architectus
jestico + whiles
CH2MHILL

ARCHITECTURAL PERFORMANCE BRIEF

Revision History			
Issue	Date	Status	Comments
A	07/09/12	For Review	For CIS/ SoP/ Peer Review Comment Document incomplete, EMI, Acoustic, HAZMAT/DG input missing.
B	27/09/12	ECI Issue	
C	04/10/12	PPR Issue	
D	12/10/12	Final PPR Issue	RDS relocated to Section 6. Updated comments from SoP and CIS.

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1. FUNCTIONAL BRIEF – USE OF DOCUMENT

1.1 Purpose and Scope

1.1.1 Purpose

a. The Functional Brief describes the specific requirements for facilities to be procured in the AIN-Physics Building project.

b. The Contractor shall comply with the requirements of the Functional Brief to provide *Works* that are fit for the purpose specified herein.

c. The Functional Brief forms part of the *Contract* and must be read in conjunction with all other scheduled contract documents. The Functional Brief and associated Performance Specifications must be used in conjunction with all parts of the D+C ECI Request for Proposal (RFP) to determine the full requirements of the *Contract*.

d. The relevance of this document's content within the contractual framework is determined by the order of precedence of documents forming the *Contract*.

1.1.2 Scope

a. The Functional Brief comprises the following:

i Section 1 – Use of Document: A description of the contents, scope and parameters of usage of the document.

ii Section 2 - External Building Requirements: A description of the requirements and considerations to be addressed by the *Contractor* in relation to the location, size, form, materiality, architectural expression and relationship of the proposed AIN-Physics Building to its immediate Campus environment.

iii Section 3 – Internal Building Requirements: A detailed description of the functional requirements of the facilities within the proposed AIN-Physics Building consisting of an explanation of key functional relationships, a schedule of facilities with their minimum functional areas, functional descriptions and room data sheets for each area; Laboratory, Teaching & Learning and Support Facilities & Linkage space.

iv Section 4 – Operational Requirements: A description of required support facilities, maintenance requirements and operational considerations applying to the AIN-Physics Building.

v Section 5 – Performance Specification: An explicit set of requirements to be satisfied, generally expressed as functional performance criteria. The Performance Specification comprises a General Requirements section detailed within this Section of the PPR and, owing to the extent of information comprising the performance specification, a series of performance specification documents for each respective discipline applying to the project within the Appendices as listed below:

Section Title	Author	Location
- Architectural Specification (non-clean construction)	(Architectus)	Appendix A
- Architectural Specification (cleanroom & lab. construction)	CH2M Hill	Appendix B
- Tool Utility Matrix	CH2M Hill	Appendix B1
- Cleanroom Layout & Details	CH2M Hill	Appendix B2
- Civil Specification	Aecom	Appendix C
- Principal Project Requirements – Waterproofing	Aecom	Appendix D
- Structural Performance Specification	Aecom	Appendix E
- Vibration Performance Specification	Aecom	Appendix F
- Principal Project Requirements – Façade	Aecom	Appendix G
- Mechanical Services D&C Performance Specification	Arup	Appendix H
- Hydraulic Services D&C Performance Specification	Arup	Appendix I
- Specialist Gases D&C Performance Specification	Arup	Appendix J
- Fire Services D&C Performance Specification	Arup	Appendix K
- Electrical Services Performance Specification	Arup	Appendix L

-	BMCS D&C Performance Specification	Arup	Appendix M
-	Vert. Transport. D&C Performance Specification	Arup	Appendix N
-	Acoustic Performance Specification	Arup	Appendix O
-	Dangerous Goods Storage	Aecom	Appendix P1
-	Principal Project Requirements for Hazardous Materials	Aecom	Appendix P2
-	EMI Performance Specification	TBC	Appendix Q
-	Audio Visual and ElectroAcoustic Eng. Performance Brief	ASL	Appendix R
-	Audio Visual Power and Data Requirements	ASL	Appendix R1
-	AIN Project Brief and Security Performance Specifciations	CIS/ CSU	Appendix Z
-	CSU Security Installation Requirements	CIS/ CSU	Appendix Z1
-	University of Sydney Sustainability Framework	UoS	Appendix Z4
-	Preliminary Joinery Schedule	UoS	Appendix Z5
-	Preliminary FF&E Schedul	UoS	Appendix Z6

vi Section 6 – Guidance Documents: A set of documents developed to support the *Reference Design* the requirements and considerations of which may be of assistance to the Contractor in providing the *Detailed Design* and the *Works*.

	Section Title	**Author**	**Location**
-	BCA Report	Davis Langdon	Appendix S
-	Access – Concept Design Review	Access Assoc.	Appendix T
-	Statement of Heritage Impact	GBA	Appendix U
-	Landscape Report	Site Image	Appendix V

1.1.3 Contractor's Responsibility

a. The Contractor shall provide the *Detailed Design* and the *Works* in compliance with all requirements detailed in Sections 1-5.

b. The Contractor shall provide the *Detailed Design* and the *Works* in response to all considerations expressed within Sections 1-6.

2. FUNCTIONAL BRIEF – EXTERNAL BUILDING REQUIREMENTS

2.1 Campus Planning Principles

2.1.1 Masterplan Objectives

a. The principles and objectives of this PPR have been developed in recognition of the University of Sydney's planning documents, whose primary objective is to support academic excellence.

b. The University of Sydney 2020 Masterplan seeks to increase teaching and research accommodation for the Campus, redress the development errors of the past, and resolve longstanding issues, such as traffic and parking. Specifically, the objectives are to:

   i Enhance the campus environment

   ii Engage the community

   iii Support academic excellence

   iv Enhance the student experience

   v Ensure a green and environmentally responsible campus

   vi Achieve sustainable capital development and asset management

c. Key planning principles defined to fulfil these objectives are:

   i Respect, preserve and utilise our heritage - Removal of intrusive works from heritage buildings; coherent restoration and maintenance; appropriate adaptive reuse.

   ii Create an international campus identity - Articulated building design in precincts; linkage through landscaping; coherence of built form across campus; linkage of residential and educational precincts; quality sporting facilities.

   iii Promote urban planning of defined precincts - Definition of specific purpose precincts; whole-of-precinct planning; coherence of building design in precincts; amalgamation of building footprints; balance of open space and built form.

   iv Ensure value for money - Sustainable construction; durable quality exterior; building services capacity and purpose; flexibility of floor-plate application; capacity for refit; standardisation.

   v Promote green space in all precincts - Prevent further loss of green space to construction; remove intrusive buildings to restore open space; replace hard paving with soft landscape; promote appropriate planting; develop green edge to campus perimeter.

   vi An environmentally responsible Campus - Reduce net energy use through efficient design; promote water efficiency; reduce green waste through on-site recycling; use intelligent building management systems; use recyclable construction materials.

   vii A campus for people - Reduce total vehicle movements in campus; promote perimeter parking and remove on grade parking; limit cross campus traffic; control traffic flow to reduce congestion; promote primary pedestrian zones.

d. The Masterplan Framework Guidelines 2006 outline a strategic vision for future Teaching, Learning and Workplace Environments within the University of Sydney. This document expands upon the 5 policies of the Strategic Plan, and outlines critical success factors for future developments. Listed below is an overview summary of the guidelines in the document:

   i Create teaching and learning environments to support continuous improvement in quality teaching and learning

      - Fit for purpose learning spaces
      - Areas responsive to change
      - Areas that stimulate learning

   ii Invest in World Class research and innovation infrastructure

      - Adaptable research spaces
      - Intensive use of research spaces
      - Best quality research spaces
      - Visibility and identity of research spaces

iii Create a campus that will attract the best students

- Create a dynamic and vibrant culture
- Pursue design excellence
- Leverage the history of the Campus
- Create an inclusive environment
- Provide required services

iv Engage and foster links with the community and the Alumni

- Create a welcoming and permeable campus
- Foster engagement with the community
- Showcase the university
- Be a good neighbour

v Enact administrative and operational excellence

- Attract and support the best administrative staff
- Create a sustainable campus
- Follow implementation guidelines
- Utilise asset and information management systems

2.1.2 Site

a. The proposed site for the AIN Physics building is directly behind the heritage listed School of Physics building. The proposed site boundary abuts Wesley College to the west and St. Paul's College and oval to the South. The site falls approximately 7m to the north and 4m to the east. As part of the development, the Physics Annex building (as labelled in the following Site Plan Diagram) will be demolished.

2.1.3 Precinct Planning Guidelines

a. Precinct planning guidelines are outlined in University of Sydney Faculty of Medicine, Faculty of Nursing & Midwifery and School of Physics; Masterplan (Bates Smart, 2009). These guidelines are summarised and interpreted here in order to align with the AIN project parameters driven by the excision of the Faculty of Medicine and the Faculty of Nursing and Midwifery from the project.

b. Courtyards and Open Spaces: The built form on the University of Sydney Camperdown Campus is characterised by a series of courtyards and open spaces created in a lineage of masterplans. These spaces contribute to the character of the Campus and its iconic heritage views. The AIN-Physics Building should contribute to this tradition.

Figure 1 *University of Sydney Faculty of Medicine, Faculty of Nursing & Midwifery and School of Physics; Masterplan (Bates Smart, 2009).*

c. View Corridors: The Wilkinson Axes:

i The Wilkinson Masterplan established a series of planning axes based upon existing structures and campus topography. Many of the axes are still considered to be the archetypal images of the University. Of relevance to the AIN building project is the impact of the major axis from St Paul's College through to the Holme Building. The Physics building reinforces the Masterplan with its centre symmetrically located on this axis.

ii Although clear on a masterplan drawing, the Wilkinson Axis is not a strong feature in experiential terms consequently the following recommendations can be made;

- The axis should be acknowledged in the massing and footprint of the final building design.
- The proposed development should respect the symmetry of the existing building by restricting the development height behind the central portion of the Physics Building.

iii In negotiations with St Paul's College the University of Sydney has established an approximate height limit for the main mass of the AIN-Physics Building to the south of the central portion of the Physics Building. An RL of 44.0m has been mutually agreed as the upper limit for this portion of the scheme with an RL of approximately 40.0m for a zone of 10m either side of the axis. These restrictions are not definitive and are subject to ongoing negotiation with St Paul's College and acceptance from the relevant planning authorities.

iv The following diagram shows the Wilkinson axis that passes through the AIN Physics Building site.

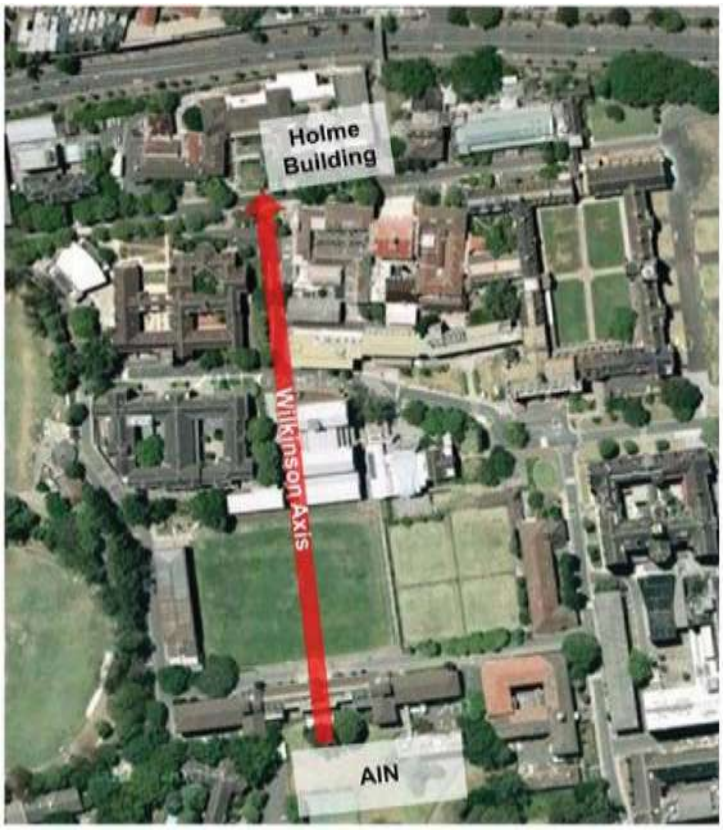


Figure 2 Wilkinson Axis Diagram *(Source: http://maps.google.com.au/)*

d. Connecting Pathways

i A series of North-South and East-West pathways create an integrated network of pedestrian and cyclist routes through the Campus. This system uses the buildings to frame and terminate vistas, providing an easily navigable experience.

ii The AIN Physics Building project presents an opportunity to further enhance this network, via the extension of the pathway from Eastern Avenue between the Madsen and Chemistry Buildings to carry through to the eastern façade of Wesley College. The Proposed development should look to maintain and extend this street axis to further interconnect the campus.

iii The following diagram further details this potential linkage.

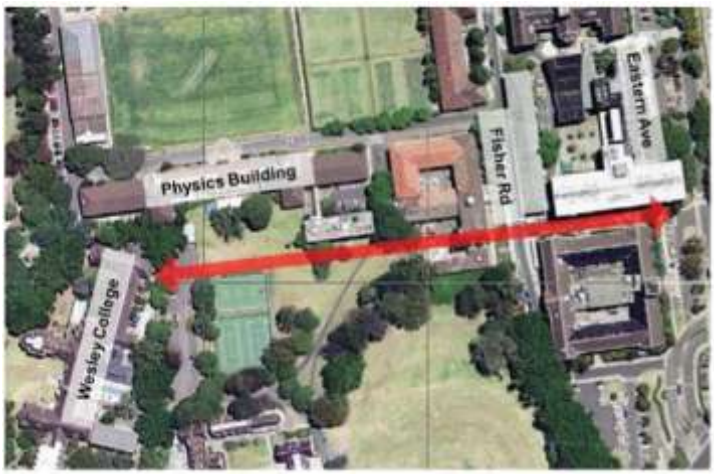


Figure 3 Diagram: Eastern Ave to Wesley College pathway *(Source: http://maps.google.com.au/)*

e. Building Setbacks

i The site offers district views from Physics Road between Edward Ford and the Existing Physics Building through to the landscaped gardens of St Paul's College. These views should be maintained in the proposed development by keeping the view corridor free of building mass.

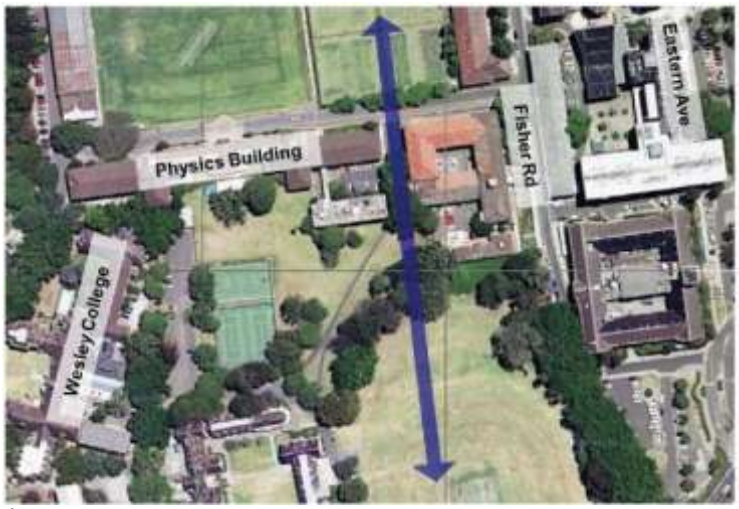


Figure 4 Diagram: View Corridor – Physics Road to St. Paul's College *(Source: http://maps.google.com.au/)*

f. Connectivity

i There is a strong desire for the new AIN Physics Building development to be closely integrated with the existing School of Physics building. There should be a minimum of two but preferably more connections. The degree of connectivity should be emphasized through physical links between the two buildings. One opportunity for creating connectivity, and to echo the network of courtyards which are characteristic of Sydney University, is to create a central 'Physics Courtyard' which could be a place where students, teaching and research staff can meet, collaborate and socialise.

2.1.4 Heritage Considerations

a. In accordance with the advice received from the Heritage Consultants, Graham Brooks + Associates, the design approach adopted for this project is that *"any new building fabric should touch the historic building lightly."*

b. With this in mind, the proposed pedestrian linkages between the new AIN Physics Building and existing heritage significant A28 Physics Building should comprise light weight, predominantly glazed enclosures with glazing recessed into channels within the existing building fabric to minimise he visual impact of any connections. A clear delineation between the masonry construction of A28 Physics Building and the lighter, more contemporary aesthetic of the AIN should be made. The perimeter roof structure of these enclosures should also be glazed to reinforce the light touch of the new building fabric to the old.

c. In considering the choice of external materials for the new building, the palette should be sympathetic to the textures and colours found on the A28 Physics façade and neighbouring heritage buildings. The colouration of cladding panels should respond to the colours found on the existing A28 rendered façade, similarly other materials could be sympathetic to the roofing tiles found on the adjacent Edward Ford Building and A28.

d. Under the current University of Sydney Conservation Management Plan for the School of Physics 2008, all existing original building fabric is classified as 'exceptional' in significance. In light of this classification, all items to the external face of the façade including: fenestration, metalwork walkways and sandstone dressings will need to be preserved. Where these items are retained on the facade, it will be necessary not to obscure or diminish their visual presence with any new construction.

e. Internally, where existing windows are proposed to be lengthened to become doorways the reveals should be left as exposed masonry to interpret the original memory of the place. The design of any new construction and assembly is aimed to be as reversible as possible and allow the prospect for restoration of the building fabric to original condition.

f. Where existing windows and openings are required to meet current regulatory fire codes, the use of fire rated masonry or lightweight construction to the internal face of the façade may be introduced and the original fenestration retained and treated with translucent film to conceal the extent of any new construction.

g. All of the above considerations are detailed for guidance purposes and are subject to approval of the relevant statutory planning authorities. Whilst tacit approval for the above principles and approaches has been provided by the Heritage Consultant, the University Heritage Representative and the St Pauls heritage Architect, approval from the required planning authority has not been received and the *Contractor* shall conduct his own investigations to determine the most suitable approach to providing a design that meets the heritage requirements of the relevant authority. Where this involves implementation of any of the above approaches this is entirely at the risk of the *Contractor.*

2.1.5 St Paul's Development

a. The proposed St. Paul's development comprises largely additional residential dwellings and a hall to the southern boundary of the AIN site.

b. The development constitutes a significant risk to the functional operation of the AIN's research laboratories. These laboratory spaces aspire to being world class, and as such even minute levels of interference from external sources could compromise this aspiration. Mitigation of any vibration or EMI issues must be part of the structural design of the AIN Physics Building.

c. The development has the potential to create many sources of interference and vibration. Lifts and large numbers of people moving through the extension will be the main generators of vibration and EMI, although these levels should fall within the band of acceptable environmental conditions for the AIN development (i.e. these types of spaces are not typically as intensive as labs or other research facilities in terms of generating vibration or EMI). However, the design of the two buildings will still need to be carefully configured to ensure lifts, or traffic on roads or car parks in the St Paul's extension do not generate excessive vibration or EMI. People movement (particularly larger numbers) will also need to be considered in relation to the location of sensitive equipment and laboratories in the AIN building. In both cases, distancing this activity and the sensitive equipment is the primary method of achieving acceptable outcomes.

d. The University, in its negotiations with St Paul's College over land acquisition, boundary lines and the interface between the two developments, has expressed its requirement for a minimum 4 metre set back from the boundary line on both sides of the boundary. This will result in a clear space of 8 meters between buildings (above and below ground level). This is reflected in the current site boundary plan and *Reference Design*.

e. It is intended that the construction of the St Pauls College development will occur concurrently with the AIN Construction program.

2.2 Building Form

a. The proposed building needs to accommodate all of the spatial requirements as detailed in the Schedule of Functional Areas. These include Workspace, Laboratories & Cleanrooms, Teaching Spaces, Central Support Spaces and Plant, Circulation & Internal walls. The total estimated GFA for the building is approximately 11,600m2

b. The site boundary for the construction of the new building A31 is shown on drawing A1013 in Appendix W the available site comprises the area to the south of the existing School of Physics (Building A28) to within 4m of the established site boundary, including the land currently occupied by the Annex (Building A29)

which will be demolished as part of the enabling works. The eastern boundary is assumed to be the existing stone wall along the driveway against the Edward Ford Building.

c. It is envisaged that the new building will be of such scale and proportion which respects the existing heritage School of Physics. The volume and massing of the new building will also need to take account of the University's masterplanning principles for the Camperdown Campus and the site specific planning guidelines. These include non interference of the viewing corridor known as the Wilkinson Axis which connects the original St Paul courtyard to the south of the site to the clock tower at the Holme Building at the northern end of the Campus. In addition, there is a tacit agreement with St Paul's College to the south that the central portion of any new addition to Building A28 should not exceed RL 40.

d. The height and massing of A31 will also be influenced by its relationship to the proposed St Paul's development along the southern boundary. The current status of the design and implementation of these largely residential blocks are unclear. Potential issues of overlooking and acoustics (in both directions) of the new building with respect to these future St Paul developments may also influence the form and massing.

2.3 Architectural Expression

a. There are no prescriptive requirements for the architectural expression of the building. There are however, considerations in terms of its function, intended uses and relationship to the existing School of Physics which is a building of recognised architectural and historical value on campus. There is extensive documentation on the conservation plan of this building which provides certain guidelines to any new addition.

b. The University has a Heritage Architect who has extensive knowledge of the existing building (A28) and the site, his views will be consulted and may have a material influence on the design of the new building. A key design consideration will be how the new building will relate to the existing – similarity or contrast of form and materials, proximity, overshadowing concerns, connection details, the nature of the separation and in between spaces, all of these will inform the decision on how architectural expression of the new building will be formulated.

c. Other considerations as regards architectural expression should take account of the fact that the AIN aspires to be a world leading nanotechnology research facility, the foremost facility of its type in Australia and therefore its appropriate formal representation, the need to convey in physical shape the prestige and excellence of the School, and to showcase the academic and research activities that will take place here, the 'marketing + PR' value to industry sponsors, grant and funding bodies, potential faculty, staff and students. These considerations suggest that the new AIN Building ought to embody characteristics of high quality, precision, forward looking, serious scientific enquiry, and a conducive work environment in which discoveries and advancement are made, whatever the form or architectural expression that this may take.

2.4 Materials & Finishes

a. Closely related to architectural expression is the subject of materials and finishes. Again, there are no prescriptive requirements here, materials and finishes must respond to the evolving design, taking account of both functional, including cost, and philosophical/aesthetic considerations. A robust, functional, easily maintained, sustainable, cost effective palette of materials is a given, regardless of the direction of visual or aesthetic preferences.

b. Clearly functional requirements will play a major role in the choices of external materials and construction systems. The office accommodation will require large degree of daylight and view as well as the ability to naturally ventilate the space by openable windows or vents. Nearly the opposite is true of the laboratories where the environment must be strictly controlled and sealed off from the external world and where in some instances, e.g. laser labs, daylight must be totally excluded. However, users have expressed the preference that where possible, some glimpse of the outside world is desirable in the laboratories. Likewise the teaching spaces can also benefit from the appropriate amount of daylight and view. The idea of having significant amount of visual connection in both directions in the cleanroom is also viewed as a positive feature by the School for the ability to showcase the science.

c. The extremes of the Australian climate dictates certain responses in the external treatment of the building, particularly in the control of solar gain and glare. This may involve some form of brise soleil or special glass or coatings or screens, always starting with the proper orientation and making use of the most effective natural measures.

d. Naturally, as with architectural expression, conservation issues relating to the existing building will enter into the thinking behind choices of external materials. Many people will have different views on this highly subjective matter, but there are no definitive rules, each approach, whether sympathetic, complementary or contrasting with the existing, will need to be judged on its merit as part of a coherent design philosophy.

e. Ultimately the selection of materials and finishes will be a function of all of the above mentioned considerations and will evolve and develop as the design itself evolves.

3. FUNCTIONAL BRIEF - INTERNAL BUILDING REQUIREMENTS

3.1 Schedule of Facilities

3.1.1 General

a. The new AIN Physics Building will provide approximately 11,600sqm of research laboratories, teaching & learning, workspace and support facilities for a 'permanent' occupant population of approximately 220 people (excluding the transient undergraduate student population using the Teaching & Learning spaces).

3.1.2 Functional Area Requirements

a. The areas detailed in the following schedule represent the minimum functional area requirements for key spaces within the new AIN Physics Building.

b. Method of Measurement

c. The area provided in the following schedule area measured in accordance with 'Method of Measurement', from the *University of Sydney - Facilities Management Office (Last Updated 01/12/1999)*

d. Fully Enclosed Covered Area (FECA)

i The fully enclosed covered area comprises the sum of all such areas at all building floor levels, including basements (except un-excavated portions), floored roof spaces and attics, garages, penthouses, enclosed porches and attached enclosed covered ways alongside buildings, equipment rooms and other fully enclosed spaces and useable areas of the building computed by measuring from the normal inside face of exterior walls, but excluding any projections such as plinths, columns, piers and the like, which extend beyond the normal inside face of exterior walls. It shall not include open courts, light wells, connecting or isolated covered ways and net open areas of upper portions of rooms, lobbies, halls and the like which extend through the storey being computed.

e. Usable Floor Area (UFA)

i The usable floor area comprises the sum of the floor areas measured at floor level from the general inside face of walls of all interior spaces related to the primary function of the building. This will normally be computed by calculating the fully enclosed covered area (FECA) and deducting all of the following areas not related to the primary function of the building.

- Common Use Area
  - All floored areas in the building for circulation and standard facilities provided for the common use of occupiers, tenants and/or the public such as lobbies and foyers to entrances, stairways and lifts, stairways landings and fire escapes, verandahs and balconies, corridors and passages, toilet and rest room areas, cloak and locker areas, cleaners' rooms and stores and cupboards, tea-making and similar amenities areas.
- Service Areas
  - All areas set aside for building plant supplying services and facilities common to the building for the use of occupants, tenants and/or public, such as mechanical plant and equipment rooms, electrical equipment and switch rooms, tank rooms, lift motor rooms meter cupboards, telecommunication switch rooms, refuse collection, loading bays, and car parks and access way thereto.
- Non-Habitable Areas
  - All non-habitable building space such as that occupied by internal columns and other structural supports, internal walls and permanent partitions, lift shafts, service ducts and the like.

f. Source: Standard method of measurements of Building Areas – Section 6 National Public Works Conference Cost Control Manual.

g. Measurement from Drawings

i In measuring building areas from drawings, figured dimensions will be used in preference to scaled dimensions. When preparing areas for CAD drawings, the polyline shall be drawn around columns attached to the walls. Freestanding columns within a room shall be included within the area. A space shall be deemed to be usable if its height is above 2100mm (i.e. standing height).

ii Note: Net : Gross Ratio = Usable Floor Area (UFA) / Gross Floor Area (GFA) x100 (%)

3.1.3 Functional Areas Schedule

a. Minimum Functional Areas

Functional Area	Area		No
Office Related			
Offices (Fit out, app. 15sqm each)	1080	m2	72
Meeting (Enclosed)	156	m2	5
Café	135	m2	1
Comms Room	45	m2	3
Facilities Room	15	m2	3
IT (Server Room)	45	m2	1
Tea and Breakout Points	55	m2	3
Storage	90	m2	7
Teaching & Learning			
Lecture Theatre	425	m2	1
Projection Booth	14	m2	1
Demo Prep Room	33	m2	1
Case Study Lecture Theatre	80	m2	1
Learning Studio	240	m2	1
Learning Studio (Store)	20	m2	1
Learning Studio (AV Room)	18	m2	1
Medium Seminar	135	m2	1
Large Seminar	220	m2	1
Student Commons	245	m2	1
Optics Teaching Lab	20	m2	1
3rd Year Teaching Lab	290	m2	1
Labs			
Lab A (Shell & Core)	78	m2	2
Lab A (Fit out)	119	m2	3
Lab B (Fit out)	271	m2	7
Lab C (Fit out)	501	m2	14
Cleanroom (Fit out)	487	m2	1
Cleanroom (Pre-gowning)	23	m2	1
Cleanroom (Shell only)	213	m2	1
TEM Suite (Shell & Core)	39	m2	1
TEM Suite (Fit out)	39	m2	1
TEM Control Room (Fit out)	19	m2	1
TEM Specimen Prep. Room (Fit out)	24	m2	1

Figure 5 Minimum Functional Areas

3.2 Design Principles

3.2.1 Adequacy

a. Ensuring the adequacy of design in the short term, while not an easy task in itself, is a relatively easy task compared to ensuring the adequacy of design for the long term. The following design principles and/ or approaches will promote long term design adequacy.

3.2.2 Organisational Planning Principles

a. The organizational planning principles for the building shall include:

i A robust planning grid for flexibility over time, 1.2m is recommended (1.5m in offices), to be tested during development of the design.

ii A logical structural bay and column spacing that has a high degree of vibration stability whilst avoiding conflicts with lab benches and aisles.

iii Spaces capable of internal reconfiguration to adapt to changing demand by adjusting settings, not structures.

iv Flexible building modules and structures to accommodate multiple uses and adapt to changes in use over time.

3.2.3 Flexibility

a. To provide short term flexibility the following design features are required:

i A 'suite' of varying workplaces designed to modular sizes to facilitate flexible office space layouts that readily permit expansion and contraction without reconfiguration.

ii Teaching spaces that can change between teacher led and collaborative study mode. The teaching space size and technology provisions are briefed to be multi-functional and easily adaptable as teaching methods change.

iii Storage rooms located throughout the building with space to allow furniture storage to support the easy change of room layouts.

iv Where space permits, spaces that are technology ready, even if the hardware is not installed on day one. The communications design is to have spare capacity to easily incorporate new technology.

b. Design features required for long-term flexibility include:

i A building structure independent of the internal arrangement of the rooms.

ii Internal fit-outs capable of easy and cost effective reconfiguration and demolition without impacting on the base building.

iii As part of the base-build/partial fit-out strategy, sections of the building which can be used for different purposes. The School of Physics anticipates that more quality laboratory space (over and above that provisioned in Figure 5) will be required in the coming decades. At least 200 square metres, or the equivalent of five laboratory modules, should be designed so that in future this space can be re-dedicated as "B" grade laboratory space.

iv Minimum clear floor to ceiling heights as follows:

- Cleanroom — 3m (excluding raised floor and plenum zones)
- Type A / B Laboratories — 4m (excluding services zone if open ceiling)
- Type C Laboratories — 3m (excluding services zone if open ceiling)
- TEM Suite — 5m
- Teaching Space — Where possible consistent with AV requirements
- Work space — 2.4m but consideration should be given to providing 4m to allow for potential future conversion to laboratory space.

v Service installations designed for ease of reconfiguration with sufficient capacity to accommodate various uses, not only the initial fit-out design.

vi The design is to include provisions for future expansion of chiller capacity to ensure adequate redundancy is available as the building load increases.

3.2.4 Work Environments

a. The workspace and building more generally, needs to be designed to support high-quality research in the physical sciences. The current successful approach to academic research, made possible in many instances by a workplace model of individual offices for academics and shared offices for students, with administrative staff accommodated at workstations should not be compromised.

b. To produce world-leading research, physics researchers need to be opportunistic and focus on the best research outcome. Often that means working with people at other institutions around the globe. Interaction within the School should be encouraged, as this leads to excellent outcomes and cross-disciplinary work, but for most users, their main mode of operation is to work alone or in small groups.

c. A total of approximately 1,180sqm (UFA) of individual workpoints and team shared workspace will be provided for the building occupants and visitors, comprising of enclosed and open settings. 'Team Shared' spaces (e.g. enclosed meeting rooms, informal areas, centralised storage, tea / coffee points), will be interwoven with individual work areas to create a range of settings.

d. Design principles to apply to the workplace environments include:

i Equity

- Equal staff office sizes for all academics to provide planning flexibility and to communicate a desired shift to a non-hierarchical culture.

ii Flexibility

- Workspace made up of a modular kit of parts, sized to suit a flexible interior planning grid for optimal integration with the architecture and future flexibility. Offices should be flexible in arrangement to accommodate 1-6 people (1 senior academic, 2-3 mid/junior level academics, 3-4 postgraduate, 5-6 undergraduate project students).
- Consolidation of staff space allocation standards to ensure the kit of parts remains compact and issues of hierarchy and churn difficulties are minimised to future proof the building.
- Cluster arrangements should ensure that the boundaries of the cluster module are flexible and that the internal planning can also change, expand and be refined to correspond to changing research and mentoring methods.
- Technical staff offices located adjacent to the laboratories.
- Overall approximately 30% of offices located adjacent to laboratories, with other offices within easy walking distance.
- Provide break-out spaces adjacent to offices and labs to facilitate collaboration

iii Technology Enabled

- Workspaces with information and communication technology that optimises connectivity, mobility, choice in where and how people work, and cost effective churn.
- Cabling infrastructure does not need to exist from day one, but cable pathways and ducting should be sufficient to accommodate any arrangement.

iv Laboratory/ Workspace Connections

- Effective vertical connections, to support high quality interactions between the laboratories and offices.

v Workplace Environment

- Generous provision of natural light with visual connections with the existing building and the activity taking place in the courtyard. Solar control devices provided as appropriate to control glare and direct solar radiation.
- Workspaces to incorporate suitable artificial light with user control to vary levels/ setting as required.
- Workspaces have good air quality including access to user-controlled natural ventilation if possible.

vi Privacy & Security

- The nature of the work undertaken in the School of Physics generally requires spells of quiet, deep thought and often confidentiality is required for discussion between academics and students, therefore offices must have sufficient acoustic and visual privacy.
- Academic offices will house confidential and valuable material and must be able to be secured.

3.2.5 Research Environments

a. Precedents

i The AIN research environment should be compared against world-class research and innovation infrastructure, including the following:

- Nanoscience Buildings
  - Bristol Laboratory
  - Birck Nanotechnology Center, Purdue University, USA
  - Stanford Nanofabrication Facility, USA
  - Laboratory for Integrated Science and Engineering, Harvard University USA
  - Building 1 Extension, NIST Boulder, USA
  - Mountbatten Building, University of Southampton, UK
  - Physical Sciences Complex, University of Maryland (inc JQI), USA
  - Centre for Integrated Nanotechnologies, Sandia National Laboratories, Albuquerque, USA
- Collegiate Workplace exemplars:
  - Cahill Centre for Astronomy & Astrophysics, Caltech, USA
  - CalIT2 at UCSD (Atkinson Hall), USA

b. The AIN Physics Building shall provide high quality research spaces that are adaptable to future changes, the following design principles shall apply:

i Location

- The research facilities are to be located with related and compatible functions and separated as much as practical from undergraduate student traffic.
- Where appropriate research facilities should have their own identity and be closely linked to a hub on the main circulation route. They should have a public address to the main 'people activity' spaces within the precinct.

ii Adaptable Research Spaces

- Research facilities are to be located and configured to enable adaptation and expansion with the ability to reconfigure adjacent spaces for research use if required. Opportunities for future expansion and densification in the precinct should be maximised.
- Whilst designed for specific tasks and functions, the research facilities are to be capable of rapid reassignment to respond to new research opportunities. This requires the provision of or spatial allocation for future services that may not be required in the initial configuration.
- Research facilities are to have independent after-hours access to support 24 hour use.
- The Cleanroom is to be a highly visible 'attractor' service that will encourage its use by people from other disciplines and external parties.

iii High quality Research Space

- Specialist research spaces are to be designed for specific applications as opposed to multipurpose designs. However, they should be shared and located together so they are readily accessible to multiple users.
- The allocation of service zoning to research facilities should make reasonable provision for future proofing to allow for installation of future mechanical, electrical and hydraulic services.

iv Vibration Sensitive Research Spaces

- The AIN Building will contain 'specialist' laboratory (and associated plant) space; areas that require stringent environmental conditions, particularly in terms of vibration, temperature and humidity. The ideal location for such facilities is on grade.
- Owing to the site topography a number of workspaces occupied for long periods of time at this level will have little access to natural light, the design solution should consider appropriate means of providing natural light to these spaces.
- To ensure a durable long term solution to the below-ground areas, there will be a requirement to incorporate a double wall (wet retaining and dry inner wall) arrangement, including subsoil drainage. Refer to the Waterproofing specification in Appendix D for further details.

3.2.6 Learning Environments

a. General

i The AIN building shall provide teaching and learning environments that stimulate and support continuous improvements in quality teaching and learning.

b. Accommodation

i General teaching and learning spaces will include one traditional lecture theatre space of approximately 425sqm for up to 320 people, a total of 2 Seminar / Tutorial Rooms will be provided, ranging in size from 135 – 220sqm. Other General Teaching Spaces include a 90p 'Learning Studio' (240sqm), a video conference-enable Case Study Lecture Theatre (75spm) and and 3rd year Teaching Laboratory.

ii The large lecture theatre and some other general teaching spaces will be available for use by non-Physics students. The footfall from this population is likely to be disruptive to the Physics community, so ideally access to these spaces will not require going through Physics itself.

iii In general, as far as possible the non-physics student population should be separated from the physics functions of the building.

3.2.7 Shared Support Spaces

a. General

i Support spaces represent a diverse range of spaces with differing scale, furniture, technology and privacy. Several of these spaces will be key central features and meeting places for the precinct, whereas others will fill the 'in between' spaces on the building access perimeter and between the formal programmed spaces.

ii Support spaces are casual settings which students, academics, researchers, and the greater community will utilise between classes and when working together in informal groups. These areas should be located along the central axis or circulation spine, remaining highly visible from inside and outside the building. The result is a strong message that this building nurtures leading edge research and knowledge-rich outcomes.

iii The design of these interactive spaces will counteract any tendency toward isolation or segregation typically brought about by individuals or groups set in long periods of concentration on complex research tasks. At the same time, there will be no compromises to sound and privacy when and where these are needed.

b. Objectives

i Spaces to enable research-led teaching to continue in varied informal and social settings.

ii Places where many research communities can come together and interact.

iii Provide 'bump space' between the residents and users of new and existing buildings.

iv Located near clustered teaching and learning spaces to encourage 'breakout' discussion.

v Facilitate several-to-many small groups meeting and collaborating in the same space.

vi Use 'situational crime prevention' techniques and design e.g. passive surveillance.

vii Minimise spatial inefficiencies caused by University security requirements for public space i.e. no natural or artificial barriers to a person's entry.

viii Provide intuitive way-finding through views through the space and simple signage.

3.2.8 Loading Dock and Other Support Facilities

a. The loading dock and associated support facilities will create vibration at levels that are unacceptable to the sensitive laboratories and cleanroom facilities. To minimise this impact, these facilities should be separated, in an appropriate manner.

3.2.9 Central Building Amenity

a. The Café will be an important destination alongside the Physics Courtyard; attracting staff and physics students alike. It will become an important feature of the Physics community, provide the context for

discussion and debate, as well as refreshment and relaxation. The nominal area required for this space is 150sqm (UFA), although the adjacent informal areas will provide an extension to the dedicated café seating area.

3.2.10 Accessibility

a. An access policy is to be developed for the building in consultation with the School and the University Access Committee.

3.3 Functional Relationships

a. The AIN-Physics Building comprises four main functions:
   i Research Laboratory space
   ii Teaching & Learning space
   iii Workspace
   iv Support and shared space

b. The inter-relationship of these spaces and key considerations in their arrangement relative to each other is described throughout the Functional Descriptions. In overall building terms the primary considerations are as follows:
   i Research Laboratory and Teaching & Learning functions should be separated to minimise the potential negative impacts of the movement of large student populations on the work being undertaken within the highly sensitive research areas.
   ii Cleanroom, TEM Suite and Type A Labs should be located on grade to achieve/ optimise vibration performance criteria.
   iii At least 30% of offices (22no.) should be located adjacent to laboratories to accommodate staff and students using those laboratories, unless significant performance and cost benefits can be demonstrated using other arrangements. Workspace must be zoned to manage the conflict created by supporting areas of intense activity alongside those demanding concentration and privacy/confidentiality
   iv A Physics courtyard at the 'heart' of the facility is desirable.

c. The above considerations are graphically represented in the following Adjacency Diagram.

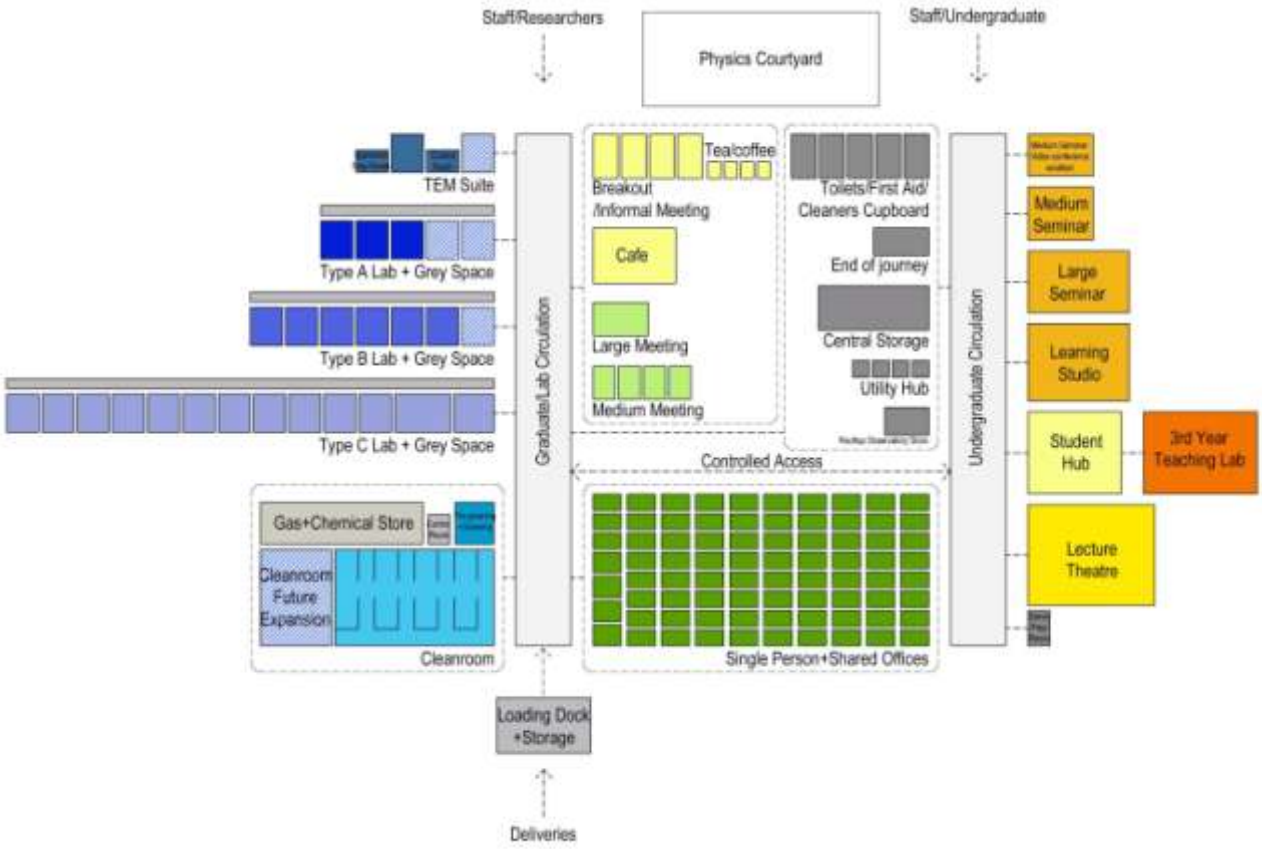


Figure 6 Adjacency Diagram

3.4 Laboratories – Detailed Functional Planning

3.4.1 Objectives

a. General

i The primary aim of the University research program is to develop new knowledge for the benefit of society through the conduct of innovative research, and to train students and junior postdoctoral fellows in research techniques.

ii Current and projected research requires a combination of generic, flexible and specialised laboratories. Research labs are also an important tool in preparing students for employment.

iii The AIN Physics Building will provide a balance of both generic and specialised laboratory environments to support the broad range of needs of research disciplines within the School of Physics.

iv A stimulating research environment encourages and enhances the following:

- motivation and productivity.
- views that create interest and ease of orientation and way finding.
- an environment to promote interaction between researchers.
- social support spaces.

v The building must be capable of addressing current and future requirements for laboratory space. Future requirements can be addressed (see 3.2.3 b(iii)) by base-building other space in the AIN to a level where it could be converted to "B" grade laboratories.

3.4.2 Specific User Requirements of Laboratory Spaces

a. The laboratory space must satisfy the following principles within the constraints of budget and technical limitations:

i Avoid typical 'clinical' laboratory aesthetic through the appropriate selection of colour, materials, furniture and surface finishes.

ii Provide direct and/or diffused natural lighting where appropriate and minimise the need for artificial lighting.

iii Create visual connections to support interaction and show activity between different spaces.

iv Each laboratory should be located near open, shared informal settings to encourage collaboration between teams during time away from a laboratory.

v Consideration should be given to using a modular layout capable of being reconfigured to organise the laboratories.

vi Laboratory furniture should be appropriate to physical science laboratories and incorporate storage for small and/or delicate items of equipment, adequate bench space for manual operations, writing in notebooks and work at computer terminals. While bespoke solutions may not be cost-effective, consideration should be given to developing custom designs that may be replicated through many of the laboratories. Furniture for wet-bench laboratories is not appropriate.

b. Laboratory Environmental Requirements

i Specialist laboratories within the AIN will house equipment that is highly sensitive to vibration and electro-magnetic interference (EMI). As such, the separation of 'sensitive' equipment and 'source' elements (e.g. lifts, loading dock, mechanical workshop, car parking, and lecture theatres) is vital to ensure the best equipment performance and therefore research outcomes. This issue is addressed in more detail in the section of this document relating to EMI. Also of critical importance is achieving tight atmospheric controls for air handling. The AIN will need to be carefully designed with respect to structure, services and architecture so that all equipment installed in the laboratories achieves its target technical performance.

ii The following environmental requirements will need to meet equipment specifications:

- Thermal and Humidity Stability
- Pressure Stability
- Airflow Velocity and change rate
- Air quality
- Electromagnetic Fields
- Vibration
- Background and intrusive noise
- Services (water, gases, power, etc.)
- Lighting and viewing panels or windows

iii The following environmental requirements are influenced by the proximity of nearby sources of Noise, Vibration and EMI.

	Potential disturbing sources
Vibration, Noise and EMI	• Vehicle movement including loading dock and local roads • Lift travel • Mechanical plant • People and equipment movement • Experimental equipment and Cleanroom tools • Electrical and communication services • Earth loops

3.4.3 Zones of Influence

a. Cleanroom tools and laboratory equipment can be adversely affected by Noise, Vibration and EMI or they can be a source of these. The sensitivity of the tool or equipment should be identified. In addition the zone of influence of the emitter should be estimated to determine the separation needed to avoid adversely affecting the performance of the tool or equipment.

b. Where it is unavoidable that a sensitive tool is within the zone of influence of an emitter then active measures can be taken to dampen or cancel its effect.

c. Spatial relationships between laboratories and offices

i Specialised laboratories, occupied by research groups, play the central role in the AIN project. They are complemented by centralized user facilities such as the Cleanroom or TEM suites, which are used by students and academics from a diverse set of groups, but are also overseen by technical staff members.

ii In the academic environment of the AIN the dual functions of teaching and research complement and reinforce each other. Our laboratory facilities are places where research is conducted, and where students engage in scholarly inquiry as members of research groups led by senior academic staff. Our research labs are not environments where users are removed from activities, as can be the case in environments dedicated to industrial production with fully automated toolsets. Students often work long hours and switch frequently between tasks at the "bench," work at a computer, and informal discussion or socialization. The AIN's centralized research user facilities (the TEM suite and Cleanroom) support research activities with technical staff moving between research spaces and offices where they may consult with users/students or plan research tasks.

iii User integration into the research laboratories and centralized facilities is therefore a key consideration for their functionality.

iv A variety of possible configurations for the massing diagram of the AIN building are conceivable, in which laboratories may be physically distributed throughout the building or concentrated on a single level. Both approaches have merit.

v Distribution of labs through the building permits co-integration of labs/user facilities with the offices for staff and students using those facilities so that, for example, the offices for members of a research group could be directly across the hall or adjacent to their labs. This allows students and junior academics easy access to their primary research spaces. There are strong benefits to this approach in an academic environment, and where possible such co-integration should be considered.

vi Concentration of labs, by contrast, permits specialized structures to be dedicated to use for laboratories, creating cost efficiencies. It could also permit large numbers of laboratories to be constructed using slab-on-grade in order to minimize construction costs.

vii The final design of the AIN should weigh these construction efficiencies against user desires for the most functional research spaces possible.

3.4.4 Design Report

a. A separate design report discussing sources of EMI will be provided, accompanied by a high level document with details of mitigation strategies suitable for guiding design decisions.

3.4.5 Building Structure

a. Slab on ground

i The vibration response of slabs on bearing on the ground will be much improved compared to normal suspended concrete floors. Equipment that is very sensitive to vibration is often located on slabs constructed on grade for this reason. Detailed monitoring will need to be undertaken to assess if there are ground induced vibrations from other sources that may be transmitted directly through to the slabs. A screening survey has been undertaken and is included in Appendix II. Refer to the screening survey for indicative ambient vibration levels.

b. Suspended Slabs

i The design of the structure for the new building will need to assess the structural response of the suspended floor slabs to vibration and be designed to ensure that the vibration limits of any sensitive equipment are not exceeded.

ii The vibration response of the floor structure used for laboratories must also be assessed and designed accordingly. A report detailing prediction methodology, model assumptions and key findings must be presented for review.

3.4.6 Environmental Controls

a. Environmental control represents one of the most important infrastructure and design considerations for this facility. Laboratory equipment used for nanoscience is extremely sensitive to fluctuations in temperature, relative humidity, and ambient pressure. As such, the design of air handling systems, ductwork, plant rooms, control systems, thermal management/heat exchange systems, and the like must be considered in detail at the design stage in order to ensure that tolerances are met.

b. Requirements vary between laboratory classes, but the most stringent requirements arise from the Type A Precision Metrology laboratories and the TEM suite. Design targets include absolute temperature fluctuations less than +/-0.1C about a user defined set-point. This set-point must be stable regardless of ambient temperature, and must be maintained under dynamic heat loads and over long periods. Relative humidity should also be controlled to +/-5% about a user-defined range.

c. Solutions meeting these and other specific environmental targets must be provided. It is recommended that environmental-control/mechanical systems consultants be retained during the design phase. Technical approaches should be benchmarked against the state-of-practice employed in comparable facilities worldwide.

d. Typical solutions may include the following:

   i Rapid exchange of laboratory air (up to 40 exchanges per hour)

   ii Minimization of pressure fluctuations and air velocity turbulent air flow

   iii Local sensors and PID (Proportional Integral Differential) controllers installed within each laboratory module to permit local tuning

   iv Soft-ductwork in order to prevent local high-velocity output from a standard outlet port

   v Vestibule entryways to prevent environmental perturbation due to entry to and egress from laboratory spaces

   vi Mitigation of acoustic vibration due both to mechanical systems and airflow in ductwork via use of separate plinths and structural design

   vii Minimization of air travel paths to local outlets

   viii Mitigation of electrical noise due to AC motors used in air handling systems via separation of power systems

   ix Innovative and energy efficient solutions are encouraged, but must be consistent with user needs.

3.4.7 Generic Relationship of Labs to Support and Spaces

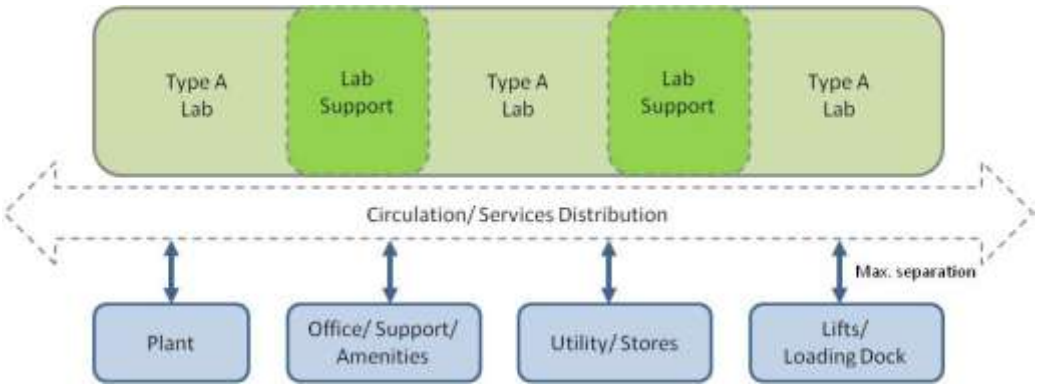


Figure 7 Diagram: Relationship of Labs to Support and Spaces

3.4.8 Type A Laboratory Space

a. General

   i The users of the Type A laboratories will include: Atomic Physics, Atom Optics, Electron Microscopy, Nanofabrication, Quantum Optics/Photonics, Scanned Probe.

   ii The laboratories will include primary laboratory space with support spaces including utility and equipment rooms and write-up spaces.

b. Functional Relationships

i Type A laboratories should be located on the ground bearing slab. Access to lifts will be necessary for people and equipment movement however these facilities should be located as far as possible from the lab.

ii Lab support functions will be located near to the lab.

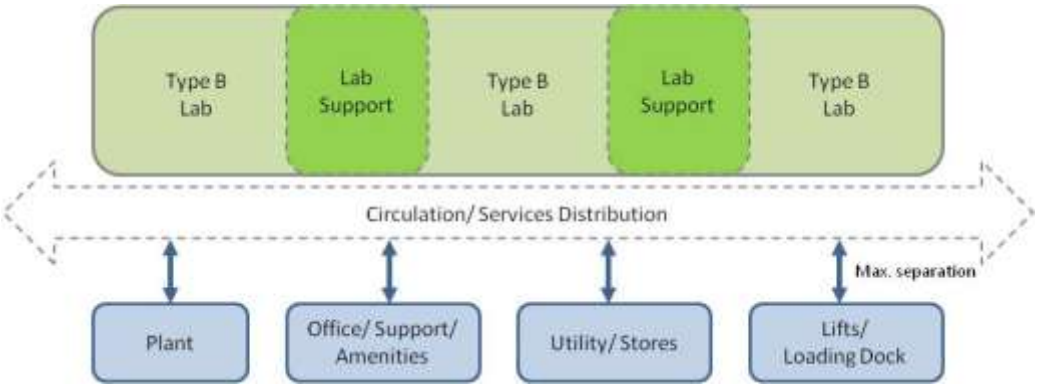


Figure 8 Diagram: Type A Laboratory Functional Relationships

3.4.9 Type B Laboratory Space

a. General

i The users of the type B laboratories will include: Fibre-based optics/photonics, General Optical Instrumentation, Integrated Nanodevices/Sensors/etc., Mesoscopic Physics, Nanomaterials growth/characterization.

ii The laboratories will include primary laboratory space with support spaces including utility and equipment rooms, and write-up spaces.

b. Functional Relationships

i Type B laboratories can be located on the upper levels of the building provided that the vibration specifications can be met. Access to lifts will be necessary for people and equipment movement. Lab support functions will be located proximally to the lab.

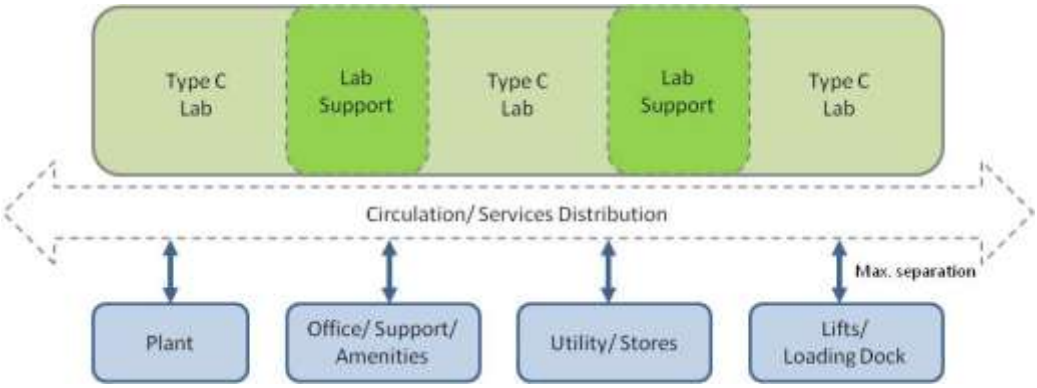


Figure 9 **Diagram: Type A Laboratory Functional Relationships**

3.4.10 Type C Laboratory Space

a. General

i The users of the type C laboratories will include: Most Photonic laboratories, Thin-film deposition, General instrument assembly, Electronics Shop. The laboratories will include primary laboratory space with support spaces including utility and equipment rooms, and write-up spaces.

ii Some labs will be used for biophysics and biointerface research, for which humidity control, deionised water and laminar flow benches will be required. Physical Containment (PC) air handling is not required for these experiments

b. Functional Relationships

i Access to lifts will be necessary for people and equipment movement. Lab support functions will be located proximally to the lab.

3.4.11 Cleanroom Laboratory Space

a. General

i A cleanroom integrating state of the art Nanofabrication facilities will be the centre piece of the AIN research laboratories.

ii The laboratory will be accessed by students, staff and visitors. It will be centrally administered as a secure facility requiring access via a series of air-locks and gowning room that create a 'clean' environment maintained at strict temperature and pressure controls. The Cleanroom may be configured as a 'bay and chase' arrangement. Detailed layouts of tooling within a bay and chase arrangements will form part of the design brief.

iii This facility also requires an observation corridor that allows for visitor viewing and education regarding the research undertaken within.

iv The cleanroom is a facility shared across different groups of the School.

v The cleanroom will accommodate equipment as follows:

- Tooling for photolithography
- Tooling for nano-scale film deposition
- Tooling for dry etching
- Tooling for wet etching
- Tooling for deposition of different materials, dielectric, semiconducting and metal

vi A preliminary list of tooling and equipment to be accommodated for current and projected future needs is contained in the Appendix.

b. Core Components

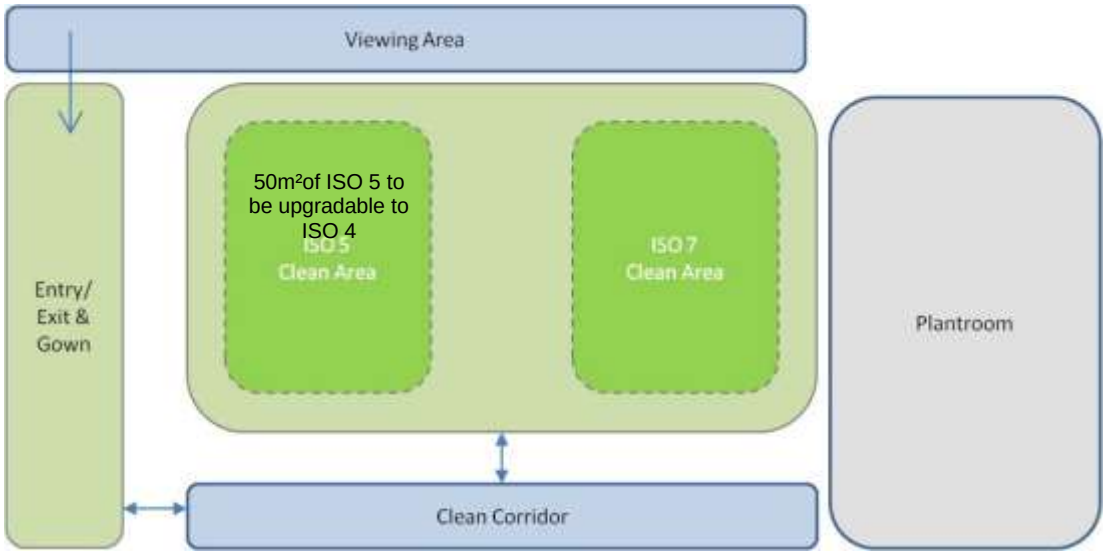
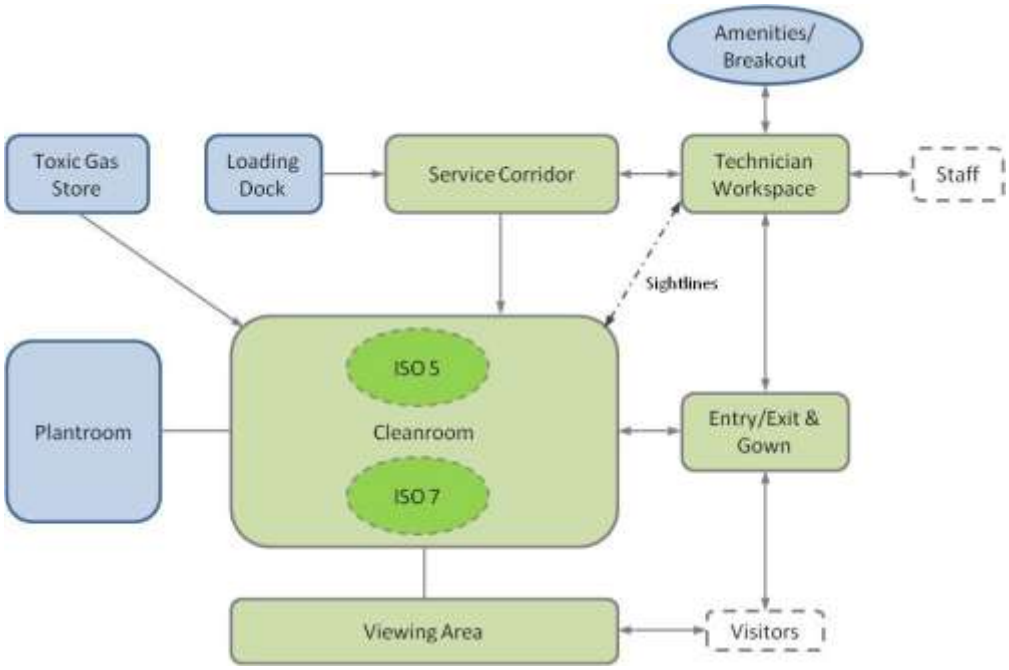


Figure 10 Diagram: Cleanroom Core Components Functional Relationships

c. Functional Relationships

i This space should be located with a slab on ground and be in proximity to the loading dock for equipment installation. The cleanroom will be near the gas stores and have a connection with its associated air handling plant room.



3.4.12TEM S

Figure 11 Diagram: Cleanroom Functional Relationships

a. General

i The TEM Suite will include two main principal instrument rooms housing a high precision TEM and a second room to house a future instrument. The rooms will be supported by equipment rooms housing power supplies, control gear and SF6 vessels. In addition a controlled entry/exit, Operator Room and Sample Preparation Room will be provided. The users of the TEM Suite will include staff from the Australian Centre for Microscopy and Microanalysis.

b. Core Components

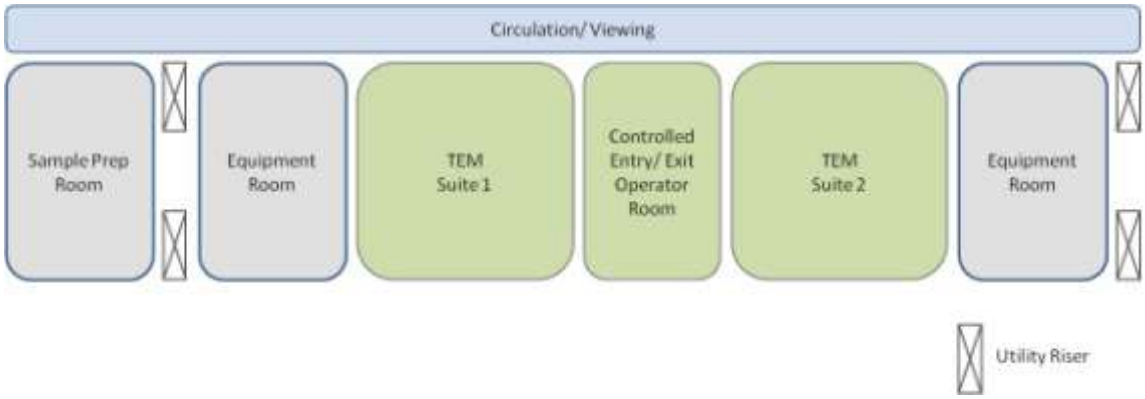


Figure 12 Diagram: TEM Suite Core Components Functional Relationships

c. Functional Relationships

i This space should be located in the basement (slab on ground) with access to amenities/breakout and direct connection to support spaces such as equipment room and controlled entry. The suite should be located with maximum separation to noise, vibration and EMI sources including plant, lifts, loading dock and high current loads in power cabling.

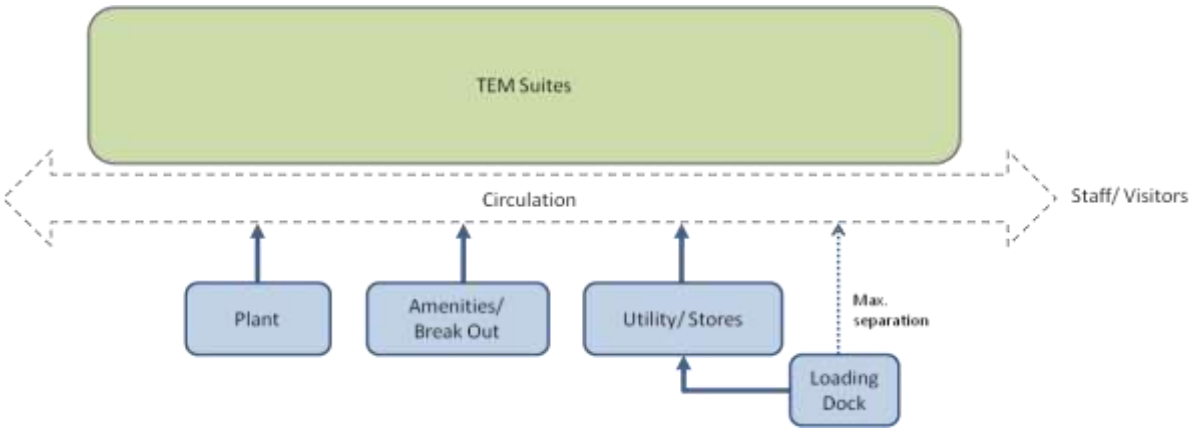


Figure 13 Diagram: TEM Suite Functional Relationships

3.4.13Cleanroom - Functional Description

a. General

i Cleanrooms are special purpose rooms with tightly controlled environments used in nano fabrication of devices including Photonic Integrated Circuits (PIC's), Electronic Integrated Circuits (IC's), Micro-Electro-Mechanical Systems (MEMS) devices, Nano-Electro-Mechanical Systems (NEMS) devices, Micro-fluidic devices and Bio Sensors.

ii The cleanroom is a facility in which a range of major items of research equipment ("tools") are maintained and operated by core staff and used by many different researchers, who are granted privileges to use different tools only after suitable training and formal approval. The University plans to operate this facility as part of a nationally accessible nanofabrication capability with operational support from the Federal Government under the National Collaborative Infrastructure Strategy (NCRIS) scheme. Many of the tools are currently housed at the premises of the University's fully-owned subsidiary Bandwidth Foundry International. Other tools are located in laboratories of A28 and the remainder are to be purchased in the coming two years using competitively won grant funds.

iii The facilities in the cleanroom are built to provide services to users across a wide range of applications. Consideration should be given to separating tools used in processes that require well-established, invariant processes (eg laser mask writer) from those that are continually reconfigured for different applications.

iv Many of the devices fabricated in the cleanroom have sub-micrometre features whose production is extremely sensitive to environmental variances and contamination during processing and evaluation. The cleanroom is the heart of the environment necessary to produce these devices. It requires very stable temperature and humidity control. In addition, the ISO 5 bays require a laminar flow of air from ceiling to floor through a densely packed ceiling of High Efficiency Particulate Air Filters (HEPA's). Laminar flow is important to keeping particulates down to reasonable levels and meeting the criteria of particles per cubic metre as outlined in the ISO Standards for ISO5 and ISO7. In those areas where photosensitive resist materials are used, lighting must be optically filtered to contain wavelengths greater than 500 nm only (yellow lighting). Approximately 50m2 of the ISO 5 cleanroom is to be capable of being upgraded to ISO 4.

v The cleanroom is a services-intensive space. For efficiency of service routing and for efficiencies of operation it would be best if the tools were grouped in different bays by function: lithography, wet deck processing, deposition tools, metrology tools, etching tools and so on. Services (power, process chilled water, CDA, nitrogen) should be reticulated ready for extending to suit tool hook up. The wet decks and other equipment defined elsewhere are to be considered as part of the base build for the cleanroom. All other tools are supplied and hooked up by the users.

vi Gases and chemicals are used in a multiplicity of cleanroom activities. Acids, bases and solvents are used in wet chemistry processes (at specially configured wet benches with fume cabinets) while gases, both common and exotic, are used in etching and deposition tools. The gases vary with the process and the material being deposited or etched but may be hazardous and/or toxic. The most common gases and chemicals that will be used and a representative range of exotic gases are listed in the Tool Utility Matrix (TUM). Provision should be made to handle additional exotic gases which may be required when researchers commence study of new materials and processes.

b. Environment

i Temperature stability

- The Laser Writer employs complex, free-space laser beams which bounce off multiple optical elements and need to be focused precisely onto a particular position in the system. Temperature fluctuations and drifts lead to instabilities in the optical beam lines, and changes in the performance of precision writing characteristics. For instance, when writing 500 nm features, a small drift in temperature can change the exposure characteristics, resulting in mask failure. Masks with these small features can often take 20 hours to write and only after processing would it become apparent that the line width changed during the writing process. Like the type A Labs, temperature stability is one of the most important parameter in the operation of the lithography equipment.

ii Pressure

- Bay pressure, although not so critical must remain positive relative to the chases, and in some cases even to other bays. Contamination in the lithography areas is disastrous and for that reason those bays would be kept pressurised above any surrounding cleanroom areas and above the chases. The gowning area would also be kept pressurised above the chases but below the adjacent cleanrooms. Rapid changes in pressure can adversely affect writing processes, particularly with regards to the performance of the stepper.

iii Air Velocity

- Laminar air flow is critical to maintaining a cleanroom environment. Micron and sub-micron particles tend to float in turbulent air streams, rather than fall to the floor. They readily move from place to place increasing the chance of contamination of the devices being made. Ensuring a laminar flow in the cleanroom area alleviates this problem.

iv Acoustics and Vibrations

- The operation of lithography equipment including the e-beam writers and optical lithography tools is extremely sensitive to vibration. These tools should be grouped in a separate bay designed to a VC-E standard. All other areas of the cleanroom are to be VC-D standard. Acoustic damping of local vibration sources including building services, sound-deadening materials, and structural engineering to minimize floor and wall vibrations via separated and damped slabs will be required.

v EMI

- Many of the lithography and characterisation tools are sensitive to pickup from unwanted fluctuations in the environment. These include 50Hz mains fluctuations in magnetic fields, slow drifts in ambient DC magnetic fields, and high-frequency sources in the radio and microwave. Many of the lithography and characterisation tools are sensitive to pickup from unwanted fluctuations in the environment. These include 50Hz mains fluctuations in magnetic fields, slow drifts in ambient DC magnetic fields, and high-frequency sources in the radio and microwave. Measures for EMI mitigation must be adopted for the electron beam lithography that are similar to those for the electron microscopes.

c. Layout, Form & Location

i Grey Space/Service Chase

- Much of the equipment operating requires substantial infrastructure such as chilled water, compressors, vacuum pumps, deionised water, etc. These pieces of equipment are significant sources of mechanical vibrations, acoustic noise, heat, and electrical noise due to their use of AC electric motors and must be placed in adjacent but acoustically decoupled spaces (chases)

ii Usage

- Usage will be approximately 24/7 with students and staff working extremely long hours, albeit in small numbers. For environmental control reasons, these labs require closed doors at all times, and this can lead to significant feelings of isolation that should be mitigated where possible through design of significant surface area of wall space being windowed. In addition the windows provide a degree of safety for the limited number of individuals working in the area at most times of the day. This facility will be operated by dedicated staff responsible for tool maintenance and operation. Access to the tools is only possible for approved users, and only those users as well as the facility staff will have entry privileges to the cleanroom. A set of protocols governing use of the cleanroom is under development.

iii Location

- The cleanrooms should be physically located in areas with minimal footfall traffic. Similarly, the cleanrooms should be separated from mechanical and electrical infrastructure such as lifts and power distribution substations, and located on ground to maximize vibration isolation. Many of the cleanroom spaces will include yellow lighting which for long periods of exposure can lead to stress, and tiredness. Opportunities for external (natural) lighting in 'non-yellow' areas of the clean room should be considered. It is desirable that students and staff spending long working hours in the labs have access to proximal "breakout space" outside the cleanroom which provides comfortable locations for informal discussions, technical meetings, or even simple relaxation.

- The cleanroom is a feature of the AIN and should be adjacent to viewing galleries from where visitors, students and others can see at close hand the clean room tools in operation.

- Tools in the cleanroom can be extremely large and heavy. Access provisions must be designed-in so that tools can be moved easily from the loading dock into the allocated space in the cleanroom.

iv Cleanroom Envelope

- The cleanroom space should have a floor to ceiling height of not less than 3 meters clear, to provide sufficient clearance above equipment to reduce turbulent flow currents in the work areas. In addition to aid in the laminar flow requirements there should be a 1.2 m (ideally) raised floor, in which some process equipment such as pumps, power conditioners, transformers, etc. can be located. The 1.2 m height allows access for convenient servicing and access to equipment stored under the floor. The construction materials for the cleanroom should be designed for use; for example, powder coated steel or aluminium skin on honeycomb panels, with tinted glass windows set in the panels and framed without any flat surfaces to collect dust. The ceiling must have sufficient coverage of HEPA filters and the flooring

sufficient perforated tiles to achieve laminar flow from ceiling to floor and thus attain the desired ISO specifications for the area. Both ceiling and floor tiles should be designed such that they can be moved to provide flexibility in space usage allowing for installation of large pieces of equipment which may not necessarily require air discharge or return directly above or below the equipment. The floor shall be designed to minimise vibration when people walk about the space and meet the requirements of the performance specification for loading. Furthermore, mitigation measures should be considered to limit the spread of a chemical or water leak.

- Also the lithography bay, wet processing bay and spaces between shall have yellow lighting (excluding any light below 500 nm).
- The operational area of the cleanroom on commencement should not be less than 500 m^2 (bays and chases included) to accommodate the range of tools that users plan to install. No less than 200 m^2 of un-fitted space should be provided as expansion space for the inevitable build-out of the cleanroom as more tools are obtained and installed. The capability to conveniently reticulate services into this space should be provided on commencement, and the building services should be designed so that extra capability can be easily added if an when such build-out occurs.

TEM Suite - Functional Description

d. General

i The AIN building will have two dedicated Transmission Electron Microscopy (TEM) labs, each housing one high performance aberration corrected TEM instrument. These instruments are used for materials science research to observe nano-scale and atomic level structures of matter, and therefore require one of the tightest environmental stability requirements. A typical example of such instrument costs in excess of $6m, and therefore will become one of the flagship instruments to be housed in the AIN building. The room design, both technically and aesthetically, must meet such high expectations. Only one TEM lab is to be fitted out under this contract, the other will be left in a shell condition. The building services: power, process cooling and environmental conditioning are to have capacity for a future fit out.

ii Each TEM instrument requires up to two operators during normal use. The main instrument structure (beam column) and its core components must be housed in a dedicated room with the tightest environmental specifications (TEM room). Some of the peripheral devices, most notably the mains power UPS and the instrument cooling water closed-cycle chiller must be installed in the adjacent grey space to minimize the environmental disturbance on the instrument. Note: the UPS battery and the closed-cycle chiller are outside the scope of this project though the power and heat exchanger to the closed-cycle chiller are included. The operator will only need to enter the TEM room during the specimen exchange procedure, and the actual instrument operation and imaging will be performed in the adjacent room (control room) via a remote control workstation over Ethernet or other cables connected to the instrument. The control room should be located between the two TEM rooms, so that both instruments can be operated from one room. Therefore, the anticipated typical operator occupancy of the TEM room is zero, and the control room is four (two instruments, two operators per instrument).

iii The exact TEM Vendor and model specifications have not been announced at this point. It is expected that the rooms will be designed to meet the installation requirement specifications of some of the most advanced instruments that are currently used in this field of research. Two primary candidates are FEI Titan Cubed (Titan 3 G2 60-300) [www.fei.com] and JEOL JEM-ARM200F [www.jeol.com]. The room must meet all aspects of the installation requirement specifications provided by the vendors of both models, so that either of these instruments can be installed without any room modifications. Once the final TEM model has been selected the *Contractor* shall verify the room criteria with the Vendor. The verification process is to include a review of the methodologies and the measurement equipment used by the Vendors. The Vendor will undertake an independent review of the room performance prior to Practical Completion. The room must achieve the criteria to allow the TEM to be installed.

e. Environment

i Temperature and airflow stability

- The main structure (beam column) of a TEM instrument is mounted on an air suspension to minimize the effects of ground vibration. Therefore, any perturbations in the room temperature and airflow will cause the column to oscillate, which will result in image drift or distortion. A TEM is a microscope that is often used in magnification ranges in excess of 1,000,000x, so any instability in the instrument may be magnified by one million times in the resultant image.

- Special air conditioning mechanisms such as chilled beams or cloth diffusers may be fitted to meet the installation requirement specifications. Environmental measurements will be conducted at the instrument column and therefore the position of the column in the room will also contribute to the room performance. Any changes in the ambient temperature will affect the instrument calibration, so it is important to ensure that the specifications are met throughout the day without abrupt changes or slow drift, even during off-peak after hours, holidays and seasonal variations.

- It is also important to ensure that the TEM room is kept under positive pressure with minimal pressure fluctuations, to avoid dust from flowing into the room when the door is opened.

ii Acoustics and Vibrations

- Ground vibration is one of the most important environmental parameter that must be addressed, because it directly affects the imaging stability of the instrument. The instrument should be positioned on its own isolated concrete slab, typically in excess of 1m thick. This is to ensure that the microscope is isolated from building or equipment induced vibrations. Instrument vendors typically require floor stability to be better than VC-E criterion curve, with additional requirements based on the specific model. It is expected that the specifications will be met without the use of additional vibration control systems of any form.

- Acoustic requirements of the room are not as critical, and the Vendor specifications are often generic, typically requiring around < 40dB (C-wt).

iii EMI:

- The TEM instrument uses a beam of electrons that travel through a long column made from non-magnetic metal. The beam is manipulated by precise controls of several magnetic lenses installed in the beam path.
- The instrument must be protected against any forms of EM drift and noise, because even a small change in the environmental EM field will cause the beam to lose alignment, and any small noise in the EM field will cause the beam to lose stability, thus causing the loss of image resolution. If the vendor offers several EM field grades and the corresponding absolute resolution limits achievable, the room must meet the tightest EM field requirement specified. All aspects of EM disturbances must be considered and appropriate measures taken to rectify them.
- Examples of considerations within the AIN building:
  - Take sufficient distance between all high current power cables and the TEM rooms
  - Avoid shared/chained power cable with other rooms/offices
  - Physical locations of other facilities and instruments that may be high EM emitters
  - Interference from nearby EM field compensation devices
  - Avoid the use of lighting solutions that may be a source of EM noise.
  - Isolated structural reinforcing bars to avoid earth loop formation and consider effects of contaminated building earth paths
  - Metallic water pipes and other conduits that may carry current
- Examples of considerations outside the AIN building:
  - Presence of underground power cables
  - Presence of other nearby buildings or future building sites that may have high EM emitters (e.g. elevators, plant rooms, car parks)
  - Periodic or occasional high EM emitters (e.g. generators, factories)
- The use of some form of EM shielding may be considered (e.g. Permalloy wall enclosure). However, active field compensation devices will not be used to meet the required specifications. Active devices are typically used to compensate for slow field drifts over time (e.g. geomagnetism) and is not an appropriate solution to eliminate all forms of wideband EM field issues.

f. Layout, Form & Location

i Room access

- TEM rooms should only be accessed via the control room. Direct access into the TEM rooms from the common building corridor should not be possible. A viewing window between the TEM room and the control room in the style of a recording studio is required. A viewing window between the building corridors to the TEM rooms may be installed. The purpose of this window is so that the casual visitors and tour groups do not need to go into the control room to view the instrument in action. Exact design of the doorways and windows will be subject to satisfying all of the installation requirement specifications.

ii Usage

- Unlike other lower-grade labs where doors may be left open and users may have informal meetings, these labs required closed doors at all times (for environmental stability), which can lead to significant feelings of isolation that should be mitigated where possible through design.

iii User access

- The TEM labs will be an extension of the Australian Centre for Microscopy & Microanalysis (ACMM) and will operate under normal ACMM access provisions, which in-turn, are access arrangements that must be consistent with the national facility funding that is planned for use to procure the instruments. Access to this facility will be via swipe card. Accredited users will need access 24/7/365 and therefore a secure access route will need to be established so that such users can access only the ACMM facility out of hours (i.e. any other non-ACMM labs along the route will need to be swipe access protected). This facility should be fully self-contained so that users have access to all the labs (and no others) once they have swiped in.

iv Location

- The TEM lab should be located underground in areas with minimal footfall traffic to maximize vibration isolation. This means that the labs should be separated from high-traffic areas such as lecture theatres and other undergraduate student dominated areas. Environmental concerns from the rooms above the instrument is also of equal concern and should only consist of rooms with minimal footfall traffic. Similarly,

the labs should be separated from mechanical and electrical infrastructure such as lifts and power distribution substations. The TEM lab should be adjacent to the TEM suite prep lab so that the time taken to transfer the specimen to and from the instrument is minimized to avoid contamination. The TEM staff office rooms do not need to be directly adjacent to the TEM lab, but should be in close proximity for easy access. Students and staff spending long working hours in the labs have need for access to proximal "breakout space" which provides comfortable locations for informal discussions, technical meetings, or even simple relaxation. This is especially important because of the relative isolation of these labs.

v Room dimensions

- Typical TEM instruments are greater than 3m in height, and require a large air space and insulation above to ensure mechanical stability.
- All door spaces must allow easy access for instrument delivery and assembly, including the positioning of a portable crane that is used for the instrument maintenance.
- The Control Room should accommodate minimum of four operators working comfortably with sufficient bench space for at least three desktop computers and other peripheral devices per instrument.
- Grey space must be large enough to house the instrument UPS, closed-cycle water chiller and other service equipment for the instrument with sufficient environmental considerations such as the heat and noise generated from the equipment.

vi Room layout

- In addition to housing the TEM instrument, there should be no requirements for additional storage space. However a non-ferrous antistatic bench space with lighting is required to perform specimen exchange procedure, which involves delicate tweezers manipulation of millimetre size specimens.
- The floor shall comprise ESD/chemical resistant sheet, but should not have marble style design pattern so a dropped object can easily be found.
- The operator must be able to walk from the control room to the instrument to perform specimen exchange without the risk of tripping on cables and conduits on the floor. All four sides of the instrument should have sufficient clearance to the walls so that a service engineer can conduct maintenance and move parts in and out as required.
- Electrical wiring and cooling water plumbing must be neatly arranged and separated to avoid the risk of potential water leakage. Installation of any building safety and security devices must first be consulted with the users prior to fitting.
- The TEM room should have zero occupancy during use, but should be designed so that the instrument faces towards the viewing windows to give good visual impression of the suite.

vii Grey Space

- The TEM instrument requires substantial infrastructure such as a UPS and a closed cycle water chiller. These pieces of equipment are significant sources of mechanical vibrations, acoustic noise, heat, and electrical noise, and therefore must be placed in adjacent, but decoupled spaces. The supporting slabs must be physically separated, and equipment cannot be mounted on walls that could transmit noise and vibrations to the labs. Both the UPS and the water chiller may require single or 3-phase mains power depending on the instrument to be installed. The exact power requirements and other properties are subject to the instrument specifications. The UPS must support the instrument and the water chiller for sufficient duration until the building backup generator is available. The water chiller may also require a building chilled water supply as part of the heat exchanger mechanism.

viii Other considerations

- The TEM instrument uses a compressed SF6 (sulphur hexafluoride) gas as an insulator in closed containers for high-tension voltage generation and the electron gun. This is assumed to be completely sealed and may only be partially vented to the atmosphere during major instrument maintenance. However, vendor or regional government regulations may require additional extraction systems that are dedicated to dealing with this gas. The gas is heavier than air so typically a small extraction duct is brought down to floor level to remove the gas effectively.

3.4.14TEM Specimen Preparation Room - Functional Description

a. General

i TEM Suite Prep lab is based on a standard Type C lab design with descriptions specific to providing specimen preparation facilities for the research conducted in the Transmission Electron Microscopy (TEM) lab.

ii TEM specimens are small metallic discs (3 mm) that are typically fabricated from a bulk material via a series of mechanical cutting, acid electrochemical polishing and ion beam milling. Most of the equipment fitted to the prep lab is small bench-top devices that run independently without requiring tight environmental conditions. These devices include optical microscopes, portable diamond disc cutting saws and compact ion polishing systems. However, some larger equipment such as fume hoods must be installed, and therefore the overall room layout must be optimized to cater for both storage utility and functional usability.

b. Specific Descriptions

i Usage and location

- Up to two users may occupy the room at any time. A user will typically bring their bulk material to the prep lab, perform specimen preparation to create a TEM specimen, and transport it across to the TEM room to be analysed in the TEM instrument. The most significant issue involved in this process is the contamination of the specimen due to prolonged exposure to the atmosphere, particularly humidity and airborne dust. Therefore, the prep lab must be positioned adjacent to the TEM rooms to reduce the specimen transfer time as short as possible. The location should avoid areas of high footfall traffic and contamination.

ii User access

- The prep lab will be an extension of the ACMM and will operate under normal ACMM access provisions, which in-turn, are access arrangements that must be consistent with the national facility funding that is planned for use to procure the instruments. Access to this facility will be as described previously. Large equipment: Two large equipment to be fitted to the room are a specimen storage fridge (a typical household fridge size), and two fume hoods, one of which must be equipped with a scrubber system suitable for perchloric acid based solutions. Both fume hoods must contain sinks and compressed air as part of regular fittings.

iii Storage equipment

- The prep lab must act as a storage space for many of the users TEM specimens and preparation consumables such as acids and solvents. Therefore, large perimeter workbenches with under-bench cupboards, wheeled drawer cabinets, glassware, solvents and acids storage cabinets must be fitted to the room without sacrificing the room for users to walk around and sit down on stools to perform delicate operations.

iv Building facilities

- The prep lab must have appropriate plumbing for process chilled water, compressed air gun and a sink with hot and cold water. A hand wash basin with an eye wash station may be fitted for user safety protocols. Dedicated acid drains will not be required since the concentrations of the acid solutions used are typically very low.

3.4.15Type A Laboratory - Functional Description

a. General

i In Type A labs a variety of experiments are performed focused on the broad field of precision metrology. This field, at its heart, attempts to advance measurement science, by allowing the realization of previously unattainable levels of accuracy and precision in a variety of experiments. For instance, we may aim to control exotic quantum systems with unprecedented fidelity, or measure the frequency of an optical transition in an atom to many decimal places, minimizing uncertainty in this measurement. Experimental systems of interest may be trapped atoms in ultra-high-vacuum systems, nanoscale scanned-probe imaging systems, or precision lasers and interferometers. In some cases large-scale custom pieces of equipment are built, and in others specialized optical and electronic measurement systems on large optical tables are relied upon.

ii All of these research efforts share a common need for exceptional environmental stability. Due to the nature of the research there is no single set of requirements - custom built experimental equipment requires custom solutions. However, in general requirements are similar to those required for operating aberration-corrected Transmission Electron Microscopes. Key needs are identified and explained below:

b. Environment

i Temperature stability

- In many experiments complex laser systems in free-space are employed – laser beams reflecting off multiple optical elements and being focused precisely to a particular location in a system. Temperature fluctuations and drifts lead to instabilities in the optical beamlines, and changes in the performance of precision electronics and optical sources. For instance, the precise frequency output by a laser is very sensitive to the temperature of the ambient environment - small fluctuations or slow drifts can prevent the experiment from working. The system must be able to rapidly adjust to changes in the dynamic load in the room. Temperature stability is the most important parameter in the operation of many precision metrology laboratories

ii Pressure:

- Pressure fluctuations in the environment similarly lead to changes in the performance of optical systems as systems may expand or contract on scales of optical wavelengths. For instance, opening the door to a pressurized optics lab can result in a diode laser's external cavity moving enough to shift the frequency of the output light by amounts large compared to the required stability.

iii Air Velocity

- In many cases researchers are forced to allow optical beamlines to propagate through air as fiber optical systems are unavailable for the colours we use. Small currents in air, or changes in local density lead to effective changes in optical beamline path-lengths, and results in failure of our experiments. As such, extremely low local air velocity with low turbulence is required. This must be managed in conjunction with the need for extreme temperature stability, generally mandating rapid air changes in the lab. Soft ducting and soft diffusers are a new and useful solution that permits low local air velocities.

iv Acoustics and Vibrations

- As many experiments require optical phase stability, they are extremely sensitive to fast changes in the length of an optical beam on very small length scales, down to nanometers. Motion of optical elements of a nanometer or two can be caused by acoustic pickup from the air causing elements to vibrate, or vibrations being translated from the floor into experimental systems. Similarly, many precision electrical systems suffer from stray electrical noise caused by mechanical agitation, with sensitivity on the same scale. In either case, these effects cause "noise" which often degrades the performance of the experiments. Acoustic damping of local vibration sources including building services, sound-deadening materials, and structural engineering to minimize floor and wall vibrations via separated and damped slabs are required.

v EMI

- All experiments are sensitive to ambient sources of electromagnetic interference. Ultimately, researchers attempt to exert precise control over a variety of optical and electrical systems which are sensitive to pickup from unwanted fluctuations in the environment. These include 50Hz mains fluctuations in magnetic fields, slow drifts in ambient DC magnetic fields, and high-frequency sources in the radio and microwave. Passive shielding of building services, while possible, is often not cost effective, especially at low frequencies. Active cancellation of slow drifts can be quite effective. Similarly, mitigation strategies preventing fluctuations of electrical voltages and currents are required in the conditioning of power delivered to the labs. Noise sources from other nearby labs must also be mitigated by separating wiring to prevent cross-talk between labs. Further details on EMI of generic importance to our experiments are

provided in a separate document that discusses EMI sources.

c. Layout, Form & Location

i Layout issues

- In addition to housing experimental hardware, there is a significant need for storage space tailored to the kind of experiments performed therein (e.g. lots of drawers and shelving for optics-focused labs), bench space is required in the labs for performing detailed assembly of optical and electronic systems, and users taking data from benches and computer stations must be accommodated. The layout of the lab must permit multiple users at these "peripheral" stations, while others stand and work at the optics tables or main experimental hardware, with sufficient clearance and walking space between these. Equipment on wheels, such as portable electronics or storage dewars for cryogens must be able to be rolled through the labs easily.

ii Grey Space/Service Chase

- Much of the equipment requires substantial infrastructure such as chilled water, compressors, vacuum pumps etc. These pieces of equipment are significant sources of mechanical vibrations, acoustic noise, heat, and electrical noise due to their use of AC electric motors. These pieces of equipment must be placed in adjacent, but decoupled spaces. The supporting slabs must be physically separated, and equipment cannot be mounted on walls that could transmit noise and vibrations to the labs. Suspended walls are sometimes useful to mitigate any stray transmission of vibrations from the grey space to the floor of the main lab.

iii Usage

- Unlike other lower-grade labs where doors may be left open and users may have informal meetings or even seating/discussion areas in the labs, these labs required closed doors at all times (for temp. stability), which can lead to significant feelings of isolation that should be mitigated where possible through design (see location, below).

iv Ceiling Height and Access

- Much of the equipment used in these labs is tall, and in general, clear ceiling heights must be a minimum of 4m. This height also helps reduce air velocities at table level by permitting air distribution systems to be placed very high above the users. Equipment may also be very large, such as optical tables that are up to 4m x 1.5m weighing ~1,000 kg. Suitable access must be provided from hallways through double doors. Many experiments also use suspended overhead "gondolas" over optics tables, providing custom shelving solutions and equipment storage over experimental tables - this also allows heat-generating support electronics to be placed high above the most sensitive systems.

v Location

- Type A labs should be physically located in areas with minimal footfall traffic. This means that the labs should be separated from high-traffic areas such as lecture theatres and other undergraduate-student-dominated areas. Similarly, the labs should be separated from mechanical and electrical infrastructure such as lifts and power distribution substations. Labs are often located underground or partially underground to maximize vibration isolation. As a result, they generally have no/limited natural light. Students and staff spending long working hours in the labs have need for access to proximal "breakout space" which provides comfortable locations for informal discussions, technical meetings, or even simple relaxation. This is especially important because of the relative isolation of these labs. Proximal location of these breakout spaces should be a priority for these labs.

3.4.16Type B Laboratory - Functional Description

a. General

i Type B Laboratories will enable a range of experimental activities of current interest in the School as well as establish a highly flexible space for unforseen future research directions. Current activities set to occupy this space include nanomaterials, nanophotonics, nanoelectronics and magnetic resonance research, which involves very sensitive optical, electrical and magnetic measurements on small samples and integrated circuit chips, often at extremely low temperatures. Common activities include contacting circuits on a nanoscale and making electrical measurements in the nano-volt and pico-amp regime across wide frequency bandwidths and precision physical property measurements, for example analysis of surfaces using probe microscopies that require mechanical stability.

b. Environment

i EMI

- These Laboratories typically comprise a great deal of electrical test and measurement equipment and the research is sensitive to EMI, from power (50 Hz) to radio frequencies and beyond. Close attention must be paid to the design rules for mitigating EMI when designing these laboratories and the surrounding environment. Approaches to decoupling mains power grounds and circuits and minimizing EMI from proximal laboratories should be strongly considered. In other cases, where nanomaterials are synthesized low particle counts are paramount.

ii Magnetic fields

- Magnetic fields are used extensively in these laboratory spaces. These range from superconducting solenoids in the range 2-10 Tesla (used in conjunction with dilution refrigerators and NMR/MRI systems) to large Helmholtz electromagnetics for electron spin resonance.

- Consideration needs to be given to the potential impact of fringing fields from these magnets on the aberration-corrected electron microscopes in the TEM suite.

iii Vibration

- The need for vibration isolation and decoupling is more stringent than Type C Labs, but not as strict as Type A. Vibrations present difficulty when using microscopes and apparatus that involve probing or contacting sub-micron electron devices. Vibrations can also lead to heating in dilution refrigerator cryogenic systems, compromising their performance.

iv Temperature and Humidity

- Temperature variations lead to drifts in the performance of electronic equipment. In some instances such drifts cannot be tolerated and methods to stabilise the temperature are required. The Labs contain large racks of electronic units and computer equipment, each dumping considerable heat into its environment. Higher temperatures lead to a need for constant recalibration of expensive and precision instrumentation and in extreme circumstances a shortening of the equipment's lifespan. Large variations in humidity can also influence measurements made on nanomaterials and should be controlled.

v Flooring and electrostatic shock

- The nanoscale electronic devices are extremely sensitive to static electricity, which can destroy them. Electrically dissipative flooring is needed as well as humidity specifications that suppress discharge.

vi Chilled water

- Modern, cryogenic apparatus and magnet systems make use of compressors that require significant cooling water. To maintain warranty and operation of these systems the cooling water specifications are tightly controlled in terms of temperature, flow rate, and pH levels. Water-to-water heat exchange units are typically used to decouple these "clean water" systems from the building-wide cooling water infrastructure.

vii Power

- Type B Laboratories have extensive power requirements. The large number of instruments and electronic equipment leads to a high density of single-phase outlets, of the order of 2 outlets every 30 cm around a room as well as occasional 3-phase outlets. In addition, the compressors used in cryogenic systems require 3-phase power and consume of order 10 kW each. A suite of type B labs may have 4 or 5 such systems with compressors and cooling water located in proximal grey space.

c. Layout, Form & Location

i Layout and Use

- Type B Labs may contain a number of experimental "stations", eg, scanning probe, IR and optical

microscopes, ellipsometers, probe stations, circuit bonders, soldering stations, electrical measurement setups, computer terminals, cryostats, and magnets. Researchers move between the stations regularly during a test and development phase, but may then occupy a key piece of infrastructure for days or months during an experiment phase. Movement in and around these measurement stations is key.

ii Human space

- Nanoelectronics research involves experiments that last for months at a time. During an experiment, researchers (often graduate students) will effectively live in the laboratory, leaving only to sleep and eat. Aspects that improve the comfort of the space without compromising the technical specifications should be considered. The use of acoustic isolation, natural light and lighting options, potable water, sinks, and comfortable building materials and textures are key considerations for ensuring the space is liveable during the sometimes gruelling experiments. It must be possible to exclude daylight when sensitive spectroscopic measurements are to be made.

iii Cryogenics

- Central to the operation of Type B Labs are cryogenic apparatus. These include dilution refrigerators that allow milli-Kelvin temperatures to be maintained continuously. These cryogenic platforms require the use of vacuum, cryogenic liquids in large mobile storage dewars (nitrogen and helium), and compressed gases. Modern systems typically make use of pulse-tube cryocoolers in which a remote helium compressor extracts heat from the cryostat via high-pressure helium gas lines.

iv Fume hoods,

- Chemicals, sinks, and sample preparation Space is required for the preparation of samples and the cleaning and preparation of equipment. Often mild solvents such as acetone and isopropanol are used. Occasionally more aggressive chemicals can be used in the maintenance and service of equipment, eg trichloroethylene and other degreasers and acids. These require fume hoods for safe operation.

v Grey space

- The compressors and pumps are noisy and typically located in proximal service grey space. In laboratories where nanomaterials synthesis is conducted, plasma based synthesis vacuum systems will be housed. They require high purity feed gases, clean vacuum pumps, RF and pulsed DC high voltage power supplies. The pumps and gas bottles need to be located in proximal grey space.

vi Large floor to ceiling height

- The use of dilution refrigerators requires high ceilings, typically well above 4m. These are needed to accommodate sample-loading interlocks that maintain vacuum in vestibule chambers.

3.4.17Type C Laboratory - Functional Description

a. General

i In Type C labs a variety of experiments are performed primarily in optics, photonics, biophysics and biointerfaces. In much of the work light is guided and routed between and around large optical tables using optical fibres. In other laboratories, liquid flow experiments are integrated with optical sensing and optical microscopies. Some research activities involve free space optics, for which clean and reasonably mechanically stable environmental conditions are required. Other research activities for which Type C labs will be used include measurement and characterisation using optical and electronic equipment and for light mechanical and electronic instrument assembly. Biophysics and biointerface will require humidity control and the provision of special services.

ii Photonics and biointerface research is a major component of the School of Physics' overall research effort. Much of this activity is linked across laboratories through major, long-term grants under which teams of researchers move between multiple laboratories. For efficiency of operation, it is highly desirable that large groups of Type C labs be clustered contiguously to accommodate these linked research activities. The design of the laboratories should enable the laboratory modules to be joined through elimination of common walls, creating larger areas housing major facilities like the terabit per second test laboratory presently housed in room 218 of A28. In some cases proximity to B laboratories used for related research, in nanomaterials for example, is required.

b. Environment

i Temperature stability

- Temperature stability is not as stringent as in Type A and B labs, but must be maintained within the ranges specified in the room data sheet (RDS) despite the heat dumped in the room by the large numbers of electronic controllers and power supplies.

ii Pressure

- The room will be over pressured.

iii Acoustics and Vibrations

- Most experiments are carried out on optical tables that contain some degree of vibration isolation, but the level of vibrations should still be laboratory standard (as per the RDS). If the C labs are located above ground, care should be taken to damp any potential resonances in the floor. Suitable acoustic material on walls is necessary to ensure that the ambient sound levels from equipment in the room are damped.

iv EMI

- Refer to Appendix Q EMI Performance Specification.

c. Layout, Form & Location

i Location

- All laboratories including Type C labs should be separated from high-traffic areas such as lecture theatres and other undergraduate student dominated areas. They should be separated from mechanical and electrical infrastructure such as lifts and power distribution substations, although this is not as critical as for A, B and TEM labs.

ii Grey Space/Service Chase

- Much of the equipment we operate requires infrastructure such as compressors, vacuum pumps etc which are best separated from the research equipment. We require 'grey spaces' immediately adjacent to the laboratories to house such equipment. These spaces could double as chases through which services (compressed dry air, process chilled water, vacuum exhaust and others as specified in the RDS) are reticulated to and throughout the laboratories. The grey spaces might also be used as 'dirty' space for research support functions.

iii Ceiling and walls

- Most of the equipment in these labs is on or above optical tables or benches. Much of the electronic control equipment is mounted above the optical table, using gondola-style supports attached to the soffit. Ceiling heights around 3.5-4m allow easy attachment of these gondola structures and will accommodate all anticipated research equipment.

- We have specified one double height C lab, whose function has not yet been allocated, as part of the suite of laboratories. Such a laboratory could accommodate a fibre draw tower or other piece of research equipment whose height is > 5 metres. Users will advise whether this laboratory is to be fitted out or will remain as a shell.

- Where possible and consistent with the environmental requirements, these laboratories should have windows for natural light. All windows however should be fitted with black-out blinds.

iv Layout issues

- All Type C laboratories will have a mixture of optical tables and control racks, with a mixture of storage cabinets for ancillary equipment (optical parts, cables, electronic equipment, vacuum fittings etc) and well-lit bench workspaces for use by researchers. In one laboratory, a sink and space for refrigerators, a fume cupboard and an incubator are required. Well-designed storage space and work bench space is essential to the successful operation of all Type C laboratories.

3.4.18 Common Laboratory Facility Rooms

a. See Room Data Sheets for:
   i Grey Space
   ii Gas Rooms
   iii Gas Cylinder Room
   iv Chemical Room (Storage)
   v Chemical Room (Dispense)
   vi Dewar Room
   vii Delivery Yard

3.5 Teaching & Learning Spaces

3.5.1 General

a. The aspiration for teaching and learning in the AIN Physics Building is that it is research-led, active, participatory and requiring interaction and collaboration from its users. The explicit model of teaching is one that is modern, innovative and supported by educational literature.

b. Some of the teaching and learning areas such as the lecture theatre, learning studio and seminar rooms will be used by students from other faculties of the University.

c. There is no requirement for direct adjacency of teaching space to other functions of the building.

d. The building will play a significant symbolic function, providing both a feeling of progression for students as they progress through the years of their education, as well as providing a home for all physics students. The sense of progression is supported by having distinct 'year' teaching lab for third year students, as well as ensuring the teaching space exposes students to research spaces in the rest of physics such as the cleanroom and other specialist laboratories.

e. The sense of 'home' will be supported by providing an open-access, informal, collaborative learning space at the heart of the Physics teaching precinct.

f. The new teaching spaces in the AIN Physics Building should complement the teaching spaces in the existing A28 Physics Building. The objective is to provide an integrated and holistic solution for the teaching needs of the School of Physics.

g. The building and the associated spaces need to be flexible enough to adapt to 50+ years of changes in teaching practice. Spaces should support not only what is taught now, and the existing pedagogical approaches, but also anticipate changing pedagogies. Spaces therefore need to be designed with the flexibility to change over time, as the methods of teaching and learning within them will no doubt change also.

h. To safeguard future development teaching and learning space will be best delivered in large, contiguous blocks that will provide flexibility to accommodate changing teaching needs.

i. It is not envisaged that teaching spaces will need to change on a short term basis. Spaces will have relatively static set ups with most functions staying in-situ.

j. Design to allow for use of space for entertainment purposes to meet BCA requirements for lecture theatre and associated public spaces including provision of power requirements.

3.5.2 Teaching Spaces

a. Physics teaching and learning currently features a combination of contact time (e.g. lectures) and private or collaborative work by students (e.g. assignments). The new building will provide space for both:

   i Contact in lectures (large and small), laboratory classes, tutorials (in first year), duty tutoring (in first and second year), some tests.

   ii Private/collaborative work in assignments (paper and on-line), on-line quizzes and private study.

3.5.3 Common Requirements

a. General

   i Teaching and learning spaces shall generally facilitate large format, research-led learning, and will be capable of supporting a range of delivery and education methods. In order to support this model of teaching practice, all teaching and learning space must:

   - Provide flexibility though the use of highly mobile furniture, and technology to appropriately support each individual space configuration. (excluding the Lecture Theatre and Small Case Study Lecture Theatre).
   - Maximise use of transparent and semi-transparent materials to maintain visual connection while still providing the appropriate level of privacy.
   - Provide access to natural light and views where available, either directly or via transparency afforded by glazing, with dim out for visual presentations.
   - Provide appropriate access to technology including AV, videoconferencing, teleconferencing, intranet / internet access, wireless technology, and other devices needed to access and present information. The premise is that student laptops will usually be fed by the wireless network. Only University supplied equipment will be wired, although provision for future wired access may be made in some spaces.

- Provide ubiquitous access to high speed wireless Internet.
- Where acoustic privacy is required, utilise materials and technologies to contain, dampen and reduce sound transfer,
- Have convenient access to shared storage areas that allow equipment to be brought out or stacked away easily to meet changing education needs.
- Be shaped in such a way that allows direct (seated) sightlines across a space without obstruction by furniture, columns or IT / AV equipment. This is particularly important of spaces that are able to be configured for 'one-to-many' presentations.
- Particularly for larger spaces, have a secondary entry / exit point located away from display / presentation areas so as not to disturb lectures / seminars in progress.

b. Audio Visual

i A comprehensive assessment of the AV requirements for power and data in the Teaching & Learning spaces has been provided in a separate document, titled *Audio Visual Power and Data Requirements* refer to Appendix R1.

c. Signage and graphics

i Signage and graphics shall be provided to all Teaching & Learning spaces in accordance with the University Standard Signage Design Guidelines.

d. Waste & recycling

i Designated space for rubbish and paper recycling bins shall be provided to all Teaching & Learning spaces.

e. Amenities

i Natural light should be encouraged to all spaces.

ii Filtered water to the University standard should be provided nearby to all teaching spaces.

3.5.4 Lecture Theatre - Functional Description

a. General

i The Large Lecture Theatre will be a General Timetable Space (GTS) for formal, traditional lecture style teaching for up to 320 students. This size will allow the largest current 1st year Physics unit to be split into 2 lecture streams.

ii It will be used predominantly by the various University faculties and their students for tertiary teaching however, it should be capable of hosting conferences, public lectures and the like outside of academic timetabling usage.

iii The duration of lectures ranges typically from one to three hours.

iv This will be the School of Physics premier and showcase lecture theatre.

b. Format

i A shallow format space, which is broader than it is deeper, to support intimate/ interactive teaching modes by minimising the distance between the lecturer and audience, is required.

ii The internal volume shall be nominally double height (a minimum of 6.0m clear), at the front stage area, and single height (a minimum of 2.4m clear), at the rear top tier entry area.

iii Visual presentation material shall be projected onto three motorised screens, at the front of the space, with the side projection surfaces angled towards the centre of the space to optimise viewing angles.

iv Seating geometry shall comprise shallow curved tiered rows to further assist viewing angles of the tri-screen arrangement and to provide clear visibility of the demonstration bench and front of stage area.

v The rake of the seating shall be within the range of 15-20° such that every member of the audience has an uninterrupted view of the stage and demonstration bench.

vi Columns within the space are not permitted.

c. Access

i Access to the Lecture Theatre shall be from a foyer area of sufficient size to permit comfortable access and egress at full lecture changeovers.

ii Access to the Lecture Theatre should be remote form the vibration sensitive laboratories and the cleanroom.

iii The adjacent foyer area should provide sufficient free space for pre/post lecture gatherings with facilities for display of posters and the like to facilitate its conference usage.

iv Primary access should be from the rear, top tier of the theatre via at least two airlock lobbies comprising a minimum of two sets of double doors.

v Access must allow flow of up to 320 students entering and 320 students exiting almost simultaneously within a ten minute period.

vi Secondary access shall be provided to the base stage area via a minimum of one airlock lobby comprising a minimum of two sets of single doors, primarily for lecturer entry/exit and wheelchair access.

vii Primary and secondary access points shall be positioned such that the natural flow of people is away from the area between the mobile demonstration bench and the preparation room.

viii Vision panels shall be provided to the doors of all entry lobbies as a means of determining if the space is in use.

ix Wheelchair access is required to the top tier area and bottom stage area.

x A minimum of six wheelchair spaces shall be provided. In both locations, designated wheelchair stations shall be marked to prevent them being used for purposes which would render them unavailable for the intended users.

d. Circulation

i The seating arrangement must include a minimum of two separated circulation aisles from the top to bottom tiers accessed from separate entry points at the top landing.

ii As far as possible, seating shall be distributed evenly between central and side aisles, namely ¼ - ½ - ¼ ratio to minimise the distance between the aisle and any seat. A central aisle should be avoided.

iii Provision of a handrail to the aisle stairs may be required to meet accessibility requirements however an alternative solution to facilitate removal of this handrail by replacement with a more appropriate installation should be sought.

e. Seating

i Audience seating shall comprise single seats each with tablet arms of sufficient size to comfortably accommodate a laptop.

ii Minimum seating dimensions shall be as follows:

- Seat width: 525mm.
- Centre to centre seat spacing: 550mm.
- Seat row to row spacing: 1000mm.

iii Each seating row should be offset by one half width, to improve sightlines.

iv Seating shall be sourced from a currently available, proprietary commercial grade range and as a minimum shall include:

- Mounting on a rail system, not individually mounted.
- A high-quality, upholstered, fabric finish to both seat pad and back pad.
- Commercial grade, stain resistant fabric recommended by the manufacturer for the intended usage.
- Each seat shall support individual note taking comprising a fold down type tablet arms, minimum A3 size. The arm mechanism of which shall be robust and require minimum maintenance. The arm mechanism must not be prone to retracting or collapsing unintentionally.
- Durable and graffiti resistant tablet top material.
- Visible seat numbers to all fixed seating.

v The number of left handed tablet arms should total approximately 10% of the room capacity, possibly of contrasting colour to other tablets and randomly distributed, unless tablets are of sufficient size to suit both left and right handed usage.

vi Wheelchair spaces shall include a free-standing, post-mounted, adjustable writing tablet.

vii One double GPO per two seats shall be provided, with outlets positioned to prevent laptop power leads becoming potential trip hazards. Final design to be reviewed and approved by Principal.

viii Provide space for future possible cabled network to each seat for high bandwidth applications.

ix Where feasible seating shall be fixed to the riser for ease of cleaning.

x Selection of seating shall take into account durability and availability of spare parts.

f. Stage Area

i A flat floor at the front of the lecture theatre is required, the installation of a raised stage area or podia is not permitted.

ii Demonstration Bench

- The demonstration bench shall comprise a fixed element, minimum size 3m x 1.2m, to house built-in hydraulic services and a mobile element (2 off, but only 1 in the theatre at any one time), minimum size 3m x 1.2m, to facilitate pre-preparation of experiments in the adjacent Demonstration Preparation Room. The benches should be at a standard bench height.
- The fixed bench shall include the following:
  - Heat proof, durable and scratch resistant surface.
  - A flush, low-profile sink with associated cover with finish to match bench, located on the end of the bench towards the centre of the lecture theatre.
  - A flip-up tap for hot and cold water supply
  - Associated drainage.
  - Two double gas supply points – one pair for natural gas and one for compressed air, located on one side of the bench near the end of the bench towards the centre of the lecture theatre.
  - Power: 8 DGPO's.
  - Power: robust soft wire management system for connection to mobile benches (connection may be made and broken several times a day). Design solution to be reviewed and

approved by Principal.

- Data: 2 double data points.
- AV panel for connection of portable cameras with high and standard definition inputs, located on one side of the bench near the end of the bench towards the centre of the lecture theatre.
- Minimum 50mm overhang to permit clamping of demonstrations

- The movable bench shall include the following:
  - Heat proof, durable and scratch resistant surface.
  - Soft wire management system with 8 DGPOs and 4 data points for connection.
  - Lockable castors that facilitate easy manoeuvrability.
  - Minimum 50mm overhang to permit clamping of demonstrations.
- The whole demonstration bench should be located centrally to the stage area, accordingly the fixed bench should be placed off centre so that when the moveable bench is in use, the "joint/edge" between the two benches is aligned with the centre of the room.
- Bench dimensions shall be identical to facilitate seamless connection between fixed and movable element.
- Minimum clearances around the demonstration bench shall be as follows:
  - 2.1m clear between bench and rear wall.
  - 4m clear between bench and first row of seats (aisle steps should not encroach into this space). This space is to facilitate selected School of Physics experiments including a pendulum experiment in which the pendulum can swing freely across the width of the theatre and a gas-powered car experiment in which the vehicle crosses the width of the stage.
- Hooks shall be provided on the ceiling and walls to the space in front of the demonstration bench to facilitate the large pendulum experiment – 3 on ceiling and 1 on each wall of Lecture Theatre, nominal load 150kg.

iii Lectern

- A University standard, fixed lectern, approximately 1600mm x 800mm at the front of the room will feature audio visual hardware to enable control of the presentation system and lighting. The lectern, which shall be separated from the demonstration bench shall include the following:
  - University of Sydney standard touch-screen AV control panel.
  - Flat panel computer display monitor.
  - Keyboard and mouse.
  - Layout space for a minimum of two A4 sheets of paper, plus a laptop.
  - Dedicated, user controlled, adjustable lighting to the reading surface.
  - Gooseneck microphone.
  - Space for AV hardware and/or resident PC.
  - Document camera.
- A floor-box shall be provided under the lectern to facilitate cable entry for power and data.
- The lectern shall be positioned such that it does not block views of the screens, whiteboards and demonstration bench however, it should be located as close as practicable to the demonstration bench and whiteboards while still providing space to easily walk between them.
- An internal contact phone shall be wall-mounted to the front presentation wall in an appropriate location adjacent to the lectern.

g. Audio Visual

i A brief summary of the key features of the audio visual system is outlined below, refer to the Audio Visual Specification for more detailed information.

ii Display wall

- The display wall shall comprise the following:
  - Three large high definition, high quality projected images via three ceiling mounted projectors projecting onto motorised screens in which each screen can show a different

image.

- One interactive whiteboard (e.g. Smartboard) will be located underneath the centre projection surface. The whiteboard is to have vertical adjustment such that the base of whiteboard is movable between 0.8m and 1.2m above finished floor level to accommodate lecturers of various heights.
- Four (4) standard whiteboards. These are required such that the theatre can be functional using "chalk-and-talk" teaching methods in the event of an AV system failure by using conventional whiteboard surfaces, in addition to the Smartboard surface. The whiteboards should be mounted in pairs on either side of the interactive whiteboard. Each pair will be mounted on rails to allow it to be swapped vertically.
- Two possible configurations for the whiteboards and screens are shown below

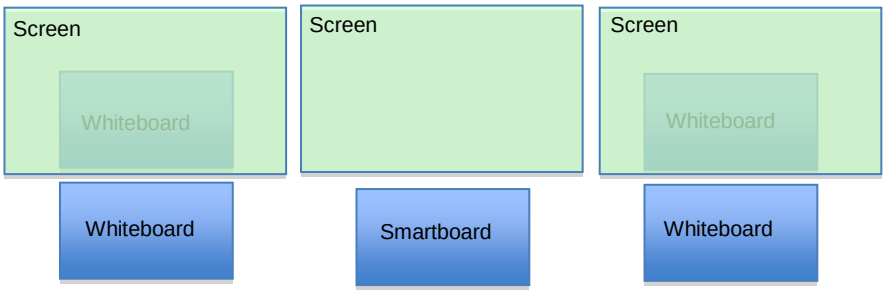


Figure 14 Lecture Theatre Presentation Wall Arrangement – Configuration 1

- Depending on the relative size of whiteboards and screens it may be that all 3 whiteboards fit under a single screen, as seen below, in this case outlying 'screens' may actually be white wall surfaces

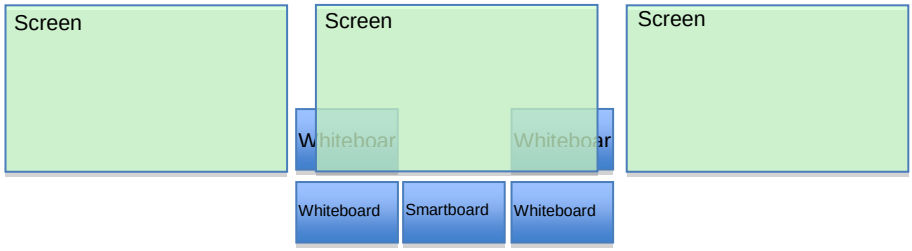


Figure 15 Lecture Theatre Presentation Wall Arrangement – Configuration 2

iii Image size

- The image size shall be in accordance with the recommendations of the AETM Design Guidelines for Tertiary Teaching Spaces. Refer to the AV brief for a full specification, the key considerations are detailed below:
  - Height of screen = distance from screen to most distant audience member/5.3
  - Width of screen : Height of screen ratio = 16:10

iv Control

- AV and lighting control are to be to the University Standard.
- Automatic shutdown of AV and lighting after appropriate period of inactivity (or lack of movement in room).
- A hearing augmentation system shall be provided to meet BCA requirements, preferably comprising an underfloor or in ceiling induction loop system or infrared system if induction loop is problematic in meeting building EMI requirements.

v Media Presentation/ Recording

- Provision for media presentations and Television recording of presentations is required. This will comprise provision of sufficient space to set up television camera to the top tier of the space and a roof mounted lighting bar for attaching specialist lighting. Provide 4 DGPOs and 2 network connections on the

ceiling to serve the lighting bar.

- To accommodate audience questions for recording (or normal lectures), make provision for roving microphones or fixed microphones that can be activated as required, as per University AV standards

h. Wi-Fi

i High bandwidth wireless must be provided at sufficient density to service a full capacity audience on the network.

i. Character

i The Lecture Theatre is the premier, showcase presentation space that will be used extensively by students and visitors. The detailed design must reflect its significance.

ii The internal environment shall be contemporary and comfortable. It should feature the use of natural, self-finished materials including solid and veneered timber. The design response should develop the curved and stepped geometry of the space to articulate its form. A planning module that incorporates lighting, ventilation and structure is to be developed and expressed in the floor, wall and ceiling design to create a harmonious whole. It shall be commensurate in terms of the quality of internal finishes with the following reference designs:

- Faculty of Law Building Lecture Theatre 101

j. Finishes

i Floor

- Floor finishes are to be durable, stain resistant and low maintenance.
- The floor finish adjacent to the demonstration bench shall be water resistant for a minimum of 1.5m from the edge of the bench.
- Safety stair nosings and aisle floor lighting are required.

ii Walls

- Wall surfaces should be durable, easy to clean and of low reflectivity. Wall surfaces up to 1200mm above finished floor level shall be constructed from or lined with hard-wearing materials which are resistant to scuffing and scratching.
- Acoustic panels will likely be required to the side and end walls, the extent and configuration of which should result from the acoustic space modelling to optimise speech clarity.

iii Ceiling

- The ceiling form shall be defined to suit the primary acoustic requirement of speech legibility.
- The provision of servicing infrastructure and equipment that requires maintenance should be minimised to the ceiling. Lighting solutions that avoid or minimise ceiling mounted lighting should be explored. Mechanical systems which avoid maintainable equipment in the ceiling are preferred.

iv Other

- Use solid, neutral colours for tablets and horizontal surfaces.

k. Lighting

i Theatrical grade lighting with 15:1 contrast ratio is required and shall be designed by a specialist lighting designer. It shall conform to AS1680 and meet the following requirements:

- Lighting presets to conform to the 4 preset University standard.
- Lighting to be controlled from the entry points and lectern utilising a DALI control standard or equivalent for fine-tuning of lighting levels throughout the space.
- Lighting to be zoned and dimmable with full control from the lectern to support light sensitive demonstrations on the stage.
- Directional lighting for the lectern and bench areas must achieve lux levels equivalent to or greater than that for the audience. It must have good beam shaping characteristics, be dimmable and use high output LED technology with high CRI ratings.
- Designed to minimise, or control "spill" onto the projection surfaces. Maximum permissible spill/bounced light on the screen area for standard lecture mode lighting preset 2 is approximately 60 lux and 30 lux for preset 3, which still allows note taking.

- Lecturers to be lit without ambient spill light from other sources.
- Luminaires should provide direct illumination only and sufficient cut-off angles and non-reflective louvers to eliminate glare and spill. Fittings that reflect light on surfaces do not control light spill sufficiently and are not permitted.
- Use high efficiency luminaires and low energy lamps where possible.

l. Acoustic Considerations

i Speech clarity is the critical acoustic criteria, it is not anticipated that musical performances will take place in the space so the acoustic qualities of the space shall be designed for speech. 3D computer acoustic modelling of the space to test its performance is essential, results should be presented to the University for review and/or approval.

ii Noise isolation

- The Lecture Theatre should be separated from noise generating spaces such as toilets and plant areas.
- Construction of the envelope shall reduce noise penetration to and from the Lecture Theatre to adjacent spaces.
- Provide sufficient isolation from noise generating areas such as the adjacent Foyer and plant areas

iii Ambient Noise

- Ambient noise from mechanical systems and adjacent plant/ laboratory areas must be carefully considered and controlled. Steady state noise should be restricted to NR30.
- Door grilles or undercuts are not permitted.

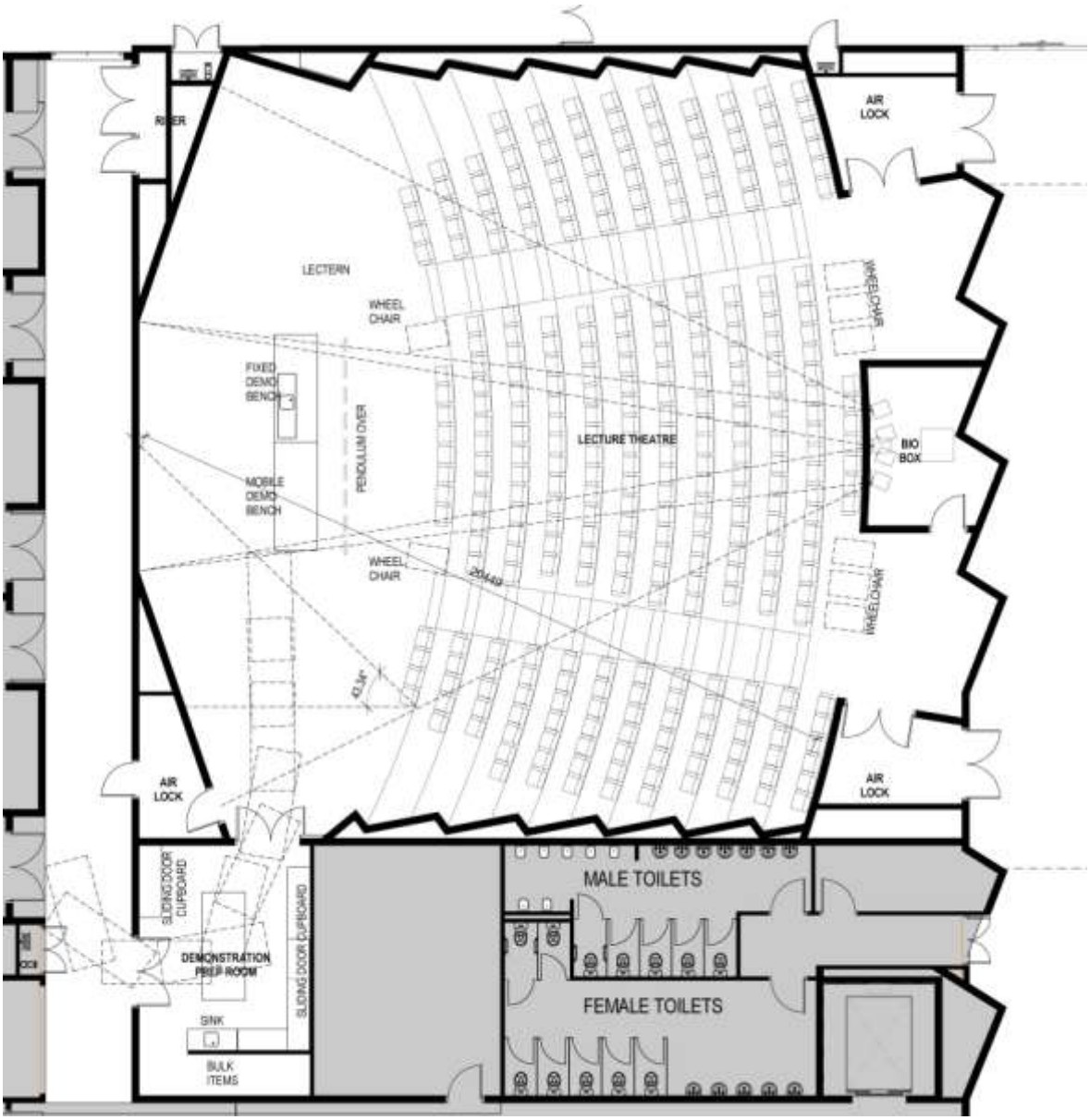


Figure 16 **Reference Plan: Lecture Theatre Plan**

3.5.5 Demonstration Preparation Room - Functional Description

a. General

i Lecture demonstrations are an integral part of teaching physics. The setting up and removal of demonstrations in the Lecture Theatre must occur rapidly, typically in less than ten minutes, to meet timetabling requirements.

ii The Demonstration Preparation Room provides an area, in a separate room directly adjacent to the Large Lecture Theatre, for the storage, preparation and testing of experiments in advance of lectures. Movable, wheeled benches are required so that demonstrations that have been arranged and tested can be rolled smoothly and quickly into the lecture theatre for instant use.

iii The preparation of demonstrations can take from 5 minutes to over an hour, typically experiments that are in 'active' use will be stored in the room for a maximum duration of one week.

iv The tallest demonstrations reach a maximum height of 2.5m when on the bench.

b. Access

i The Demo. Prep. Room must be accessible from both an adjacent corridor and the lecture theatre.

ii The Demonstration Preparation Room should be readily accessible from the existing A28 Physics Building to facilitate movement of experiments/ demonstrations between the two buildings.

iii Doors to the Demonstration Preparation Room opening directly into the Lecture Theatre should provide a minimum clear opening of 2m wide x 2.5m high and be locakable. They shall include a vision panel to allow occupant to assess if the lecture theatre is in use and have a black-out mechanism to prevent unwanted light spill into the lecture theatre.

iv The threshold between the Demonstration Preparation Room and Lecture Theatre shall be flush to facilitate rolling delicate experiments on trolleys over without undue disturbance.

v A further set of double doors shall be provided to the adjacent corridor, a minimum of 1.5m wide.

vi The general Storage Room on the same level as the Demo. Prep. Room shall include double doors to facilitate storage of one of the mobile benches remotely.

vii Automatic lighting shutdown after appropriate period of inactivity (or lack of movement in the room).

c. FF&E/ Storage

i The following furniture and fittings should be provided as a minimum:

ii An open work bench including the following:

- Heat proof, durable and scratch resistant surface.
- Laboratory sink with drainer.
- Hot and cold water supply with associated drainage.
- Power via minimum of eight (8) DGPO's evenly spaced within above bench height ducted skirting.
- Four (4) double data Ethernet points evenly spaced within above bench ducted skirting.
- Three (3) compressed air and three (3) natural gas outlets within ducted skirting, evenly spaced along length of bench.
- Minimum of 3m of under bench storage.
- Minimum 50mm lip on bench to allow clamping.

iii Two 3m x 1.2m mobile demonstration benches including eight double GPO's each with soft start connection.

- The benches should be at standard bench height matching the built-in bench in the lecture theatre.
- Minimum 50mm overhang to permit clamping of demonstrations.

iv Storage provision shall comprise:

- A small open storage space for bulky items and trolleys, approximately 4m², with partial partition divider from the rest of the room to prevent trip hazards and blocking of cupboards.
- Two cupboards, approximately 2400 wide x 2100mm high x 600mm deep with adjustable shelving.
- 2.4m high shelving, 450mm deep above the benchtop, minimum 6 lineal metres.

d. Finishes

i Flooring to be durable, stain resistant, water resistant and low maintenance, vinyl or similar.

3.5.6 Projection Room - Functional Description

a. General

i A separate Projection Room shall be provided to the rear of the Lecture Theatre whose primary purpose is to house the projectors and acoustically isolate them from the auditorium. Other noise generating equipment such as the AV IT rack should also be located in this space.

ii The Lecture Theatre is the prime presentation venue for the School of Physics, apart from undergraduate lectures it will be used for international conferences, public talks and high-profile presentations and needs to be suitable for media use including commercial television.

b. Location

i The Projection Room must be located centrally to the rear wall of the Lecture Theatre.

c. Access

i Access from both the Lecture Theatre and adjacent Foyer is desirable.

ii There must be no obstruction of the projectors by people standing normally in the row directly in front of the projection room, projector height must be 2100mm or above.

d. Spatial Arrangement

i The Projection Room shall be of sufficient size to accommodate all of the required equipment including:

- One IT rack, nominal size 900 x 900 x 2200mm, with clear 900mm wide access from two opposing sides.
- Three celing mounted HD projectors with a minimum 500mm clearance to walls for airlow.
- AV control equipment as detailed in the AV brief.
- Bench space for the layout of additional equipment, a minimum of 3 linear metres.

ii Projector Windows

iii The projectors shall project through three separate windows in the following configuration:

- 300mm high x 500mm wide.
- Separated by 400mm.
- The bottom edge of each window shall be above 2100mm above finished floor level.
- All windows to be tilted at 10 degrees vertically upward.

iv Construction

- Walls shall be floor to ceiling and acoustically sealed to adjacent substrate on all sides of the room.

v Lighting

- Lighting should be dimmable with full black-out capability.
- Automatic lighting shutdown after appropriate period of inactivity (or lack of movement in the room).

vi Finishes

- Flooring to be anti-static, durable, easy to clean and cost effective to maintain.
- Colours should be selected with consideration of their impact on projection and video origination.

3.5.7 Learning Studio - Functional Description

a. General

i The Learning Studio will be a General Timetable Space (GTS) for mixed learning modes, combining conventional lecturing, interactive teaching, collaborative activities and computer-based & small-scale experimental learning for up to 90 students.

ii A unique Technology Enabled Active Learning (TEAL) space is envisaged, which facilitates both traditional "front wall" and collaborative group work but also allows a traditional "front wall" teaching mode.

iii The duration of sessions will range typically from two to three hours.

b. Format

i A flat-floored space, of square plan proportions is preferred.

ii A minimum of 2.5 sqm per person is anticipated.

iii The internal volume shall be nominally single height, a minimum of 3.4m and/or the height required to meet the requirements of the AETM Audio Visual Design Guidelines – Tertiary Teaching Space.

iv A shallow raised floor system shall be provided throughout to provide flexibility in the layout of the space and facilitate provision of power and data via floor boxes to any point on the floor.

v Columns within the space are not permitted.

vi The Learning Studio shall support two possible configurations, with a selection of final configuration to be made closer to the time of fit-out:

- Configuration 1 (preferred)
  - Ten (10) quasi-circular tables ('pods') of nine (9) students with each table of nine divided into three equal segments for groups of three students with two flat panel displays per group, one to view their own work via a local PC and the other to display distributed AV from the lectern display or other student screens.
- Configuration 2
  - Fifteen (15) rectangular tables ('pods') of six (6) students with each table of six divided into two groups of three students. Groups are arranged to view a single large flat panel display mounted on a free-standing pedestal at one end of the pod in a University standard configuration.

c. Access

i Access to the Learning Studio shall be direct from an adjacent corridor/ foyer area.

ii A minimum of two access points, comprising a single set of double doors, located ideally at opposing ends of the space, is required to allow quick entry and exit for a full class.

iii Access into the space shall not be via the 'front' projection wall.

iv Vision panels shall be provided to the doors of all entry lobbies as a means of determining if the space is in use. If partitions to the foyer are glazed, or partially glazed then it may be feasible to omit vision panels.

d. Circulation

i Wide aisles are required to facilitate free movement around all tables. A minimum gap of 1.5m between tables is required such that tutors can walk around and access all desks.

e. Furniture

i All furniture should be movable perhaps using lockable wheeled castors.

ii Tables (configuration 1)

- Tables to be approximately 2.5m diameter and/or of sufficient size to accommodate 9 students around their perimeter as well as to accommodate the following:
  - Two 19" flat panel displays on adjustable monitor arms per group (six per table)
  - One PC CPU per group (three per table) underslung in central position such as not to impede users in seated position or all-in-one computers.

iii Tables (configuration 2)

- 2 tables back-to-back to form a table area 1.5m x 1.5m to accommodate 6 students around their perimeter as well as to accommodate the following:
  - One 19" flat panel display per group (two per table)
  - One large flat panel display on stand-alone frame to the end of the table (from a standard University pod).
- In addition, in either configuration:
  - Soft wire management system comprising 6 GPOs per group (18No. per table).
  - Three data points per group (9No. per table).
  - Space for keyboard & mouse and one laptop per group.
  - Space for assembly of small experiments comprising an A3 footprint box of equipment, 2 x A4 size electronic units (e.g. signal generator) and 3 x A4 books.
- LCD screens should be located such that they do not significantly obscure sightlines across the room for standing staff.

iv Lectern

- A University standard, fixed lectern, approximately 1600mm x 800mm at or towards the front of the room will feature audio visual hardware to enable control of the presentation system and lighting. The lectern shall include the following:
  - University of Sydney standard touch screen AV control panel.
  - Flat panel computer display monitor.
  - Keyboard and mouse.
  - Layout space for a minimum of two A4 sheets of paper plus a laptop.
  - Dedicated, user controlled, adjustable lighting to the reading surface.
  - Gooseneck microphone.
  - Standard University of Sydney AV hardware including space for one PC CPU box and document camera.
  - Soft wire management system comprising four (4) DGPOs and one (1) double data point, with a further double data point to the 'front' wall of the room.
- A floor-box shall be provided under the lectern to facilitate cable entry for power, data and other services.
- The lectern shall be positioned centrally such that it does not block views of the screen.
- An internal contact phone shall be wall-mounted to the front presentation wall in an appropriate location adjacent to the lectern.

v Whiteboards

- A minimum of eleven (11) whiteboards of 2000mm x 1200mm minimum size are to be provided, preferably mounted on the wall adjacent to the tables, one per table in configuration 1 format plus 1.

vi Storage

- Space in an adjacent Store to store 30 plastic equipment boxes, nominally A3 x ~300mm for 3 experiments x 10 sets and some tables.
- Adjacent Learning Studio AV Room shall contain a minimum of three (3) 1000mm (l) x 800mm (w) x 2100mm (h) cabinet racks.

f. Audio Visual

i The following summarises the key features of the audio visual system, refer to the Audio Visual Specification for more detailed information.

ii Visual Display (configuration 1)

- The lectern AV system will distribute to the two flat panel displays per group of three students, one to view their own work via a local PC and the other to display distributed AV from the lectern display or other student screens.

iii Visual Display (configuration 2)

- The lectern AV system will distribute to the one flat panel display per group of three students, plus one larger free-standing display per table (three groups). The smaller flat panel display will be used to view their own work via a local PC and the other larger one to display distributed AV from the lectern display or

other student screens.

iv In both cases, a minimum of one, centrally located, projection image shall be provided in which the height of screen = distance from screen to most distant audience member/5.3 is preferred if it can be accommodated to augment the pod based displays.

v Audio

- Voice reinforcement shall be provided via a lectern mounted gooseneck microphone and wireless lapel microphone to allow the facilitator to move freely around the room.

vi Control

- AV and lighting control are to be to the University Standard and should allow users to save their preferred settings for future use.
- Automatic shutdown of AV and lighting after appropriate period of inactivity (or lack of movement in the room).

vii Other

- A hearing augmentation system, preferably comprising an under floor or in ceiling induction loop system or infrared system if induction loop is problematic, shall be provided.

g. Wi-Fi

i High bandwidth wireless must be provided at sufficient density to service a full capacity audience on the network.

h. Character

i The provision of natural lighting shall be encouraged to assist in creating a calm, light filled environment conducive to creating the optimum environment for extended teaching and learning sessions.

i. Finishes

i Floor

- Floor finishes are to be durable, stain resistant and low maintenance. Heavy duty commercial grade carpet tiles or alternatives suitable for wheeled chairs shall be provided.

ii Walls

- Wall surfaces should be durable, easy to clean and of low reflectivity. Wall surfaces up to 1200mm above finished floor level shall be constructed from or lined with hard-wearing materials which are resistant to scuffing and scratching.
- Acoustic panels may be required to the side walls, the extent and configuration of which should result from the acoustic modelling/ calculations to optimise speech legibility.

iii Ceiling

- The ceiling shall be of a light colour to give the impression of height, exposed concrete with discrete panels for acoustic performance is preferred.

j. Lighting

i Zoned lighting with special consideration given to minimising light spill onto the projection surface is required. Refer to the AV Brief for additional details.

k. Acoustic Considerations

i Speech legibility is the critical acoustic criteria.

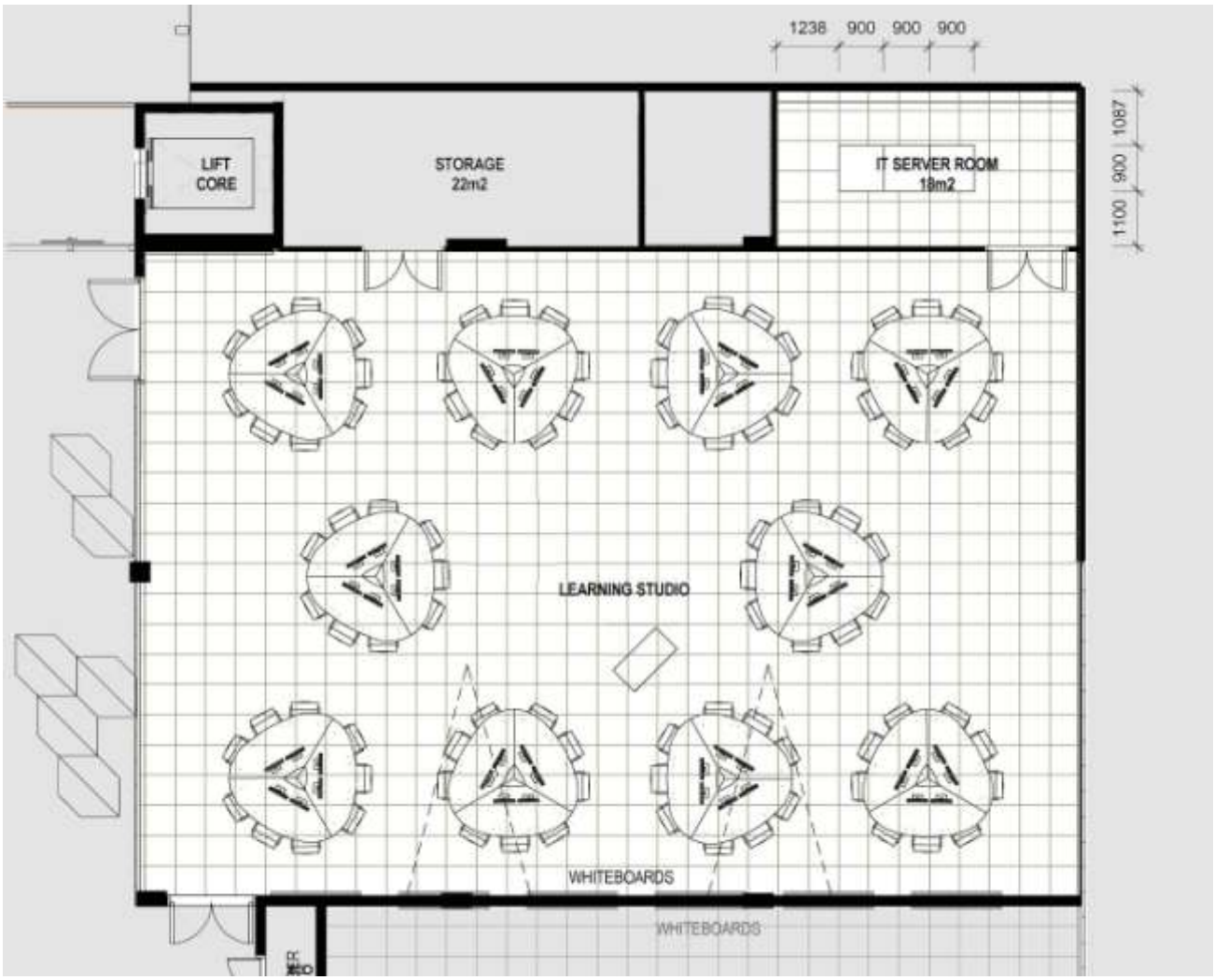


Figure 17 **Reference Plan: Learning Studio**

3.5.8 Large Seminar Room - Functional Description

a. General

i The Large Seminar Room will be a dedicated School of Physics teaching space. It will be a flexible, multi-purpose space, primarily used for tutorial workshops for up to 80 students during teaching semesters and for exams, exam marking, conference poster sessions and meetings, commercial seminars and the like outside of semester teaching weeks.

ii The duration of sessions ranges typically from one to three hours.

b. Format

i A flat-floored space, of square plan proportions is preferred.

ii In typical academic usage it is envisaged that students will work at desks in groups of four, with specific demonstrations setup on five dedicated benches distributed around the room to prevent local over-crowding.

iii The internal volume shall be nominally single height, a minimum of 3.4m and/ or the height required to meet the requirements of the AETM Audio Visual Design Guidelines – Tertiary Teaching Space.

iv A shallow raised floor system shall be provided throughout to provide flexibility in the layout of the space and facilitate provision of power and data via floor boxes to any point on the floor.

v Columns within the space are not permitted.

c. Access

i Access to the Large Seminar Room shall be direct from an adjacent corridor/ foyer area.

ii A minimum of two access points, each comprising a single set of double doors, located ideally at opposing ends of the space, is required.

iii A third access point, comprising a single set of double doors, to the adjacent Medium Seminar Room, should it be suitably located, is desirable in order to facilitate movement of furniture between the two spaces.

iv Vision panels shall be provided to all entry doors as a means of determining if the space is in use. If partitions to the foyer are glazed, or partially glazed then it may be feasible to omit vision panels.

d. Circulation

i Wide aisles are required to facilitate free movement around all tables. A minimum gap of 1.5m between tables is required.

e. Furniture

i All furniture should be movable, excluding the fixed demonstration benches, such that the room can be fully cleared to host stand-up functions.

ii Demonstration tables and benches

- Demonstration tables (750mm height) and benches (900mm height) are to be distributed around the perimeter of the room. A total of five demonstration areas are required. Three areas are made up of two 1500 x 750mm tables and two areas comprising linear fixed benches. All tables and benches shall include the following:
  - Dimensions of 1500mm x 750mm..
  - Compressed air and gas supply taps mounted above table/ bench height in ducted skirting on the wall adjacent to the tables/ benches.
  - Power comprising 4 double GPO's within above table/ bench height ducted skirting.
  - Data comprising 2 double data points within above table/ bench height ducted skirting.
- The fixed benches shall comprise the following:
  - Minimum 4m length with under bench storage to accommodate equipment up to 3m in length (air tracks).
  - Compressed air and gas supply taps mounted above bench height in ducted skirting on the wall adjacent to the benches
  - Power comprising 4 double GPO's within above bench height ducted skirting.
  - One bench to include the following
  - Laboratory sink with drainer.

- Hot and cold water supply with associated drainage.
- Zip hydra-tap
- Isolation taps for compressed air and gas to the room.

iii Desks

- Provide standard two person rectangular, modular desks that are lightweight and flexible to facilitate configuration for workshop tutorials, seminars or exam format. Desks must either include castors or be lightweight and stackable on proprietary trolleys. Desks shall comprise the following:
  - Minimum dimensions of 1500mm x 750mm.
  - Durable, scratch resistant, vandal proof surfaces.
  - Lockable castors that facilitate easy manoeuvrability.
  - Appropriate cable management systems.
  - Soft wire management systems to facilitate connection of table power and data to floor boxes. Table power requirement is 1 x DGPO per table + 2 tables per floor box. Each floor box should include power and allowance for future provision of 4 data points, for a future University standard 'pod'.

iv Chairs

- Chairs shall be University standard stackable chairs supplied by USYD.

v Lectern

- A lectern, approximately 1600mm x 800mm at the front of the room will feature audio visual hardware to enable control of the presentation system and lighting. The lectern shall include the following:
  - University of Sydney standard touch screen AV control panel.
  - Flat panel computer display monitor.
  - Keyboard and mouse.
  - Layout space for a minimum of two A4 sheets of paper plus a laptop.
  - Dedicated, user controlled, adjustable lighting to the reading surface.
  - Gooseneck microphone.
  - Standard University of Sydney AV hardware including space for one PC CPU box and document camera.
- A floor-box shall be provided under the lectern to facilitate cable entry for power, data and other services including:
  - Power comprising 4 DGPOs
  - Data comprising 4 data points.
- The lectern shall be positioned such that it does not block views of the projection screens and whiteboards at the front of the room however, it should be located as close as practicable to front centre of the space.
- An internal contact phone shall be wall-mounted to the front presentation wall in an appropriate location adjacent to the lectern.

vi Whiteboards

- A minimum of five (5) whiteboards of 2000mm x 1200mm minimum size are to be provided evenly spaced around the perimeter of the room.

vii Storage

- A storage area should be located directly adjacent with capacity to store all loose furniture. This can be the Medium Seminar Room if appropriately located.

f. Audio Visual

i The following summarises the key features of the audio visual system, refer to the Audio Visual Specification for more detailed information.

ii Visual Display

- Two HD projectors, projecting images onto white wall surfaces, height of screen = distance from screen to most distant audience member/5.3.

iii Audio

- Voice reinforcement shall be provided via a lectern mounted gooseneck microphone and wireless lapel microphone to allow the facilitator to move freely around the room.

iv Control

- AV and lighting control are to be to the University Standard.
- Automatic shutdown of AV and lighting after appropriate period of inactivity (or lack of movement in the room).
- A hearing augmentation system, preferably comprising an under floor or in ceiling induction loop system or infrared system if induction loop is problematic, shall be provided.

g. Wi-Fi

i High bandwidth wireless must be provided at sufficient density to service a full capacity audience on the network.

h. Character

i The provision of natural lighting is essential to this space to assist in creating a calm, light filled environment conducive to fostering effective outcomes from extended teaching and learning sessions. Brownout blinds are required to all external glazing to facilitate effective AV presentations.

i. Finishes

i Floor

- Floor finishes are to be durable, stain resistant and low maintenance, heavy duty commercial grade carpet tiles or similar.
- The floor finish adjacent to the fixed demonstration bench with sink shall be water resistant for a minimum of 1.5m from the edge of the bench.

ii Walls

- Wall surfaces should be durable, easy to clean and of low reflectivity. Wall surfaces up to 1200mm above finished floor level shall be constructed from or lined with hard-wearing materials which are resistant to scuffing and scratching.

iii Ceiling

- The ceiling shall be of a light colour to give the impression of height, exposed concrete with discrete panels for acoustic performance is preferred.

j. Lighting

i Zoned lighting to facilitate effective AV presentation is required.

k. Acoustic Considerations

i Speech legibility is the critical acoustic criteria.

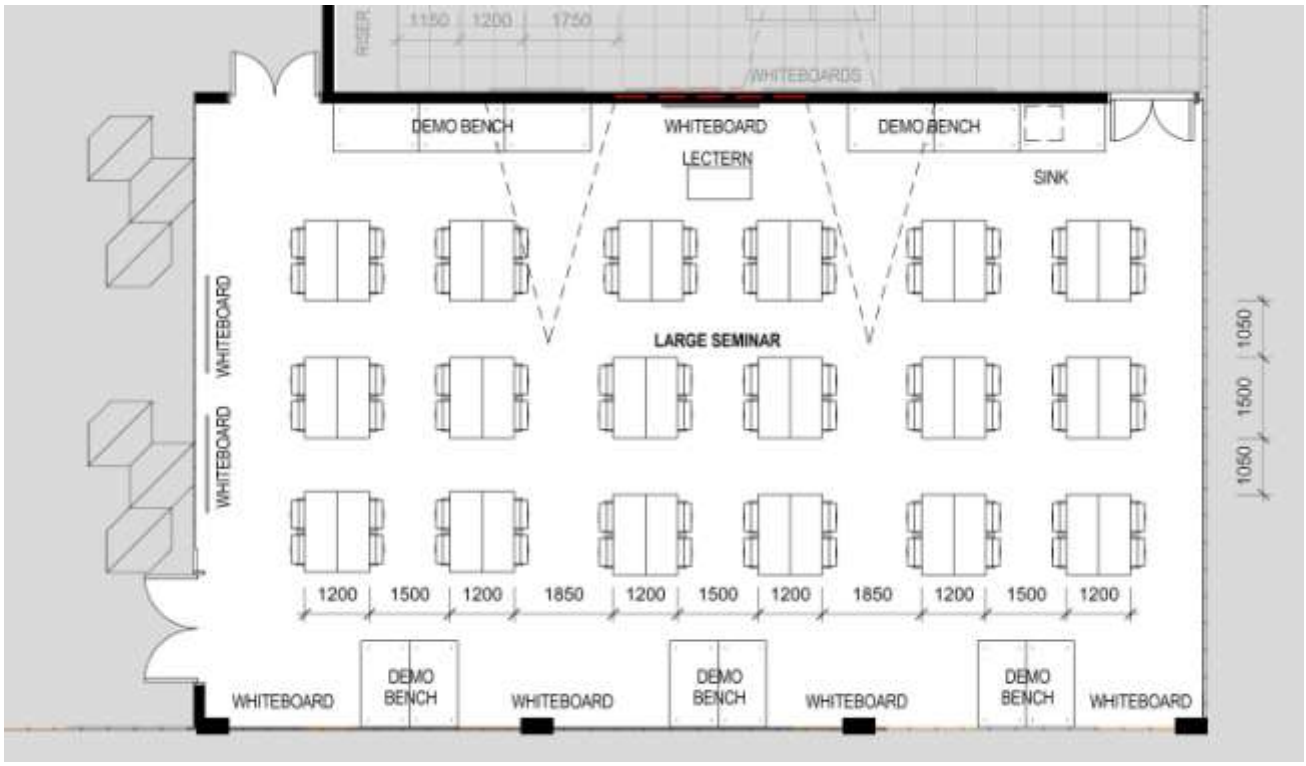


Figure 18 **Reference Plan: Large Seminar Room (nb: dimensions and whiteboards not accurate – refer text in functional description)**

3.5.9 Medium Seminar Room - Functional Description

a. General

i The Medium Seminar Room will be a will be a flexible, multi-purpose General Timetable Space (GTS), for tutorials, small group discussions/workshops, lab presentations and conventional lecturing for up to 40 people.

ii The space will be used primarily as a tertiary teaching space but will also be used by research groups outside of academic timetabling requirement.

iii The duration of sessions will range typically from one to three hours.

b. Format

i A flat-floored space, of square plan proportions is preferred.

ii The internal volume shall be nominally single height, a minimum of 3.4m and/or the height required to meet the requirements of the AETM Audio Visual Design Guidelines – Tertiary Teaching Space.

iii A shallow raised floor system shall be provided throughout to provide flexibility in the layout of the space and facilitate provision of power and data via floor boxes to any point on the floor. Floor box locations are to suit the multiple furniture configurations.

iv Columns within the space are not permitted.

c. Access

i Access to the Medium Seminar Room shall be direct from an adjacent corridor/ foyer area.

ii A minimum of one access point, comprising a single set of double doors is required.

iii Vision panels shall be provided to the entry doors as a means of determining if the space is in use. If partitions to the foyer are glazed, or partially glazed then it may be feasible to omit vision panels.

iv A second access point, comprising a single set of double doors, to the adjacent Large Seminar Room, if suitable located, is desirable in order to facilitate movement of furniture between the two spaces.

d. Circulation

i Wide aisles are required to facilitate free movement around all tables. A minimum gap of 1.5m between tables is required.

e. Furniture

i All furniture should be easily movable on wheeled castors, such that the room can be fully cleared to host stand-up functions.

ii Desks

- Standard two person rectangular, modular desks that are lightweight and flexible to facilitate configuration for workshop tutorials, seminars or exam format (in groups, rows or individually) and that can be stacked on proprietary trolleys are required. Desks shall comprise the following:
  - Minimum dimensions of 1500 x 750mm.
  - Durable, scratch resistant and vandal proof surfaces.
  - Lockable castors that facilitate easy manoeuvrability.
  - Appropriate cable management systems.
  - Soft wire management systems to facilitate connection of table power and data to floor boxes. Table power requirement is 1 x DGPO per table x 2 tables per floor box. Each floor box should include power and allowance for future provision of 4 data points, for a future University standard 'pod'.

iii Chairs

- Chairs shall be University standard stackable chairs supplied by USYD.

iv Lectern

- A lectern, approximately 1600mm x 800mm at the front of the room will feature audio visual hardware to enable control of the presentation system and lighting. The lectern shall include the following:
  - University of Sydney standard touch screen AV control panel.
  - Flat panel computer display monitor.
  - Keyboard and mouse.

- Layout space for a minimum of two A4 sheets of paper plus a laptop.
- Dedicated, user controlled, adjustable lighting to the reading surface.
- Gooseneck microphone.
- Standard University of Sydney AV hardware including space for one PC CPU box and document camera.

- A floor-box shall be provided under the lectern to facilitate cable entry for power, data and other services.
- The lectern shall be positioned centrally to the front of the space but such that it does not block views of the screen and whiteboards.

v Whiteboards

- A minimum of four (4) whiteboards of 2000mm x 1200mm minimum size are to be provided evenly spaced around the perimeter of the room.
- An internal contact phone shall be wall-mounted to the front presentation wall in an appropriate location adjacent to the lectern.

vi Storage

- Storage is not required.

f. Audio Visual

i The following summarises the key features of the audio visual system, refer to the Audio Visual Specification for more detailed information.

ii Visual Display

- One projector, projecting an image onto white wall surfaces, height of screen = distance from screen to most distant audience member/5.3.

iii Audio

- Voice reinforcement shall be provided via a lectern mounted gooseneck microphone and wireless lapel microphone to allow the facilitator to move freely around the room.

iv Control

- AV and lighting control are to be to the University Standard.
- Automatic shutdown of AV and lighting after appropriate period of inactivity (or lack of movement in the room).
- A hearing augmentation system, preferably comprising an under floor or in ceiling induction loop system or infrared system if induction loop is problematic, shall be provided.

g. Wi-Fi

i High bandwidth wireless must be provided at sufficient density to service a full capacity audience on the network.

h. Character

i The provision of natural lighting is essential to this space to assist in creating a calm, light filled environment conducive to fostering effective outcomes from extended teaching and learning sessions. Brownout blinds are required to all external glazing to facilitate effective AV presentations.

i. Finishes

i Floor

- Floor finishes are to be durable, stain resistant and low maintenance, heavy duty commercial grade carpet tiles or similar.

ii Walls

- Wall surfaces should be durable, easy to clean and of low reflectivity. Wall surfaces up to 1200mm above finished floor level shall be constructed from or lined with hard-wearing materials which are resistant to scuffing and scratching.

iii Ceiling

- The ceiling shall be of a light colour to give the impression of height, exposed concrete with discrete panels for acoustic performance is preferred.

j. Lighting

i Zoned lighting to facilitate effective AV presentation is required.

k. Acoustic Considerations

i Speech legibility is the critical acoustic criteria.

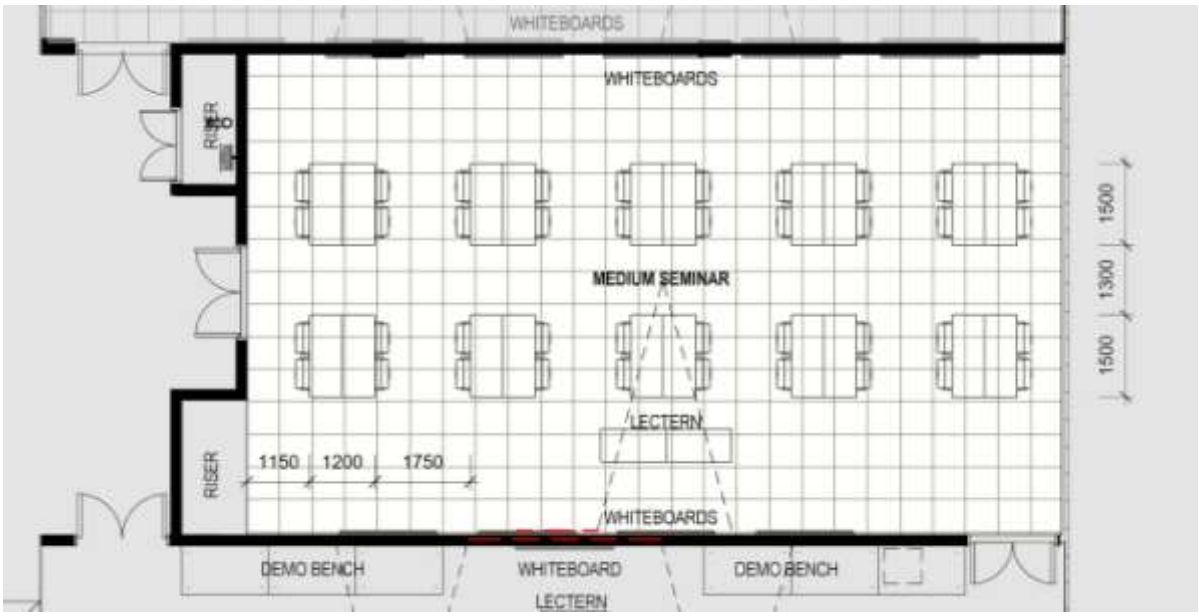


Figure 19 **Reference Plan: Medium Seminar (nb: dimensions and whiteboards not accurate – refer text in functional description)**

3.5.10 Small Case Study Lecture Theatre - Functional Description

a. General

i The Small Case Study Lecture Theatre will be a purpose-designed video-conference enabled General Timetable Space (GTS), for medium and small group video-conferencing, web-conferencing and collaboration work for up to 40 people. The room will support remote access for distance learning programs, it may also be utilised for conventional lectures, seminars, tutorials and presentations.

ii The duration of sessions ranges typically from one to three hours.

b. Format

i A shallow format tiered space, which is broader than it is deeper, to support intimate/ interactive teaching modes by minimising the distance between the lecturer and audience, is preferred.

ii The internal volume shall be nominally single height, a minimum of 3.4m to facilitate comfortable heights at the top tier and/ or the height required to meet the requirements of the AETM Audio Visual Design Guidelines – Tertiary Teaching Space.Visual presentation material shall be projected onto a white wall surfaces (screen), at the front of the space.

iii Seating geometry shall comprise curved tiered rows in a fan arrangement facing the central podium/camera to allow clear sightlines such that every member of the audience has an uninterrupted view of the screen and podium and is able to be viewed/ recorded by the camera.

iv Columns within the space are not permitted.

c. Access

i Access to the Case Study Lecture Theatre shall be direct from an adjacent corridor/ foyer area.

ii A minimum of two access points, comprising at least one double door is required. Access points to either end of the room are preferred to enable entry to the space during presentations with minimal disturbance.

iii Vision panels shall be provided to the entry doors as a means of determining if the space is in use.

iv Wheelchair access is required to the bottom stage area.

v A minimum of one (1) wheelchair space shall be provided appropriately marked as a designated wheelchair station to prevent it being used for purposes which would render it unavailable for the intended user.

d. Circulation

i Wide aisles are required to facilitate free movement around front and back of all tables. A minimum gap of 1.5m between tables is required.

e. Furniture

i Furniture shall comprise a continuous fixed desk top with University standard chairs..

ii Desks

- The continuous fixed desk top shall include:
  - A minimum depth of 600mm.
  - A continuous smooth curved form comprising:
  - A durable, scratch and vandal resistant writing surface formed from a homogenous material.
  - A steel framed cantilevering structure with legs positioned such as not to impede users from moving along or locating at any point along the desk.
  - Soft wire management system with flush mounted single GPO (or shared DGPO) for each position in desk top (hard wired for fixed benches).
  - Wireless network – no hardwired data-points to desktops, provide space for possible future cabled network to each seat for high bandwidth applications.
  - Proprietary cable management system with all power and data reticulated through fixed furniture into floor void.

iii Chairs

- Chairs shall be University standard stackable chairs supplied by USYD.

iv Lectern

- A lectern, approximately 1600mm x 800mm at the front of the room will feature audio visual hardware to

enable control of the presentation system and lighting. The lectern shall include the following:

- University of Sydney standard touch screen AV control panel.
- Flat panel computer display monitor.
- Keyboard and mouse.
- Layout space for a minimum of two A4 sheets of paper plus a laptop.
- Dedicated, user controlled, adjustable lighting to the reading surface.
- Gooseneck microphone.
- Standard University of Sydney AV hardware including space for one PC CPU box and document camera.
- VC hardware rack not in lectern, to be located remotely.

- A floor-box shall be provided under the lectern to facilitate cable entry for power, data and other services.
- The lectern shall be centrally positioned but it shall not block views of the screens.
- An internal contact phone shall be wall-mounted to the front presentation wall in an appropriate location adjacent to the lectern.

v Whiteboards

- A minimum of two (2) whitebaords of 2000 x 1200mm minimum size are to be provided evenly distributed around the perimeter of the room.

vi Storage

- Storage is not required.

f. Audio Visual

i The following summarises the key features of the audio visual system, refer to the Audio Visual Specification for more detailed information.

ii *Functionality*

- The video-conferencing system should permit all participants, in the room and remotely, to see and hear the speaker, any material being presented and the audience at any linked location to promote the best interaction..
- A minimum of two (2) cameras located to support smooth interactive sessions are required.
- Remote login without video conferencing will likely be limited to viewing the presented material and receiving audio. The system must support remote connection from students without full video capacity, who will be using their laptop to view the presentation.
- The minimum number of remote login sites to be supported is ten (10).

iii Visual Display

- Twin ceiling mounted projectors, projecting images onto white wall surfaces, height of screen = distance from screen to most distant audience member/5.3.

iv Audio

- Voice reinforcement shall be provided via a lectern mounted gooseneck microphone and wireless lapel microphone to allow the facilitator to move freely around the room. In addition one 'button' microphone mounted flush with the desktop, per two positions mounted on the fixed desk joinery.

v Control

- AV and lighting control are to be to the University Standard.
- Automatic shutdown of AV and lighting after appropriate period of inactivity (or lack of movement in the room).
- An equipment rack shall be provided either in the room in a suitably acoustically isolated enclosure or in an adjacent space.
- A hearing augmentation system, preferably comprising an under floor or in ceiling induction loop system or infrared system if induction loop is problematic, shall be provided.

g. Wi-Fi

i High bandwidth wireless must be provided at sufficient density to service a full capacity audience on the network.

h. Character

i The provision of natural lighting is not essential however if provided, brownout blinds will be required to all external glazing.

i. Finishes

i Floor

- Floor finishes are to be durable, stain resistant and low maintenance, heavy duty commercial grade carpet tiles or similar. Carpet is encouraged as a means of creating suitable acoustic conditions.

ii Walls

- Wall surfaces should be durable, easy to clean and of low reflectivity. Wall surfaces up to 1200mm above finished floor level shall be constructed from or lined with hard-wearing materials which are resistant to scuffing and scratching.

iii Ceiling

- The ceiling shall be of a light colour to give the impression of height, exposed concrete with discrete panels for acoustic performance is preferred.

j. Lighting

i Zoned lighting to facilitate effective AV presentation and facial recognition in video-conferencing mode is required. Lighting is especially important in this room for clear vision by remote viewers.

k. Acoustic Considerations

i The main acoustic requirements for rooms used primarily for speech, such as lecture theatres, is that speech should be intelligible without an undue strain on the listener. The secondary requirement is to retain the natural character of the speaker's voice. According to Mehta M. et al 1999, the following factors are important in the acoustical design of rooms for speech:

- Providing optimum reverberation time;
- Eliminating acoustical defects such as echoes and flutter echoes;
- Maximising loudness in the audience;
- Minimising the noise levels in the room; and
- Providing a speech reinforcement system where needed.

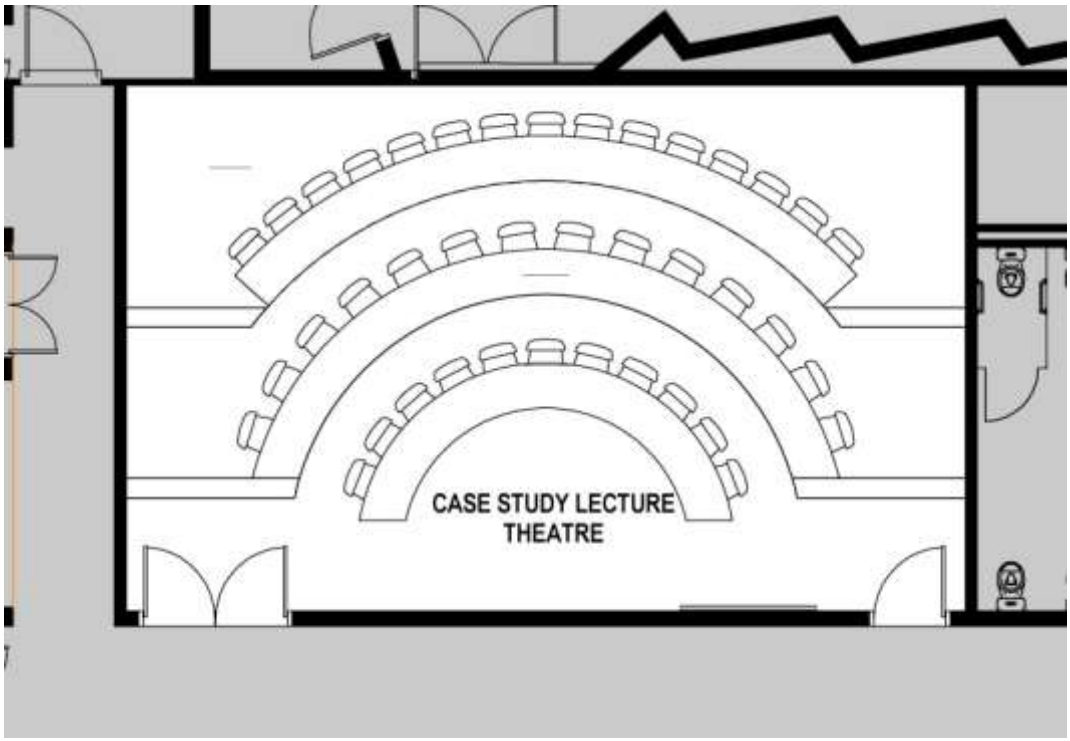


Figure 20 **Reference Plan: Small Case Study Lecture Theatre**

3.5.113rd Year Laboratory - Functional Description

a. General

i The 3rd Year Laboratory will be a dedicated School of Physics space for teaching specific aspects of senior physics as well as providing an environment for the development of critical thinking and problem solving skills, attributes essential to the modern physicist.

ii It will accommodate up to 40 students working individually, on different experiments, at benches or, where larger equipment is used, experimental stations, supervised by up to five instructors.

iii Experiments are modular but rarely moved comprising mostly electronic, vacuum and optical equipment. Chemical usage is minimal and restricted to cleaning solvents and photographic film development. Glassware and cleaning facilities are not required. Lab coats will not be worn.

iv Computers will be used extensively to control experiments and analyse experimental data.

v The duration of sessions will range typically from three to four hours.

b. Format

i A flat-floored space, of approximately square proportions is preferred.

ii It shall be predominantly open-plan to maintain clear sight-lines across the space for instructors to observe multiple benches at once. Enclosed areas for specific experimental equipment and/ or support functions shall be provided but should not impede sight-lines.

iii Benches shall be arranged in groups of a maximum of two in either a back to back or end to end configuration.

iv A shallow floor system shall be provided throughout to provide flexibility in the layout of the space and facilitate provision of power and data via floor boxes to any point on the floor.

v A specific experiment comprising a neutron source will require an exclusion zone (no idle person within 2m of the source) to be provided. Ideally this should be located in the far corner of the room from the entry point, adjacent to the external walls.

vi The internal volume shall be nominally single height.

vii Columns within the space are not permitted.

c. Access

i Access to the 3rd Year Laboratory shall be direct from an adjacent corridor/foyer area.

ii A minimum of two access points, comprising a single set of double doors, located ideally at opposing ends of the entry wall, is required to allow quick entry and exit for a full class and to facilitate move-in and out of equipment.

iii Vision panels shall be provided to all entry doors as a means of determining if the space is in use, If partitions are glazed or partially glazed it may be feasible to omit vision panels.

iv Owing to the specific nature of the experiments set-up in the 3rd Year Laboratory providing say 10% adjustable benches is not practicable. A management in use plan is to address the provision of equitable access and use of the space.

d. Circulation

i Wide aisles are required to facilitate free movement around all side of all pairs of benches within the body of the room. A minimum gap of 1.5m between pairs of benches is required.

e. Furniture

i General

- Laboratory furniture will predominantly comprise modular lab benches with appropriate mobile seating. It shall be flexible and modular enabling sections to be reconfigured to support different functions or experiments.

ii Laboratory Benches

- Two types of work benches are envisaged; movable benches, positioned back-to-back in the body of the room for general individual smaller experiments and fixed benches on the perimeter of the space for larger experiments and/ or those requiring hydraulic services.

- All benches will comprise the following:

- Minimum dimensions 1600mm (length) x 900mm (width) x 900mm (height)
- Timber framed construction (to avoid magnetic interference with certain experiments).
- Over bench shelves comprising a single 300mm deep shelf in a variety of lengths as follows:
- 25% full length
- 25% three-quarter length
- 50% half length

- Central, movable benches require the following:
  - Power provision via soft wire management system from floor boxes comprising three (3) DGPOs per bench.
  - Data provision comprising 1 (one) double data point per desk fed from floor box.
  - Provision for one PC CPU per desk underslung in position such as not to impede user.
  - Provision for one flat-screen monitor with flush grommet for cabling.
- Fixed perimeter benches will comprise:
  - A minimum of 32 linear metres with spaces in between certain benches for free-standing experiments, (nominal dimensions 1.6m x 1.0m x 1.5m high).
  - Power provision via ducting above bench level - three (3) DGPOs per bench against the back wall (6 in total).
  - Data provision via ducting above bench level - 2 double data points per bench against the back wall (3 in total).
  - Power provision via ducting above bench level - one (1) DGPO per bench against the other walls (15 in total).
  - Data provision via ducting above bench level - 1 double data point per bench against the other walls (15 in total).
  - A minimum of 2 laboratory sinks with associated drainers.
  - Hot and cold water supply to each sink.
  - Space for up to three (3) multi-function printer/photocopier devices.

iii Chairs

- University standard ergonomic laboratory stools supplied by USYD.

iv Teaching pedestal

- In lieu of a dedicated lectern, a minimal AV lectern (pedestal) shall be provided adjacent to the 'front' of the room. The function of the pedestal and associated projection system is to allow informal presentations to small groups, not the whole class. The pedestal shall include the following:
  - Space for a laptop.
  - AV touch screen panel and associated connection ports.
  - Document viewer.
  - Layout space for a minimum of two A4 sheets of paper, plus a laptop.
  - Two (2) DGPOs and two (2) double data points.
  - Small rack to support functionality

v Whiteboards

- A minimum of six (6) whiteboards of 2000mm x 1200mm minimum size are to be provided, at least one to be located at the 'front' of the room adjacent to the teaching pedestal/ projection screen and the others evenly spaced around the perimeter of the room. Where mounted in front of glazing provide a sliding rail system.
- An internal contact phone shall be wall-mounted to the front presentation wall in an appropriate location adjacent to the AV pedestal.

vi Other

- Access to a printer(s) is essential.

vii Storage

- A minimum of 8.5sqm of storage shall be provided. A compactus and/ or pedestal units under perimeter benching is acceptable. The compactus may be in one of the adjacent rooms (Optics teaching lab or Technical Officer's Office).

- A minimum 1800mm high x 450mm deep bookcase, of at least 5 linear metres is required including a pigeonhole system for ~60 lab books.
- No separate electronics rack space is required.

f. Audio Visual

i The following summarises the key features of the audio visual system, refer to the Audio Visual Specification for more detailed information.

ii Visual Display

- One (1) ceiling mounted projector image shall be provided in which the height of screen = distance from screen to most distant audience member/5.3.

iii Control

- AV and lighting control are to be to the University Standard and should allow users to save their preferred settings for future use.
- Automatic shutdown of AV and lighting after appropriate period of inactivity (or lack of movement in the room).
- A hearing augmentation system, preferably comprising an under floor or in ceiling induction loop system or infrared system if induction loop is problematic, shall be provided.

g. Wi-Fi

i High bandwidth wireless must be provided at sufficient density to service a full capacity audience on the network.

h. Services Infrastructure

i Grey space shall be provided directly adjacent to the 3rd Year Laboratory to house noise generating equipment such as pumps & compressors and a maximum of four (4) standard gas bottles including nitrogen, argon and helium, from which services can be reticulated to a minimum of ten (10) separate perimeter experiment locations along a minimum of the full length of two (2) sides of the space through above bench ducted skirting.

ii Services reticulation, including power, data, compressed air, cooling water and nitrogen shall be provided to a minimum of the full length of two (2) sides of the space through above bench ducted skirting.

iii Grey space should be accessible from the adjacent corridor and can be located within plant space if located next to the 3rd Year Laboratory. A minimum of 20sqm of grey space is required.

iv Services shall be reticulated within the space via the walls or floor, ceiling mounted droppers are not acceptable.

v Floor boxes shall be provided throughout to facilitate provision of power and data to each central bench position.

vi Facility is to have a laboratory sink and hand wash basin.

i. Amenity

i Temperature control is required to ensure the stable operation of experimental infrastructure and to achieve acceptable comfort levels. To facilitate natural ventilation under acceptable conditions mixed-mode mechanical systems are encouraged.

j. Character

i Access to natural light is essential, with ventilation and views where achievable a priority to keep students refreshed and attentive during 3-4 hour laboratory sessions. The provision of natural lighting shall assist in creating a calm, light filled environment conducive to fostering effective outcomes from extended teaching and learning sessions

ii Brownout blinds are required to all external glazing to facilitate effective AV presentations.

k. Finishes

i Floor

- Floor finishes are to be durable, stain resistant and low maintenance, heavy duty vinyl or equivalent.
- The floor finish adjacent to the sinks shall be water resistant for a minimum of 1.5m from the edge of the bench.

ii Walls

- Wall surfaces should be durable, easy to clean and of low reflectivity. Wall surfaces up to 1200mm above finished floor level shall be constructed from or lined with hard-wearing materials which are resistant to scuffing and scratching.

iii Ceiling

- The ceiling shall be of a light colour to give the impression of height, exposed concrete with discrete panels for acoustic performance is preferred.

l. Lighting

i A zoned lighting system with local dimming of lights at and adjacent to projection surface to facilitate effective AV presentations and to allow selected 'black-out' of areas for optical experiments is required.

ii Selected optics experiments undertaken in the space require control of lighting. Enclosing black curtains which individually enclose each of three paired desks are required to darken the space around those tables, not black them out.

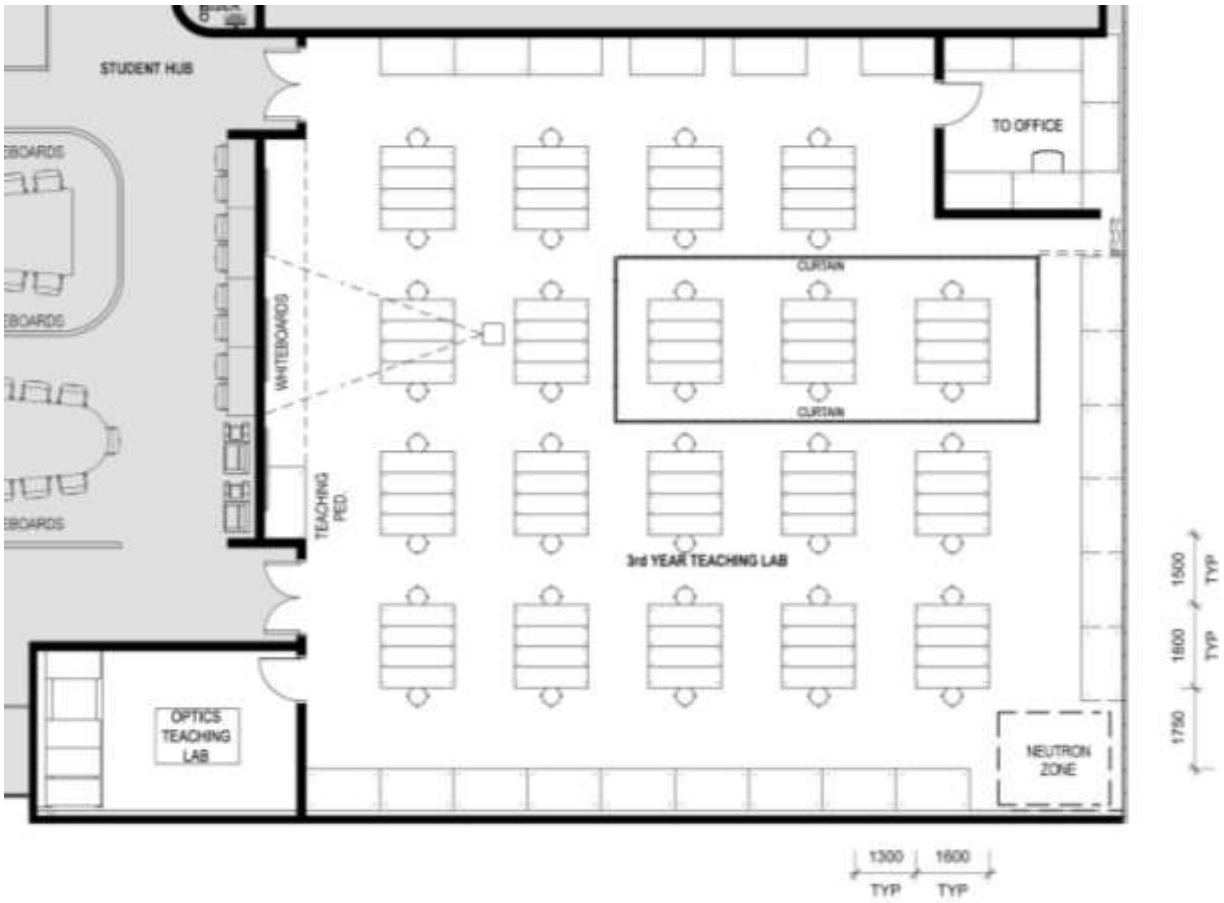


Figure 21 Reference Plan: 3rd Year Laboratory (placement of curtained area is indicative only)

3.5.12 Optics Teaching Lab - Functional Description

a. General

i A separate Dark Room for optical experiments which may include use of a high power laser shall be located in a separate room within or adjacent to the 3rd Year Laboratory.

b. Location

i The Optics Teaching Lab should be located directly adjacent to the 3rd Year Laboratory

c. Access

i It is to be accessed directly from the 3rd Year Laboratory.

ii The door to this room shall have an interlock with the laser

d. Spatial Arrangement

i The Optics Teaching Lab shall be of sufficient size to accommodate a maximum of 4 (usually 2) persons and all of the required equipment including:

- One (1) 2400mm x 1200mm optical table with minimum 1.2m clear permineter circulation, located over one centrally located floor box providing 2 DGPOs and 2 double data points.
- Minimum of 3.2 linear metres of bench 900mm (width) x 900mm (height). Over-bench ducting with 3 DGPOs and 1 double data point.

e. Construction

i Walls shall be floor to ceiling of opaque construction to prevent light/laser spill from within the space out.

f. Finishes

i Flooring shall match the 3rd Year Laboratory.

ii Minimize the use of reflective surfaces and adopt other precautions consistent with laser safety.

g. Lighting

i Automatic shutdown of lighting after appropriate period of inactivity (or lack of movement in the room).

ii Auto off with no motion is acceptable but lighting must not activate without being switched on (its a dark room)

iii 2nd light switch near/over table location in parallel with light switch near the door - allow on/off from two locations.

3.5.13Technical Officer's Office - Functional Description

a. General

i The space will function as an office for the Technical Officer (TO), who maintains the laboratory and its infrastructure, as well as a facility for the repair of laboratory equipment.

b. Location

i The TO Office shall be located within or directly adjacent to the 3rd Year Laboratory with lines of sight across the whole laboratory floor.

c. Access

i It is to be accessed directly from the 3rd Year Laboratory and/or from an adjacent corridor.

d. Spatial Arrangement

i The TO Office shall be of sufficient size to accommodate two persons and all of the required bench space and storage.

e. Furniture

i The TO Office shall include a minimum of:

- 1 standard desk
- 8 linear metres of open work bench 900mm (width) x 900mm (height) including the following:
  - Heat proof, durable and scratch resistant surface.
  - Over bench shelving similar to that in the lab itself
  - Power via minimum of eight (8) DGPO's evenly spaced within above bench height ducted skirting.
  - Three (3) double data Ethernet points evenly spaced within above bench ducted skirting.
  - Two (2) Compressed air outlets within ducted skirting, evenly spaced along length of bench.
  - Minimum of 3m of under bench storage.
  - Minimum 50mm lip on bench to allow clamping.
- Storage provision shall comprise:
  - Cupboards, approximately 2400 wide x 2100mm high x 600mm deep.

f. Construction

i Walls shall be floor to ceiling. Walls bounding the laboratory shall be substantially glazed to permit views of the whole floor area of the Lab from within the office.

g. Finishes

i Flooring shall match the 3rd Year Laboratory.

h. Lighting

i Automatic shutdown of lighting after appropriate period of inactivity (or lack of movement in the room).

i. Amenity

i To facilitate natural ventilation under acceptable conditions mixed mode mechanical systems are encouraged.

j. Character

i Access to natural light is essential, with ventilation and views where achievable a priority to keep students refreshed and attentive during 3-4 hour laboratory sessions. The provision of natural lighting shall assist in creating a calm, light filled environment conducive to fostering effective outcomes from extended teaching and learning sessions.

3.5.14Student Commons – Functional Description - Functional Description

a. General

i The Student Commons is an open access informal learning environment to foster a collaborative approach to learning, primarily for the use of third-year Physics students. It is envisaged as a centrally located 'home' for third year students and is recognised by the School of Physics as a vital piece of the student experience and a key factor in the retention strategy for these students into Honours and postgraduate study programs. It must be inviting and engaging.

b. Function

i The Student Commons shall provide a diverse range of mostly informal learning settings. Group sizes will range from the individual to a maximum of approximately eight persons.

ii Activities will include personal quiet study, small group meetings and 'open-plan' collaboration and socialising.

iii Different functions/ settings shall be zoned to assist effective acoustic separation.

iv The space will operate largely on a Bring Your Own Device (BYOD) basis, with the exception of the two pods, the University will not provide computer hardware.

c. Format

i An open plan space with a mixture of settings.

d. Access

i Access to the Student Commons shall be unrestricted during working hours however, its location should encourage use by Physics students and discourage use by other students.

ii It must be located directly adjacent to the 3rd Year Laboratory and in part will form the circulation/ lobby area for entry/exit into the Lab.

iii Student Commons should be part of, or at least adjacent to the main circulation/ foyer void feeding into the Teaching & Learning spaces.

e. Circulation

i Free movement through the space shall be encouraged with multiple entry and egress points

f. Furniture

i Pods

- Two (2) pods shall be provided comprising:
  - Minimum 1800mm and maximum 1950mm high nominally three-sided enclosure characterised by smooth, homogenous curved screen with integrated audio visual display screen.
  - Screen to be formed from a durable, scratch and stain resistant material with smooth seamless joints and acoustic treatment to provide absorptive surface to control reverberation and enhance speech legibility.
  - Two (2) whiteboards, or writable wall surfaces of 2000mm x 1200mm minimum size are to be provided, positioned on side screen partitions.
  - Table of suitable size and shape to allow a minimum of six (6) users to view large screen concurrently.
  - Provision of power and data to table via floor box – 3 DGPOs and 2 double data points, sufficient for pod computer and screen , plus student power (not network) to the table.
  - Soft wire management system with 2 flush mounted desk top DGPOs per table.
  - One PC CPU per screen located in lockable cupboard integrated into pod

ii Workpoints

- A variety of workpoints shall be provided.
- A minimum of 24 DGPOs shall be provided, typically distributed one per two workpoints.

iii Loose furniture

- A mixture of formal seating areas and other more informal seating settings shall be provided.

iv Whiteboards

- A minimum of six (10) whiteboards of 2000mm x 1200mm minimum size are to be provided, positioned on walls or screens throughout the space adjacent to workpoint settings.

v Storage

- Approximately sixty (60) small lockers must be provided for 3rd year students – suitable for storing some books and a laptop.

vi Kitchenette

- A kitchenette shall be provided comprising the following:
  - 2.4 linear metres of benchtop, minimum 650mm deep
  - Sink and drainer
  - Hot and cold water supply
  - Zip hydra tap

vii Other

- Provide a minimum of four (4) square metres of notice board in an appropriate central location.
- A location for two (2) vending machines shall be provided to support extended hours of operation

g. Audio Visual

i Refer to the Audio Visual Specification for detailed information.

ii Visual Display

- Pods shall include one (1) flat screen monitor per pods two (2) in total.
- A connection point for one (1) flat screen television shall be provided.

h. Wi-Fi

i High bandwidth wireless must be provided at sufficient density to service a full capacity on the network throughout the space.

i. Other

i Automatic shutdown of AV and lighting after appropriate period of inactivity (or lack of movement in the room).

j. Amenity

i Access to natural light is essential, with ventilation and views where achievable.

k. Finishes

i Floor

- Floor finishes are to be durable, stain resistant and low maintenance.
- The floor finish adjacent to the kitchenette shall be water resistant for a minimum of 1.5m from the edge of the bench.

ii Walls

- Wall surfaces should be durable, easy to clean and of low reflectivity. Wall surfaces up to 1200mm above finished floor level shall be constructed from or lined with hard-wearing materials which are resistant to scuffing and scratching.
- Acoustic panels will likely be required to the side and end walls, the extent and configuration of which should result from the acoustic space modelling to optimise speech legibility.

iii Ceiling

- The ceiling shall be of a light colour to give the impression of height, exposed concrete with discrete panels for acoustic performance is preferred.

l. Lighting

i Lighting shall comprise ceiling recessed/suspended fittings for general lighting with wall mounted fittings providing ambient light as well as functional lighting for reading in pods and selected other areas.

m. Acoustic Considerations

i Atrium Space

- The propagation of sound within the atrium has the potential to impact on users of the atrium and adjoining Student Commons areas. Therefore, it is important that the atrium provides a unique space that acts as a transit and meeting space for people. At the same time the atrium should have acoustic characteristics that do not adversely impact on occupants of either the atrium or surrounding learning/meeting areas.
- Thus the control of unwanted sound as well as adequate absorption of sound is required to ensure a good balance is achieved between the atrium and the adjoining spaces.
- Noise sources within the atrium space comprise a combination of continuous sources such as mechanical services, and transient sources such as people talking.

ii Atrium Finishes

- Atriums can be acoustically harsh in particular when they are small in volume and consist of hard surfaces and have little diffusion or acoustic treatment. In this instance the acoustic environment can be intrusive to occupants in the atrium as well as to adjacent office spaces.

iii Recommended acoustic treatment to atria and Student Commons

- Provide diffusive surfaces i.e. angular and irregular surfaces whereby sound is not evenly reflected between parallel surfaces;
- Add absorptive treatment to surfaces either locally or distributed throughout the atrium;
- Balustrades: Provide absorption panel (e.g perforated plywood with insulation backing);
- Locate noise sensitive spaces away from the atrium;
- Locate opened plan spaces and other less noise sensitive occupancies facing the atrium, e.g. amenities rooms, corridors;
- For areas within the Student Commons facing the atrium include in these absorptive suspended ceilings with a NRC rating between > 0.7;
- It is "good design practice" to incorporate diffused and angular walls and irregular surfaces to prevent sound lingering in reverberant spaces. Therefore, we recommend to incorporate such surfaces where ever possible in addition to what has already been designed and documented (e.g. window frames, the openings in the lobby walls, lift lobby balconies, etc.);
- Atrium Floor: introduced soft furnishings, reduce hard floor areas by providing carpet, rugs, rubber matting, etc.
- Student Common: Introduced soft furnishings, reduce hard floor areas by providing carpet, rugs, rubber matting, etc.
- Consider the use of free-standing acoustic screens with absorptive finishes to buffer quiet areas from noisy areas within the Student Common areas.

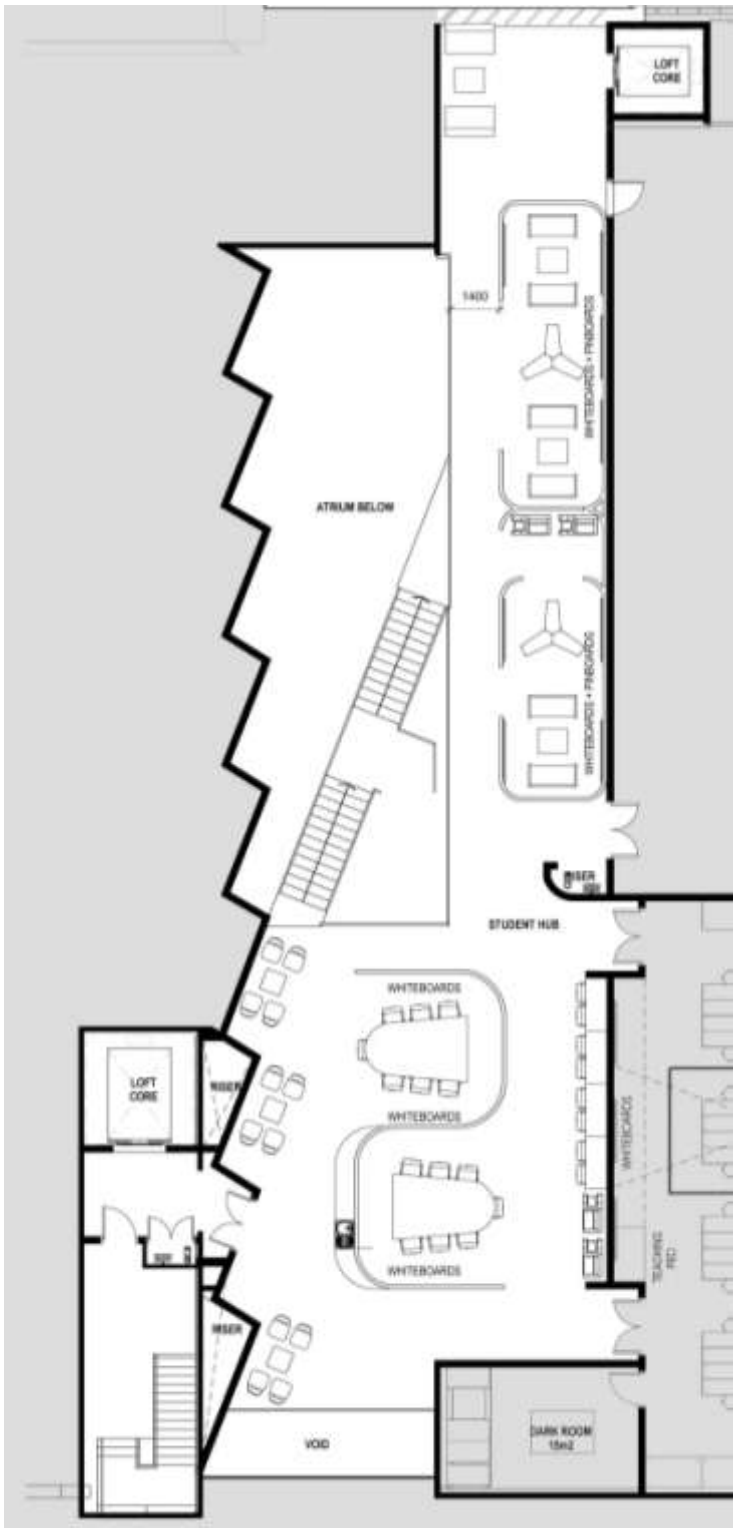


Figure 22 Reference Plan: Student Commons

3.5.15Rooftop Observatory – Functional Description - Functional Description

a. General

i The Rooftop Observatory will accommodate one fixed optical telescope in an enclosed weather protected structure (likely a commercial dome), with provision for at least one portable optical telescope in open space nearby, all in an area that will also facilitate presentations to groups of up to 30 people (standing). In addition, one fixed radio telescope (satellite) dish accessible for servicing but not for routine student access.

ii The optical telescopes are used primarily by the 1st year undergraduate and continuing education (adult) astronomy classes, whilst the radio telescope is used primarily by 3rd Year undergraduate laboratory classes. 'Public' viewing by staff and students using the optical telescopes is also occasionally required.

b. Format

i The Rooftop Observatory shall be a rooftop space open to the sky with minimal interference to viewing angles from adjacent structures/ features, notably the St Paul's College development.

ii A clear 360 degree viewing angle, free of any item that will prevent a clear view of the sky of approximately 15degrees from horizontal is required for all telescopes. Consequently, it is preferred that the Rooftop Observatory is at, or near, the highest point of the building and located away from treesand a maximum distance from the proposed St Pauls College development to minimise obstruction of the southern sky.

iii The telescopes are sensitive pieces of equipment, and as such should be located away from any roof-mounted plant and equipment that may impact the telescopes' operation via vibration, air-flow or electrical interference.

c. Access

i Access is required from a main circulation corridor, or similar.

ii Equitable access for wheelchairs is required, consequently lift access must be provided to the roof level.

iii Access to toilets, preferably without having to move through restricted research space.

iv Rooftop is to be BCA compliant to cater for student/staff occupation

d. Equipment

i Telescopes

- The Rooftop Observatory shall accommodate a dome to house the main optical telescope measuring approximately 5m in diameter and 4.5m high. An example of the Observatory dome structure can be found at http://siriusobservatories.hopout.com.au .
- Telescopes are currently:
  - Meade LX-200 30cm aperture (in the dome) (see http://meade.com/lx200) – approx. space occupied 1.5m x 1.5m x 2m high
  - Newtonian 20cm aperture reflecting telescope (portable) (e.g. see http://www.bintel.com.au/Telescopes/Dobsonian/Bintel-BT202-B-8--Dobsonian/72/productview.aspx) – approx. space occupied 1.5m x 1.5m x 2m high
  - 3m diameter radio telescope (satellite) dish – approx. space occupied 3.0m x 3.0m x 3m high
- Provision of a minimum of four (4) externally rated DGPOs is required at suitable locations for connection to the telescopes including one (1) 15A outlet.
- Cabling for Signal/ DC power is required from the radio telescope to a nearby computer in a weather-proof location.
- Provide a minimum of four (4) externally rated data points at suitable locations for connection of laptops to the network and/ or telescopes.
- All external power points shall be located to prevent the requirement for exposed cabling to run across the roof surface and create a potential trip hazard.

ii Storage

- A storage room shall be provided adjacent to the Observatory on the same floor level for the storage of the portable telescope and other equipment when not in use.

e. Finishes

i Balustrades

- Balustrades shall be provided to the perimeter of the roof to a minimum height of 1350mm. Balustrades to be of frameless glass construction.

f. Lighting

i Lighting shall be carefully designed to minimise any spill from surrounding parts of the building and adjacent buildings which may affect the performance of the telescopes. All rooftop lighting must be able to be switched off.

g. Rooftop Observatory Store

i A small enclosed storage room to store a portable optical telescope and other equipment related to the optical Observatory. Must be adjacent to the observatory and the lift access to the roof.

ii Provide one (1) DGPO.

3.6 Support Facilities & Linkages

3.6.1 General

a. The Support Facilities & Linkages comprise the facilities within AIN that are not covered by the Research or Teaching & Learning including:

   i Offices and workspaces

   ii Meeting Rooms

   iii Foyer and corridors

   iv Café and courtyard

   v Tea points

   vi Linkages between A28 and A31

   vii Loading Dock and associated storage and ancillary areas

   viii Sanitary facilities, including End of Journey facilities

   ix IT and networking spaces

   x Storage

b. The Support Facilities & Linkages Working Group (SF&LWG) is the University User Group responsible for these facilities.

3.6.2 Workspace

a. Workspace needs to support the existing work practices of staff and students. Physics has specific requirements, particularly researchers, who need to be opportunistic and focus only on the best research outcome. Often this means working with people at other institutes around the globe. Occupants move between laboratories and offices and use at weekends is typically more frequent than in commercial offices.

b. The workspace shall provide a comfortable environment to support academics and HDR students given their long hours of often intensive work, with technological support allowing occupants to select where, when, and how they complete their work.

c. Ideally, a diverse suite of settings will be provided within the work environment that both supports the focused individual activities currently undertaken by academics and students as well as providing meeting spaces to support the collective activities of research teams, these will comprise:

   i Primary workspaces; offices or desks where people sit to do their work, to support both the concentrated activities of academics, HDR students, and researchers generally, as well as the tasks of the administrative staff within the School. The primary work setting is likely to be an enclosed office.

   ii Secondary settings; spaces to support and encourage collaboration both across research teams but also between individuals, reflecting the fact that collaboration and concentration do not sit comfortably together.

d. This diversity of spaces and places acknowledges that different work activities require varying levels of interaction, concentration, confidentiality and technology. Additionally, as the research groups that will occupy AIN evolve and change over time, this diversity in settings will increase the flexibility of the Workspace, allowing changing activities to be supported with minimal reconfiguration and impact to productivity.

e. All areas of Workspace must satisfy the following overarching principles:

   i Reflect and support the non 9-5 academic lifestyle, where long hours and blurring of work-life are a reality.

   ii Provide adequate security at all times.

   iii Provide ready access for student to academics and supervisors.

   iv The walls of enclosed and semi-enclosed spaces (e.g. offices and meeting rooms) should ensure privacy appropriate to the purpose while ensuring that as much natural light as possible enters the workspace.

   v ICT must be embedded to enable and encourage mobility within the Workspace. This should also progress in future to providing staff with suitable mobile technologies to allow them to utilise the complete menu of work settings available at AIN Physics Building.

vi All workspace, especially Secondary Work settings and informal interaction zones, will be supported by access to high-speed wireless connectivity and network capability.

vii Enclosed workspace (including single person offices, shared offices, and small meeting rooms) must:

- Provide for privacy to support confidential discussions
- Not block natural light to other areas or staff; and
- Be arranged and located in a way that facilitates the availability of daylight and aspect for the maximum number of staff.

viii Shared areas (e.g. breakout space, meeting rooms) within Workspace should be located with the best external views wherever possible to encourage use.

ix Workspace should have modular, movable furniture that allows for ease of reconfiguration.

x Workspace should be standardised to allow for adaptability and reuse over time.

xi Workspace design shall support a culture of cooperation and collaboration, reinforcing that the objective of this space is to support and facilitate research activities, rather than to symbolise hierarchy or status.

3.6.3 Formal Meeting Spaces

a. As the spaces where the majority of formal collaboration is expected to occur, meeting spaces must provide comfortable furniture, seamless integration of IT / AV tools and systems, and be distributed through the workspace such that each research group will have access to a range of sizes and settings.

b. These should be naturally lit and located adjacent to offices but may also be used by Laboratory user groups. It is anticipated that the Teaching & Learning Seminar Rooms may also be used as meeting spaces by workspace users.

c. Meeting spaces are required that:

i support a range of group sizes from a minimum of 4 people to a maximum of 20 people seated;

ii comfortable, modular furniture tailored to either formal or informal spaces;

iii provide IT and AV, appropriate to the size and nature of the meeting space, from large group presentations requiring display technologies, to small working sessions requiring interactive surfaces, to virtual collaboration including teleconference and videoconference capabilities; and

iv support planned and ad-hoc use and therefore are available as mix of bookable space or non-bookable space.

v Should either incorporate a teapoint or a teapoint should be located nearby.

3.6.4 Informal Meeting Spaces

a. This space will be vital for fostering serendipitous interaction between occupants as they go about 'planned' work. Spaces are required that:

i support both planned and ad-hoc collaboration in either a standing or seated mode for groups of 2-4 people;

ii promotes social interaction within and between research groups, however does not discourage individual work to also happen in these spaces in short periods;

iii are located throughout Workspace, particularly in those places and circulation junctures where people are more likely to 'bump' into each other.

3.6.5 Support Spaces

a. Support space include:

i Facilities Rooms - areas within the general workspace area that accommodate equipment for copying, printing and faxing and has supply storage;

ii Tea / Coffee Points - team breakout and informal meeting space that includes facilities for making tea and coffee.

iii 'End of Journey' Facilities – centrally located shower and change amenities to support cyclists and active AIN occupants.

iv Bike lockers or racks.

v Storage rooms on each level for (new) furniture and equipment, to facilitate flexibility in room usage.

b. At least 30% of offices (22no.) should be located adjacent to laboratories to accommodate staff and students using those laboratories, unless significant performance and cost benefits can be demonstrated using other arrangements. Workspace must be zoned to manage the conflict created by supporting areas of intense activity alongside those demanding concentration and privacy/confidentiality

c. The need for confidentiality is a factor that shall be managed through the design and use of Workspace by locating the primary and secondary work settings so that confidential discussions can happen in the appropriate of space

3.6.6 Corridors - Functional Description

a. General

i Corridors comprise the major circulation routes through the building with linkages into corridors of the existing building.

b. Access

i The building will be open to the public from 8am to 6pm with all major corridors accessible during this time.

ii Access control to corridors bounding Laboratories, the Cleanroom and TEM Suite will apply at all times.

iii Academic offices, excluding those adjacent to Laboratories shall be publicly accessible during business hours with access control outside of normal working hours.

iv Stairways and lifts between floors need to respect this difference by not linking a public corridor directly to a controlled one.

c. Circulation Dimensions

i Generally corridors shall be the maximum height available, no lower than the minimum requirements of the BCA and as follows to selected areas:

- Main circulation routes to Laboratories to be a minimum clear width of 2400mm wide x 2400mm high.

ii Selected facilities will remain in the existing building, for example the workshop, which will require circulation routes to facilitate movement of large objects between the two buildings. This will necessitate the following:

- At least one clear opening to the existing building of 2.2m wide x 2.4m high.
- Any 'ramps' on main circulation routes should not exceed a gradient of 1:20.

d. Amenity

i The provision of natural lighting, where feasible, is to be encouraged.

e. Finishes

i Floor

- Floor finishes are to be durable, stain resistant and low maintenance. Where possible they shall match or be appropriate to the adjacent spaces, for example vinyl to the laboratory areas and carpet tiles to the offices.

ii Walls

- Wall surfaces should be durable, easy to clean and low maintenance. Wall surfaces up to 1200mm above finished floor level shall be constructed from or lined with hard-wearing materials which are resistant to scuffing and scratching.

iii Ceiling

- Laboratories: full width perforated metal pan system.
- Other: set plasterboard or grid ceiling.
- Install cable trays within ceiling spaces with the capacity for current services plus expansion space.

3.6.7 Foyer Teaching & Learning- Functional Description

a. General

i The Teaching & Learning Foyer will be a large lobby or anteroom space for meeting and assembling prior to and after lectures in the adjacent Teaching and Learning spaces.

ii The Foyer should provide the entry point into the majority of the teaching spaces, in particular the lecture theatre should link to the existing A28 building if feasible.

iii No dedicated reception facility is required in the AIN Physics Building. The reception in the existing A28 Physics Building will serve this function for both buildings.

b. Format

i A spacious, predominantly double height volume is envisaged.

ii Space for exhibits, art/ science displays and the like shall be provided.

iii Pedestrian Modelling may be required to demonstrate the adequacy of the total floor area and vertical circulation to accommodate the number of students and ease of movement at changeover times.

c. Access/ Circulation

i The Foyer area and configuration shall facilitate the movement of up to one thousand (1000) students in and out of the Teaching & Learning spaces within a ten minute period at changeover, without undue congestion.

d. Amenity

i Rubbish and recycling, filtered water and University Signage required.

e. Character

i The provision of natural lighting is essential as is a high atrium style space. The character of the space should be upmarket and aesthetically impressive (see walls for more details) as the lecture theatre and teaching spaces will be used for outreach and external functions involving high profile people.

f. Finishes

i Floor

- Floor finishes are to be durable, stain resistant and low maintenance. A hard floor finish, stone or epoxy resin flooring or similar is required.

ii Walls

- Wall surfaces should be durable, easy to clean and low maintenance. Wall surfaces up to 1200mm above finished floor level shall be constructed from or lined with hard-wearing materials which are resistant to scuffing and scratching. Appropriate space must be provided for display boards and artworks to be positioned on walls to produce an aesthetically pleasing and inspiring area.

iii Ceiling

- The ceiling shall be of a light colour to give the impression of height. Rooflights are required.

g. Lighting

i Lighting shall comprise standard suspended pendants augmented with adjustable floodlights from high level.

ii Automatic shutdown of lighting after appropriate period of inactivity (or lack of movement in the room).

h. Acoustic Considerations

i Control of reverberant sound is critical to minimise nuisance noise.

i. Wi-fi

i High bandwidth wireless must be provided at sufficient density to service a large population of students awaiting a class.

3.6.8 Linkages – Functional Description

a. General

i A minimum of two linkages shall be provided between the new and existing A28 building providing sufficient connection to function practically and experientially as a single School of Physics building.

ii Linkages should provide a seamless connection between the two buildings

b. Format

i Linkages shall be provided, as a minimum, at two (2) locations at level 1 (grade), two locations at level 2 and a connection at level 3 at the eastern end of the building adjacent to Lecture Theatre 1 (LT1) in A28.

ii Wherever reasonably practical, levels between the two buildings shall match with any level changes minimised and addressed via ramps of a maximum gradient of 1:20.

c. Access/ Circulation

i Linkages shall generally be a minimum of 2.4m wide excluding the connection point to the existing building where openings are to match the existing building opening sizes.

ii There shall be at least one opening between the two buildings that is a minimum of 2.2m clear to allow for the moving of palettes between the two buildings.

d. Services

i Linkages shall convey services between the two buildings, including but not limited to optic fibre and other communications cabling, and process cooling water from new plant to laboratories within the existing building.

e. Character

i The provision of natural lighting is highly desirable. In double height spaces, the upper linkage should include glazed balustrades to increase natural light to lower levels.

f. Finishes

i Floor

- Floor finishes are to be durable, stain resistant and low maintenance. They shall be appropriate to the adjacent spaces.

ii Walls

- Wall surfaces should be durable, easy to clean and low maintenance. Wall surfaces up to 1200mm above finished floor level shall be constructed from or lined with hard-wearing materials which are resistant to scuffing and scratching.

iii Ceiling

- Laboratories: full width perforated metal pan system.
- Other: set plasterboard or grid ceiling.

3.6.9 Offices - Functional Description

a. General

i A successful research environment must encourage interaction and collaboration between scientists whilst providing private workspaces for academic work requiring long periods of deep thought and undisturbed concentration. The workspaces at AIN must accommodate these potentially conflicting requirements.

ii Approximately eighty (80) offices are required.

iii Offices will be utilised by four groups; academics, post-doctoral fellows, post-graduate students and honours students.

b. Format

i Individual enclosed offices are essential for Academics and Post-Doctorate researchers for reasons of visual privacy, acoustic confidentiality, security, and to create an environment suitable for undisturbed, deep thought.

ii An open plan model utilising shared, enclosed rooms for confidential discussions is not viable for these users owing to the necessity to have personal records at hand and the extent of academic work requiring privacy.

iii The requirement for individual enclosed offices for post-graduate and honours students is not as definitive but still preferable. Any open-plan arrangements proposed will require secure at-desk storage and areas to facilitate quiet concentration.

c. Size

i Offices shall be a consistent, standard size, nominally 15m² with sufficient flexibility to accommodate one (1) to four (4) occupants:

- 1 x Academic (continuing academic staff of all standing to have same size office)
- 2 x Post-Doc fellows (locate desks diagonally in two-person layout)
- 3 x Post-Grad students
- 4 x Honours students.

ii The office planning grid shall permit future conversion of three (3) 15m² modules into two (2) 24 m² modules for 5-6 occupants. The combination of a greater number of modules to create larger enclosed, or open plan areas should also be considered. In this scenario, wherever possible, avoid the requirement for work-points in the middle of a room/ space.

iii All offices shall be nominally single height.

d. Location

i Approximately 30% of offices (22no.) should be located adjacent to laboratories to accommodate staff and students using those laboratories, unless significant performance and cost benefits can be demonstrated using other arrangements. Workspace must be zoned to manage the conflict created by supporting areas of intense activity alongside those demanding concentration and privacy/confidentiality

ii Offices should be located as close as reasonably practical to vertical circulation, ideally being clustered around open stairs to facilitate easy, inter-floor access between offices and laboratories areas.

iii Offices should be located in reasonable proximity (not more than 50m) to the Facilities Room on each level for printing, photocopying, binding etc.

e. Access/ Circulation

i Corridors outside offices will generally be accessible during office hours to allow students to walk freely to academics' doors.

ii Each office will have University standard Bi-lock security lockable door with master key. An internal snib shall be provided such that the occupant can lock the door manually from the inside.

iii All offices are to be wheelchair accessible in accordance with the requirements of the AS1428.

f. Amenity

i Offices should be configured to provide daylight and views to the maximum number of staff.

ii Individual environmental control is strongly preferred. This shall comprise opening windows or natural ventilation with individual fan-coil units operating in a mixed-mode air-conditioning system.

g. Furniture

i All office furniture is to be loose with no built-in joinery.

ii Furniture shall be modular and movable to provide maximum flexibility.

iii Desks/ Chairs

- Provide lockable, mobile pedestal units to shared offices.
- A single academic office shall accommodate three (3) visitors chairs to allow frequent small meetings of up to four people.

iv Whiteboards/ writing wall

- Provide a minimum of one (1) glass writing wall per office a minimum of 2200mm long x 1500mm high. It is envisaged that this will be located above a 900mm high narrow open shelving unit on the opposite wall from the workstations. Blackboards are prohibited.
- Provide additional wall space for a projection surface

v Storage

- Storage shall comprise the following:
  - 4.4 linear metres of free-standing shelving unit per desk.
  - One (1) three-drawer under bench pedestal unit per desk.
  - One (1) open bookcase 2200mm long x 900mm high x 350mm per occupant in a 1-3 person office.
  - One (1) four drawer filing cabinet to each single occupant office.

h. Electrical/ Audio Visual

i Ducted skirting shall be provided to the two flanking walls of a typical office, i.e. not to the corridor or facade walls. It shall be mounted below desk height to hide cabling and shall include the following:

- Two (2) Data points per workstation
- Two (2) DGPOs per workstation

ii An additional wall mounted DGPO shall be provided per room.

i. Wi-Fi

i Wi-Fi system points must consider sensitivity of any adjacent labs.

j. Character

i A pleasant, healthy and productive office environment is required.

ii Every office shall have access to natural light to assist in creating a calm, light filled environment conducive to academic work. Glare blinds are required to all external glazing.

iii Offices shall have access to views where feasible.

k. Finishes

i Floor

- Floor finishes are to be durable, stain resistant and low maintenance, heavy duty commercial grade carpet tiles or similar.

ii Walls

- Partitions between offices are to be full height (slab to soffit), acoustically sealed and of opaque construction, painted plasterboard is envisaged.
- Partitions between offices and circulation corridors shall comprise a solid core door, a minimum of 30% and maximum of 40% glazed area. Glazing shall incorporate a 1300mm high frosted strip, (or similar to achieve the same functional requirement), starting from 500mm above finished floor level, or similar, to allow the passage of light through the office into the corridor but to provide privacy for occupants.
- Provide suitable wall strengthening to flanking walls for mounting shelving.

iii Ceiling

- Exposed in-situ concrete is preferred for thermal mass to reduce fluctuation in diurnal temperature variation.
- A bulkhead may be required to house the FCU and associated services. This shall be located adjacent to the corridor and shall not exceed 30% of the room floor area.
- The ceiling shall be of a light colour to give the impression of height, discrete panels for acoustic performance may be required, where possible acoustic absorptive surfaces should be incorporated into the bulkhead.

l. Lighting

i Typically lighting shall comprise one (1) centrally positioned suspended linear fluorescent with RAL 9006 polyester powder coated finish or similar and individual desk mounted task lights per workstation.

m. Acoustic Considerations

i The offices must provide sufficient acoustic privacy for confidential discussion.

3.6.10Medium Enclosed Meeting Room - Functional Description

a. General

i The Medium Enclosed Meeting Rooms will be traditional format meeting spaces for up to 10 people.

b. Format

i It is envisaged that these rooms will be used predominantly with desks arranged centrally in a small hollow rectangle or U-shape. The U-shape being preferred for meetings involving audio visual presentations as all attendees can see the AV screen when placed at the open end of the 'U'.

ii To ensure that all occupants can focus on one presentation area, a single presentation wall is preferred comprising a 55" flat screen panel and 'whiteboard' positioned to ensure visibility for everyone in the room without having to place the board and the flat panel monitor/screen on different walls. The lower edge of the display area of the screen shall be approximately 1100mm above finished floor level to permit all participants a clear view.

iii The presentation wall should be as clean as possible, thermostats, switches and the like should be located elsewhere.

iv A nominally single height space, of square plan proportions is preferred.

c. Location

i Meeting rooms should be adjacent to office areas accessible from main circulation routes and distributed relatively evenly across the building.

d. Access/ Circulation

i Access shall be direct from an adjacent corridor via a single door.

ii Access into the space shall not be via the 'front' presentation wall.

e. Furniture.

i Table(s) & chairs

- Furniture will comprise modular tables on wheeled lockable castors that are lightweight and flexible to facilitate configuration into a variety of meeting room table settings.
- A minimum of one table shall include a soft wire management system with flush table top outlets, or connection to a central floor box unit including:
  - Two (2) Data points
  - Two (2) DGPOs

ii Whiteboards/ writing wall

- Provide a minimum of one (1) glass writing wall surface of 2000mm wide x 1200mm high minimum size, adjacent to the flat screen unit on the front presentation wall. The bottom edge of the writing wall surface shall be positioned 900mm above finished floor level. The writing surface can be split into two equal sections either side of the screen if required.

f. Storage

i Storage is not required.

g. Audio Visual

i A total of three (3) Medium Meeting Rooms shall include AV systems including a 55" Flat screen display located on the 'front' presentation wall.

ii A CPU will not be provided, the space will function as a BYOD (laptop) driven presentation space.

iii A central floor box with two DGPO and two double data points is required.

iv A further two (2) DGPOs to the front presentation wall shall be provided.

h. Amenity/ Character

i Natural lighting is essential to all meeting rooms to assist in creating a calm, light filled environment suitable for productive meetings. Brownout blinds are required to all external glazing to facilitate effective AV presentations.

ii Access to views where feasible is desirable.

i. Finishes

i Floor

- Floor finishes are to be durable, stain resistant and low maintenance, heavy duty commercial grade carpet tiles or similar.
- Meeting rooms shall include cable pathways from a wall to the centre of the room to allow for future installation of AV/ VC equipment and table boxes at a later date.

ii Walls

- Partitions between meeting rooms and adjacent rooms are to be full height (slab to soffit), acoustically sealed and of opaque construction, painted plasterboard is envisaged.
- Partitions between meeting rooms and circulation corridors shall be fully glazed with the exception of a full height, solid core entry door. Brown-out blinds for privacy and to facilitate audio visual presentations shall be provided to the full extent of partition glass. These should prevent those in the corridor from being able to discern information on the AV screen.
- The external facade to the meeting room shall be predominantly glazed with manually operated brown-out blinds to all external glazing.

iii Ceiling

- Exposed in-situ concrete is preferred for thermal mass to reduce fluctuation in diurnal temperature variation. Suspended acoustic ceiling panels may be required to provide suitable acoustic conditions.
- A bulkhead may be required to house FCUs and associated services. This shall be located adjacent to the corridor and shall not exceed 30% of the room floor area.
- The ceiling shall be of a light colour to give the impression of height, discrete panels for acoustic performance may be required, where possible acoustic absorptive surfaces should be incorporated into the bulkhead.

j. Lighting

i Typically lighting shall comprise one (1) centrally positioned suspended linear fluorescent with RAL 9006 polyester powder coated finish or similar.

ii High bandwidth wireless must be provided at sufficient density to service a full capacity audience on the network.

k. Acoustic Considerations

i Speech legibility is the critical acoustic criteria.

3.6.11Large Enclosed Meeting Room - Functional Description

a. General

i The Large Enclosed Meeting Room will function as both a traditional and Video-Conference (VC) enabled meeting space for up to 20 occupants.

b. Format

i The room should be configurable in a 'boardroom', 'classroom' or 'video-conferencing' format.

ii The 'boardroom' format comprises tables arranged in a conference style or hollow rectangle configuration with participants seated around all four sides for committee meetings and the like.

iii The 'classroom' format comprises tables arranged in rows facing the speaker/ presentation wall.

iv The video-conferencing format ideally comprises tables arranged in a v-shape such that the face of all participants is covered by one central video camera. The distance to the camera is as similar as possible for all the participants minimising the requirement for camera focus adjustments during a conference. If the proportions of the room do not support this arrangement, video-conferencing will occur using a conference style configuration.

v To ensure that all occupants can focus on one presentation area, a single presentation wall is preferred comprising the flat screen panel/ projection image and 'whiteboard' positioned to ensure visibility for everyone in the room without having to place the board and the flat panel monitor/screen on different walls. The lower edge of the display area of the screen shall be approximately 1100mm above finished floor level to permit all participants a clear view.

vi The presentation wall should be as clean as possible, thermostats, switches and the like should be located elsewhere.

vii A nominally single height space, of rectangular plan proportions is envisaged.

viii Columns within the space are not permitted.

c. Access/ Circulation

i Access shall be direct from an adjacent corridor via a single door.

ii Access into the space shall not be via the 'front' presentation wall.

iii A minimum 1.5m clearance between the perimeter table edge and inside face of adjacent wall in standard conference style arrangement shall be provided.

d. Furniture

i Table(s) & chairs

- Furniture will comprise modular tables on wheeled castors that are lightweight and flexible to facilitate configuration into a variety of meeting room table settings.
- A minimum of two (2) tables shall include a soft wire management system with flush table top outlets, for connection to two central floor boxes each including:
  - Two (2) Data points
  - Two (2) DGPOs
- If the room configuration supports a v-shaped video-conference table arrangement a modular table design including a section with curved sides to create a rounded centre may be selected.
- Tables shall have a matte, unreflecting surface.

ii Whiteboards/ writing wall

- Provide a minimum of three (3) glass writing wall surfaces of 2000mm wide x 1200mm high minimum size, with at least one adjacent to the flat screen(s) on the front presentation wall. The bottom edge of the writing wall surface shall be positioned 900mm above finished floor level.
- Where whiteboards/ writing wall surfaces will be visible by the camera manual background curtains should be installed to cover the surfaces during video conferences.

iii Lectern

- A lectern, approximately 1600mm x 800mm at the front of the room will feature audio visual hardware to enable control of the presentation system and lighting. The lectern shall include the following:
  - University of Sydney standard touch screen AV control panel.

- Flat panel computer display monitor.
- Keyboard and mouse.
- Layout space for a minimum of two A4 sheets of paper and a laptop.
- Dedicated, user controlled, adjustable lighting to the reading surface.
- Internal contact phone.
- Gooseneck microphone.
- Standard University of Sydney AV hardware including space for one PC CPU box and document camera.

- A floor-box shall be provided under the lectern to facilitate cable entry for power, data and other services.
- The lectern shall be positioned adjacent to the front presentation wall but such that it does not block views of the screen and whiteboards.

iv Kitchenette

- Provide a kitchenette comprising a minimum 3.6m length of linear bench-top to the 'back' wall (i.e. the wall opposite the front presentation wall), to include the following:
  - Sink and drainer
  - Hot and Cold water supply
  - Zip hydra-tap
  - Two (2) bar fridges
  - One (1) dishwasher
  - Built-in below bench cupboards

e. Storage

i Storage shall comprise a single credenza unit.

f. Audio Visual

i The following summarises the key features of the audio visual system, refer to the Audio Visual Specification for more detailed information.

ii Visual Display

- VC capacity requires Two LCD Screens

iii Audio

- Voice reinforcement shall be provided via a lectern mounted gooseneck microphone.

iv Control

- AV and lighting control are to be to the University Standard.

v Hearing Augmentation

- A hearing augmentation system, preferably comprising an under floor or in ceiling induction loop system or infrared system if induction loop is problematic, shall be provided.

g. Wi-Fi

i High bandwidth wireless must be provided at sufficient density to service a full capacity audience on the network.

h. Character

i The provision of natural lighting is essential to this space to assist in creating a calm, light filled environment conducive to fostering effective outcomes. Brownout blinds are required to all external glazing to facilitate effective AV presentations.

ii Internal surfaces should be clean and free from elements that attract attention. Colours shall be selected to avoid strong contrasts with whatever is in the foreground be the goal, and the colour choice should be adapted to avoid strong contrasts for the VC camera with whatever is in the foreground, usually the lecturer and board grey hues are well suited.

i. Finishes

i Floor

- Floor finishes are to be durable, stain resistant and low maintenance, heavy duty commercial grade

carpet tiles or similar.

- Meeting rooms shall include cable pathways from a wall to the centre of the room to allow for future installation of AV/ VC equipment and table boxes at a later date.

ii Walls

- Partitions between the large meeting room and adjacent rooms are to be full height (slab to soffit), acoustically sealed and of opaque construction, painted plasterboard is envisaged.
- Partitions between the Large Meeting Room and adjacent circulation corridor shall be fully glazed with the exception of a full height, solid core entry door. Black-out blinds for privacy and to facilitate audio visual presentations shall be provided to the full extent of partition glazing. These should prevent those in the corridor from being able to discern information on the AV screen.
- Wall finishes are to be clean, neat texture & pattern free of a grey hue, containing a minimum of 15% black to suit the video camera.
- All glazing receiving daylight to the external facade shall be equipped with manually controlled black-out blinds.

iii Ceiling

- Exposed in-situ concrete is preferred for thermal mass to reduce fluctuation in diurnal temperature variation. Suspended acoustic ceiling panels may be required to provide suitable acoustic conditions.
- A bulkhead is not desirable. Clean lines and a consistent height ceiling with inbuilt FCU are preferred. The ceiling shall be of a light colour to give the impression of height, discrete panels for acoustic performance may be required, where possible acoustic absorptive treatment shall be incorporated into the ceiling.

j. Lighting

i Zoned lighting to facilitate effective AV presentation is required.

ii The lighting solution shall be customised to provide natural colour rendering using a video camera, to evenly light all participants and reduce facial shadows.

iii Automatic shutdown of lighting after appropriate period of inactivity (or lack of movement in the room).

k. Acoustic Considerations

i Speech legibility is the critical acoustic criteria.

3.6.12 Open Informal Meeting - Functional Description

a. General

i The Open Informal Meeting areas are envisaged as spaces adjoining primary movement routes, providing informal meeting settings to support planned or ad-hoc collaboration.

b. Format/ Location

i Open Informal Meeting spaces should be located adjacent to windows where possible, directly off primary circulation corridors adjacent to open stairs and double height voids (if provided).

c. Furniture

i Loose furniture comprising four (4) comfortable chairs and one (1) small table shall encourage small group interactions.

d. Character

i The provision of natural lighting is essential to encourage usage. Internal finishes shall create a warm, pleasant environment with comfortable, 'lounge' seating. Where views or aspects to exterior spaces can be achieved they shall be capitalised upon.

e. Finishes

i Floor

- Floor finishes are to be durable, stain resistant and low maintenance, heavy duty commercial grade carpet tiles or to match the adjacent corridor floor finish as appropriate. A rug or other device to soften the formality of the setting should be considered.

ii Walls

- Wall surfaces should be durable, easy to clean and resistant to scuffing and scratching. The use of feature colours or textures should be explored to differentiate this informal setting from the more formal building functions.

iii Ceiling

- The ceiling shall be of a light colour to give the impression of height, exposed concrete with discrete panels for acoustic performance is preferred.

3.6.13Facilities Room - Functional Description

a. General

i The Facilities Room will function as a service area for printing, photocopying, binding and the like. It will provide storage space for paper, stationery and consumables.

ii One (1) Facilities Room is required on average for every 50 occupants and to each floor of the building.

b. Format

i The Facilities Room does not need to be enclosed and where appropriate it is spatially advantageous to provide the required facilities in an open galley arrangement parallel to a corridor.

c. Access/ Circulation

i The Facilities Room shall be open and accessible at all times to those with access to the corridor.

d. Furniture

i Built-in joinery shall comprise the following:

- Benchtop, minimum length of 2.4m.
- Underbench storage cupboards, equal in length to the benchtop, 50% with lockable doors for consumables (printer cartridges and the like) and 50% with non-lockable doors for paper storage.
- Overhead storage cupboards, equal in length to the benchtop.
- Space for one (1) multifunction device printer and photocopier.
- Pinboard, above bench (splashback) 500mm high, equal in length to the benchtop.

ii The Facilities Room shall include a waste station point with sufficient space for one (1) 240lt general and one (1) 240lt recycling bin, preferably recessed behind a closable door

e. Electrical

i Power and data points shall be located appropriately to service the multi-function printer/ photocopier with adequate provision for above bench points.

f. Finishes

i Floor

- Floor finishes are to be durable, stain resistant and low maintenance, heavy duty commercial grade carpet tiles or to match the adjacent corridor floor finish as appropriate.

3.6.14Tea Point - Functional Description

a. General

i The School of Physics wants to encourage its permanent research & teaching staff and students to use the central café to foster collaboration and increased communication. For this reason tea points on each floor are to provide only a basic level of amenity. They are to be used solely for the preparation of hot drinks and should discourage hot food preparation. A small bar fridge will be provided but microwaves and dishwashers are not permitted.

b. Format/ Access/ Circulation

i The space shall be accessible from primary circulation corridors and located in close proximity to the offices.

c. Furniture

i Built-in joinery shall comprise the following:

- Benchtop, minimum length of 2.4m.
- Sink & drainer with associated hot and cold water supply
- Zip Hydro-tap, or equivalent
- Underbench storage cupboards, equal in length to the benchtop with 600mm wide open space for bar fridge.
- Overhead storage cupboards, equal in length to the benchtop.

d. Electrical

i Provide one (1) under bench DPGO and one (1) wall mounted DGPO. There are to be no above bench power outlets.

e. Finishes

i Floor

- Floor finishes are to be durable, water resistant, stain resistant, slip resistant and low maintenance, resilient flooring or similar.

ii Walls

- Wall surfaces should be durable and easy to clean.
- A colour-back glass splashback shall be provided to the full length of the benchtop.
- Lightweight partition walls shall comprise moisture resistant lining materials.

3.6.15Breakout Lounge - Functional Description

a. General

i The Breakout Lounge combines the functionality of the Open Informal Meeting Spaces and Teapoints to provide a space adjoining primary movement routes, providing informal meeting settings to support planned or ad-hoc collaboration with preparation area for hot drinks.

b. Format/ Access/ Circulation

i Breakout Lounges shall be accessible from primary circulation corridors and located in close proximity to offices.

c. Furniture

i Built-in joinery shall comprise the following:

- Benchtop, minimum length of 2.4m.
- Sink & drainer with associated hot and cold water supply
- Zip Hydro-tap, or equivalent
- Underbench storage cupboards, equal in length to the benchtop with 600mm wide open space for bar fridge.
- Overhead storage cupboards, equal in length to the benchtop.

d. Electrical

i Two (2) under bench DPGOs and two (2) wall mounted DGPOs are required. There are to be no above bench power outlets.

e. Furniture

i Loose furniture comprising eight (8) comfortable chairs and two (2) small tables shall encourage small group discussions.

f. Character

i The provision of natural lighting is essential to this space to encourage usage. Internal finishes shall create a warm, pleasant environment with comfortable, 'lounge' seating. Where views or aspects to exterior spaces can be achieved they shall be capitalised upon.

g. Finishes

i Floor

- Floor finishes are to be durable, stain resistant and low maintenance, heavy duty commercial grade carpet tiles or to match the adjacent corridor floor finish as appropriate. A rug or other device to soften the formality of the setting should be considered.
- The floor finish adjacent to the kitchenette shall comprise water resistant flooring to a 1.2m strip for the length of the benchtop.

ii Walls

- Wall surfaces should be durable, easy to clean and resistant to scuffing and scratching. The use of feature colours or textures should be explored to differentiate this informal setting from more formal building areas.

iii Ceiling

- The ceiling shall be of a light colour to give the impression of height, exposed concrete with discrete panels for acoustic performance is preferred.

3.6.16 Storage - Functional Description

a. General

i Where the design permits and space is not suitable for labs or offices, provide 1 storage space per level from 5-40 m².

ii The storage area is primarily for surplus furniture and miscellaneous items.

iii The storage space should be fitted out such that it can be used as a temporary work area if required.

b. Access/ Circulation

i Locate the storage rooms directly off corridors with sufficient clearance for the movement in and out of large pieces of equipment.

ii Storage rooms exceeding 10m² shall include double door access a minimum of 1.5m clear, otherwise single door access is acceptable. The storage area closest to the Lecture Theatre Demonstration Preparation Room shall incorporate a double door access to permit storage of one of the lecture theatre movable benches.

c. Electrical

i Provide ducted skirting to the perimeter of the room to incorporate DGPOs and Data points as per the RDS.

d. Finishes

i Floor

- Floor finishes are to be durable, stain resistant and low maintenance, heavy duty commercial grade carpet tiles or similar.

ii Walls

- Wall surfaces should be durable and easy to clean. Wall surfaces up to 1200mm above finished floor level shall be constructed from or lined with hard-wearing materials which are resistant to scuffing and scratching.

3.6.17Cafe - Functional Description

a. General

i The café will be a scientific facility of considerable importance. It will be the social heart of AIN and the School of Physics, providing a prominent and contiguous space for chance meetings and casual interaction for all users of A28 and A31/AIN to help foster collegiality and collaboration. Its design should capture the energy and excitement about the world class research and teaching taking place within the Physics precinct.

ii The cafe shall provide facilities for staff and students to prepare and consume their own food and beverages and also space for a commercial food and beverage vendor to operate from a stand-alone 'coffee-cart' or similar retail element.

iii It is envisaged that the commercial operation will sell coffee, other beverages and light snack food during working hours, with a free-standing kitchenette element available for staff and student usage at all hours.

iv The café will provide access to food and beverages 24 hours to support intensive use of the research facilities.

v The internal layout shall function equally well with or without the free-standing retail element.

b. Format

i The internal volume shall be at least one and a half floor heights, a minimum of 4.5m clear height for at least 50% of the floor area.

ii An external area (courtyard) should be directly accessible from the cafe without any level change.

iii Sliding, bi-folding doors with a flush threshold shall be provided to facilitate an open connection between the cafe interior and adjacent exterior, to be opened in favourable conditions.

iv Seating shall include indoor and outdoor settings.

v The configuration of the space shall create a range of settings including incidental meeting spaces, spaces to support collaborative work/ team meetings and individual study.

c. Location

i The cafe shall be centrally located at the 'heart' of the Physics precinct (comprising both A28 and A31).

ii It shall be located between the existing and new building adjacent to the proposed courtyard and on the primary circulation spine of the Physics precinct.

iii It is viewed as a Physics facility not a general campus facility and its location should reflect this, as such it should be located within the precinct and should not advertise its presence to other campus users.

iv No tea/ coffee point is required on the café level as the café will serve this function.

d. Access/ Circulation

i All users of the building should be able to access the cafe.

ii Elements within should be arranged to facilitate free and direct linear movement through the space on primary circulation routes.

e. Furniture, Fittings and Equipment

i Kitchenette

- A single, free-standing island kitchen benchtop for staff and student usage shall be provided comprising the following:
  - Minimum dimensions of 6000mm(l) x 1200mm(w) x 900mm(h).
  - Heat proof, durable and scratch resistant benchtop surface fabricated from a solid, seamless, non-porous homogenous solid surface or engineered stone material to the full extent of the benchtop and to the two short ends.
  - Kitchen cabinetry accessible from both sides of the island bench comprising carcasses, doors and all associated fitments and fixings carcasses comprising:
  - Carcasses fabricated from moisture-resistant factory-laminated particleboard.
  - Doors and drawer fronts comprising 18mm minimum thickness, moisture-resistant MDF coated in 2 pac polyurethane paint, or similar.

- Heavy duty, commercial grade, proprietary cabinet hardware comprising drawer runners, connection fittings, hinges and the like. All drawer runners and hinges should include a "soft closing" mechanism to limit noise
- Stainless steel handles.

- Two (2) commercial grade stainless steel sinks and drainers
- Hot and cold water supply to each sink
- Two (2) Zip Hydrotaps or equivalent
- Two (2) built-in below bench mounted microwaves
- Three (3) built-in below bench bar fridges
- Two (2) built-in below bench dishwashers

ii Kitchen equipment

- Commercial grade kitchen infrastructure is not anticipated, no cooking equipment, hobs, hot plates, ovens, grease-traps and the like are required or should be provided.

iii Chairs & Tables

- Furniture shall be high quality and provide a mix of traditional café-style and soft-seat settings for casual interaction or small informal group meetings.
- Chairs and tables shall provide flexibility in the arrangement of settings and shall be of external grade for usage inside and directly outside the cafe space.

iv Storage

- Storage, above and beyond that in the kitchen island unit is not required.

f. Audio Visual

- The cafe will not include any provision for Audio Visual systems.

g. Electrical

i One Double Data point to be positioned at proposed location of commercial café counter for cash register.

h. Wi-Fi

i High bandwidth wireless must be provided at sufficient density to service a fullcafe on the network.

i. Character

i The provision of natural lighting is essential to create a light filled environment, with extensive external glazing to offer broad aspects of adjacent exterior spaces, the existing and new buildings.

j. Finishes

i Floor

- Floor finishes are to be durable, water resistant, stain resistant and low maintenance, a stone or epoxy resin flooring is envisaged.

ii Walls

- Wall surfaces should be durable, easy to clean and of low reflectivity. Wall surfaces up to 1200mm above finished floor level shall be constructed from or lined with hard-wearing materials which are resistant to scuffing and scratching.

iii Ceiling

- The ceiling shall be of a light colour to give the impression of height, exposed concrete with discrete panels for acoustic performance is preferred.

k. Lighting

i Lighting shall include feature pendant luminaires with supplementary down-lighters to provide contrast and localised lower ambient lighting for an intimate atmosphere.

l. Acoustic

i Limit noise and reverberation by conducting acoustic modelling and installing acoustic treatment.

3.6.18End of Journey - Functional Description

a. General

i The End of Journey facility will provide showers, toilets and changing facilities for staff who cycle, run or walk to AIN or who exercise during the day.

b. Format/ Location

i The End of Journey facility shall be located near to a convenient building entry point and the cycle storage facilities.

ii It shall comprise separate male and female facilities and a separate accessible combined toilet and shower room.

c. Access/ Circulation

i Access will be via swipe card and as such will only be available to academics and post-graduate students engaged in full-time work at AIN.

d. Facilities

i The facilities shall comprise the following

- Showers and associated washroom partitions
- WCs and associated toilet cubicle partitions
- Vanity units with sinks, taps, soap dispensers and the like
- Changing room including:
  - lockers with locking mechanism;
  - benching;

e. Furniture, Fixtures & Equipment

- FF&E shall be provided in accordance with the Room Data Sheet with additional items installed as required to satisfy any reasonable functional requirement

f. Storage

i Bike storage for approximately 20 staff and PhD students with lockable bike racks is required in a suitable external location accessible from a cycle entry point to the site and close to the appropriate building entry. To be designed to University standards (e.g., weather protection).

g. Finishes

i Floor

- Floor finishes are to be durable, water resistant, stain resistant and low maintenance, ceramic non-slip tiles on waterproofed substrate or similar. Resilient vinyl safety grid wet area matting shall be provided to circulation areas.

ii Walls

- Wall surfaces should be durable, water resistant, easy to clean and low maintenance, ceramic tiles on waterproofed moisture resistant board substrate or similar. Walls shall be floor to ceiling and acoustically sealed to adjacent substrate on all sides of the room.

iii Ceiling

- Moisture resistant board, painted.

h. Lighting

i Where feasible provide high-level natural lighting through opening window lights for ventilation. Provide privacy film/ treatment as required to prevent direct sightlines into the room.

ii Automatic shutdown of lighting after appropriate period of inactivity (or lack of movement in the room).

3.6.19WC - Functional Description

a. General

i WC provision shall be calculated on the following basis, subject to confirmation from the School of Physics/ University of Sydney and acceptance by the Certifying Authority.

- Teaching & Learning Areas: 1:1/ male:female
- Research Laboratories: 3:1/ male:female

ii Sanitary provisions shall be calculated in accordance with the expected populations of staff and students in accordance with the requirements of the BCA subject to the adjustment detailed above.

b. Location

i Two types of toilets are required, those for general public use by students and the like to be located off the primary circulation/ foyer area, and those for researchers and staff located off secondary circulation areas near offices and laboratories.

ii As a minimum male, female and accessible toilets shall be provided on each floor of the building.

iii On the main teaching level separate toilet facilities shall be provided for the student population to the full time research and academic contingent.

- Facilities

iv The facilities shall comprise the following

- WCs and associated toilet cubicle partitions
- Vanity units with sinks, taps, soap dispensers, and the like
- Hand dryers
- All fittings and fixtures required to equip an accessible WC

c. Furniture, Fixtures & Equipment

i FF&E shall be provided in accordance with the Room Data Sheet with additional items installed as required to satisfy any reasonable functional requirement

d. Lighting

i Automatic shutdown of lighting after appropriate period of inactivity (or lack of movement in the room).

e. Finishes

i Floor

- Floor finishes are to be durable, water resistant, stain resistant and low maintenance, ceramic non-slip tiles on waterproofed substrate or similar. Resilient vinyl safety grid wet area matting shall be provided to circulation areas.

ii Walls

- Wall surfaces should be durable, water resistant, easy to clean and low maintenance, ceramic tiles on waterproofed moisture resistant board substrate or similar. Walls shall be floor to ceiling and acoustically sealed to adjacent substrate on all sides of the room.

iii Ceiling

- Moisture resistant board, painted.

3.6.20First Aid/ Nursing Room - Functional Description

a. General

i The First Aid/ Nursing Room will function as a short term resting place for people with minor, undiagnosed ailments of a non-life threatening nature, an interim holding space for people with injuries awaiting an ambulance and/ or someone to collect them, and a private area for nursing mothers to breastfeed, express and store milk and for parents to feed infants.

b. Location

i A central location with public access is required, ideally adjacent to the main Teaching and Learning Foyer.

ii It needs to be easily accessible by ambulance personnel and should be located near to toilets. Other special requirements should include easy access for ambulance stretchers and manoeuvring space for prams. A small safe play area for infants is desirable but not essential.

c. Furniture

i The room shall consist of the following:

- Built-in cupboards and benchtop of minimum length 1.8m
- Sink with hot and cold water supply
- Drinking water tap
- Medical couch
- Refuse bin and other miscellaneous items.

d. Finishes

i Floor

- Floor finishes are to be durable, water resistant, stain resistant and low maintenance, resilient flooring or similar.

ii Walls

- Wall surfaces should be durable, easy to clean and low maintenance with ceramic tiled splashback to the length of the benchtop.

3.6.21 Cleaner's Cupboard - Functional Description

a. General

i AIN requires one primary cleaning room with secondary cleaning rooms on every level. Where the building design is such that there are 'sectors' of the building that do not directly access across a floor plate, there may be a need for more cleaning rooms to prevent the need to transport cleaning equipment between sectors via vertical movement and transfer between sections.

b. Primary Cleaning Room

i The Primary Cleaning Room shall be located ideally in a service area adjacent to a primary circulation corridor and shall provide sufficient space to accommodate the following with adequate circulation room to move comfortably in the space:

- Polivac (1m x 1m)
- Mop buckets x 2 (0.5m x 0.5m)
- Cleaning trolley (1m x .5m)
- Cleaner's sink with hot and cold water taps (taps with screw fittings)
- Wall hanging space for vacuums, cords, mops, brooms etc.
- Consumable cabinet/s for 15 - 20 boxes of consumables.
- Chemical cabinet/s / shelves
- Clear height to allow picking up and maneuvering of mops and poles.

c. Secondary Cleaning Room

i The Secondary Cleaning Room shall be located at a suitable position ideally adjacent to the WCs on each floor to share hydraulic risers and shall comprise the following:

- Cleaner's sink with hot and cold water taps (taps with screw fittings)
- Shelves / cabinet for small amount of consumable product, chemical bottles and cloths

d. Finishes

i Floor

- Floor finishes are to be durable, water resistant, stain resistant and low maintenance, ceramic non-slip tiles on waterproofed substrate or similar with floor waste.

ii Walls

- Wall surfaces should be durable, water resistant, easy to clean and low maintenance, ceramic tiles on waterproofed moisture resistant board substrate or similar. Walls shall be floor to ceiling and acoustically sealed to adjacent substrate on all sides of the room.

iii Ceiling

- Moisture resistant board, painted.

3.6.22Server Room - Functional Description

a. General

i The Server Room is to accommodate servers and clusters used in Physics. It will not house any network hubs except as needed by the servers and clusters themselves.

ii The Server Room is intended to house 12 Standard 19" cabinet style racks with an anticipated power density of 5kW per rack.

iii The room will require substantial air conditioning capable of effectively cooling high-density rack-mounted equipment and be able to prevent local hotspots by effective air circulation. The air conditioning system should have built-in redundancy to allow for maintenance and breakdowns (n+1).

iv In addition to air-cooling, chilled water outlets should be provided to two rack locations to allow for water-chilled systems. Note however, that the cooling capacity of the air-cooled system must be suitably sized to handle the maximum heat load.

v A false floor is required for some cable reticulation and air conditioning. Cable trays should be installed above each row of racks.

vi Each rack requires three 20A pendants. Cable trays, distribution boards and pathways should be sufficient to accommodate expansion of one extra pendant per rack.

vii The room will require an Uninterruptable Power Supply (UPS) of ~25KVA (client supplied).

viii The surrounding walls will require 8x 10A DGPOs evenly distributed. Network feed to the room will comprise 10Gb single mode fiber cables with at least 12 cores.

b. Format

i The Server Room will be of sufficient size and configured to accommodate the following:

- Twelve (12) 1000mm x 800mm cabinet racks in bayed configuration, 2 x 6 or 3 x 4.
- Minimum 1500mm clearance at the front and 900mm clearance at the rear of each rack.

ii Columns within the space are not permitted.

c. Location

i Avoid locating the Server Room adjacent to an external wall of the building.

d. Access/ Circulation

i Swipe card access and CCTV are not required. Access shall be controlled by key lock.

e. Services

i Services provision shall include the following:

- Dedicated air-conditioning system to control temperature, humidity and particle filtration with a minimum of n+1 redundancy, single point of failure tolerance.
- Provision for connection of two water cooled racks.
- Three (3) 20Amp pendants to feed into top of each rack, 36no. in total (power and network connections located within rack cabinets).
- Eight (8) wall mounted standard DGPO, one for each set of three servers.

f. A comprehensive fire protection system including passive and active design elements

i Pre-action sprinkler system (note, water sprinklers should be a last resort due to the high volume of computers used in the room)

ii Early warning aspirating smoke detection system (VESDA or equivalent)

g. Finishes

i Floor

- A raised floor is a not definitive requirement and shall be determined by assessment of the heat load management strategy. Cabling can be reticulated through above rack cable trays at high level.
- The floor finish shall be anti-static vinyl of a light colour.

ii Walls

- Walls shall be floor to ceiling and acoustically sealed to adjacent substrate on all sides of the room. The

Server Room is a potential source of nuisance noise and its construction shall provide adequate acoustic isolation to adjacent spaces.

- Wall surfaces should be durable, easy to clean and low maintenance, painted plasterboard to metal stud partition or similar.

iii Ceiling

- Exposed concrete soffit sealed/ painted white, a false ceiling is not required.

h. Lighting

i Provide lighting, with a motion sensor, over each aisle to minimise shadowing to operatives undertaking works to the server cabinets.

i. Acoustic Considerations

i Perimeter partition construction shall minimise egress of noise from the Server Room to any adjacent spaces to an acceptable level.

3.6.23Comms Room - Functional Description

a. General

i The Communications Room(s) (Comms. Room) are spaces to house communications terminations and equipment to connect to the campus network.

b. The provision of Communications Rooms across the building shall comprise:

- One (1) Main Comms Room per building
- One (1) secondary Comms Rooms per floor, potentially four (4) in total. Additional Comms Rooms may be required if cable runs exceed the maximum cabling distance, approximately 90m.

c. Format

i All Comms Rooms will be of sufficient size and configured to accommodate the following:

- Main Comms Room: Three (3) 880mm x 800mm open frame racks (Rack Technologies OF3801 – 38RU or similar) in linear configuration 1 x 3.
- Secondary Comms Rooms: Four (4) 880mm x 800mm open frame racks (Rack Technologies OF3801 – 38RU or similar) in linear configuration 1 x 4.
- Racks to be supplied and installed by The University of Sydney ICT Department.
- Minimum 900mm clearance to the front and back of each rack.

ii It is beneficial if the Comms Rooms are stacked in plan across floors to enable direct vertical feed of services between Comms Rooms on different floors.

iii Columns within the space are not permitted.

d. Location

i Comms Rooms shall be centrally located to minimise cable runs. Every effort should be made to locate the Comms Room such that cable runs do not exceed 90m to point of termination.

ii Avoid locating the Comms Rooms adjacent to an external wall of the building.

iii The Main Comms Room must be located on grade.

e. Access/ Circulation

i Swipe card access and CCTV are not required. Access shall be controlled by key lock.

f. Services

i Services provision shall include the following:

- Dedicated air-conditioning system to control temperature, humidity and particle filtration.
- No redundancy or single point of failure tolerance.
- CAT 6a cable backbone
- Ten (10) 15Amp pendants, in total, to feed into top of racks.
- One (1) wall mounted standard DGPO.

ii It is essentail that there be 10Gbps lines, or better, between all comms rooms/switches in the AIN building.

g. Finishes

i Floor

- A raised floor is not a definitive requirement and shall be determined by assessment of the heat load management strategy. Cabling can be reticulated through the ceiling void via trays at high level.
- The floor finish shall be a light-coloured anti-static vinyl.

ii Walls

- Walls shall be floor to ceiling and acoustically sealed to adjacent substrate on all sides of the room. The Server Room is a potential source of nuisance noise and its construction shall provide adequate acoustic isolation to adjacent spaces.
- Wall surfaces should be durable, easy to clean and low maintenance, painted plasterboard to metal stud partition or similar.

iii Ceiling

- Exposed concrete soffit sealed/ painted white, a false ceiling is not required.

h. Lighting

i Provide lighting over each aisle to minimise shadowing to operatives undertaking works to the servers.

i. Acoustic Considerations

i Perimeter partition construction shall minimise egress if noise from the Server Room to adjacent spaces to an acceptable level.

3.6.24Loading Dock - Functional Description

a. General

i The Loading Dock will facilitate deliveries and collections of equipment, materials and waste from AIN.

b. Location

i The Loading Dock will be located to the eastern end of the site with access from Physics Road via the existing vehicular access ram. The position and configuration of which may be modified to a limited extent for access requirements and to include provision of protection against overland flow from Physics Road. Requirements in this regard are to be specified in the flood study.

ii Vehicular access will be directly adjacent to pedestrian access routes, the configuration of the loading dock and its vehicular access shall provide good visibility for drivers and clear delineation between vehicular and pedestrian zones. A shared vehicular and pedestrian zone is undesirable.

c. Format

i It is envisaged that the Loading Dock will be at grade with a loading dock platform adjacent to the building for vehicles to back up to, to transfer items from truck bed level to grade/ internal floor level. The levels within the loading dock will be graded away from the building to form a basin, which will be designed to contain runoff and emergency storage, in case of downstream blockages within the stormwater network. This storage is proposed for flood management purposes to ensure that water levels in the loading dock remain below building FFLs. This is in addition to requirement for OSD which shall be provided separately.

d. Access

i Storage areas for gas, chemicals, the substation and selected facilities requiring fire brigade access must have direct access to the loading dock.

e. Circulation

i The Loading Dock and it associated vehicular manoeuvring area shall be designed to accommodate a maximum design vehicle size of a 12.5m truck. Whilst the area available is limited, every endeavour shall be made to allow this maximum design vehicle to perform drive in, load/ unload and drive using a maximum three-point turn manoeuvre.

ii Effective segregation of pedestrian and vehicular traffic is essential, shared zones should be avoided wherever practicable.

f. Equipment

i Dock Leveller

- Loading Dock levels will not readily facilitate a traditional loading dock platform. A loading dock platform, scissor lift or similar shall be provided to transfer items from truck bed to grade/ internal floor level.

ii Oversize Items

- Provison for future installation of a lifting beam for hoisting oversize objects, that will not fit into the Goods Lift, to level 2 shall be allowed for. This may comprise a removable section of cladding or similar.

iii Liquid Nitrogen Tank

- A Liquid Nitrogen Tank should be located at an appropriate position adjacent to the loading dock.

iv Storage

- Hazardous Materials Storage – refer to the Appendix P1 Dangerous Goods Storage

g. Waste Management

i Garbage Collection is to occur at the Loading Dock. A central Waste Services garbage room shall be located within 25m of the truck collection point with a flat, or close to, route from the garbage room to the collection point.

ii The garbage room shall be sized to accommodate:

- Two (2) x 660lt bins and;

- Eight (8) x 240lt bins.

iii The Garbage Room shall be located internally with large opening doors from building to truck collection point.

h. Acoustic & Vibration Considerations

i Any critical laboratories adjacent to the loading dock must be suitably isolated to mitigate risks posed by vibration resulting from vehicular movement and associated loading dock activity.

i. Signage

- Appropriate signage should be provided to indicate maximum vehicle sizes, speed limits and any other pertinent vehicular or pedestrian

4. BUILDING OPERATIONAL REQUIREMENTS

4.1 Loading Dock

a. The building shall include one (1) loading dock area for delivery of equipment & materials and for collection of refuse. Detailed requirements for the Loading Dock Area are described in the Functional Descriptions.

b. The Loading Dock shall be located at the eastern end of the site and shall be accessed from Physics Road via the existing vehicular access between A27 and A28.

c. The Loading Dock vehicular manoeuvring area shall comprise an access route large enough to accommodate a delivery/ fire truck up to 12.5 x 2.5m.

d. The Loading Dock shall facilitate the delivery of all goods to a central location from which they can be separated into general, laboratory and dangerous goods and managed appropriately.

e. A holding/ storage areas for deliveries with specialist storage rooms for hazardous materials and dangerous goods, shall be located directly adjacent to the Loading Dock.

f. Selected other facilities including the substation, nitrogen storage tank, chemical stores, gas store rooms and the like should be directly accessible from the Loading Dock to facilitate easy and safe delivery.

4.2 Pedestrian Access

a. Pedestrian access to the site is possible from the north via the existing Physics Building, from the western boundary via the Wesley College car park and from the east via the car park/ loading dock.

b. The gap between the AIN Physics Building and the proposed St. Paul's College development to the south provides the opportunity for east-west pedestrian connectivity between Fisher Road and Western Avenue, such a pathway may facilitate direct access to the upper levels of the building.

c. Appropriate disabled access from car parks to the AIN Physics Building will need to be provided.

4.3 Car Parking/ Bicycle Racks

a. The building shall provide a minimum of eight (8) car parking bays of which one (1) shall be a disabled bay, one shall be a visitor bay, two contractor bays and four for USYD. One (1) bay shall be marked as a loading zone to encourage short term parking.

b. The car park shall be located at the eastern end of the site adjacent to and sharing access with the loading dock. A mirror(s) shall be provided at the car park access to oversee the traffic entering the car park from Physics Road to increase sight lines for vehicles in the car park.

c. Staff and other contractors will need to park elsewhere.

d. Bicycle racks for staff and post-graduate students shall be provided for twenty (20) bicycles in a secure storage area (cage with swipe access, or similar).

e. Additional general access bicycle rails shall be provided adjacent to the building in a suitable location.

4.4 Security

a. General

i Security for the AIN Physics Building will be provided by the UoS CIS Security Service. The design of the security system shall comply with the UoS's Policy and Procedures for Electronic Security Systems. Refer to the following documents for details of the Security Project Brief and Security Installation Requirements:

- Appendix Z: CSU - Security - AIN Project Brief - Performance Requirements
- Appendix Z1: CSU - Security Installation Requirements - SEPT 2012

ii The *Contractor* shall consult CIS Security Service during *Detailed Design*, who will provide a full schedule of the security requirements for each door using standardised UoS equipment.

4.5 Hours of Operation

a. Normal hours of opening for the facility will be 8am to 6pm, Monday to Friday, although selected facilities operate from 8am to 9pm. Entry doors to the facility will be locked after 6pm. Access to the facility after hours will be via access card only, in accordance with security permissions recorded on the card.

b. Many functions and laboratories within the building will operate during extended hours. Zoning of security, services, and support areas will need to reflect the anticipated operating hours of each component of the facility.

4.6 Waste Handling

a. Central waste handling will need to be incorporated within the Loading Dock and Storage Area. This will comprise of:

   i General Waste Collection Area

   ii Hazardous Waste Collection Area

b. Following are recommended processes for the transfer and management of various waste types, in accordance with current University practice:

   i General Waste

   - General waste should be removed from bins throughout the facility by CIS cleaners, bagged, and transported to the General Waste Collection area. Management of waste from restrooms should operate on an exchange system, whereby cleaners deposit a number of full bins, then collect empty bins to replenish the waste receptacles. The General Waste Collection area therefore will require a space for empty bins as well as full.

   ii Recyclable Waste

   - Recent University guidelines require recyclable waste (glass, paper and cardboard) to be separated from general waste at point of source. It is envisaged that paper recycling will occur at desks with other recycling facilities for glass and cardboard provided in the Facilities Room on each level. CIS Cleaners will collect the recycling from the Facilities Room for transport to a central recycling store in the loading dock area.

   iii Hazardous Waste

   - Hazardous waste management will operate on an exchange system, whereby laboratory staff transport a full waste bin of a particular type to the appropriate collection point in the Central Waste Collection area, deposit the full bin as directed, then collect an empty bin of the same type to return to their laboratory. The empty bin area needs to be separated by distance from the full bin area.

   - Hazardous waste will be collected in approved dangerous goods drums available from UoS WH&S, or as supplied in its original packaging. UoS's chemical waste contractor will collect the waste from the chemical waste collection room and remove to an off-site location for disposal. Collection of hazardous waste from the AIN Physics Building should be managed by the University's WHS and Injury Management Office in conjunction with the AIN Waste Manager.

   iv Chemical Waste

   - Research staff will transfer hazardous chemical waste to the central Chemical Waste Collection Area, located within the Loading Dock Area. Chemical waste will be managed by the Waste Manager.

   - The Chemical Waste Collection Area should allow for separation of waste streams, using cabinets to isolate different classes of chemicals in accordance with AS/NZS 2243.10:2004 Safety in laboratories - Storage of chemicals. It is recommended that the design team involve an explosives consultant in the design of the Chemical Waste Collection Area. The Chemical Waste Collection Area will be secured using the AIN electronic access card system.

   v Compressed Gas Cylinders Waste

   - Used compressed gas cylinders shall be transported by AIN laboratory staff to a Gas Cylinder Collection Area within the Loading Dock Storage Area. From here they will be collected by the gas manufacturer. The Gas Cylinder Collection Room will be secured using the AIN's electronic access card system.

4.7 Maintenance

a. Building Fabric

i Routine building maintenance will be performed by CIS, including maintenance of lifts, standard laboratory services, and built-in fixtures such as fume hoods, gas, water, and drainage. CIS will maintain a programme of preventative maintenance provided that all building assets are logged and recorded in accordance with templates and labelling conventions for the USYD ARCHIBUS system available from CIS.

b. External Cleaning

i The *Contractor* shall be cognisant of the current University practices for cleaning of the external envelope of the AIN-Physics Building in which window cleaning is provided by CIS as per their budget allowance, which is currently for windows to be cleaned once per year.

ii Ease of access for window, high level glass and external facade cleaning shall be considered during the design stage. The facade shall be designed to provide good access for window cleaning at all levels.

4.8 Environmentally Sustainable Design (ESD)

4.8.1 University Context

a. The University of Sydney addresses environmental, social, and economic sustainability across a broad spectrum of its academic and administrative departments. Over the last several years, the University has developed a new Sustainability Framework as a commitment to reducing its carbon footprint and to demonstrating its environmental leadership among Australian and international peer research universities.

b. There has been some discussion about a tri-generation plant on campus that may be able to supply the AIN building. Therefore the AIN plant rooms should be designed with sufficient space to allow connection to a remote tri-gen plant as a sustainability initiative in future. Extra plant room space is also desirable wherever possible for future expansion of other facilities.

4.8.2 University of Sydney Sustainability Framework

a. General

i The Sustainability Framework integrates sustainability across masterplans, precinct plans, buildings and social spaces.

ii The School of Physics has great interest in providing the most sustainable design solution for the AIN building. However, great care must be taken to ensure that the performance of research laboratories is not compromised as a result.

iii The preferred approach for the AIN project is to incorporate the Sustainability Framework, which will, in reference to the aims of the framework;

- Ensure the project will address the University's sustainability aspirations
- Provide a decision making process and assurance process around sustainability issues
- Embed sustainability initiatives into the design process
- Ultimately deliver sustainable Campus development for the University
- Sustainability initiatives must not compromise core research activities, which often have tight requirements on environmental controls or large electricity consumption

iv This approach is preferred over industry rating tools, which typically penalise high-consumption environments such as the specialist laboratories within the AIN Physics Building. The Sustainability Framework will link measureable outcomes to sustainability goals and initiatives that can be made specific to the AIN project. This framework will also enable customisation of roadmaps and rating systems, while still allowing comparison against relevant components of other building projects.

v The design approach to sustainability for the AIN Physics Building shall be comprehensive and not limited to architecture and building systems. The University believes that sustainable design should be from first principles, with the intention of providing teaching, research and learning environments that support the cultural and behavioural change required for sustainable and healthy living.

vi The University's Sustainability Framework consists of eight key themes, each with a series of outcomes as detailed below. The *Contractor* shall address the outcomes of the framework using any approach, as it is not a prescriptive tool, but rather sets a performance baseline and provides recommended strategies.

b. Contractor's responsibility

i The *Contractor* shall be responsible for the management and effective application of the Sustainability Framework Tool to the Detailed Design phase and construction phase of the Works.

ii The *Contractor* shall address the eight themes described below and provide regular reporting as to progress with regard to each item as part of the University's Sustainability Framework process.

c. Place Making and Amenity

i The project shall be oriented appropriately to maximise passive design opportunities, including mixed-mode ventilation and day lighting. Acoustic concerns should also be considered, given the site, with respect to proposals for natural or mixed-mode ventilation.

ii The project should consider the pedestrian scale of the campus and interface adequately with the public and campus realm. Consideration should be given to existing buildings, landscape and heritage value in the precinct; the proximity or need to provide connections to adjacent precincts, buildings, transportation networks and pedestrian routes; and the provision of a landmark as part of the project to aid in campus navigation. The design team should address security concerns and 24-hour access.

d. Intellectual Leadership

i The *Contractor* shall consider how the sustainable design attributes of the project can be effectively communicated to the building's occupants, visitors and the wider community.

e. Communication, Engagement and Community Benefit

i The development of the AIN Physics Building shall consider stakeholder – both community and occupant – feedback. The building design should consider how the building operation can be improved and tuned based on occupant feedback. The *Contractor* should also consider how the building's design and performance can be shared with the wider community, either through reporting building performance data or sharing lessons learned with peer laboratories and universities.

ii The design process should provide mechanisms to ensure that the *Contractor*, School of Physics AIN Project User Group (PUG), CIS and consultants are consistently incorporated into the *Detailed Design* and further user engagement process. An overall lifecycle cost evaluation should be made at the strategic and system level to gauge feasibility of any design response.

f. Healthy Environment

i The design of the AIN shall implement best practice design approaches for incorporating good day lighting, glare reduction, and external views into the building. The building should take advantage of the views toward green spaces adjacent to the site, as well as sightlines to other campus landmarks and thoroughfares.

ii The façade design should ensure good thermal comfort and reduced external reflectivity. Air intakes and exhaust locations should be carefully located to ensure good indoor air quality, and will also need to be away from hazardous gasses and scrubber exhausts. Site lighting should respond to existing and planned pedestrian routes, comply with dark sky best practice, and provide consistency with the campus and adjacent city lighting schemes.

g. Resource Use

i The AIN Physics Building will be designed to operate for 100 years, therefore selected systems and materials will need to be robust, adaptable, and low-maintenance.

ii The University recognises that specialist laboratories for the AIN will require large amounts of energy to operate. Thus, the *Contractor* shall propose a comprehensive energy efficiency strategy to focus on overall and peak demand reduction, passive design, efficient equipment and systems, extensive metering and operational efficiency.

iii In addition, the team should consider how the building's loads will fluctuate given existing use patterns in campus lab buildings. The *Contractor* is expected to develop ways to minimise peak loads and to consider ways in which excess electricity can be provided to other buildings on campus.

iv In line with University practice, the consultant team will develop a comprehensive energy model as part of the design process to identify potential energy savings and gauge expected building performance. To further reduce energy use, the design team should consider incorporating adaptive comfort features (e.g. adaptive comfort temperatures and providing a degree of occupant control) where appropriate. Consideration should be given to the contrast between heavily controlled areas, such as labs, and adjacent spaces to ensure a uniformity of comfort expectations.

v A lighting control and building management system should also be included. The design and consultant team should consider approaches to equipment design and selection and how these approaches can be effectively integrated into the design process.

vi The hydraulics systems for the AIN Physics Building should be designed to reduce potable water consumption through efficient tapware, metering of large water loads and laboratories, non-potable water systems and innovation. Additional methods for reducing potable water use in the laboratories should also be examined. At a minimum, the design should include rainwater collection and reuse, but should also consider the larger storm water and irrigation systems in response to the surrounding green spaces within the precinct.

vii The AIN Physics Building should also incorporate a comprehensive waste management strategy appropriate for laboratories, teaching and learning and workspace; from the individual to the larger scale of site-wide collection and hazardous waste disposal.

viii The design and consultant team should consider the implementation of a materials strategy to address indoor environmental quality, end-of-life concerns, recycled content, sustainable harvesting and rapidly renewable materials, and the elimination of toxic and potentially harmful substances from the building's components, finishes, and furnishings.

h. Climate Change Impact and Design

i The University recognises that its buildings must be designed to be flexible and adaptable to respond to changes in the Sydney climate expected in the next 30 to 100 years, based on the design life of the building. The design shall address how the building will contribute to Sydney's heat island effect, respond to increased flood risk where appropriate, provide for comfortable pedestrian access to and through the site, and reasonably accommodate occupants in instances where mechanical ventilation systems may fail to deliver comfort conditions.

ii Consideration should be given to microclimate conditions at the ground plane and the effect of the building on surrounding public spaces through the creation of sun and shade spaces, shelter (wind and rain), calm and active spaces, and spaces that avoid wind funnelling and turbulence.

i. Infrastructure

i The *Contractor* shall consider the AIN Physics Building in the context of the larger physics precinct and identify existing utility infrastructure, including electricity, gas and water that could be expanded or enhanced for the project.

ii Transportation infrastructure shall consider vehicle and pedestrian access —both existing and planned, particularly in regards to linking adjacent buildings in the precinct—and the incorporation of alternative strategies for car parks. 'End of Journey' facilities will be included for use by building occupants, students and visitors.

j. Land use, Landscape and Biodiversity

i The *Contractor* shall identify ways to minimise the impact on the greenfield site. The importance of minimising the indirect land and biodiversity impacts through choice of building materials, equipment efficiency and passive design features are orders of magnitude higher than any of the direct on-site impacts.

ii The site design should enhance biodiversity through a comprehensive landscape design that also balances the need to reduce irrigation water consumption, therefore the inclusion of a 'waterless garden' should be considered. Native plants should be used when possible, however the landscape should also fit within the context of the University campus.