0 LIFT SERVICES

13.1. PREFERRED CONTRACTORS

Contractors either tendering or working on projects at Edith Cowan University must be approved by the ECU Project Manager and or already be an approved supplier on the University Procurement Panel.

13.2. LIFT CONTRACTS

Tenders from lift contractors are to be considered based on:

- Initial capital cost
- Annual maintenance costs over 25 years

Details of maintenance contracts should be submitted for evaluation with the tender and the supplied lift must be able to be maintained by the nominated University annual maintenance contractor who may not be the supplier of the lift. The supplied lift must not contain components/controls etc. that cannot readily be obtained by the University's nominated annual lift maintenance contractor. Lift contractor must supply a statement to this effect with the Tender.

13.3. LIFT DIMENSIONS

Lift car dimensions and requirements should be checked with the University. Lifts should be suitable for persons with disabilities access and use and at least one lift in the building should be of size to accommodate stretcher access. Minimum clear door opening width shall be 900mm x 2000mm high (but to be in accordance with AS1735.12-1999 relevant to access).

13.4. TYPES OF LIFT

5500 electric motor driven lift or equivalent to be installed. No hydraulic type lifts to be included in feasibility or projects. Lifts shall have a minimum capacity of 1156kg.

Minimum 100 starts/hour with flexibility to increase starts/hour if required.

Future campus lift should include, Schindler CUBE diagnostics, or equivalent, swipe to bring to dedicated floor voice commands to call the contractor out if stuck in lift. Sensor lighting to be provided in the lift

13.5. SECURITY

The facility shall be provided in all lifts to park the lift at the ground floor and to lock off access to and from any floor by means of key switches keyed to the University's master keying system.

Include all necessary wiring and control logic to allow access control of lift cars.

In the event of fire alarm programme lift to go down to level 1, open doors and stop.

13.6. FACILITIES FOR PERSONS WITH DISABILITIES

Lifts shall be designed for use by people with disabilities and shall be constructed such that operating controls, telephone etc. are easily accessible with all to be located on the side wall.

Operating controls are to be arranged horizontally 900 above lift car floor

A handrail shall be provided internally and shall be positively fixed such that it is not subject to vandalism. Facilities must be in accordance with the requirements of the National Construction Code of Australia. Provide tactile/braille labelling of lift buttons including voice activation to floor level and on fire alarm activation.

13.7. LIFT CAR

13.7.1. INTERNAL FINISHES

Lift doors and frames shall be finished satin stainless steel for both car and landings. Internal car finish shall be such as to minimise the possibility of damage.

Provide vandal resistant buttons and fixings.

13.7.2. CAR PROTECTION BLANKET

Each lift shall include a protective blanket for the walls of the car.

13.7.3. CAR OPERATING PANEL

The following shall be provided on the panel faceplate:

- Illuminating car call buttons
- Emergency stop button
- Alarm button
- Door open button
- Door close button
- "Car overloaded" illuminating indicator
- Engraved load notice
- Illuminating direction of travel indicators
- Digital car position indicators
- Exclusive service key switch
- Light key switch
- Fan key switch
- Arrangement of controls horizontally to comply with ECU accessibility requirements.

13.7.4. SIGNAGE

Allow for installation of following signs

- "No dialing required, lift handset and await response".
- Identification of car by Building Number and Lift Number.
- The carrying capacity of the car shall be engraved on the car operating panel faceplates.
- Lift Car Number to be fitted to the inside of the car and to match ECU's numbering system.

13.7.5. TELEPHONE WILL STILL BE NEEDED

Telephone to be provided and will be "hot keyed" (automatically connected) to the lift service provider. Programming will be organised by the ITSC Voice team. Handset underside to be located 900mm above car floor level.

13.7.6. Lift Indicators

Indicators are required at each floor to indicate position of lift. Provide a digital car position indication in the car.

13.7.7. Car Exhaust Fan

An extractor fan is required on the car enclosure complete with sound isolated supports. Fan to be a 150mm diameter propeller fan connected to an isolating switch plug unit.

13.7.8. Car GPO

Allow for a single-phase GPO in the telephone recess of the lift car. Outlet is to have a stainless-steel fascia plate and fixing screws.

13.8. Lightning Surge Diverters

Allow for installation of lightning surge diverter protection.

13.9. Emergency Lighting

Provide an emergency light unit in accordance with the code with the power supply provided by a continuous trickle charged battery system mounted on the roof of the car.

Emergency car lighting shall be supplied from an inverter power supply and it shall illuminate the fluorescent light nearest the car operating panel together with the panel in the telephone cabinet door.

13.10. Lift Machine-Room

The design shall comply with the following requirements:

- The Sub-contractor shall provide a clean, completed machine with a 2-hour fire rated door. Lighting, power points and adequate ventilation, in compliance with S.A.A. Lift Code and building regulations.
- The machine-room access door, closer and notice shall comply with S.A.A. Lift Code. The machine-room access door shall swing out.
- Fire extinguishers, or a sprinkler system in compliance with S.A.A. Lift Code, shall be supplied.
- Provision of a key-safe adjacent to the lift motor room entry door.
- Filtered fresh air intake and exhaust shall be installed.
- Where possible, finishes to walls, floor and ceiling shall be durable and painted in full gloss enamel for easy cleaning. Where possible, the ceiling colour shall be white and walls off-white. Floors shall be properly sealed and receive 2 coats of grey coloured paving paint.
- Control and hoisting equipment shall be well lit by room lights, which shall be twin 36-watt fluorescent reflector-type fittings with protective guards. Lighting shall be positioned so that Maintenance Technicians are not working in their own shadow.
- The control gear shall be illuminated by emergency lighting.

13.11. Keys

Provide a set of keys to the ECU so that in case of a fault the Lift can be Parked.

13.12. MANUAL

Provide drawings of system and Maintenance Manuals in soft copy

13.13. MAINTENANCE & WARRANTY

The complete installation is to be guaranteed for 12 calendar months from date of practical completion and is to be fully serviced and maintained for that period.

During defects period, regular weekly servicing of equipment is required and a 24 hour call out service is to be provided.

During defects period completion of onsite logbooks provided under the contract are to be maintained.

13.14. IDENTIFICATION OF EQUIPMENT

All items of equipment shall be identified with engraved trefelite labels, in accordance with the University's Computerised Maintenance Management System QFM Coding structure. Contact the Electrical Services Branch for details. This includes all new assets i.e. switchboards, fire panels, transformers etc.

14.0 ELECTRICAL SERVICES

14.1. PREFERRED CONTRACTORS

Contractors either tendering or working on projects at Edith Cowan University must be approved by the ECU Project Manager and or already be an approved supplier on the University Procurement Panel.

14.2. SUSTAINABILITY

All utility consumption is to be metered and data from meters presented in a form to allow comparison against historical data to enable fine tuning of systems to achieve maximum efficiency. Refer mechanical services for linking to the BMS. In addition to the BMS electrical meter data directed to the University metering system proposal to be approved by the Technical Electrical Officer prior to implementation. Data gathering and reporting systems must be fully operational before practical completion.

14.3. SCOPE

This section of the Standards outlines the University's minimum requirements for electrical services including telephone block wiring.

14.4. FLEXIBILITY OF DESIGN

The layout of light fittings, Telecom outlets and power outlets should allow flexibility such that spaces can be subdivided into separate areas. Where island rooms exist, these shall be conduited to allow for the installation of power and telephone outlets from the relevant sub board or F.D.P. where these are not installed in the first instance. At least 2 x 32mm conduits shall feed each section of the skirting ducts in these areas.

Island floor outlets are not permitted as they present a trip hazard.

14.5. RCD PROTECTION

Prior to work commencing on any refurbishment works, regardless of electrical changes or alterations, all general power outlet and lighting circuits must be reviewed to ensure that they are protected via RCD. If not, RCD or RCBO protection must be installed.

14.6. LIGHTING

14.6.1. PERFORMANCE STANDARDS

Lighting levels on the working plane shall be in accordance with the requirements of AS 1680 Series of Standards. The defined level shall be minimum with calculated levels being no greater than plus 10%. Over illumination shall be discouraged. Areas nominated for specialised requirements will be identified by the user and the appropriate lighting levels recommended, however, at no times are these to be less than code requirements.

Options available for the control of lighting to be reviewed to ensure optimum cost-effective energy management solutions are incorporated including:

- Motion detection/occupancy sensors.
- Daylight/level sensors.
- Time schedules.
- Manual switching and grouping.
- Dimming.
- LED lighting to be installed where applicable.

Such controls should be achieved by further development of existing lighting control systems on the campus.

Light fittings are to be accessible 3 metres from finished floor level so as not to necessitate the need to use scaffolding

14.6.2. Design Requirements

1) Lighting fittings should be manufactured from Australian made components where possible and be approved by Western Power. The fittings are preferable to be manufactured within Australia. Downlights shall be of the LED type, to be approved by the Electrical Manager ECU. No compact fluoro's shall be used in any situation. If the fitting is not available in Australia, then they may be sourced from abroad provided the quality is acceptable to the University. Light fitting selection to be approved by the University Electrical Manager, in general lamp types to conform to University standard selection.
2) For general lighting, fittings should be rated at 4000K. For specialist areas, design for the requirements of that area and seek approval from ECU
3) All fittings should be adequately ventilated or designed to ensure excessive temperatures within the fittings does not result. Temperature rise in the fittings should be restricted to 50°C above ambient.
4) Where recessed downlights are installed, they shall have non-flammable ceiling guards installed to prevent the insulation from encroaching on the fitting causing overheating and the opportunity of a fire commencing. Similar or equal to Ceiling Light Guards supplied by supplier.
5) Diffusers shall be easily removable, and all components shall be easily accessible. Fittings which must be dismantled to replace lamps shall not be used. Standard diffusers shall be as a minimum K12 prismatic in general service areas, Louvered Style Diffusers in general office areas Separate whiteboard illumination using fluorescent tube lighting or similar shall be provided. The lighting design in Teacher areas, where multimedia presentations are accommodated is to incorporate greater flexibility and control of lighting than normal conventional designs. Design solutions should incorporate dimming of all lighting with flexibility to allow switching off light fittings that adversely affect presentations on projection screens.
6) Light fitting design and layout should satisfy the intensity requirements for open offices but should have sufficient flexibility to enable partitioning of individual perimeter or island offices.
7) The length of fitting should suit the ceiling module.
8) External lighting of buildings shall be discussed with the University Manager and Technical Electrical Officer. The external paths associated with a particular building project shall be illuminated as part of that building. All external lighting shall be consistent with that of existing buildings. External lighting control shall be through the use of BMS or building lighting control system where provided.
9) Where false ceiling exists, fittings shall be connected to the wiring loom by means of a three-pin plug and 2000mm of flexible lead. Suspend/secure cabling within building spaces of removable tile ceilings in such a manner and spaced above ceiling to ensure cables do not interfere with removal and reinstallation of tiles, or maintenance of in ceiling equipment. A Maximum fixing distance of no more than 900mm apart.
10) Unless otherwise approved by University all wiring, including sheathed cables and conduiting, shall be concealed within or by the building structure in a manner that can be replaced without damage to the completed building finishes.
11) Where no false ceilings exist, consideration may be given to running all services exposed. Conduit runs in this case are to be carefully worked out prior to installation.
12) Starters shall be of the electronic type equivalent to WOTAN DOES ST171 except for 20W fittings where 20W starters shall be used. Non flickering electronic starters shall be used in all areas.
13) Downlights shall not be used for general illumination. LED downlights in conjunction with fluorescent lighting shall be used in teaching spaces where directed to provide dimmable lighting for video projection requirements.

14) Metal halide type fittings shall NOT be used in teaching or office areas due to the minimum of the 15 minutes strike up time and the fitting being susceptible to loss of function due to power disturbances.

14.6.3. Works of Art

In the public areas of the building and in all meeting rooms within the building, ensure the spaces can be used to display the University's Art Collection. Liaison should occur at an early date in the development of the plans with the Project Manager and Art Curator to identify "gallery" areas.

The following guidelines apply in such gallery areas:

- Designated walls in gallery areas should receive no direct sunlight.
- Lighting in designated gallery areas should provide an even illumination of the wall.
- Where spotlights or wall washers are used, they should be dimmable LED to allow adjustment of the lighting level between 50 lux for works on paper and 150 lux for works on canvas.
- Where spotlights are used, they shall be LED and at least 2 metres (if LED can be closer) from wall.

14.6.4. External Lighting Poles & Bollards

Lighting Poles & Bollards shall be "Avenue" style preferred on all campuses.

External lighting. Control of external lighting to be through the BMS. External lights consist of grounds circuits and security circuits. Inline circuit breakers/fuses will be installed to each light pole supply. A balanced supply load to each circuit and that grounds and security lighting are evenly distributed around external areas. Typically 50% of each.

14.7. Switching

Switches should wherever possible be located on permanent walls or columns. Switches are to be 900mm above the finished floor level. Block switching should not be used except where special circumstances dictate. Intentions to block switch areas should be discussed with the Technical Electrical Officer, prior to final design. Switching and dimming in all teaching spaces shall be in accordance with requirements for Lecture Theatres. All switch plates shall be identified with IPA studs as to circuit and switchboard of origin.

Light switches are to be rated at 15 amps (not 10 amps) and to have heavy-duty mechanism for fluorescent loads (Clipsal 30 FLM15 or equivalent).

C-Bus Lighting Control and or Dali lighting
Provide a lighting control system complete with all switching modules, dimmers, switches and other control devices, control panels, power supplies, wiring and other equipment necessary to provide a complete and operational installation.

C-Bus Lighting Control is the preferred lighting control system for all campuses.

The ECU Technical Electrical Officer must be notified prior to any additions or alterations to the C-Bus System/Network.

Once the additions or alterations have been made the contractor must submit the changes to the Technical Electrical Officer or his Deputy, for Sign-Off, before they are saved to the Network Data Base.

Personnel carrying out works on the Clipsal C-Bus ALCS are required to have undertaken the Basic and Intermediate C-Bus Training Course carried out by Clipsal Integrated Systems and attained an 'Approved Installer' and / or 'Point One Accredited Integrator' qualification for the Clipsal C-Bus ALCS. A list of suitable qualified personnel shall be submitted.

Installation, Testing and Commissioning of the Clipsal C-Bus ALCS shall be carried out in conjunction with Clipsal Integrated Systems and an approved commissioning technician.

System

The Clipsal C-Bus ALCS shall be microprocessor based and utilise Category 5E Unshielded Twisted Pair (UTP) cable with 240V AC insulation rating as the communication medium between intelligent network nodes to control lighting.

The system shall comprise modules with in-built microprocessors, which can be programmed via both learning the relationships between input and output devices without the use of a personal computer or at a higher level with a personal computer using a Microsoft Windows based application software.

All hardware shall meet the requirements for electromagnetic compatibility for certification with the CE mark.

The devices shall maintain programmed parameters during power failures with Non-Volatile Random-Access Memory (NV-RAM). The control system shall remain fully functional in the event of supervisory computer shut down or failure.

The Clipsal C-Bus ALCS shall use high speed, full duplex communications protocol. The system shall provide constant feedback on the operational status of inputs and outputs and can interrogate the status of specific modules.

The Clipsal C-Bus ALCS protocol shall implement the International Standards Organisation (ISO) Open Systems Interconnection (OSI) seven-layer reference model for communication protocol.

The Clipsal C-Bus ALCS protocol shall provide transmission error checking for all information passed over the network.

The C-Bus Automatic Lighting Management System shall incorporate the following facilities:

- Time based scheduling for energy management control of lighting.
- Photoelectric cell dimming control of the open plan area artificial lighting and lumen depreciation compensation.
- Occupancy sensors for energy management control of lighting.
- Be an easily programmable energy management and time control, using PC and Windows XPTM based configuration software.
- Could interface with the Building Automation System at high or low level.
- Automatic OFF control of lighting if required.
- Automatic ON control of lighting if required.
- Automatic On and OFF control of lighting using occupancy sensors.
- Manual ON/OFF control of lighting always.
- Provide an easily configurable logic engine to enable implementation of network logic functions and control scenarios.
- Provide a full range of plastic, stainless steel and glass faced switch panel options.
- Provide the option for ‘Dynamically Labelled*’ switch identification using DLT technology.
- Be compatible with luminaire control gear generally available.

14.7.1. ELECTRICAL

The Clipsal C-Bus ALCS shall use an extra low voltage (less than 36V DC) bus to interconnect all control and switching units. Cat 6A UTP cables shall be used as the wiring medium for this bus. Shielded communication cables shall not be used due to the risk of group loop interference.

Input and output units shall be connected on the system bus in parallel.

The Clipsal C-Bus ALCS shall be powered by a two (2) wire network, superimposing data and unit DC power supply onto one pair of data wires avoiding multiple connections of the networked devices.

Short circuit of the network power supply shall have no long-tern effect on the system once the fault is repaired.

Each unit shall have a unique serial number embedded in firmware for ongoing product traceability and warranties, be individually programmable and be identified by a unique network address code.

The Clipsal C-Bus ALCS bus shall be electrically isolated to 3500V AC RMS for one (1) minute from the mains wiring.

14.7.2. General Lighting Control System Functions

The general function of the C-bus ALCS to include but not be limited to the following general scenarios:

Offices / Administration Open Plan Areas:

- Local switch On/Off, with daylight sensing
- Provide intelligent programmable light level sensors, to measure the natural day light levels and according to a predetermined lux level to intelligently monitor and dim various circuits depending on these factors.
- 360-degree Occupancy sensors to be located within these areas as depicted on plans and setup to automatically turn lighting off for after hour operation.

Security, Corridor and Foyer Lighting

Internal and external security lighting shall be provided to operate during normal hours of darkness. Corridor and foyer lighting shall also be provided throughout all buildings. The lighting shall be switched in the following groups:

- Group 1: External Security Lighting
- Group 2: Internal Security Lighting
- Group 3: Corridor/Foyer Lighting

These lighting groups shall each be contactor controlled at the local sub-board with switch control also available in corridor/foyer for use by cleaners. A master / slave or contactor system shall be used where the master contactor is controlled by the time switching function of the BMS. This shall apply to all external lighting.

External security lighting to be controlled in conjunction with the BMS incorporating PE Cells and time clock function. Information relevant to types and source of external lighting shall be discussed with ECU Project Manager and the Technical Electrical Officer. Designated “safe lit corridor/safe lit car park” are to be identified by the ECU Project Manager and such designated areas to be totally controlled by BMS.

Each external lighting group shall have a manual override system provided at the local supply distribution board in addition to the BMS system.

For corridor lights provided in addition to the above a local override at each entry to the corridor to allow for out -of hours- use. (Alternatively occupancy sensors to be installed in the corridor areas for out-of-hours use.)

Corridors

- Light switch panel to be located at the entry to the corridor to allow for out of hours use.
- Occupancy sensors to be installed and programmed as a re-trigger able timer to automatically turn lights On / Off after 60 minutes if no movement is detected.

Storerooms/ Cleaner Rooms

- Switch On/Off, with occupancy sensor, sensors to be programmed as a re-trigger able timer to automatically switch lights On / Off after 15 minutes if no movement is detected.

Offices

- Controlled by a local switch and a PIR occupancy sensor.
- Switch in the On position sets the system in Auto mode turning the lights On and enabling the occupancy sensor, occupancy sensor to be programmed as a re-trigger able timer to switch lights Off after 20 minutes if no movement is detected.
- With the switch in the Off position this disables the occupancy sensor, and the lights remain Off.
- Alternately a PIR occupancy sensor only (no local switch panel) may be programmed as a re-trigger able timer to switch lights On/Off with a 20-minute re-trigger time delay.

Plant Rooms and Service cupboards

- Local On/ Off switch

Toilets

- Controlled by PIR occupancy sensor to be programmed as a re-trigger timer to turn lights On / Off after 30 minutes if no movement is detected.
- Occupancy sensors to be in both the Air lock and toilet cubicle area.

Stairs

- All windowless fire escape stairs and internal stairs shall have circuits controlled only at the distribution board.
- Stairs which have sufficient natural lighting shall have lights controlled by PIR occupancy sensor to be programmed as a re-trigger able timer to automatically turn lights On / OFF after 10 minutes if no movement is detected. Care to be taken in locating occupancy sensors to ensure safe use of stairs

Staff / Meeting Conference / Board Rooms

- Lighting to be controlled via a local light switch panel and PIR occupancy sensors.
- The light switch panel will have the ability to turn the lights On/Off and dim.
- Occupancy sensor to be programmed as a re-trigger able timer set to 30 minutes, when no occupancy is detected the lights to fade Off over 30 seconds.
- Dimming facility via the light switch panel with the ability to turn the lights Off adjacent to the projector screen.

Laboratory / Teaching / Prep Areas / Foyers / Study Areas / etc

- Lighting to be controlled via a local light switch panel and PIR occupancy sensors.
- The light switch panel will have the ability to turn the lights On/Off and dim.
- Occupancy sensor to be programmed as a re-trigger able timer set to 30 minutes to turn lights Off after 30 minutes if no movement is detected.
- Dimming facility via the light switch panel with the ability to turn the lights Off adjacent to the projector screen / white board.

Perimeter dimming

- The luminaries on the perimeter of the building shall generally be controlled such that in the event of there being sufficient natural light from the windows, the luminaries shall be dimmed in response to the available natural illumination by the lighting control system.

14.7.3. C-Bus Control Modules

C-Bus control modules shall be in DB and can be accessed where MCBs are located. Under no circumstances will the location of controls in ceiling spaces be permitted

14.7.4. Touch Screen

- The colour touch screen must be capable of controlling and monitoring the lighting control system.
- A programmable Touch screen device connected to the data network shall provide Scheduling and Scene management. Obtain an IP address from the Technical Electrical Officer
- Touch screen to be in a room/ service cupboard not accessible by the public. Location to be approved by Technical Electrical Officer
- Pages to be set up to mimic inputs and outputs to individual areas as nominated.
- Real time clock display and setting facilities from the touch screen.
- Touch screen to provide scheduling function for internal, external and security lighting.
- Schedules shall be able to be modified by the user without the use of any programming tools or devices

14.7.5. Ethernet Interface

Provided a C-Bus Ethernet interface part number 5500CN located in the communications room and patched back to the communications cabinet. Network the system and connect to the lighting control maintenance PC at the Joondalup campus administration building.

MAC addresses, port and switch information is to be provided to ITSC for the provisioning of VLAN's and assignment of static IP's. This information will then be provided back to the Technical Electrical Officer.

14.7.6. Network Bridge

Network bridges shall be allowed for the building as required. Limit each network to a maximum of 70 devices and 700 meters of network cabling to allow 30% expansion for future use. If this is to be exceeded the project must be split into multiple networks and then joined via a 5500B Network Bridge. A backbone network topology for the project is to be submitted to Clipsal Integrated Systems for approval prior to construction.

14.7.7. Relay and Dimmer Controllers

The relay, dimmer and DSI gateway modules shall be housed in an approved enclosure adjacent the floor distribution switchboard within the electrical riser. Alternatively an extension to the floor distribution switchboard can be provided to house the modules.

14.7.8. System interface:

The lighting management system shall have the ability to interface to the building management system at various levels.

- Volt free contact.
- BACnet IP Gateway
- OPC Server software

14.7.9. Naming Convention

The C-Bus lighting control system is installed across multiple buildings. A naming convention is required to:

- Ensure consistency in the naming of various projects, networks, devices and load groups in each building.
- Provide a mechanism to easily identify where the device is located and what area it controls.
- Minimise the use of cryptic acronyms wherever possible.

General Format

General Format for naming of a point shall be:

Project>Network>Application>Group Address

Project	Describes the name of the building and site (up to 8 characters)
Network	Describes the vertical or horizontal location as a floor level.
Application	Describes the control system application
Group Address	Describes the controlled load type and location. Include ipa\ circuit# if a relay

Example:

Project	**Network**	**Application**	**Group Address**
Building 21	Level 2 East	Lighting	Rm 2.01 front W1

The concept is that a programmer or maintenance staff person can identify the group address or tags with minimal reference to drawings or documentation.

Project identifier can only have 8 characters; all other identifiers have up to 32 characters.

Device Identification

All units on a C-Bus network have a unique identity code called a unit address, this identifies a specific device connected to the C-Bus network. A reserved unit address approach should be taken when designing the project.

Following format shall be followed:

Unit Address	Unique code that identifies each unit on a single network.
Part Name	Tag to identify unit. Restricted to 8 characters.
Tag Name	Tag to identify unit, up to 32 characters.

Example:

Unit address	**Part Name**	**Tag Name**
052	Rm 508 Rm	508 switch 1

Note:

- Reserved address approach should be used where the outputs start a unit address 001 and input devices from unit address 020 and above.
- Unit address 255 is reserved as a default for new units, no C-Bus device with this address should be left connected to the network once commissioning and handover has been completed.
- Abbreviations should only be used where the C-Bus system cannot accommodate the full text description.

14.7.10. DOCUMENTATION

The Installing Contractor shall provide a complete set of 'as installed' drawings and an end user instruction booklet

Label all C-Bus distribution board schedules internally include C-Bus unit number on module.

Include secure copies of electronic databases of all programmed devices including C-Bus Tag database, C-Touch Project file xml, PAC xml file or any other files needed.

14.7.11. WARRANTY

The Clipsal C-Bus will carry a two-year warranty; the installer to provide proof of installed dates and is subject to manufactures conditions of Warranty.

14.8. POWER

14.8.1. SOCKET OUTLETS

Unless specific requirements are detailed, allow two double Socket outlets per workstation or 10m^2 of net useable space. All socket outlets shall be identified by means of circuit identification I.P.A. red, white and blue studs as to the circuit on which they are installed and the switchboard of origin. In the case of the Clipsal 2000 range socket outlets the IPA shall be installed under grid plates and an adhesive label to the face between the socket outlets.

All three phase outlets shall have 5 round pins.

Emergency power isolation is required for all power outlets in each laboratory, machine room that are hazardous areas but such rooms do not include computer teaching rooms where general teaching in computing is carried out and is to be located at the lecturer's bench or in locations approved by the ECU Project Manager and the Technical Electrical Officer. All services emergency stop control for an area shall be grouped together for easy, convenient access.

All socket outlets (1 phase and 3 phase) shall be protected by devices incorporating 30mA RCD Protection (Residual Current Device).

All Socket outlets protected by RCD's shall be engraved in 5mm high green filled lettering "RCD PROTECTED".

Unprotected power may only be provided when written permission has been given by the Technical Electrical Officer.

All Socket outlets not protected by RCD's shall be engraved in 5mm high red filled lettering "Not RCD Protected" with the name of device under, i.e. "NOT RCD PROTECTED BOILING WATER UNIT ONLY".

Engraving of removable surrounds is not acceptable.

Provide dedicated Socket outlets for cleaners (engraved accordingly) at appropriate locations throughout the building, catering for vacuum cleaners, etc. These outlets are to be installed 600mm above floor level.

All socket outlets are to be switch operated.

All lectern GPO's require soft start.

14.8.2. SWITCH BOARDS AND SUB BOARDS

Main Switchboard.
Regardless of the initial requirements, the main switchboard shall be designed to Form 3B and be able to withstand the maximum prospective fault level for the maximum design capacity of the substation. All switchboards will be fitted with smoke detection. The main switchboard shall be of type tested construction,

floor mounted, free standing compartment cubicle type construction ("dead front" type and fitted with circuit breakers or switch fuse units to control outgoing circuits).

The unimpeded space around a Main Switchboard shall not be less than 1.2 Metres where the panels are removable either with or without tools to permit the tradesperson enough exit space.

The switchboard is required to be approved prior to manufacture by the University Technical Electrical Officer. All such switchboards are to be of steel construction.

Building main switchboard shall incorporate Shunt Surge Diversion to the incoming supply. In addition inline surge reduction filtering shall be provided to “clean power” supply to boards serving Teaching and Laboratory areas as directed by University.

All switchboards shall be provided with an individual feed to a 10A Socket Outlets incorporated into the switchboard or in an easily accessible location on the wall within the cupboard, for test equipment use.

Provision shall be made to extend the main busbar systems in either direction. At least 25% spare space shall be provided as an absolute minimum. Main switchboard shall have capacity for additional switchgear and sub mains for future expansion. Mains cables shall be sized accordingly to take account of the full expansion potential of the board.

All Switchboards shall have Isobars fitted.

Generator Supply
Where specified a Generator Supply inlet socket shall be fitted to the outside of the Building Main Switchboard, Sub Board or Switchroom or as specified by the Technical Electrical Officer. An electrically interlocked changeover switch shall be installed on the switchboard and labelled accordingly. Key access to switchboards is to comply with the University's Keying System.

The main switchboard shall be designed in accordance with AS 1136 "Switchgear and Control Gear Assemblies for Voltage up to 1000V AC".

Following full load being applied to board, typically mid-way through the defects liability period, condition monitoring of switchboards to be carried out using thermal imaging. Report on thermal imaging to be included in electrical manual.

Sub Distribution boards, lighting and power supply.
Sub-boards shall be of steel construction and arranged for floor or wall mounting unless circumstances dictate otherwise. At least 30% spare capacity shall be provided on all sub-boards. Sub mains cables shall be sized to take account of the full expansion potential of the board. Escutcheons shall not be interlocked with switches, isolators or circuit breakers.

Key access to switchboards is to comply with the University's Keying System.

Lighting, power and 3 phase circuits shall have clearly defined separate areas on the sub board with each having its own isolator in addition to the distribution board main switch. A separate mechanical services switchboard (MSSB) or separate section on the board shall be provided for air conditioning feeds. Boards servicing Teaching and Laboratory areas may also require separate “clean power” chassis section and isolator.

Vermin Protection.
All switchboards and sub boards shall be designed to be vermin proof.

Fuse Cartridges.
All fuses shall be HRC cartridge type conforming to AS2005 and AS3135. A minimum of six (6) spare cartridges for each rating shall be supplied at each switchboard position. Spare fuse cartridges shall be mounted on a suitable rack, easily accessible without removing escutcheon plates. At the main switchboard, in switch rooms or substations, spare fuses shall be in a wall mounted enclosure. At distribution boards, cupboards, the fuses shall be mounted internally on rear face of door. In special circumstances DIN fuses may be acceptable up to 32 amps.

Sub Metering.
Metering shall be provided by microprocessor based networked monitoring devices providing complete electrical metering and indication Schneider approved metering with pulse output capabilities.

Master meters shall be provided in each building main switchboard to register building consumption and consumption for each of the main building services emanating from the board including, but not limited to Air conditioning and mechanical services, Hydraulics and Hot Water with slave meters for submains to selected distribution boards. The main meter for the building provide Pulse kWhrs output to the BMS.

Push Buttons.
Shall be of the shrouded type.

KW Transducers.
Shall not be used without prior approval from the Technical Electrical Officer.

Indicating Lights.
Shall be of the integrated LED lamp type with a minimum life of 100,000hrs .

Meters.
All meters should be digital

Metering test link. Shall be provided for all current transformer sensing metering complete with voltage isolating links and current shorting links.

Labelling.
Each control, switch etc. on main switchboards, sub-boards etc. shall be clearly labelled. All labels shall be engraved traffolyte and attached to the switchboard by means of non self tapping type screws.

All ECU assets to have asset list identification labels attached. This will be carried out under the project and installed by the contractors.

Circuit Schedules.
Shall be typed and be provided at all switchboard positions. The information contained on the schedules shall consist of circuit breaker identification number, phase colour corresponding with type and location of each circuit. This information shall incorporate room number and whether it serves power, lighting, mechanical services, etc. The switchboard schedule to indicate where supply is fed from, cable type and size to be laminated and fixed to inside of switchboard door and shall also contain the switchboard sub-main size and point of origin.

Colour.
All switchboards shall be colour orange X15 (AS2700 1996).

Circuit Breakers.
To final subcircuits shall be Schneider or equivalent type miniature circuit breakers and shall have individual RCD protection for all power circuits and lighting circuits. Other circuit breaker types may be submitted to the University for approval.

Discrimination.
Prior to selection of switchgear a supplier, the switchboard manufacturer must ensure discrimination can be achieved as follows.

Co-ordinate the protection equipment on all main and distribution switchboards such that in the event of any condition of over-current or short circuit occurring at the load side of terminals of any submain protective device or final subcircuit equipment isolator/connection device:

- Sub-mains protection effectively discriminates.
- All lighting circuits continue to operate apart from any lighting which is supplied by the faulty circuit.

Short circuit calculations shall be for all faults up to and equal to the prospective fault current at each distribution switchboard.

Certify compliance with the above in writing to the Principal, including fault and discrimination calculations for switchgear used prior to submission of switchboard shop drawings for examination.

Submission of equipment list and manufacturer's discrimination and enhanced selectivity charts are acceptable in lieu of individual calculations, where these are available.

All Neutrals, Earths and Active Cables.

Shall be number ferruled to correspond to the circuit breaker number. All circuit breakers shall be numbered consecutively on the escutcheon plate and on the circuit breaker mounting bracket for ease of identification once the escutcheon plate has been removed.

All active cables entering circuit breakers shall be via cable lugs. All control wiring shall have number ferruled with numbers as indicated on as constructed drawings.

Neutral bars shall have the same number of terminations as there are circuit breakers and holes for main neutral and MEN connection. Earth bars to have terminations equal to the number of circuit breaker positions. Blue point connections shall not be permitted within switchboards and sub boards without prior approval from the Technical Electrical Officer. System of earthing shall be MEN system.

Standard Equipment.
For all switchboards and sub boards for light, power, air conditioning or other building services shall be as follows:

Alarm Relays	Releco MR C 11 pin base.
Time Relays	Releco MR C 11 pin base.
Auto/Off/Manual Switches	Kraus and Naimer.
Active Links	Blue Point or Busbar System.

A sample of the contactors shall be submitted for University approval prior to their installation in switchboards.

Inspection and Testing
The University reserves the right to inspect during construction. The sequence of inspections is as follows:

1) Approval of switchboard drawings prior to commencing manufacture.
2) Factory inspection when the switchboard is assembled prior to painting.
3) Factory inspection after ductor, primary/secondary current injection and hi-pot tests have been carried out prior to leaving the factory.
4) During the warranty period, the highest load time frame to be agreed with the university for a thermographic and Power quality analyse be carried out and a written report be submitted to Buildings and Maintenance.

14.8.3. Quality of Power Supply

At the point of attachment to any new building, the Power Factor shall be less than 0.85 during ON PEAK hours at normal running load. If the Power factor is not less than 0.9 then Automatic Power factor correction equipment shall be installed at no cost to the University.

The Currents across the three phases shall be balanced within plus or minus 10% of each other.

The quality of the power at the point of supply to a new building shall conform to AS2279 and Western Power Technical Requirements. A power quality audit shall be carried out prior to tenant's occupation and after during the peak load period to verify it conforms to the standards specified. If the supply is non-conforming due to tenants equipment then the University shall cover the cost of filtration but if the source the distortions are for example from a Variable speed drive on the Air conditioning plant then the contractors will be responsible to

cover the cost of installing Filtration or rectifying. The reports of Quality Audit are to be provided for inclusion in the Electrical Maintenance Manual for the Building.

14.8.4. SUB MAINS.

Underground sub mains shall be in PVC conduits, via cable pits (Gatic lid and brick construction trafficable type where in paths). Where fibro cement or similar pits are used they shall be installed with 100x100mm concrete collar to strengthen lid support lip. Provide adequate spare conduits for future use. Pits shall be drilled for conduit access and gaps around conduits filled to approval.

14.8.5. EARTHING

Provide all Earth Testing data of the total installation to indicate compliance with regulations.

14.9. GENERAL WIRING

Power and 240V control cable shall not be less than 2.5mm^2 stranded copper, 240-volt control cable shall be not less than 1.5mm^2 stranded copper conductors. Lighting circuits shall be wired using not less than 1.5mm^2 stranded copper conductors. Colour coding shall be in accordance with AS 3000 part 3.2. Control wiring shall be white with a minimum size of 1.5mm^2 stranded copper cable. Single core copper cables shall not be used.

Colour differentiate power from light cables. Black TPS for power and white for light.

Install and conceal all wiring, including sheathed cable, within or by the building structure in a manner that can be easily replaced without damage to the completed building finishes.

Suspend/secure cabling within ceiling spaces of removable tile ceilings in such a manner and spaced above ceiling to ensure cables do not interfere with the removal and reinstallation of tiles, or the maintenance of in ceiling equipment.

Loop cables from point to point with joints and connections only at switches or outlets.

Seal cabling passing through a roof with a mechanical screw-up gland and apply an approved non hardening UV resistant sealant.

Do not install cables in any area until all construction work which is likely to damage cable is completed.

Group and install all cabling in straight runs parallel with line of building. Refer to AS3000 Wiring Rules regarding derating factors for cables. Cable sizes specified have not been derated for grouping of multiple circuits unless otherwise noted. Where derating is necessary due to installation method/grouping, increase cable sizes as specified in AS3008.1.

Cable entries to switchboards or equipment shall be via gland plates or through panels shall be made using circular, orange sheathed, cable and suitable compression glands. Double insulated flat cable may be used if entering through ducts or conduits.

All metal Cable Trays, Ducting, Trunking, Cable Enclosures and conduits shall be bonded to earth, back to the nearest switchboard.

Portable electrical equipment and heaters used in hazardous areas to comply with AS3000 and AS1076.

Cable trays, conduits and conduit saddles shall have the following colour coding throughout the entire installation:

- Orange for power, lighting and 240V controls.
- Grey for Data or Extra Low Voltage or Low Voltage Controls.
- Blue for all data cables.

Conduit saddles shall be of type to ensure conduits are installed flush with wall/ceiling surface. Ducts and cable trays shall be fully galvanised where exposed to the weather and colour banded to the above schedule every 3 metres (to all locations). All cable trays shall have 15% spare carrying capacity.

14.10. Emergency Lighting

Emergency lighting shall be provided in accordance with the requirements of the National Construction Code of Australia and the Australian Standards.

Careful selection of emergency lighting shall be made so that the lighting meets the University's statutory obligation in a discrete way, particular attention to this issue must be made when emergency lighting may impact on architecturally splendid areas such as building entry points or architectural areas of importance.

Where existing Nexus monitored emergency lighting systems exist those systems shall be added to and extended as necessary. All systems shall be fully tested and commissioned to the supplier's and ECU's satisfaction.

All new buildings shall have Nexus monitored emergency lighting systems installed to match the existing systems on ECU campus. Any such new system shall be networked back to the head end PC on Joondalup campus as part of the project.

Emergency exit lights shall be of a LED type. Battery types shall be of the highest quality and designed to provide the longest possible life for the battery. Where access to emergency lighting is at normal ceiling height battery pack shall be mounted local to each fitting. Where situations with high ceilings or difficult to access areas exist other options may be considered in consultation with ECU. Surface mount type fittings shall not be used.

As constructed data for emergency lighting systems shall include fully documented drawings including type and locations of fittings. Where computerised systems have been provided emergency lighting database reference information shall also be contained on the drawings.

Refer to AS 2293 "Emergency Evacuation Lighting in Buildings".

Emergency lights shall only be decommissioned with ECU approval prior to any work being carried. (We have a lot of faults on the Nexus system, due to contractors disconnecting Lights and not recommissioning them)

14.11. Exit and Stair Lighting

Exit and stair lighting shall be in accordance with the requirements of the Fire Safety Act. Exit and stair lighting in enclosed stairs shall be designed to be "ON" at all times. Switching therefore shall be provided only at the circuit-breaker. In non-enclosed stairs, or stairs where natural light is sufficient for daytime use, stair lighting shall be switched by the external lighting program of the BMS and energy management lighting control system when applicable. Emergency lighting to these areas shall be installed. Provide exit and stairway signs to comply with relevant codes. Emergency lighting system shall be monitored by the emergency lighting control systems. All light fittings to be installed no more than 3 metres finished floor level.

14.12. Lightning Protection

Lightning protection shall be provided, if required, to all buildings in accordance with AS 1768 1991. Lighting protection is required on all Joondalup Campus Buildings due to the high "strike" incidence on the campus.

14.13. Electric Fans and Fan Heaters

Only allowed for use for medical reasons

14.14. TOILETS

Allow for one socket outlet adjacent to the mirror in toilet areas. No socket outlets for general use shall be installed within the restricted zones as defined by AS 3000.

Supply, install and commission duress alarms in the disabled toilets. The alarm system to consist of an alarm button, a sign in the toilet and two flashing/buzzing lights (one just outside the toilet and another in a general area) - refer to photo 1, 2 and 3 below. A parallel signal from the button to be wired back to the security system to be included in the access control monitoring system relayed back to the Security Control Centre.

Photo 1

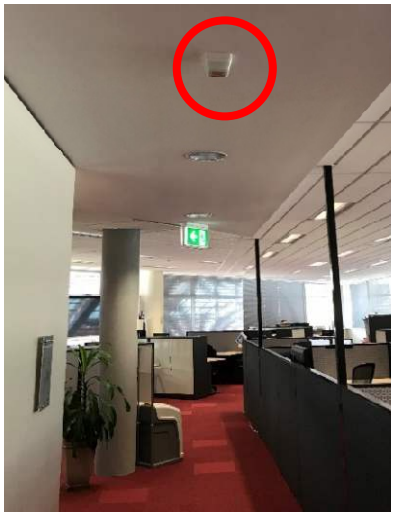


photo 2

photo 3

14.15. TEA ROOMS

Allow for sufficient power for briefed equipment including general power outlets for general use.

3 phase power to be provided for water heater where specified.

14.16. GAS METERS

All wiring connected to all gas meters to be installed as per Standards Association of Australia requirements for electrical circuits in a Zone 2 environment protection is required to enable the circuits to be rated as intrinsically safe.

14.17. DISTRIBUTION SYSTEM

Distribution of power and telephone/data wiring may be by means of a two-channel perimeter aluminium skirting of colour as directed by the consultant architect.

In large open areas, in floor, two channel duct with floor boxes and sealed cover plates should be considered as well as service poles. Where island rooms exist, these shall be conduited to allow for the installation of power and telephone outlets from the relevant sub board or F.D.P. where these are not installed in the first instance.

Floor outlets for power and telephone outlets shall be of Clipsal manufacture or equal, however floor outlets are not recommended as they present a "trip" hazard.

All ducts shall have a minimum of 2 x 32mm feeds from the sub board to each section of the duct.

14.18. Clock System

Clocks only used in Exams

14.19. Electric Water Heaters and Circulating Pump

Water heaters and circulating pump shall be controlled through the BMS with over-riding control at the distribution board supplying the circuits.

14.20. Underground Services and Pits

All underground services shall be installed in accordance with the requirements of AS 3000 shall be colour coded as follows:

Gas Services = yellow painted lid

Fire = red

Water = green

Electrical = orange

and shall be laid in sand with 75mm below and 150mm above and to sides and shall be identified by laying an approved continuous PVC marker tape 300mm min. above the conduits.

Only selected backfill shall be used and shall be compacted in layers not exceeding 200mm to a density of 90%. Compaction Standard achieving a standard penetrometer reading of 8 min blows per 300mm. The minimum cover shall be in accordance with AS 3000 and in any case, not less than 600 mm to top of conduit. Concrete cover to conduits to a lesser depth will be allowed only after written approval from the Technical Electrical Officer.

Minimum size of underground conduit shall be 32mm. Underground cable shall be PVC/PVC cable, not less than 2.5mm^2.

Underground cable joints are not acceptable on sub mains. Maximum distance between pits on underground cable runs shall be 60m.

All underground pits shall have their lids marked indicating the service installed and pits shall be adequately drained.

All cable passing through pit shall be permanently tagged to approval indicating point of origin and termination.

Provide clearance between services as required by relevant Acts, Regulations.

All underground electrical services are to be laid in straight, direct lines.

All external cable Pits are to be trafficable.

14.21. Substations

Where required, provide new substation, new boundary switch room or modify existing substations as required.

Electrical feed to be a ring main type system to new buildings.

Allow for new switchboards, transformers, switchgear as required. Substations to be 2-hour fire rated and comply with requirements of Western Power and AS 3000.

Transformer size to be determined and to be part of the contract.

Provide spare FCUs for future use.

All high voltage switching shall be performed by Western Power trained staff having the required certification. No work shall commence on high voltage network without an Access Permit in place and signed by all parties who will be carrying out the works.

Where any high voltage cable is to be cut, altered or moved, the Contractor shall arrange with the Consultant and Technical Electrical Officer to test and mark the cable to ensure that it is the correct cable and that it is not "live" before work commences.

Once the cable is proved DEAD it shall be "Spiked" with the approved equipment before any work is commenced.

All work shall be checked and tested as appropriate before the switching is carried out. Final approval for energising of a new substation lies with the supply authority. No switching shall be carried out without their approval.

The Contractor shall meet all costs associated with switching and commissioning.

14.22. Regulatory Authority Notices

For all electrical installation work Electrical contractor shall submit a Minor Works or a Preliminary and Completion Notice to the supply authority and at the same time a copy to the Technical Electrical Officer.

Contractors shall also complete an entry in the campus site electrical record book detailing:

- the location and nature of works;
- the number of the notice;
- Contractor's name, name of person carrying out work and their license number.

Any Electrical Work and or equipment that does not conform to these Planning and Design Guidelines shall be removed and reinstated to the appropriate standard, at the Contractors expense.

14.23. Auto Doors

Operator
Operators for auto doors to be Dorma EL301 or similar approved and be complete with:-

- Separate entry exit sensors.
- Electric constant rated stall proof capacitor start squirrel cage motor.
- Battery back-up for a minimum 300 operations.
- Photo-electric cells across doorway.
- Controls to be interfaced with the buildings Fire Alarm and Security access control systems.
- Switches and push buttons shall be mounted 900mm above finished floor level.

Operation
Normal Hours

- The doors shall allow free access and exit via local movement sensors.
- Close after time delay

- Fire Alarm condition – Doors operate as normal.

After Hours

- The doors shall be controlled via the Security access system. Only a valid card holder is permitted.
- Exit via Exit push button or in secure areas via a card reader with a back-up break glass. Close after time delay.
- Fire Alarm condition – Doors open and remain open until the fire alarm is reset.

Request to Exit Button
The request to Exit (EX) push button shall be momentary bell press switch. The push button shall be a Clipsal prestige series P30MBP or equivalent in the same orientation to other fittings.

The push button shall be engraved in red “PUSH TO EXIT in capital letters a minimum of 8mm in height and centrally located above the button. All “End of Line Resistors” shall be located on the rear of each plate and securely fixed.

Key Switch
Dorma key switch is SK. Allow to replace lock barrel with ECU Lockwood standard barrel 245K.

15.0 COMMUNICATIONS

15.1. GENERALLY

Contractors
Any work carried out on the University Communications cabling and systems can only be done by contractors on the current ECU Procurement Panel approved list of preferred contractors.

ACA Specifications, Approval and Australian Standards
This work shall be carried out strictly in accordance with the current ACA specifications and appropriate Australian Standards by an appropriately registered cabling contractor. The cabling installation shall comply with the current issue of AS11801, "Generic Cabling for Customer Premises", unless this brief specifies otherwise.

Equipment to be provided
The cabling contractor to supply and install data/telephone cabling system complete with all equipment racks (unless directed otherwise), patch panels, terminal blocks, connectors, cables, patch leads, records, jumpers, accessories and consumables. All projects shall be ACA approved and clearly marked as such. Cabling Contractor to install conduits and wiring access for facility cabling. All cable trays and supports for block wiring shall be supplied and installed by contractor.

Telephone/Data Backbone Cabling
Telephone and data backbone cabling shall be included in the contract.

Telephone Handsets and Final Connection
Telephone handsets will be supplied and installed by the University. Final connection of the telephone i.e. jumpering on the IDF/MDF and connection of the patch lead in the Communications Cupboard/Room shall be carried out by the University. For New Building the IDF/MDF jumpering will need to be completed by the Electrical or Communications contractor.

Earthing
Provide a complete earthing system to ACA approval for telephone and data distribution system, including connection to the main earth.

Locks and Handles
All locks on Communications Rooms and Cupboards shall use an "AS2" cylinder in the University's standard lock series unless otherwise specified. Doors shall only be able to be opened with a key and be self-locking on closing but shall have a handle on the inside or be arranged to prevent persons being trapped. Doors shall open outwards and shall have a fixed handle on the outside.

15.2. CABLING PROVISIONS

15.2.1. GENERAL

Provide for communications cable distribution using either two or three channel skirting duct mounted either at skirting level or bench height depending on application. In staff offices the ducting is to be at skirting level.

Ensure duct has adequate conduit entries for cabling requirements.

Provide a detailed block diagram for each building specifying:

- Cable type
- Patch Panel Number
- Wall Outlet Number
- Outlet type
- Origin
- Destination
- Termination connection points/Number off

Provide lightning surge diverters to data/telecommunications lines.

All cabling to be as per ACA TS 102-1998 (Australian Communications Authority Technical Standard Customer Equipment and Cabling) and the other applicable Australian Standards. All cabling contractors shall be registered with the ACA as accredited registrar.

15.2.2. SITE CABLING

Special Services Cable
Provide special services cabling in conduits between the building's main data frame and the Special Services Frame in each building. Terminate on Krone frames at each end.

Fibre Optic Cable
Optical fibre cabling shall meet the requirements of AS/ACIF S008 and shall meet or exceed the performance requirement of AS/NZS11801.1 Optical fibre cables shall terminate at fibre patch panels located. Each cable shall be continuous from one patch panel to the destination patch panel without intermediate joins or connections. The cable strength member shall be securely fastened at the termination enclosure. Leave a five (5) metre loop of cable at each end for future connection by the University.

Where fibre optic cables pass through underground cable pits provide cable loop (⍰ 300 dia) and cable tie to prevent loop uncoiling. Indelibly label all underground cables within pits clearly notating where the cable originates, type of cable and where it terminates.

Cabling Requirements
All cabling shall be installed in full accordance with the manufacturer's recommendations.

Cables shall be installed with due skill and care such that:

- maximum permitted hauling tension is not exceeded
- minimum bending radius of the cable is not exceeded
- maximum permitted crush rating is not exceeded
- the cable is protected from damage.

Cable bundles shall not obstruct the installation and removal of equipment within equipment enclosures.

Wiring frames shall be wired such that jumper connect wires follow clear paths between sections and are not obstructing patch fields, and that lengths of jumper connect wires are minimised.

Equipment and patch cables shall be laid out such that patch cords follow clear paths and do not obstruct patch fields.

All copper cabling entering a building shall be provided with line protector surge arrestor units at both MDF and IDF ends, Critec SLP 10-K4 or equal approved to TS009.

15.3. DETAILED REQUIREMENTS

15.3.1. SERVER ROOM

Server rooms are critical infrastructure. In general the following to be considered:

- Heat loads of equipment to be accurately determined.
- Plan for heat dissipation must be based on a clear understanding of air flow.
- Power supply to be uninterruptible.
- The Air-conditioning Systems to be based on N+1 Duty/Standby back up, the Duty to be a Chilled Water System and the Standby back up to be a Direct Expansion System.
- Facility to be fire protected and include a fire suppression system.
- Facility to be secure and have access control.
- A risk assessment to be prepared and signed off by the ECU Manager, Technical Services (IT).
- Access for delivery and installation of equipment.

15.3.2. COMMUNICATIONS ROOM

General

Each building shall have at least one Communications Room, preferably centrally located on the ground floor, to securely house equipment to provide communications and computing services for general use in the building. The Communications Room is the hub for the communications wiring for the building and shall be directly connected to the underground service duct network.

The room shall be sized to accommodate a minimum of 2 42U type racks with adequate space to install and service equipment. Floor covering shall be anti-static vinyl and room to be dust free.

Environment

The room shall preferably not have any windows but must be air conditioned to specifications . Of the hardware installed into the room

The provision of two Airconditioning systems based on N+1 Duty/Standby, the Duty to be a Chilled Water System and the Standby back up to be a Direct Expansion system

Generally:

- To dissipate equipment heat loads.
- To provide Full power back up.

Electrical Requirements.

Room lighting shall be provided.

Equipment power supply to be uninterruptible. Unless otherwise directed UPS to of Emerson Network Power manufacture. System to have the ability to monitor power consumption both at the UPS and at each individual rack (metered power rail).

Ducting Requirements

All ducts shall enter the room adjacent to the communications rack. The room shall be directly connected to the underground communications duct network by at least two 100mm ducts in each direction. The rooms shall be connected to building communications cupboards by ducts with easy access for future modification of cable infrastructure.

15.3.3. COMMUNICATIONS CUPBOARDS

General

Each cupboard shall be sized to accommodate 2 of 42 U racks with adequate space for the installation and servicing of equipment.

There shall be at least one Communications Cupboard on each floor from which there shall be access by conduit or via the ceiling space to run cable to all rooms on the floor. Cupboards shall be vertically aligned one above the other, where practicable

There shall be at least one AV Cupboard on each floor from which there shall be access by conduit or via the ceiling space to run cable to all rooms on the floor. Cupboards shall be vertically aligned one above the other.

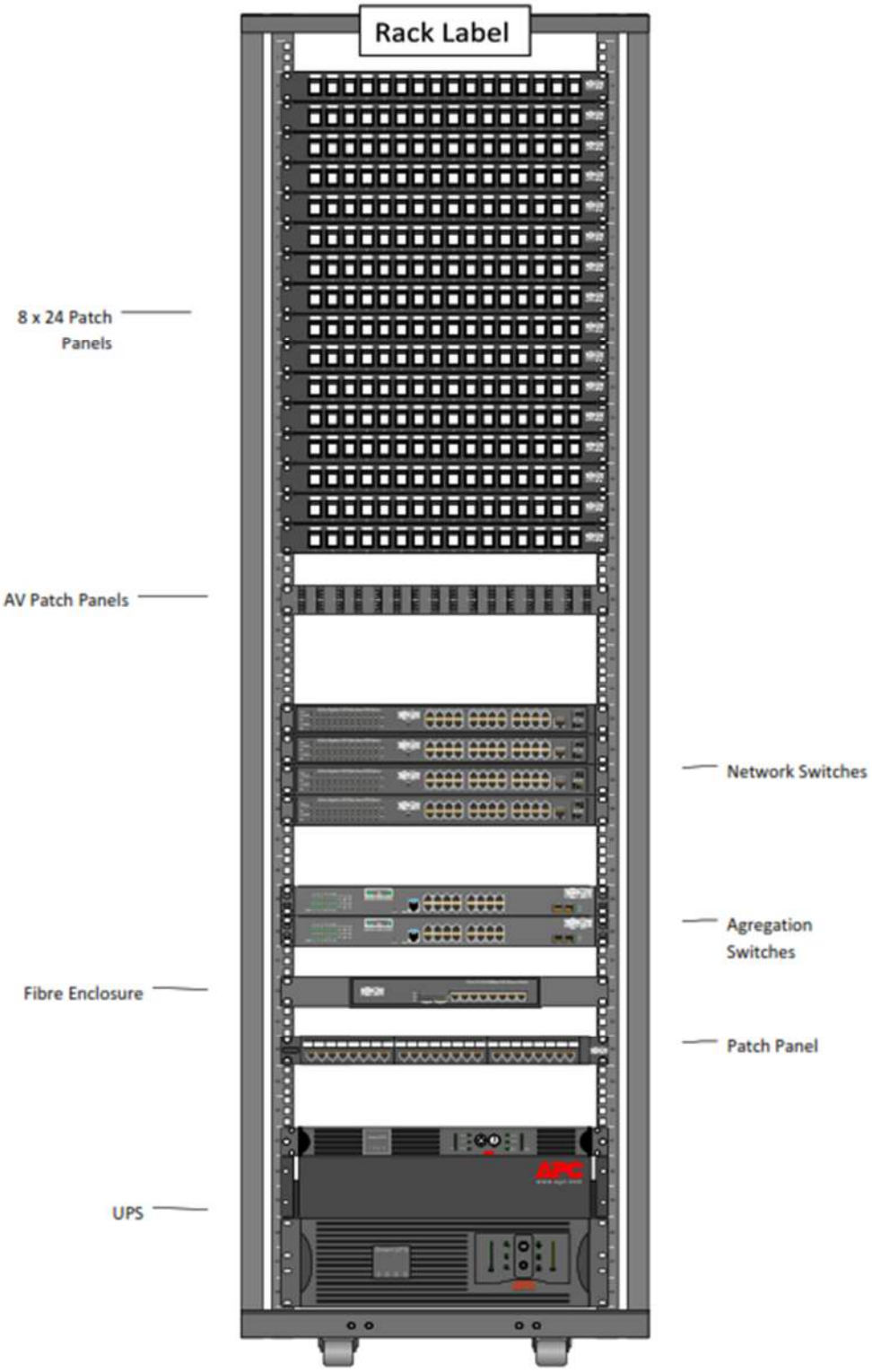
If space permits this can be combined with the Communications Cupboard that can house both communications and Av equipment in one central location.

The cabling run from any outlet to a communications rack shall not exceed 90m. No Communications cupboard shall be more than 180m wiring run from the Communications Room. Additional Communications cupboards and rooms shall be provided, where necessary, to ensure that these lengths are not exceeded.

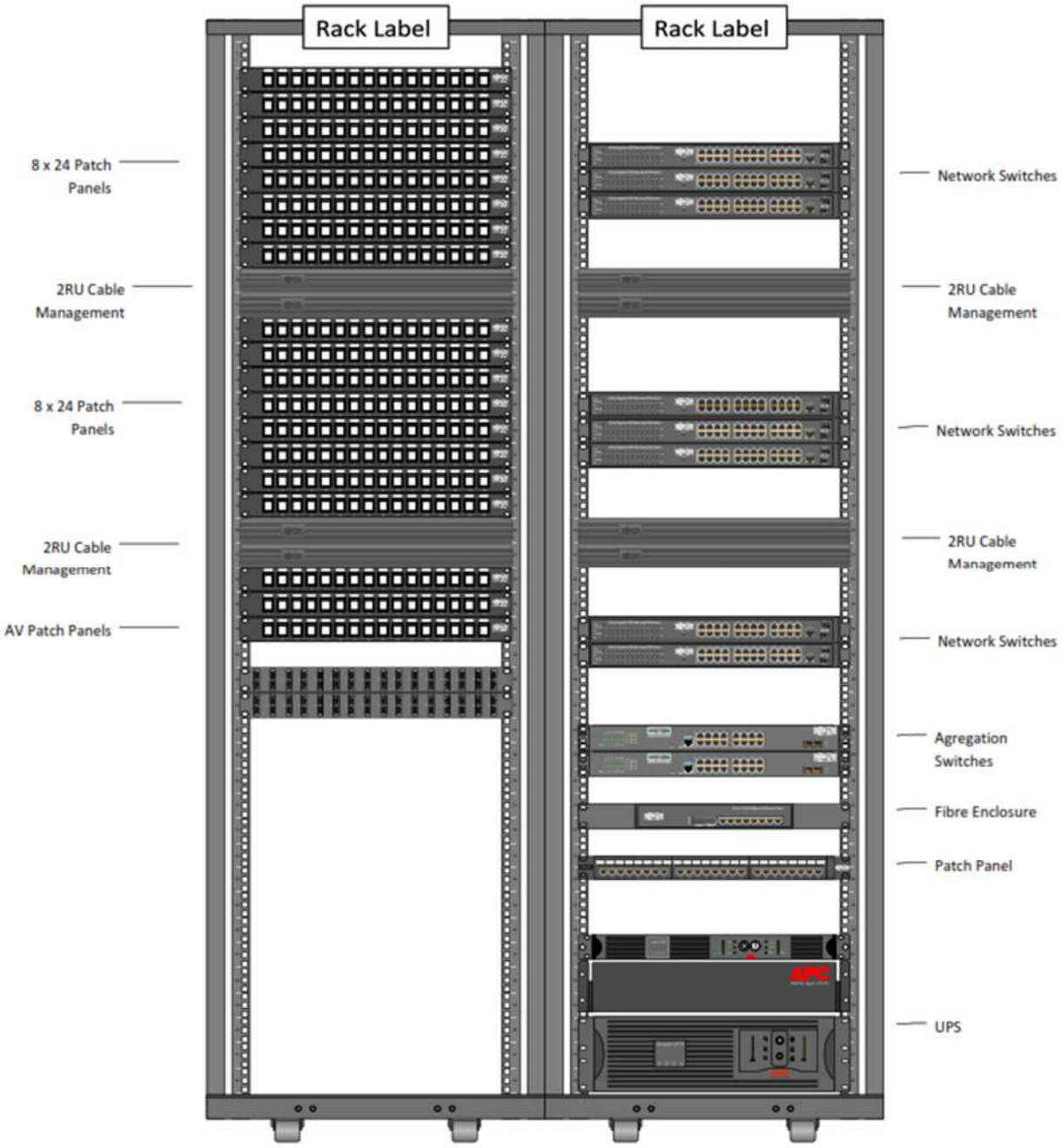
Cables terminating at the enclosures shall be neatly loomed within the enclosure, utilising an appropriate cable management system

See following diagrams:

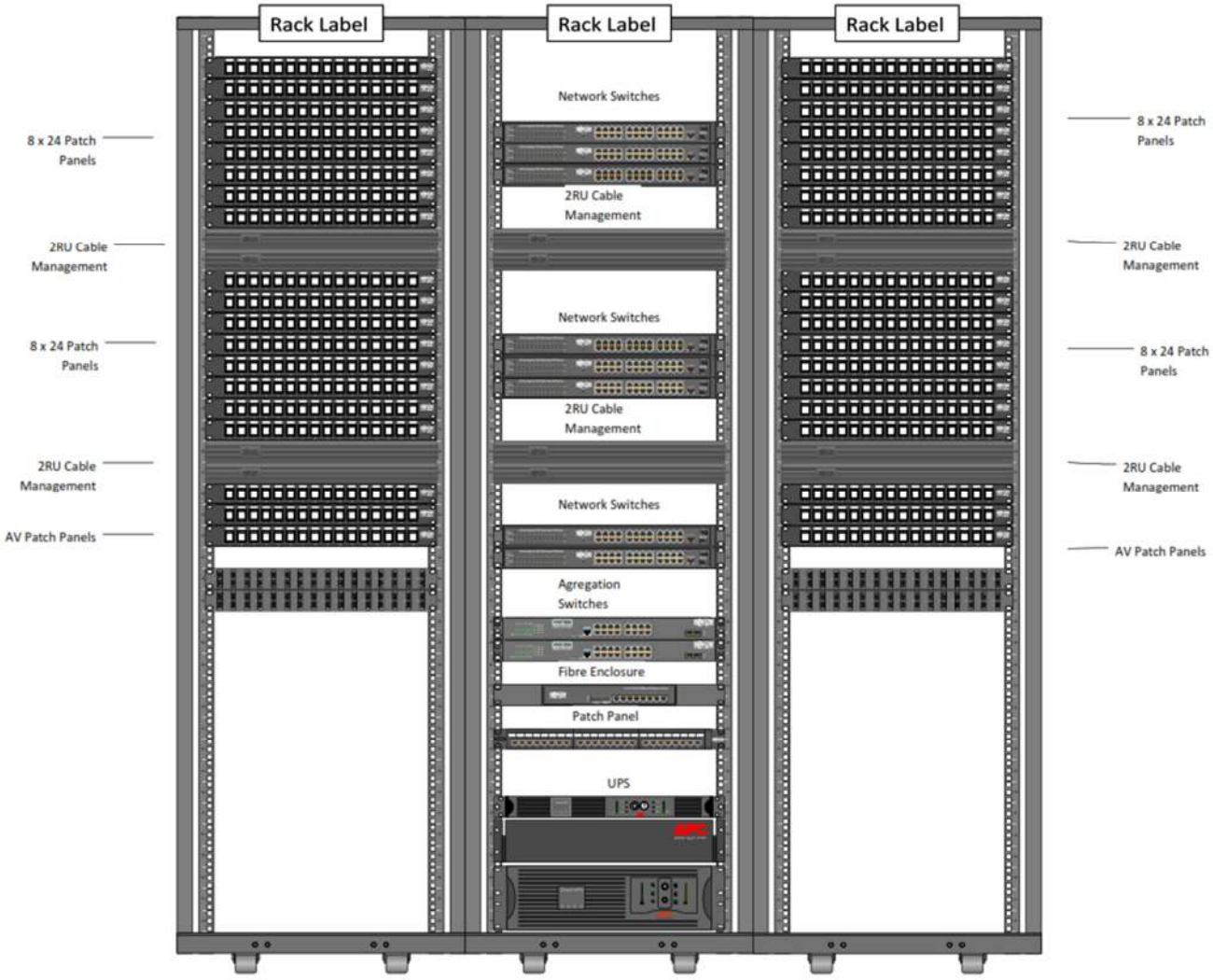
SINGLE RACK LAYOUT



TWO RACK LAYOUT



THREE RACK LAYOUT



Environment
Equipment heat loads to be determined by ITSC and appropriate solution for the dissipation of heat determined based on required equipment based on the Equipment's heat loads. At a minimum cupboard to be provided with an exhaust system triggered by an over temperature alarm.

Cupboards to be dust free and include finished ceiling and sealed floor.

Electrical Requirements
Internal lighting shall be provided. There shall be a double socket outlet adjacent to each rack. Power to each rack is to be provided with a Power Clean LF-8 horizontal power rail having 8 outlets, fixed horizontally on the middle of each rack.

Each rack should have two separate power supplies each from a separate circuit

Power outlets in riser/cupboards shall be supplied directly from UPS installed in Main Communications Room.

Ducting Requirements
Where there is more than one floor, cupboards shall be vertically interconnected by conduits or wiring access with the equivalent space of not less than three 150mm conduits.

Where more than one cupboard is provided on the same floor, cupboards shall be horizontally interconnected by conduits or wiring access with the equivalent space of not less than two 100mm conduits.

Where additional cupboards are provided on the same floor as the Communications Room, the cupboards shall be horizontally interconnected by conduits or wiring access with the equivalent space of not less than three 150mm conduits.

15.3.4. Outlets at the Workplace

All outlets shall be provided in sets consisting of a RJ45 terminated Cat 6a (Class EA) cabling or better. These outlets shall be assumed to be one for data and one spare each set of outlets shall have an adjacent double GPO unless specified otherwise.

Outlets other than those for workstations will be project specific and are to be individually determined.

If older cabling exists eg:CAT5 cabling this should be removed and replaced with Cat 6a (Class EA)

Any old cabling removed should be completely removed from ceiling cavities and patch panels and wall outlets

15.4. Facility Cabling and Patch Leads

15.4.1. Cabling to Outlets

Provide the appropriate number of Krone Highway 32 panels (or equivalent) on the rack and an RJ45 termination per wall outlet. Copper cabling shall be category Cat 6a (Class EA) cable from each RJ45 outlet located around the building in accordance with the plan. Outgoing cables shall be installed in conduit or in the ceiling space and dropped down to the skirting ducts at suitable locations. Termination of wires at the outlets shall use the pin/pair assignments specified in AS11801.

Fire sealant should be used appropriately when penetrating ceiling voids and spaces

Colour codes shall be as specified in AS11801.

Data and VoIP Patch Leads

For each data outlet provide one 3 metre lead for the connection from the wall outlet to a computer, one 2 metre lead for patching (unless required to be longer because of the size of the patch field) and one 1.5 metre lead for patching from VoIP Telephone to computer. All patch leads to be of type Molex manufacture, certified UTP category Cat 6a (Class EA) with appropriate ACA approval. All leads to be left unconnected in the appropriate Communications Room/Cupboards at the completion of the contract.

Analogue Telephone Patch Leads

For each analogue telephone identified in the project scope provide one 2 metre white Cat 6a lead due to the backbone cable terminating on 50pr voice panels. (Unless required to be longer because of the size of the patch field). All leads to be left unconnected in the appropriate Communications Room/Cupboards at the completion of the contract. Provide one 3 metre lead for the connection from the wall outlet to a phone. This lead to have a RJ45 connector on one end and a RJ12 on the other.

15.4.2. Data Distribution Cabling

Patch Panels

Provide a data distribution panel on the equipment rack below the facility patch panel in each Communications Cupboard and Communications Room and fit with one RJ45 data connector per data distribution cable.

Data Distribution Cabling

Provide additional cables between the Communications Cupboards and the Communications Room and provide additional cables between Communication Cupboards as specified by Manager, Technical Services (IT).

15.4.3. Telephone Distribution and Backbone Cabling

The requirement for telephone distribution and cabling depends on the technology requirements and services provided. As Mobile and Data technologies advance the requirement for hardwired telephone connections may be reduced. It is best to seek clarification of the scope of work to determine if this type of technology will be required at the time of the build.

Intermediate Distribution Frame

On one of the racks in the Communications Room, mount the required number of Krone terminal blocks to provide backbone cabling to the campus Main Distribution Frame (MDF) and distribution cabling to each Communications Cupboard that is fitted with a "Telephone" block. Mark the backbone block "Telephone Backbone". Mark the distribution blocks "Telephone CCXX", where CCXX is the Patch Panel identification in the appropriate Communications Cupboard as specified in Paragraph 17.8. Blocks to be electrically insulated from the rack in accordance with ACA specifications. Refer Clause 17.10 diagram for location of Krone terminal blocks on the rack.

Final Distribution Frame

Mount the required number of Krone terminal blocks on one of the racks in each Communications Cupboard or Room as required for telephone distribution cabling. Mark the blocks "Telephone". Blocks to be electrically insulated from the rack in accordance with ACA specifications. Refer Clause 17.10 diagram for location of Krone terminal blocks on the rack.

Telephone Distribution Cabling
Install a suitable size telephone pair cable from "Telephone" terminal blocks located in the equipment rack in each Communications Cupboard to the appropriate "Telephone CCXX" terminal block located in the equipment rack in the Communications Room.

Telephone Backbone Cabling
Mount the required number of Krone terminal blocks and any associated hardware on the campus MDF in the PABX room. Location on the MDF to be agreed with the University Collaboration Manager. Install a suitable size telephone pair cable from "Telephone Backbone" terminal blocks located in the equipment rack in the Communications Room to the terminal blocks on the MDF.

Telephone Jumpering
Jumpering to be provided in the Communications Room between the "Telephone Backbone" terminal blocks and the "Telephone CCXX" distribution terminal blocks.

15.5. LABELLING AND DOCUMENTATION

Labelling
Outlets on the patch panel shall be identified using the following convention:

PP« Patch Panel »-P« Panel »-« Outlet » e.g. PP25-P2-10

Number the Panels downwards from the top. Number the outlets from the top left hand of the panel across then downwards. On the Patch panel: label the top of the patch panel with the Patch Panel number; label each panel with its panel number; label each outlet with the outlet number. All labels to be engraved lettering on traffolyte hard plastic strip or a suitable approved alternative. Labels to be permanently attached to the panel.

Label each combined wall outlets with the full identification of the corresponding patch panel outlet.

Patch Panel Documentation
Documentation to be provided at each Patch Panel showing Panel to wall outlet mapping

Provide a CAD plan to the ECU Project Manager, of the building with the full identification marked on the plan against each wall outlet.

As Constructed Plans
Contractors shall provide CAD presentation of information on building and site plan disks to be provided by the University, the following "as constructed" information:

- Exact location, number off, and identification (specified in 17.8 above) for each wall outlet.
- An indication of the route between outlets and the communications room/cupboards.
- The route of any cable runs between communications cupboards and to the communications room where these are not vertically one above the other.
- For any cabling exterior to a building, the type of cable, the exact route taken, the method of construction, e.g. overhead, in duct or direct buried, and if ducted, which duct bores used.

"As constructed" plans in CAD and hard drawing format shall be available when the installation is inspected and shall be submitted to the ECU Project Manager on completion of the work.

15.6. ACCEPTANCE, TESTING CERTIFICATION AND WARRANTIES

Acceptance

On completion of the installation of the Voice/Data Cabling System check test all Voice/Data Cabling System outlets and confirm that the equipment has been installed and interconnected in accordance with the Specification and drawings and that the specified performance is achieved.

Testing of all FTP cabling shall be carried out using Level 3 handheld testers Omniscanner 3, HP wirescope, Philips fluke DSP4000 or equal approved, complete with system compatible test probe/s.

All UTP cabling shall be tested and be compliant to TIA EIA 568 Draft 6 Category 6a specifications and retested and be compliant to ISO/IEC 11801 Category 5 (enhanced).

Provide both Channel and component Cat 6a (Class EA) compliant test results.

Test all FTP cable pairs and check for:

- Continuity;
- Correct Sequence;
- Reversed Pairs;
- Transpositions;
- Split Pairs;
- Pin Assignments;
- DC resistance and continuity for each pair;
- Return Loss (must meet the Category 6a (enhanced) minimum requirement);
- Capacitance for each pair;
- Active ACR;
- Compliance to ISO/IEC 11801 Category 5E (pass or fail) utilising Cat 6a patch leads.
- Compliance to TIA/EIA 568 Draft 6 Category 6a (pass or fail)

Test all outlets for compliance utilising Cat 6a (Class EA) or higher relevant modern standard in use

Testing of all multimode fibre optic cabling shall be carried out using Optical Light Loss testing except where cables are installed such that the installer has no visual confirmation of the cable route or optical light loss test are more than the recommended losses. In these situations Optical Time Domain Reflectometer testing shall be carried out.

Testing of all single mode fibre optic cabling shall be carried out using Optical Time Domain reflectometry.

Test all fibre optic cabling and check for:

- End to end continuity.
- Correct core sequence at both ends (White-White, Blue Blue, etc.).
- Cable free from kinks and strain.
- Cable has sufficient clearances at bends.
- Cable has been supported to manufacturer's recommendation and specified.
- Cable jacket maintained as close to the point of termination as possible, within the termination unit (box, tray, etc.).
- Through Couplers are secure in termination units.
- Connectors are standards compliant and free from discrepancies, prior to termination.
- Cable has been properly stripped and prepared, all jelly cleaned from the cores, all supports removed from the inner tube, and the cores cleaned and freed from grease oils and any other impediments.

- Light losses at both ends of the terminated cable. This test must be conducted from both ends, i.e. test all cores from end 'A-B'. Then test all cores from 'B-A'. Results must be recorded for each test sequence.
- Losses must not exceed 3.0Db for the overall length of each individual core and 2 connectors.

Sufficient advance notice of testing is required to allow for the witness of tests. Complete all tests prior to Practical Completion.

All cables failing specified testing shall be replaced at no cost to the contract.

Submit two disk copies of test results.

Certification and Guarantees

Provide a performance certification and guarantee on all installed cables and connectors. The guarantee shall confirm satisfactory operation of the cabling system for the application.

The complete voice/data cabling system shall have a minimum warranty of ten (10) years, with respect to all components of the system, from the time of practical completion.

Acceptance of the installation is conditional upon testing and certification as specified below and the telephone work being inspected and tested by ACA and a Certificate of Acceptance being issued by ACA. Acceptance of the installation is also conditional upon the work being inspected by the Communication Branch of Information Technology Division of Edith Cowan University and completed to their satisfaction.

15.7. MEDIA SERVICES

General

Media services and the manner that media is employed for teaching is a rapidly changing environment. Standards therefore will be established on a project specific basis.

Designers should be aware that provision for media should be grounded on education and information need with a direction toward collaborative teaching spaces. Very broadly media services consist of display systems and audio systems and conferencing systems. In some situations these systems must work in conjunction with traditional teaching methods and tools. Location of display system and controls must take into consideration size of facility and the way the facility is to be used.

Trailing cables which result in trip hazards are to be avoided.

In general media services are user driven with minimal support, user friendliness is an imperative. In situations such as general teaching area and bookable meeting spaces help is provided via telephone. Ensure a telephone outlet is provided for these facilities. This telephone must be located as close as possible to the lectern/lecturer's teaching area.

All Teaching and conferencing spaces should be designed for minimal light interreference and audio acoustic optimisation.

The latest AV standards can be provided by the collaboration team upon request.

15.8. CONTRACTORS AND EQUIPMENT

Any work carried out on University Media Services can only be done by contractors approved by the IT Collaboration team and be specified as an approved contractor by the University Procurement Hub. All equipment and cabling specification used must be as per the teaching and collaboration space specifications. Technical specifications and schematics can be provided by IT Collaboration.

Larger projects will require an AV contractor for scoping and design of specialised AV systems.

15.9. ANTENNAE

In general all buildings are to be fitted with a free to air antennae system with the ability to connect at each floor provided in nominated communications cupboards.

15.10. SECURITY OF EQUIPMENT

All media hardware to be provided with adequate physical security – padlocked mounts for projectors; lockable tethers for LCD screens; lockable cupboards for equipment etc. All equipment in a room must be keyed alike, as per AV Cabinet or lectern keys specified earlier.

Any lockable cabinets or AV enclosure must allow access to service and support AV devices. These cabinets are to be designed with heat dissipation in mind, and active airflow is encouraged in spaces housing large quantities of equipment.

16.0 FIRE SERVICES

ECU – Standard for Fire Indicator Panels and Fire Plans
Ampac fire panel or equivalent, to network all FIP panels to isolate and de-isolate areas and fire alarms. Provide a software package so it can be operated remotely on PC in fire room/security

FIB display – e.g.

Top Line – Bldg. 4 Level 2 West Zone 5
Bottom Line – Zone 5 Loop 3 S24

Fire Plans
- Must be colour.
- Show each Zone in different colours (same colours can be used on a different floor).
- Fixed to wall and laminated.
- Minimum size – A3.
- Electronic version .DWG to be provided but If a soft copy (CAD) is not available due to legacy conditions, then allow to redraw
- Fire plans to be updated to reflect changes to internal office areas.

Password – 3333

16.1. GENERAL

Each building shall be provided with a system of fire protection in accordance with relevant codes and standards. Each individual system shall be designed and installed in such a way as to guarantee the maximum insurance rebate allowable for that system.

The Project Architect shall consult with the Fire Brigade at the earliest possible stage in the design process so that the Fire Brigade's requirements are met and delays will not be experienced at the building occupation stage.

This section of the Engineering Standards outlines the University's minimum requirements for the following types of Fire Protection Systems:

- Automatic Fire Alarms.
- Hydrants and Hose Reels.
- Hand Extinguishers.
- Automatic Fire Sprinklers.
- Special Systems as required e.g. gas extinguishing systems, high velocity water sprays.
- Lightning surge diverter protection required to fire alarm lines.

Note code requirement for Public Building exhaust to outside air in event of fire.

16.2. PREFERRED CONTRACTORS

Contractors either tendering or working on projects at Edith Cowan University must be approved by the Technical Electrical Officer.

16.3. Fire Alarms

16.3.1. General

Generally, a fire alarm system is required to all buildings with independent FIBs connected back to the main site FIB and to the Fire Brigade. This requirement also applies to refurbished buildings.

All fire alarm systems shall be provided with a fire plan drawing adjacent to the fire panel. The drawing shall be to scale and of a size that can be easily read from 1m away. Any alterations to the building or fire system to be recorded on the fire plan.

Fire panels to be changed to show new or additional room numbers.

16.3.2. Emergency Warning and Intercommunications Systems (EWIS)

For each project, an Emergency Warning and Intercommunications system shall be installed subject to funds being available.

The system shall be in accordance with AS1670.4 / AS ISO 60849 (most current version overrides). The EWIS panel shall be located next to the fire indicator board in the entry foyer and connected to every warden intercom point and to be a system for distributed loudspeakers on every level. It shall provide an AV termination signal that can be used by AV equipment to ensure adequate coverage of teaching spaces and meeting/collaboration areas. The EWIS system shall be activated to the alert mode on the occurrence of all or any of the following:

- Activation manual call point
- Activation of smoke/thermal detector.

Facility such that the operator can override the system and include any of the following functions to all or any part of the building by using one specific button for each function:

- Alert tone
- Evacuate tone
- Public address systems.

The EWIS panel shall have illuminated push/hold and push/release button for each intercom point on every level of the building.

Intercom points shall be installed in the immediate vicinity of the fire stair exit and in all fire hose reel cupboards.

On commissioning, sound level readings shall be taken for all rooms including plant and associated areas. A minimum sound level shall be attained for each room of 75Db. Note strobe lights to be used in conjunction with audible alarms in areas with equipment which require occupants to use hearing protection.

16.4. Automatic Fire Alarms

16.4.1. General

In general all buildings shall be equipped with automatic fire alarms connected via the building's Fire Indicator Board, to the local Fire Brigade.

16.4.2. Detection

In general the buildings shall be protected with ceiling mounted smoke detectors and thermal alarms in ceiling spaces or harsh environments in accordance with the requirements of AS 1670, Automatic Fire Detection and Fire Alarms.

Thermal alarms shall be of the electro pneumatic, compensating rate of rise type. Thermo pile and solid-state alarms are also acceptable. Detectors shall be in accordance with the requirements of AS 1603.

Smoke detectors (photoelectric type) should be used where early warning is required in areas such as sub stations, switch rooms, P.A.B.X. and M.D.F. rooms.

Smoke detectors (obscuration type) should be used in air conditioning systems in supply and return air systems to comply with the requirements in AS 1670.1:2018. Special areas should consider multi-point aspirating smoke detectors (e.g. VESDA)

Consideration should be given to an intermixing of smoke detectors of both types in areas such as computer rooms and rooms containing sophisticated electronic equipment particularly where air movement is considerably high. All detectors shall be provided with neon or L.E.D. indicating lamps.

Note: Break glass alarms are also required in all laboratory areas, corridors and foyers. Concealed space detectors shall be equipped with remote neon or L.E.D. indicators labelled with the type and location of the detector.

16.4.3. Sub Fire Indicator Board

Each building shall be equipped with its own Fire Indicator Board showing all alarm circuits. Allow on each Sub Fire Indicator Board a minimum of 25% spare space. A maximum of 30 thermals or 15 smoke detectors shall be provided on any circuit.

It is essential that all fire indicator panels on each campus be configured identically. Unless otherwise directed fire panels to be Ampac Fire finder fully addressable analogue type.

The building shall be connected via the Special Services Cable to the Site Fire Indicator Board/Fire Alarm Multiplexers from which an alarm will be transmitted to the Brigade. Provision shall be made for all connections fees etc. and modifications necessary to the site plan forming part of the Site Fire Indicator Board. Each F.I.B. shall also be linked via a DGP point in the building to indicate an alarm on the BMS.

Fire Indicator Boards shall be placed in a position easily accessible to the Fire Brigade from vehicular access and the position of the F.I.B. should be checked at documentation stage with the relevant parties. The University has generally standardised on F.I.Bs being located behind an unlocked door sign written in accordance with the code. Signs on the doors are provided by the University.

All to the requirements of AS1603 "Control Indicating Equipment".

16.5. Hydrants and Hose Reels

Hydrants are to be provided to serve all buildings in accordance with the BCA and appropriate Australian Standards. In General each level of a building shall have sufficient unequipped Brigade landing valves such that no portion of that level is more than 30m from a hydrant. Hose reels should be placed at or adjacent each hydrant and should be a minimum of 36m x 20mm I.D. hose. Hydrant systems shall be designed to provide water within the range of pressures specified by the BCA and Australian Standards. Brigade booster connections, if required, shall be provided in accessible locations for all buildings. Pumps shall be provided if required to meet design pressure. The system is to be subject to a Fire Brigade test for approval.

Provide signs (coiled hose reel design) mounted at right angles to the wall to signify location of hose reels and hydrants.

Fire hose reel nozzles, etc., to comply with the following:

- Hose reel gate valve must lock end of hose nozzle to hose reel and retain it in that position when not being used.
- To permit hose nozzle to be detached from hose reel gate valve, the gate valve must be released which will at the same time allow water to flow into the hose. When the hose is unraveled and taken to the fire, water is released upon turning on of the hose nozzle.
- Hose reel cupboard doors to be painted a distinctive colour which is different to all the other doors.
- Consultants are to organise formal certification from the Fire Brigade that location of units and operation of system is in accordance with Regulations.

16.6. FIRE EXTINGUISHERS

Fire extinguishers shall be provided to all areas in accordance with Fire Services requirements. In general the following extinguishers should be used for standardisation and shall be provided under the contract:

General office areas	2kg carbon dioxide extinguishers to be in reception or office areas where photocopiers, facsimile machines, multiple computers occur
Cooking areas	4.5kg dry chemical powder (B.E. Powder) extinguisher plus blanket 1200 x 1800
Switchboards and/or Transformer rooms	Carbon dioxide or dry chemical (4.5kg)
Laboratories	Carbon dioxide (4.5kg) plus Dry chemical (4.5kg) and 1200 x 1800mm fire blanket
Computer rooms	3.4kg carbon dioxide
Computer laboratories	3.4kg carbon dioxide
Plantrooms	Carbon dioxide (4.5kg) and dry chemical (4.5kg)
Student Housing kitchens	Dry chemical (2.5kg) and fire blanket

Extinguisher spacing to be based on BCA and AS2444 requirements

Other extinguishers should be used where the risk so demands. All extinguishers shall be provided with coded location signs and usage signs in accordance with the requirements AS1851:2012.

Maximum size of extinguisher (excluding water storage type is to be 4.5kg and minimum size to be 2.2kg.

In general only extinguishers approved by the SAA will be acceptable.

Extinguishers which require inversion for operation shall not be specified.

Extinguishers shall be installed in accordance with the requirements of the Fire Brigade, installed at a height of 1000mm above floor level and in accordance with the requirements of AS 2444 (Portable Fire Extinguishers Selection and location).

Provide signs at right angles to the wall to signify location of fire extinguishers.

Maximum walking distance between water extinguishers to comply with code with minimum extension size.

Where deep fryers are installed, extinguisher to be located next to exit from the room.

Carbon dioxide, foam and dry chemical extinguishers are preferred for flammable liquid fires (BCF is deprecated for this purpose on environmental grounds).

Water extinguishers are not to be used on fires associated with electricity/electrical equipment nor on flammable liquids.

Foam extinguishers, being water based, are not suitable for use on electrical equipment.

16.7. Fire Blankets

In kitchenettes and cooking areas and laboratories, provide and install under the contract a 1200mm x 1800mm fire blanket.

16.8. Automatic Fire Sprinklers

Sprinklers must be installed in areas where required by Australian Standards, National Construction Codes or Authority requirements. Refer to AS 2118, etc. In general, any area should be considered individually and a proposal for Sprinkler Protection should be discussed with the University prior to documentation.

16.9. Special Systems

In certain applications consideration may be given to special systems such as:

- Common systems include Inergen, Argonite, FM-200 or Novec 1230extinguishment systems.
- High velocity water spray systems.
- High expansion foam systems.
- Tail end dry pipe.
- Pre-action systems.

Any proposal for any of the above systems should be discussed with the Project Manager Buildings prior to documentation.

17.0 SECURITY SERVICES

17.1. GENERAL

17.1.1. PREAMBLE

Designers interpreting these guidelines are to understand that changes to technology and policy may outpace the content of these guidelines. Prior to calling of tenders for any work related to ECU Security the following must be approved by the Security and Traffic Services Manager:

- Access control/ security management plan. Plan must clearly indicate strategy for prevention of unauthorised entry and the access paths for users who would enjoy access to defined areas only.
- Schedule of equipment. Door locking devices; door closing devices; card readers; control buttons; CCTV cameras and enclosures, Network Video Recorders (NVR's).
- Location and type of security phones.
- Schematic wiring diagrams and cable specification.
- List of potential tenderers for access control.
- List of potential tenderers for video surveillance.

All facilities that require 24-hour access and contain equipment of high value must be provided with CCTV surveillance and access control. Rooms or areas which would require controlled access for many people are to be provided with access control (this includes any area which would require the issue of more than 6 keys).

17.1.2. PREFERRED CONTRACTORS

Contractors either tendering or working on projects at Edith Cowan University must be approved by the Security and Traffic Services Manager. Projects include both new builds and Renovations.

Security Consultant/Lead Consultant to develop a comprehensive Security Management Plan in conjunction with Security and Traffic Services Manager, ECU Project Manager and relevant Campus Support Manager.

Security Plan to:

- Provide access control all to ground level access points thereby securing the perimeter.
- Compartmentalise building into manageable portions and allow for access control to these portions.
- Identify any security risks and provide access control to these areas.
- Provide access control to any area or room which would require the issue of more than 6 keys.

17.1.3. EQUIPMENT TO BE PROVIDED

The security contractor is to supply and install the security system complete with all cabling, documentation, operational equipment, required software, fittings, finishing, and appropriate connection to existing systems. Consultants and contractors shall abide by the relevant legislation and Australian Standards. The security contractor is to install all necessary conduits and wiring access for facility cabling.

17.1.4. SYSTEMS INTEGRATION

All electronic security systems shall be fully integrated through the utilisation of the existing Gallagher system, and CCTV digital surveillance network. The Gallagher system's primary function is to integrate all access control systems, intrusion alarm systems, future security systems and future Intelligent Building Systems. The ISMS and the digital surveillance systems communicate with sub-systems and field equipment over the existing Security Systems' Virtual Local Area Network (VLAN).

17.1.5. LICENSING

The designers of the University's security systems shall be licensed security consultants and the employer of the designers must be a licensed security agent. Similarly security installers must be licensed. Copies of the employer's Security Agent's licence and the actual designer/specifier's licence and installers licence shall be forwarded to the Security and Traffic Services Manager prior to commencing work. Please note that it is illegal in Western Australia for a company or individual to design, specify, or install security measures without the relevant licence. Unlicensed personal and companies will be barred from security design and installation work at ECU.

17.2. CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN (CPTED)

17.2.1. GENERAL

The University requires attention towards the environment to complement and enhance the security of the campuses. Crime Prevention Though Environmental Design is an approach to preventing crime where its objective is to improve security by limiting criminal opportunity using natural barriers and natural surveillance. Where possible, the University prefers CPTED to be used in conjunction with traditional electronic, mechanical, and structural crime prevention techniques. When conducting security related work, consideration shall be given to the following:

17.2.2. TERRITORIALITY

Territorial reinforcement of an area is the physical design that helps develop a sense of territoriality by the user that produces a perceived risk to an intruder. This shall be achieved using clearly defined perimeters by way of barriers (fences, hedges or rows of trees) and other visual indicators (changes in ground lay material, lighting levels or wide-open spaces). Where applicable, the security designer shall demonstrate territoriality in instances that require the restriction of individuals.

17.2.3. NATURAL SURVEILLANCE

Keeping intruders under observation will result in a higher perception of detection. This shall be achieved by techniques that minimise the opportunities for intruders to conceal themselves and their actions. Large glass windows, well-kept gardens, lighting and wide-open spaces will increase the natural surveillance of an area. The effectiveness of electronic CCTV systems is further increased when natural surveillance techniques are employed. Where applicable, the security designer shall demonstrate natural surveillance particularly in the vicinity of CCTV cameras.

17.2.4. NATURAL ACCESS CONTROL

The prevention of access to an area and the creation of the perception of detection and increased effort required by an offender constitutes Natural Access Control. Lighting can be employed to control the movements and concentrations of people. Individuals will be attracted to brightly lit areas at night. Natural Access Control shall be utilised to provide an increased level of safety for authorised individuals.

17.3. ELECTRONIC ACCESS CONTROL SYSTEMS

All future electronic access control systems shall be compatible with the existing Gallagher access control System. Any technologies used will be compliant with existing standards in use and operated through the University's

Security Systems' VLAN and contactless cards. The University's Manager, Technical Services (IT) must be consulted to ensure appropriate ports and IP addresses are available for access to the network.

This may include any aspects of facial recognition and person tracking throughout the building to be included and implemented within CCTV coverage

All lockers to be used should be fully integrated with the access control system to allow release when codes/cards are forgotten and auditing of usage.

Toilet Duress buttons

Supply, install and commission duress alarms in the disabled toilets. The alarm system to consist of an alarm button, a sign in the toilet and two flashing/buzzing lights (one just outside the toilet and another in a general area) - refer to photo 1, 2 and 3 below. A parallel signal from the button to be wired back to the security system to be included in the access control monitoring system relayed back to the Security Control Centre

Photo 1

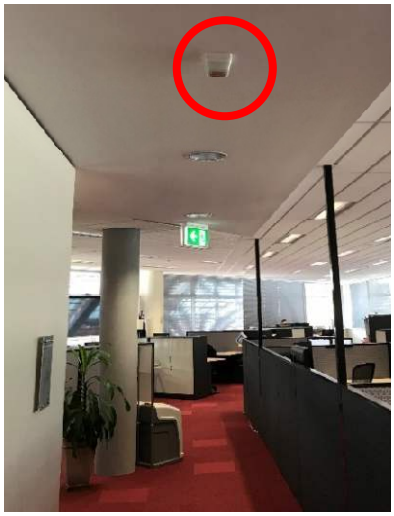


Photo 2

Photo 3

17.4. ELECTRONICALLY OPERATED DOOR LOCKS & HARDWARE

All auto doors should be fully integrated (with all necessary options boards) to allow for modification of operation through the access control system

Unless otherwise approved. Configuration of hardware to be restricted to the following:

- Auto Door – Card Reader, auto door interface card, door release and break glass.
- Swing Door – Electric Lock, card reader, reed switch, DOTL and door sounder.

17.4.1. ELECTRO-MECHANICAL MORTISE LOCKS

Unless otherwise specified, all new doors requiring electronic access control shall be fitted with electro-mechanical mortise locks from the Lockwood 3570 series, configured for fail safe but with an internal free handle to allow egress; and external locked handle for entry. These will require locks to be fitted to allow for manual key override.

Door furniture shall be from the Lockwood 3580 series and the handles shall be model number 1070 with a square end and radius corners.

A "request to exit" push button is required for exit. A break glass is required for emergency egress.

Provision of door sounder to be confirmed.

Purpose designed concealed door loops type DL-400, an equivalent approved, shall be utilised and where practicable doors shall be pre-wired for the locks, or wiring channels shall be utilised. The conduits and termination boxes shall be purpose designed for this application and shall be as small and secure as practicable. General-purpose conduits will not be acceptable.

17.4.2. Electromagnetic Locks

In cases where it is not practicable to install an electric mortise lock (e.g. some existing doors) an electromagnetic lock may be utilised. The holding mechanical force of each electromagnetic lock shall be a minimum of 2000N. Some doors may require 4000N. The designer shall determine the force required and make calculations available to the Security and Traffic Services Manager. The lock shall be suitable for installation on glass frame doors where applicable. The contractor shall provide all necessary rigid metal supports to ensure that the locks are always secured firmly.

Locks installed below the minimum doorway height specified by the National Construction Code of Australia or relevant legislation will not be acceptable.

All surface mounted electromagnetic locks shall incorporate a concealed built-in door status sensor.

Doors that are installed with electromagnetic locks shall also be fitted with a mechanical key lock. The mechanical lock shall be installed with a lock cylinder on the insecure side of the door plus a holdback cylinder for retracting the bolt by key operation. While the electromagnetic locks are operational the holdback feature would be in use. However during times when electromagnetic locks are without power, the holdback cylinder on the mechanical lock shall be released by key holders to allow operation of the mechanical lock as an automatic dead latching lock. A free handle shall be utilised on the secure side of the door. The handle on the insecure side shall be key lockable. The cylinders shall be keyed to match the existing master key system.

A ‘request to exit” pushbutton is required for egress. A break glass is required for emergency egress.

17.4.3. Electric Strikes

Electric strikes are not to be used unless the ECU Project Manager or Security and Traffic Services Manager specifically requests this type of locking mechanism on a particular door. Electric strikes shall be from the Padde ES2000 series with compatible mortise locks from the Lockwood 3500 series, or similar, and shall be fail safe.

The cylinder shall be keyed to match the existing master key system. The key override shall be monitored in a manner that generates an alarm at the integrated security management system (e.g. using a tongue sensor in the strike).

A ‘request to exit” pushbutton is required for egress. A break glass is required for emergency egress.

17.4.4. Door Openers and Closers

Where the ECU Project Manager requires an auto-door opener for a swing door it shall typically be a Dorma ED 200 or equal. All other electrically operated swing doors must be fitted with a good quality hydraulic door closer. The closer should be mounted on the secure side of the door. The closing power shall be sufficient to consistently and reliably close the door sufficiently for the electric locking device to engage and secure the door.

In the case of an existing door closer, it may need to be replaced to ensure sufficient closing power and it must be located on the secure side of the door.

17.4.5. Reed Switches

Each door controlled by the electronic access control system shall be monitored by a reed switch. Reed switches may be incorporated into the electric locking mechanism. In this case the reed switch must be installed and wired in accordance with the manufacturer's instructions. If an integral reed switch is not available then a separate reed switch shall be installed at the head of the door and be recess mounted in the door frame. The magnet shall be mounted in the top edge of the door. In the case of an integral reed switch in an electro-mechanical mortise lock, the magnet for the reed switch shall be mounted in the doorframe at the position recommended by the lock manufacturer.

17.4.6. Push/Pull Labels

Where required by the ECU Project Manager, the door pull plate shall be labelled "PULL" and the door push plate shall be labelled "PUSH". The labels shall be manufactured from brass with a satin chrome finish and etched with 19mm high letters.

17.4.7. Card Reader Location

All card readers shall be located within the range of access of the card with a minimum of 1cm (10mm) additional clearance to allow for RF interference.

Reader must not be mounted behind glass.

17.5. Card Control

17.5.1. Contactless Smart Card

The access control card shall be a multi-application contactless smart card incorporating MiFare Classic & Mifare DesFire hardware technology. It shall be fully compatible with existing smart cards in use at the University. The smart card must incorporate access control and identification technology, which utilises radio frequency (RF) circuits in microchip form. The microchips shall be encoded and transmit the encoded information when activated. The thickness of the smart card shall be like a bank/credit card.

The suitable contactless smart card shall have the following characteristics:

- The smart card shall be capable of operation with any of the existing university smart card readers. It shall be a polycarbonate or PVC based card.
- The smart card shall have the facility to allow direct printing on one surface using the existing card printer.
- Card identification must be consistent with the existing series in use at ECU and must utilise ECU's existing facility code.

The card shall comply with ISO 14443 for contactless transmissions. For most projects, contact cards are not required. However should there be a specific requirement for contact cards they shall comply with ISO 7816 parts 1-10.

Access cards and the system should be fully integrated to the university system and compatible with future (Desfire 2) cards to be used by Transperth.

17.5.2. Card Readers

The access control card readers shall be used for access to certain rooms. As a rule egress readers are not to be utilised. However where the ECU Project Manager or Security and Traffic Services Manager specifically requests an egress reader for a room it shall be like an access reader. Card readers shall possess the following minimum features:

- The card readers shall support contactless smart card technologies and be resistant to tampering.
- All card readers shall display at least two separate and distinct visual signals to indicate to the user, whether access is granted of denied and whether the door is locked or unlocked.
- Card readers shall have a built-in antenna providing a read range of at least 5cms and be Bluetooth enabled wired into an HBUS port on the Controller.
- Where required by the ECU Project Manager, card readers shall be of a design that may be hidden behind a panel. Where mounted on dark timber panels, card readers shall have brushed aluminium surround to make them obvious.

Card readers shall be mounted 900m above floor to allow easy access for people standing or sitting in a wheelchair.

17.5.3. Egress Control

Unless otherwise directed by the ECU Project Manager or the Security and Traffic Services Manager, normal egress control through doors fitted with either automatic opening operation, electromagnetic locks or electric strikes shall be affected using a simple “request to exit” push-button. The push-button shall be black with a white surround and be large enough and conveniently positioned to be operated by persons with disabilities and able-bodied persons.

On doors controlled by automatic opening operation electromagnetic locks and fail-safe electric strikes it will be necessary to install an emergency break glass release pushbutton on the secure side of the door. This break glass shall be used to disconnect the electrical power to the local fail-safe electric door lock, bypassing the control circuit. The surround for the break glass shall be white and be suitably labelled. Configuration of break glass on auto doors. If activated external PIR disabled however door to be able to be manually operated. Internal PIR to remain enabled.

Request to exit buttons and emergency egress break glass buttons shall be mounted at 900m above floor level in a position easily accessible to people standing or sitting in a wheelchair.

In a fire alarm situation the power to electric locks within the alarm zone shall be cut.

17.5.4. Field Controllers Panels

Existing field controller panels shall be utilised wherever possible. If a new field controller is necessary, it shall be installed at a position to be approved by the ECU Project Manager, Security and Traffic Services Manager and the Manager, Technical Services (IT). The Manager, Technical Services (IT) must be consulted to arrange for provision of a suitable port, IP address and connection to the Security Systems VLAN.

Field control panels shall only be installed in secure areas. Typically communications cupboards.

17.6. Closed Circuit Television

17.6.1. General

a) The University utilises an IndigoVision IP base licensed CCTV system, compatible with onvif protocol devices. The University is agnostic to Sensor advances and requires that all devices used be the relevant technologies available at the time of project completion. The Security and Traffic Services Manager will determine what system will be utilised based on suitability to the application.
b) All CCTV systems are to be IP Based and compatible to the system in use at the time of project completion.
c) 3rd party integration software (middleware) is not to be used at any stage of design or implementation within the CCTV system.

17.6.2. Network Video Recorders (NVR).

NVRs are to be in a secure area accessible by security personnel only.

Windows based NVR infrastructure will be considered the standard, with standalone specialised NVR's being available only in specific circumstances.

NVRs shall:

- Utilise a decompression algorithm suited to codec type used by the cameras (MPEG4/H.264)
- Incorporate separate host processors to perform video operations and other necessary options ensuring that video performance is not affected during processor loading, including during playback of stored video streams.
- Incorporate Windows based architecture for incorporation into the existing system and shall include standard security.
- Have the capacity for up to 64 devices but shall have a maximum of 20 connected devices to allow storage management and future capacity.
- Be supplied with support for minimum RAID5 technology.
- Locally and automatically perform disk space management.
- Be fully configurable via the connected network utilising administration credentials.

Movement Detection
The system shall have the ability to detect movement and be programmable to record at a higher resolution when movement is detected. Movement detection shall be performed at source on the host processor to ensure scalability and reliability. The system shall be fully configurable, including five modes of operation, sensitivity and delay time. Any movement detected after hours shall initiate an alarm signal. Alarm information shall activate corresponding camera or cameras to view alarm area or area most relevant to alarm area.

CCTV Cameras and Lenses
Cameras to be capable of industry standard identification (dependant on application) as set out by the UK Home Office CCTV standards. Approved fixed type and shall incorporate a ratified form of video compression being MPEG4/H.264 codec guaranteeing full frame video of minimum 1080p Quality when displayed through the Indigovision head end software.

Lens specification such as focal length, aperture, field of view, to suit application and to be confirmed by the Security and Traffic Services Manager or an approved delegate

Tamper alarms shall be active twenty-four hours per day regardless of other timed settings.

NVR to be Windows based IndigoVision server

Where practicable, all DVR infrastructure should be replaced with digital CCTV and NVR technology. When this is infeasible, the existing CCTV workstations and digital video recorders (DVR's) may need software and/or hardware upgrades to accommodate additional cameras. The designer shall determine the specific requirements.

The designer must seek approval from the Security and Traffic Services Manager for the location (and type) of proposed CCTV cameras, NVRs, monitors (where required) and workstations. All camera applications shall comply

with the requirements of relevant legislation and be employed in such a way that the opportunity for abuse is minimised.

Cameras and lenses
All CCTV cameras and associated lenses shall be of sufficient quality for commercial application. All applications of cameras within the University shall utilise robust anti-vandal domes. In applications where cameras are facing windows or areas where there is expected to be large differential changes in the ambient light levels dynamic auto adjusting cameras shall be used. In all other installations where the light levels are to be more consistent, the standard High-definition cameras will be used.

Where practicable, a guaranteed high degree of colour night vision is required by all external cameras installed.

Ensure lighting control is compatible with camera selection. In areas where motion detectors are used to control lights critical lights should not be able to be isolated by the light switch.

Outdoor mounting brackets shall be of a heavy-duty construction suitable for supporting the combined weight of camera, lens and housing. The brackets shall be suitable for wall and/or pole mount applications.

Under no circumstances shall CCTV cameras be installed in either indoor or outdoor applications without an appropriate housing. The final selection for camera housing and mount shall be made with consideration towards the field of view, vandalism/tamper and the prevention of moisture and dust penetration. The final selection must be approved by the Security and Traffic Services Manager.

Recording and Archiving
Where Practicable all images captured from CCTV cameras shall be recorded on a digital video recorder located in the immediate building (typically in a communications room or cupboard). This recorder shall have the function to simultaneously record images from at least 16 cameras and provide playback over the Security Systems' VLAN.

The connection to the VLAN may only occur after express approval of the University Manager, Technical Services (IT) and after the necessary network connection fees have been paid (i.e. port provision plus rack space in existing racks).

NVR storage disk sizes will be consistent with 60 days retention of all installed cameras with an additional 10% redundancy. All calculations are to be based on maximum frame rates of the approved cameras.

Manual archiving of recorded images will be achieved remotely by way of an existing University systems backup drive located in the CCTV workstation in the Joondalup campus Security and Traffic Office.

17.6.3. Housings and Mounts

All CCTV cameras installed within the University shall be appropriately mounted and contained in housing suitable for the immediate environment. Consultation on mounting heights and location should be undertaken with ECU security.

Housings installed in indoor environments can be of the plastic dome type or turret style cameras .

Individuals in the camera's field of view must be able to clearly see the camera through the housing. Unless determined otherwise by the Security and Traffic Services Manager, housings installed in outdoor environments are to be of a weatherproof metal and plastic construction with fitted sunshield. The housing shall be a size that will fit the selected camera and lens with room for necessary cabling.

17.6.4. Vehicle zones and bollards

All CCTV where vehicles operate should have ANPR capability which fully integrates into the existing ANPR solution within ECU. This should include all loading zones and pick up and drop off areas

All bollards should be automated within the ECU security system and include IP based intercoms that connect directly to the security control room. At all of the automatic bollard points CCTV should be available to show both the vehicle (including plates) and occupants of the vehicle (I.e. driver and any ID as held up to a camera)

17.6.5. CAMERA AND INTERCOM LOCATIONS

- All vertical transport including Lift and Stairwell
- All external access points shall be fitted with an IP video intercom fully configure to the University access control system.
- Building external perimeter providing full coverage
- All common areas
- All areas identified as of interest to Security

17.7. INTRUSION ALARM SYSTEMS

17.7.1. GENERAL

Intrusion alarm systems must only be used for a specific purpose and approved by the Security and Traffic Services Manager. Where possible system must be integrated with the access control system - use of keypads to arm and disarm intrusion alarm system is to be avoided.

Intrusion alarm systems shall be managed by the Gallagher System by way of an existing alarm workstation on each campus and portable devices as applicable.

17.7.2. ALARM DEVICES

The nature of the integrated system shall allow intrusion alarm devices to be either dedicated or incorporated into other security devices. For example, dedicated alarm devices may comprise of volumetric intrusion detectors, and integrated alarm devices may constitute CCTV motion detection.

The University prefers Passive Infrared (PIR) detectors for the detection of volumetric movement. The success of these detectors, measured in terms of low false alarm rates and nuisance alarm rates, is dependent on the way the detectors are installed. To maximise the effectiveness of these detectors, consideration shall be given to the following:

- PIR detectors shall not be positioned towards direct sunlight, objects of high temperature or where there is likely to be rapid changes in ambient temperature.
- Where possible, PIR units shall be positioned so that people in the field of view are forced to walk across the face of the unit, instead of towards it.
- PIR detectors shall not be installed in outdoor environments (unless it is a type especially designed for outdoor use).
- Where possible, PIR units shall be installed in a way that they are less vulnerable to tamper and vandalism. This includes the use of tamper alarm circuits.

All alarm cables from the field controller to the alarm device shall be monitored using dual end-of-line resistors. The end-of-line resistors shall be installed in each alarm device housing and configured to sense current and voltage changes on the alarm signal and the tamper signal wires. Any change in voltage or current shall initiate an alarm at the field controller and the operator station.

The Security and Traffic Services Manager reserves the right to reject any design or device that is deemed to be of an inadequate security standard.

17.8. Field Hardware Communications

Field hardware communications between TCP/IP addressable security devices and workstations shall be via the existing Security Systems' VLAN. The University Manager, Technical Services (IT) will make available a reasonable number of Ethernet RJ-45 ports at each campus to enable the connection of the contractor's equipment to the Security VLAN (typically achieved in a communications room). There is a charge for this connection. Similarly, if the designer proposes to use existing IT rackspace (e.g. for NVRs) then the University's Manager, Technical Services (IT) will also charge for the space used. The designer should consult with the University Manager, Technical Services (IT) to determine the current charges. It is also very important that the designer ensures that IP addresses are made available for access to the Security VLAN. The IP addresses are available from the University Manager, Technical Services (IT).

The contractor shall be responsible for the supply and installation of any additional networking equipment necessary to interface to the security VLAN. The security contractor shall be responsible for all cable terminations necessary to make the security system fully functional.

Radio reception within the building should be maintained using the universities existing digital radio solution (Hytera) and be fully integrated into the existing Hytera system. Signal testing needs to be conducted to ensure radio signal is available through the building.

17.9. Key and Locker Management

Key Management
All Master keys and Service keys are to be stored on an Electronic Key Locker that is programmed to operate using the current University Key Watcher key management system. The Electronic Key cabinet must be installed in a secure staff only area and be covered by a dedicated CCTV camera.

Electronic Key cabinet
The cabinet size and capacity must be determined in consultation with the ECU STS team.

Lockers
The staff and Student lockers installed must be compatible with the ECU Access Management system (Gallagher) and be programmed to allow Management through the ECU Control room.

The Locker area must have CCTV coverage.

17.10. Power

17.10.1. Main Power

Unless noted otherwise in the contract documents, the security contractor shall supply and install all necessary power cabling, trunking, circuit breakers and distribution boards, necessary to make the security systems operational.

All vertical cables shall be installed in risers or ducts unless otherwise approved.

The security contractor shall install all necessary power circuits from the existing distribution board to suitably placed power outlets in the communications room, cupboard or riser.

17.10.2. Uninterruptable Power Supply

Where Practicable, all security systems shall continue to be fully operational for at least two hours after mains power failure.

Where practicable all network connections associated with the CCTV system should also be on UPS power supply to maintain connection between cameras and servers.

17.11. Fire Monitoring and Emergency Management

The building shall be fitted with Automated fire monitoring and remote fire zone isolation to enable security response.

A digital radio communications system should be considered for all fire warden points which communicates directly with the security control room.

The building shall include a configurable (by floor, and combined floors) Emergency building occupant warning system. This should be fully integrated into the existing Barix system currently in service at ECU.

17.12. Space management

All spaces should be able to change security zone without modification to physical systems e.g. public zone should be configurable to a student staff only zone or a secure zone through software and process modification rather than changes being required to physical infrastructure i.e. should be built to accommodate staff/student only zones as a minimum requirement.

Space utilisation sensors should be installed, configured and fully integrated into the existing ECU space utilisation software.

Person tracking within the building should be utilised wherever possible.

Any local security control room should be fitted (as a minimum) to replicate the main security operations control room located on the Joondalup campus. (this is to provide redundancy)

All stairwells should have controllable and configurable anti-linger (audio) deterrent devices which can be operated through the building access control system.

17.13. Documentation

Project Documentation
Consultants and Contractors shall provide the University with all relevant documentation. Provide an AutoCAD plan of the building to the ECU Project Manager detailing all specifications of the security work performed.

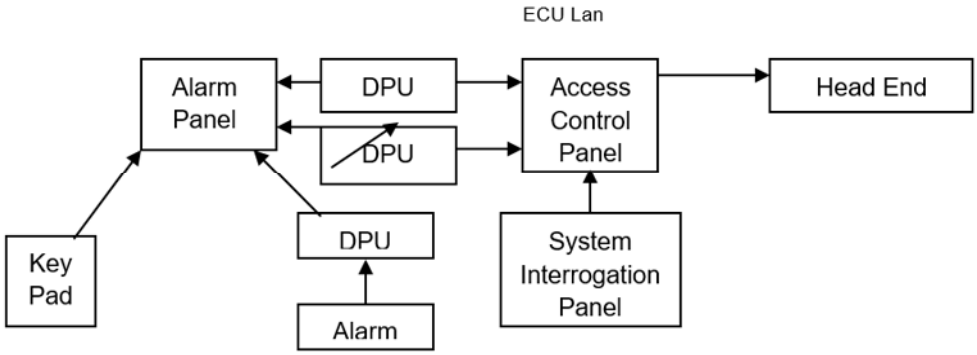
As Constructed Plans
Contractors shall provide to the University AutoCAD drawings indicating project information in the following manner:

- Exact location, number of, and identification of each security component. In the case of CCTV cameras, an indication of the direction to which they point, and their field of view shall be included.
- Actual cable routes between the security components and the controlling system shall be indicated and detail of these provided.
- For any cabling exterior to a building, the type of cable, the exact route taken, the method of construction (e.g. overhead, in duct or direct buried), and if ducted, which duct bores.

“As Constructed” plans in CAD and hard drawing format shall be available when the installation is inspected and shall be submitted to the ECU Project Manager on completion of the work.

17.14. ACCEPTANCE TESTING AND CERTIFICATION

An acceptance test and performance demonstration program shall be developed and documented by the security contractor under the direction of ECU or its agents for all security projects. These requirements shall apply to all system components and software. The contractor shall perform the tests and document the results under the supervision and witnessing of ECU or its agents. Operational scenarios shall be developed and used by the security contractor to simulate the actual use of the system in the normal environment of ECU. Acceptance of the installation is also conditional upon the work being inspected by Edith Cowan University's security consultants (i.e. the designers) and completed to their satisfaction



18.0 COLOUR CODING – PLANT AND EQUIPMENT

NOTE: Where colours are not specified for items of plant, the University shall be consulted before colours are nominated. All plant and equipment shall be painted to the following colour scheme. All pipework, valves and fittings in plant rooms, ducts and wherever exposed to view shall have the colours applied over their entirety. Pipework identification shall be achieved throughout by use of Safetyman pipe markers and labels to indicate contents and flow.

NOTE: Colours are selected from

AS 2700 Colours for General Purposes

AS 1345 The identification of piping Conduits and Ducts.

18.1. PUMPS

Domestic Cold-Water Pumps		**AS 2700 Colour**
Motor	Orange	X15
Pump	Canary	Y11
Coupling Guard	Golden Yellow	Y14 with black stripes
Base		Black

Domestic Hot Water Pumps		
Motor	Orange	X15
Pump	PumpkinX12	
Coupling Guard	Golden Yellow	Y14 with black stripes
Base	Black	

Fire Service Pumps		
Motor	Orange	X15
Pump	Signal Red	R13
Coupling Guard	Golden Yellow	Y14 with black stripes
Base	Black	

Chilled Water Pumps		
Motor	Orange	X15
Pump	Canary	Y11
Coupling Guard	Golden Yellow	Y14 with black stripes
Base	Black	

Condenser Water Pumps		
Motor	Orange	X15
Pumps	Pumpkin	X12
Coupling Guard	Golden Yellow	Y14 with black stripes
Base	Black	

18.2. AIR-HANDLING PLANTS

Fan Coil Units

& Conditioners:	Deep Cream	Y25
External Motors	Orange	X15
Belt Guards	Golden Yellow	Y14 with black stripes

Toilet Exhaust Systems

Fans	Pumpkin	X12
Motors	Orange	X15
Coupling Guards	Golden Yellow	Y14 with black stripes
Base	Black	

Supply Air Systems

Fans	Straw	Y24
Motors	Orange	X15
Belt Guard	Golden Yellow	Y14 with black stripes
Base	Black	

Fume Exhaust Systems

Supply Air Fans	Pumpkin	X12
Exhaust Fans	Pumpkin	X12
Motors	Orange	X15
Belt Guards	Golden Yellow	Y14 with black stripes

Miscellaneous Exhausts (other than those above)

Fans	Pumpkin	X12
Motors	Orange	X15
Guards	Golden Yellow	Y14 with black stripes
Base	Black	

18.3. AIR-COMPRESSORS AND VACUUM PUMPS

Air Compressors:

Motors	Sapphire	B14
Compressor	Aqua	B25
After Cooler	Sapphire	B14
Air Receiver	Sapphire	B14
Guards	Grey Blue	B43
Belt Guards	Golden Yellow	Y14 with black stripes
Base	Black	

Vacuum Pumps:

Motors	Sapphire	B14
Vacuum Pump Aqua		B25
Silencer	Sapphire	B14
Vacuum Tank	Sapphire	B14
Guards	Grey Blue	B43
Belt Guards	Golden Yellow	Y14 with black stripes
Base	Black	

18.4. REFRIGERATION SYSTEMS

Centrifugal Chillers:

Compressor/ Motor	Orange	X15
Condenser Vessel	Pumpkin	X12
Chiller Vessel	Canary	Y11
Oil Pump Vessel	Orange	X15
Frame	Black	
Pipework Tubing	Raffia	X31

Condensing Units (DX system)

Lettuce	G33

18.5. ELECTRICAL

Main Electrical Switch Board	Orange	X15
Sub-Boards Switchboard	Orange	X15
Mechanical Service Switchboard	Orange	X15
Power Load Centres	Orange	X15
Cable Trays, Ladders, Ducts & Conduits	Orange	X15
Fire Alarm Cable Trays, Ducts & Conduits	Signal Red	R13

18.6. PIPEWORK, VALVES AND FITTINGS (NOT OUTLETS)

Service	Pipe		Valves	Valve	Tops
Domestic Cold Water	Mid Blue	B15	Signal Red	R13	Black
Domestic Hot Water	Jade	G21	Signal Red	R13	Black
Chilled Water			Signal Red	R13	Black
Fire Services Water Mains	Signal Red	R13	Signal Red	R13	Black
Condenser Water			Signal Red	R13	Black
Drains	Black	-			
Gas LP	Raffia	X31	PumpkinX12	Black	
Compressed Air	Aqua	B25	Ultramarine	B21	Black
Vacuum	Ultramarine	B21	Black		
Oxygen	Raffia	X31	PumpkinX12	Black	
Acetylene	Pumpkin	X12	Black		

Other Gases (To Approval)

Demineralised Water	Palm Green	G44	Signal Red	R13	Black
Internal Downpipes & Stormwater			Mid Grey	N52	- -
Natural Gas	Canary	Y11			

18.7. SUPPORTS

Ace Unistrut Mounting Brackets, M.S. Angle Supports and Hanger Rods to be painted 'Black' where exposed.

19.0 EXTERNAL WORKS

19.1. GENERAL

The following Landscape Design Guidelines continue to be under development and the details provided are limited to the specific items listed and should in no way be regarded as complete or fully comprehensive. Any landscape design must be developed in consultation with and be approved by ECU (Manager, Grounds Services or nominee).

19.2. PLANTING

Planting shall be representative of the climate of the Western Australian southwest region, the location of the site and the expected visual appearance of the campus.

Planting design should not only reflect the specific requirements and general scale of the building development but also create a landscape with positive biodiversity and habitat values. Where appropriate this is achievable using mixed species planting as opposed to larger monoculture groupings of individual species.

Plants selections shall be based on the classification of the plant as being "Waterwise" in the Perth area.

Soft landscape design including all plant selections must be developed in consultation with and be approved by ECU (Manager, Grounds Services or nominee).

Based on campus character and environmental characteristics, the following are individual campus-based requirements:

Joondalup Campus
Plant species for use within the landscape shall be selected in priority order from the following broad plant groups:

- Indigenous (i.e. local gene pool)
- Cottesloe vegetation complex
- West Australian native
- Australian native
- Exotic (courtyards or other nominated spaces only)

Mount Lawley Campus
- Open areas including carparks and campus perimeters shall predominantly comprise of native plants species
- Formal/internal campus landscape areas shall be a mix of exotic and native plants as appropriate for the specific nature of the site including requirements due to building design or usage, shading/aspect etc.

South West (Bunbury) Campus
- Built areas of the campus shall comprise primarily native Australian plant species
- Bush areas shall be rehabilitated or embellished as required using local flora species and ideally sourced from the local gene pool within the campus or immediate area

19.3. MULCHING

All planting beds shall be mulched. Generally this will be with an organic mulch spread evenly over the entire surface to a minimum depth of 75mm.

The mulch to be used shall preferably be a relatively evenly graded high wood/low leaf content mulch sourced from recycled tree pruning material as much as possible which is free of pathogens, tree/weed seed.

Finer mulches consisting of easily decomposable organic materials and/or containing peat are generally not to be used due to limited lifespan and the sponge and hydrophobic potentials (both of which reduce the efficiency of water application

Pine bark mulch can be used on the Bunbury campus and may be used on the metropolitan campuses where there is a particular aesthetic requirement

Inorganic mulches used for either water flow treatment or for aesthetic purposes as necessary shall be a minimum of 50mm deep

All mulches are to finish 25mm below all surrounding finished surfaces such as edging, paths, road kerbs and walls

Mulch shall not be laid to cover any plant leaves or be mounded around plant stems

19.4. TURF

Turf selection shall be of suitable variety for the campus, the location and other specific site parameters. Preferred species include:

- Cynodon dactylon “Wintergreen” Couch.
- Stenotaphrum secundatum “Sir Walter” Buffalo.
- Pennisetum clandestinum Kikuyu (including “Village Green”) NOT Joondalup campus.

Turf supplies shall be sourced from growers registered with the Turf Growers Association WA or from alternative suppliers who can guarantee all turf supplied is sting-nematode free

Turf may be established either by:

- roll on turf.
- stolon planting (where speed of establishment or immediate visual appearance is not critical).
- grass seed only where grass establishment in cool season is required as a temporary measure and may be combined with stolon planting.

All weed and/or existing grass species if different shall be removed prior to turf establishment.

All turf areas shall finish with leaf level flush with adjoining hard surfaces.

New turf areas shall be of consistent grading and finished with a firm surface.

New turf areas shall be watered and fertilised at an appropriate level and at appropriate intervals during establishment.

New turf areas shall be protected during establishment.

19.5. IRRIGATION

Irrigation design shall be undertaken by irrigation design professionals.

Designs must be consistent with the ECU General Specifications (available on request).

All irrigation design must be developed in consultation with and be approved by ECU (Manager, Grounds Services or nominee).

Irrigation components (e.g. sprinkler types) shall generally only be those which ECU uses as standard. Details of these are provided in the ECU General Specification or available by request.

Irrigation installation shall be undertaken by professional irrigation installers.

19.6. PAVING

All unrestrained edges of paving shall have the full header paver wet laid on a poured concrete edge beam with locking haunch. Detail available on request

All paving shall be professionally installed, neatly laid and cut-in, and consistently graded with surface drainage discharge treated/ allowed for with no unwanted down-stream discharge effects

19.7. DECKING

Timber is no longer a preferred material for decking and other built structures due to the maintenance regime required over the life of the product. Consequently, if a timber-look product is preferred then a composite version is required. The timber alternative must:

- Be highly UV resistant
- Must resistant bleaching, chalking and surface staining or degradation on exposure to the elements and common spillages.
- Be slip resistant
- Be dimensionally stable
- Be able to absorb little or no water
- Have a minimum of a 20-year commercial warranty
- Be heavy duty and not defect under foot traffic load
- Be designed for commercial and not one generally used in residential applications.
- Is supported by a structure that can take heavy loads such as fixed furniture and dynamic loads such as the transport of goods and materials.

Traxion Mineral-fibre Commercial Decking or equal approved would be a suitable standard.

20.0 CAD DOCUMENTATION PROTOCOL

20.1. GENERAL

This section is currently in the process of being completely updated. ECU does not currently use BIM but may look at in the future. If a project is being documented in BIM, regardless of whether we implement or not, all As-Constructed drawings need to be supplied in an AutoCAD format to the standards which are being prepared.

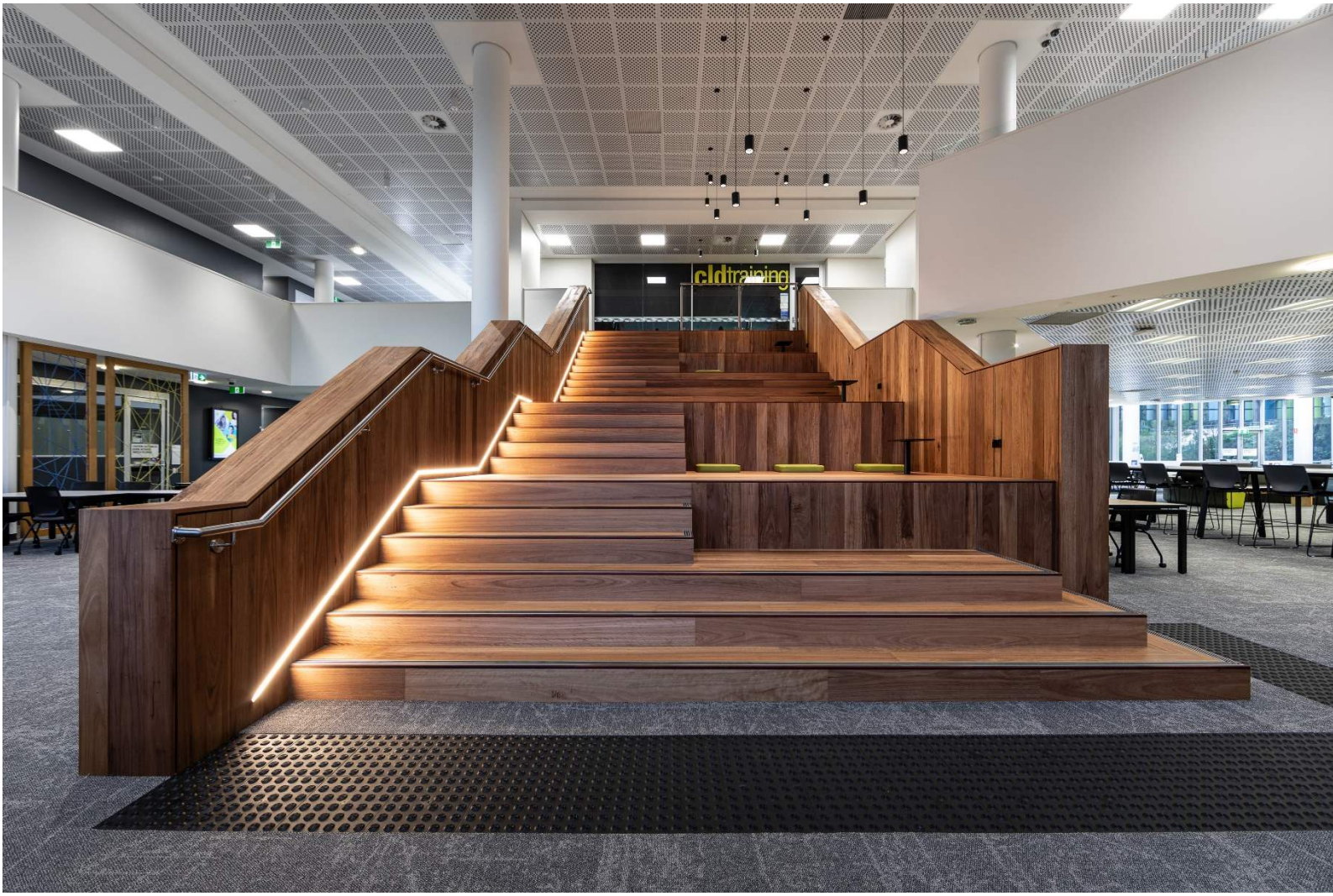
21.0 APPENDICES

21.1. TEFMA ALLOCATION AND DESIGN STANDARDS BY ROOM TYPE

21.2. 210205 T&L SPACE STANDARDS V3.1 UOF

21.3. TEACHING LEARNING AND STUDENT SERVICE SPACES EXTRACT

21.4. DESIGN LIFE PROVISIONS FOR ARCHITECTURAL ELEMENTS



22.0 APPENDIX 1

TEFMA Allocation and Design Standards by Room Type

The following is taken from the TEFMA Space Planning Guidelines Edition 3.

UFA = Useable Floor Area RT = Room Type

ROOM TYPE	SQM UFA	RT CODE
GENERAL TIMETABLED TEACHING SPACE		
Informal learning spaces such as Courtyard areas etc – external	2 - 3	200
Lecture Theatre (>100) Stepped floor – raked seating. Incl area at the front of theatre	1.7 – 1.8	201
Lecture room/ Seminar / Tutorial/ Class Room (15 < 70 seats – flat floor)	2	202
Case Study Theatre (70 <100)	2	202
Seminar Service room –General teaching area – Lecture Theatre	2	203
LABORATORIES		
Laboratory Student Information Commons - Computing	3.5	300
Scientific / Medical / Engineering Lab - Undergraduate	5 - 6	301
Scientific / Medical / Engineering Lab - Postgraduate	5 - 6	302
Laboratory – Drawing Office – Architecture/ Engineering / Design	See studios	303
Laboratory Computing Undergraduate	3.5	304
Laboratory Computing Postgraduate	3.5	305
Laboratory – Audio Visual Teaching Room	2	306
Laboratory – Clinical areas – Psychological & Anthropology	5	307
Laboratory – Gymnasium Human Movement Dance	3.6 - 5	308
Laboratory – Language & Statistics	2	309
Music Practice Rooms – Teaching (Single use rooms)	8m² (rm size)	310
Laboratory Undergraduate Training non scientific	2	311
STUDIOS		
Drawing Studios, Architecture, Town Planning, Engineering	2.2	313
Design Studios postgraduates	2.8	314
Sculpture, Metal Studio	5	315
Ceramics Studio	6	316

ROOM TYPE	SQM UFA	RT CODE
GENERAL FACILITY		
Theatre – Used for dramatic, music and film presentations not associated with teaching	1.8	612
Great Hall or large flat floor assembly area	2.0	613
Great Hall or large flat floor assembly area – Used for examinations	3.0	613
Dressing Rooms / Theatrical Gymnasium	2	614
Music Practice Rooms – Used in conjunction with theatre	8 (room size)	614
Medical Facility where Medical and Counselling Services are available to staff and students	6.4	615
Religious Meeting Place	2 – 2.1	618

TEFMA Note

The design standards for space allocations should be taken as guidelines only. However, they are based on the empirical experience of University planners working in the field, and influenced by published standards over many years of operation in Australia and New Zealand. Local Regulations and Standards related to specific space requirement, especially laboratories should always be checked

23.0 APPENDIX 2

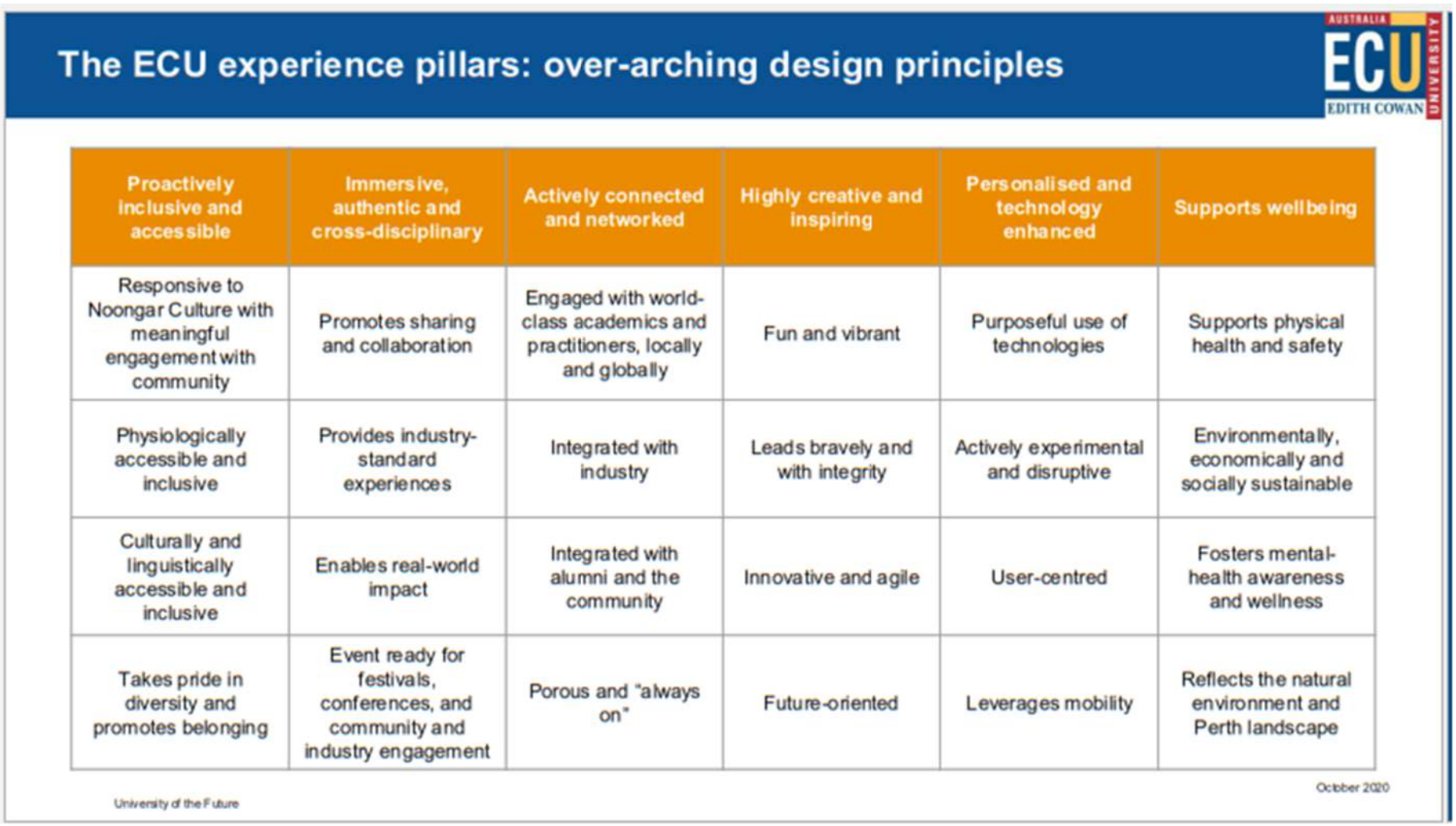
Last updated 5 February 2021. To be finalised as per Project Brief section C5 (Delayed design and procurement)

The following definitions provide a high level, non-technical standard for T&L spaces at the new City Campus, which will have a strong emphasis on **active, authentic, and collaborative learning**. This provides an understanding for staff of the intended room types that will support the defined **teaching approaches:**
Experiential - reflection on experiences
Inquiry-based - investigation and problem solving
Immersive - real-world or simulated experiences
Didactic - lectures, demonstrations

			Formal learning spaces							Informal Learning Spaces			
			Collaborative Lecture Theatre	Technology Enhanced Active Learning Space (TEAL)	Standard Active Learning Space	Standard Computer Lab (some Dell, some Mac)	Premium Computer Lab* (dual monitors; some Dell, some Mac)	Recording Booth (audio visual recording)	Green-screen Recording Studio (advanced video production)	Focussed spaces	Discussion spaces	Project spaces	Social spaces
v3.1	Target Capacity Range		50-150	36-96	30-50	30-50	30-50			50%	20%	15%	15%
last updated 12/11/2020	Supported Teaching Approaches	Direct instruction	50%	10%	10%	20%	20%	90%	90%	-	-	-	-
		Active/collaborative	50%	90%	90%	80%	80%	10%	10%	100%	100%	100%	100%
		Spanned option	◆	◆	◆	◆	◆						
Audio/ Video Equipment	Visual	Presentation - Projector(s)	2 to 6	2	2						optional	optional	
		Presentation - LCD Screen				6 to 8	6 to 8				1	1	
		Presenter camera	◆	◆	◆	◆	◆	◆	◆				
		Audience cameras	◆	◆	◆								
		Comfort monitor	2	2	2	2	2	◆	◆				
		Document camera	◆	◆	◆			◆					
		Whiteboard camera	◆	◆	◆	◆	◆						
		Interactive Whiteboards	◆	◆	◆	◆	◆						
		Green Screen							◆				
	Audio	Presenter microphone (i.e. lectern and lapel)	◆	◆	◆	◆	◆	◆	◆				
		Audience microphones	◆	◆	◆	◆	◆						
		Roving audience microphones	optional										
		Audio reinforcement	◆	◆	◆	◆	◆	◆	◆				
		Assistive Hearing System	◆	◆	◆	◆	◆						
	Tech	Wireless Presenter	◆	◆	◆	◆	◆				◆	◆	
		PC	◆	◆	◆	◆	◆	◆	◆				
		Lecture Capture on PC	◆	◆	◆	◆	◆	◆	◆				
		Collaboration Apps on PC	optional	optional	optional	◆	◆						
		Multiple PCs with Collaboration Apps for presenter and students		optional		◆	◆						
		Student Pods		◆	optional								
		Video conferencing	◆	◆	◆	◆	◆				soft-conferencing optional	soft-conferencing optional	
		Control Panel									◆	◆	
		AV Touch Panel	◆	◆	◆	◆	◆				optional	optional	
		BYOD ability to show presenter's laptop	◆	◆	◆	◆	◆	◆	◆		◆	◆	
		System Message display for projector	◆	◆	◆	◆	◆						
		Support Camera	◆	◆	◆	◆	◆						
		PIR Sensor	◆	◆	◆	◆	◆						
		Tiered single row, fixed bench, mobile seating											
		Tiered single row, fixed bench, fixed seating											

Facilities	Space	Tiered, fixed small-group benches, mobile seating	◆										
		Flat floor mobile seating and tables		◆	◆								
		Flat floor fixed tables (grouped) mobile seating				◆	◆						
		Various configurations of fixed and mobile seating and surfaces with mix of styles								◆	◆	◆	◆
	Equipment	Whiteboards / writable surface	◆	◆	◆	◆	◆						
		Multiple writable surfaces for students	◆	◆	◆	◆	◆				◆	◆	
		Fixed lectern with network and power	◆			◆	◆						
		Mobile lectern with network and power		◆	◆								
		Power points available at student locations	◆	◆	◆	◆	◆			◆	◆	◆	◆
		Window and acoustic treatments	◆	◆	◆	◆	◆	◆	◆	◆			
		Entry or other space for social working	◆										

24.0 APPENDIX 3



The ECU experience pillars: over-arching design principles

Proactively inclusive and accessible	Immersive, authentic and cross-disciplinary	Actively connected and networked	Highly creative and inspiring	Personalised and technology enhanced	Supports wellbeing
Responsive to Noongar Culture with meaningful engagement with community	Promotes sharing and collaboration	Engaged with world-class academics and practitioners, locally and globally	Fun and vibrant	Purposeful use of technologies	Supports physical health and safety
Physiologically accessible and inclusive	Provides industry-standard experiences	Integrated with industry	Leads bravely and with integrity	Actively experimental and disruptive	Environmentally, economically and socially sustainable
Culturally and linguistically accessible and inclusive	Enables real-world impact	Integrated with alumni and the community	Innovative and agile	User-centred	Fosters mental-health awareness and wellness
Takes pride in diversity and promotes belonging	Event ready for festivals, conferences, and community and industry engagement	Porous and "always on"	Future-oriented	Leverages mobility	Reflects the natural environment and Perth landscape

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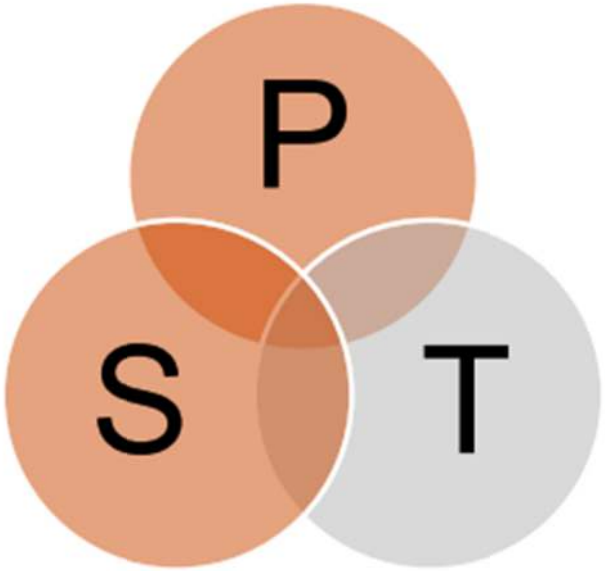
The Pedagogy-Space-Technology Nexus drives learning space design

Pedagogy

What types of learning are we trying to foster?

Space

What dimensions, shapes, furniture and fittings will foster this learning?



Technology

What technology will complement the space design to foster this learning?

Radcliffe et al (2009)

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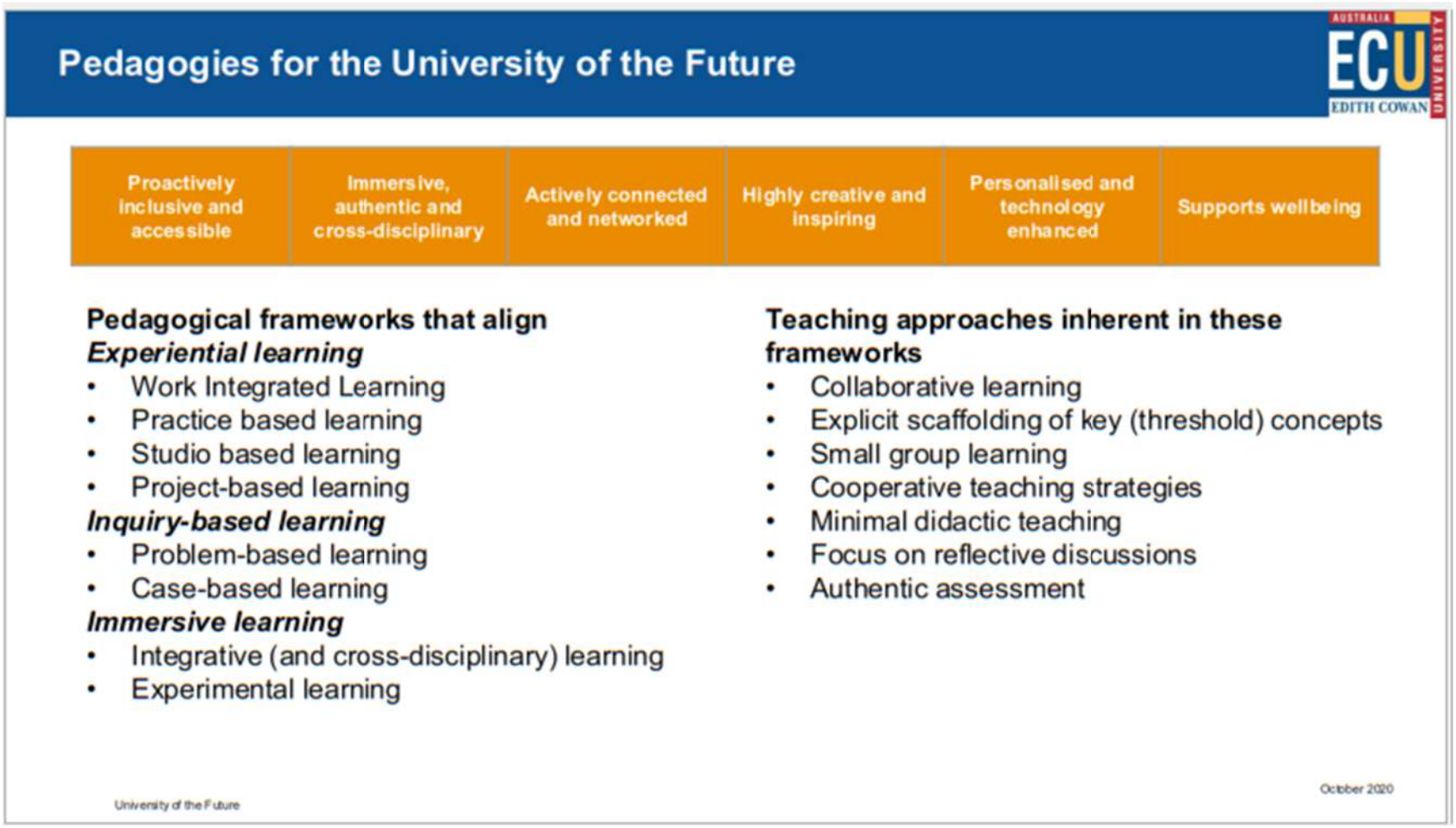
Pedagogies for the University of the Future
AUSTRALIA ECU EDITH COWAN UNIVERSITY
Proactively inclusive and accessible
Immersive, authentic and cross-disciplinary
Actively connected and networked
Highly creative and inspiring
Personalised and technology enhanced
Supports wellbeing
Pedagogical frameworks that align
Experiential learning
• Work Integrated Learning
• Practice based learning
• Studio based learning
• Project-based learning
Inquiry-based learning
• Problem-based learning
• Case-based learning
Immersive learning
• Integrative (and cross-disciplinary) learning
• Experimental learning
Teaching approaches inherent in these frameworks
• Collaborative learning
• Explicit scaffolding of key (threshold) concepts
• Small group learning
• Cooperative teaching strategies
• Minimal didactic teaching
• Focus on reflective discussions
• Authentic assessment
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October 2020

25.0 APPENDIX 4

Design Life (Architectural Works)

Element	Design Life
Waterproof membranes, tanking and waterstops	50 years
Insulation and barriers	50 years
Roofing & roof plumbing	25 years
Permanent access & safety equipment	50 years
Wall & fascia claddings	50 years
Exterior solar control provisions	50 years
Brick & block masonry	50 years
Wall or frame ties, fixings, fixing rails and sundry built-in components	50 years
Fabricated balustrades and handrails:	50 years
Fabricated ladders, stairs, platforms and walkways	50 years
Precast concrete elements	50 years
Anti-graffiti coatings	10 years
Curtain walling	50 years
Exterior aluminium window & door frames & louvres	50 years
Glass, glazing & glazing gaskets, etc.	50 years
Anodising	50 years
Thermoset powder coating	25 years
Fluoropolymer powder coating	50 years
Hot dip galvanised coatings to steelwork	50 years
Protective coating systems to structural steel	50 years
Exterior adhesives and sealants	50 years
Fire stopping	50 years
Exterior timber work	15 years
Exterior reconstituted timber decking	25 years
Automatic door operators	15 years
Doors (standard)	25 years
Overhead doors, roller shutters & grilles	25 years
Operable walls and room dividers	25 years
Door hardware, window hardware and operable walls	25 years
Fire & acoustic doors & frames	50 years
Metal door frames	50 years
Metal framed partitions & suspended ceiling support systems	50 years
Dry-linings	50 years
Interior aluminium framed & glazed partition systems	25 years

Element	Design Life
Suspended ceiling – pre-finished moulded fibre tiles	25 years
Suspended ceilings – pre-finished metal ceiling tiles and strips	50 years
Timber panel products in interior claddings, joinery, trims & floors	25 years
Interior timber joinery, trims and engineered floors	25 years
Interior compressed fibre cement products	50 years
Cabinetwork	20 years
Cabinetwork hardware	20 years
Stainless steel work	50 years
Polyester solid surfacings	25 years
Reconstituted stone surfacings	25 years
Interior metalwork fixtures and fittings	25 years
Toilet partitions	20 years
Toilet accessories & hardware	10 years
Plastering & render	50 years
Cementitious toppings and screeds	50 years
Engineered cementitious screeds	50 years
Broadloom carpets & underlays	10 years
Carpet tiles	15 years
Resilient sheet flooring	20 years
Ceramic, porcelain, stone and terrazzo floor & wall tiles & grouting	25 years
Resilient acoustic underlayers	50 years
Wet area waterproofing	50 years
Polished or honed in situ concrete or terrazzo floors	50 years
Floor sealer (in situ concrete or terrazzo floors)	10 years
Seamless epoxy floor finishes	20 years
Tactile indicators & stair nosings	25 years
Mastics, sealants and gaskets (inaccessible or hidden)	50 years
Mastics, sealants and gaskets (accessible or exposed)	25 years
Mirrors	20 years
Exterior painting	15 years
Exterior high build acrylic render	25 years
Interior painting	10 years
Interior & exterior signage	15 years
Window coverings & treatments	10 years
Tracks, operators and controllers (window coverings)	15 years

Element	Design Life
Whiteboards	15 years
Static metal shelving	15 years
Mobile shelving systems	15 years
Fabric furnishings	5 years
FF&E generally	5 - 25 years