SECTION E.3.2 LIGHTING – TABLE OF CONTENTS

E.3.2 LIGHTING – SCHEDULE OF CHANGES

As a guide only, attention is drawn to changes that have been made in the following clauses since the last revision

Revision	Clause	Date
	General revision	
	E.3.2.2.22	August 2004
4	E.3.2.2.19	November 2004
5	General Revision	February 2014
6	General Revision	April 2018

E.3.2. LIGHTING

E.3.2.1. External Lighting

E.3.2.1.1. General Requirements

External lighting shall provide an elegant, interesting environment at night as well as a safe and secure environment for people to move about.

A design for external lighting shall ensure that the following parameters are met:

- Highlighting building features and entrances
- Provision of appropriate lighting for pedestrian walkways between buildings and car-park facilities.
- Provision for appropriate lighting for Roadways.
- Provide sports lighting to suit night activity specified for the area.
- Compliance with all relevant lighting standards, Work Health and Safety (WHS) Act 2011, and Work Health and Safety Regulation 2011 for NSW.
- Conformity with existing campus installations and control systems.
- Maintainability of the installation.
- Conformity with Campus Security CCTV surveillance system.

The use of light to highlighting of building facades or points of interest may be used for the purpose of:-

- Enhancing the night image of important functional or architectural significance.

a. Providing vertical illuminance in the adjacent area to reduce contrast with the pedestrian lighting and to reduce shadows.

b. Provide visual cues to assist people's orientation at night.

c. Highlighting or decorative lighting shall be designed to avoid excessive energy usage and shall use high efficacy light sources consistent with other external lighting.

d. Where highlighting of buildings does not serve a dual purpose of public lighting, the lighting shall automatically switch off at midnight.

Appropriate lighting for pedestrians shall be provided to ensure their safety and a secure environment.

In the selection of components making up an installation for external lighting the following shall be assessed:

a. Energy efficiency of the light fittings and luminaires.
b. Maintenance of the light fitting including the ease of access and the potential future availability of spare parts.
c. Type of appropriate lamps
d. The method for the control system.

E.3.2.1.2. Lighting Fixtures

Any lighting fixture or luminaire chosen shall be from a well-known manufacturer, preferably made in Australia.

The selection of luminaires shall be based on the following:

a. Optical performance of the fitting,
b. Suitability of the light distribution for the application/task.
c. Vandal resistant
d. UV stability of component
e. Resistant to corrosion
f. Weather proof
g. Easy access for maintenance of lamp
h. Energy management provision and controls

Glare from the fitting shall be carefully controlled for comfort..

The external lighting design shall utilize the building whenever practical for mounting of luminaires. The provision for access and maintenance shall be included in all such designs.

In any installation, the choice and type of luminaire and its location shall be compatible with the Security CCTV Surveillance cameras.

Roadway luminaire shall be used in the entrance to the campus and on roads that are in open areas. Road lighting luminaires shall be full cutoff type.

E.3.2.1.3. Glare Control

Lighting shall generally be designed to minimise glare. Areas should be lit by lighting both the vertical surfaces as well as the horizontal to reduce the contrast with the fittings.

Unless symmetrical distribution flood lights are required for a particular lighting purpose, floodlights for area lighting shall be forward throw or planar types. Fittings shall have a distribution where the peak luminous intensity is offset by a minimum of 45 degrees from

the perpendicular. Fittings shall be mounted with the glass between horizontal and maximum tilt of 5 degrees. If the area cannot be effectively lit without increasing the tilt on the fitting, the mounting height should be increased in preference to increase the tilt.

E.3.2.1.4. Location of Luminaires

Luminaires shall be located for ease of maintenance and within the limits of the WHS requirements of the UNSW. While luminaires should be out of public access, other than sports lighting shall require a standard ladder or bucket truck with a reach of less than 15 metres.

No lighting shall be installed in locations requiring scaffolding, or a bucketing truck with a reach exceeding 15 metres without the prior written approval of the UNSW EM Engineering.

Where the bucket truck is required for maintenance the design shall be co-ordinated to ensure that there is a clear and permanent route with adequate clearance and all-weather load capability for the truck.

E.3.2.1.5. Numbering of Luminaire

All luminaires shall have a discrete number. The number shall conform to the UNSW's numbering protocol. The designer shall contact UNSW EM Engineering during documentation, which will provide the numbers that are to be used on the project. The number shall be indicated on the drawings, adjacent to the fitting symbol. The documents shall also specify that the number is to be permanently and neatly marked on the fitting or pole.

E.3.2.1.6. Residential Colleges

Lighting of the precincts of residential colleges shall maintain the required illumination levels required in Table 3.2.1 however specific care shall be taken to ensure that the lighting does not illuminate bedrooms.

Luminaires should not be mounted on the building structure of the residential colleges.

E.3.2.1.7. Type-of Luminaire

General
As a general principal all external fitting shall:

- Be manufactured from pressure die-cast aluminium or stainless steel.
- Have toughened glass visors or lenses.
- Use stainless steel screws, bolts and clips.
- Screws shall be fit to stainless steel threaded inserts. Threaded aluminium shall not be accepted.

- Trunnions for floodlights shall be either stainless steel or hot dipped galvanized steel.
- Unless otherwise approved external lights shall have an IP rating of IP54 or better.

The types of luminaire, which are to be used with external lighting, are as follows:

Pole Mounted Luminaire
This type of luminaire is mounted on a painted galvanized steel pole. The preferred mounting method is by separate pole bolted to a ragbolt assembly. Alternative mounting method has to be approved by the UNSW to suit the soil conditions. The luminaire shape shall match existing to be approved by UNSW EM Engineering prior to finalise design as conformity with any existing luminaire is crucial for the aesthetic of the campus .. Generally two common type of pole mounted light fittings are in use in most of the new projects in Kensington campus. Unless specified elsewhere, these fittings should be specified in new installation.

Wall Mounted Luminaires
Where area lights are mounted on walls they shall be mounted at the top of the wall or at a height of not more than 15 metres and location that can be readily accessed by a UNSW bucket truck.
Low level wall mounted fittings shall be only be used at building entrances and marker lights. Low level wall lights shall be low glare with low lamp rating.

Bollards
This type of luminaire shall be used to delineate the boundaries of walkways. This luminaire provides a low level of lighting just enough for people to move about. Bollards do not provide the vertical illuminance required for lighting of public spaces. Bollards shall only be used as minor marker lights or in areas where the vertical illuminance is provided by another light source.

Uplighters
These fitting are to be used only after consultation and written approval of UNSW EM Engineering. They are generally used for aesthetic reasons. However, they are inefficient in providing useful illuminance on pathways and create interference with CCTV surveillance system.

Downlights
Downlights used under walkways and balconies shall use either compact fluorescent/metal halide/ LED lamps. The fittings shall have a minimum rating of IP55 for both below and above ceiling.

E.3.2.1.8. Light Sources

Lamps for external lighting luminaire shall be appropriately selected from the following:

LED Lamps
These lamps shall be the preferred source for pole mounted and/or wall mounted flood lighting. They have a good colour rendering. Most of LED lamps are highly efficient and have a long service life. Lumen maintenance is good.

Fluorescent Lamps
Fluorescent lamps are low-pressure mercury discharge lamps, certain type of lamps have an excellent colour rendering (triphosphor type). These lamps have a low luminance source producing low glare and have a very high efficiency. Fluorescent lamps are suitable for many applications such as covered ways, under awnings

Metal Halide Lamps (MH)
These lamps shall be the preferred source for pedestrian lighting. They have an excellent colour rendering. Most of MH lamps are highly efficient and have a long service life. Lumen maintenance is good.

High Pressure Sodium Lamps (HPS)
This type of lamps, where appropriate, shall be used for floodlighting building façade, roadway and in some security applications.
HPS lamps have a high lighting level, long service life and stability of light output. However, the colour rendering is poor

Selection of other light sources in certain selected application shall be approved by UNSW EM Engineering.

E.3.2.1.9. Lighting Levels

The design for external lighting shall comply with the latest edition of Australian Standards, including AS1158.3.1,.

The recommended lighting level (average horizontal illuminance) shall be as follows:

Area	Min. Average Illuminance (Lux)	Minimum Illuminance (Lux) at any Location
Service roads	10	4
Entrance and nodes	35	17
Shared zones and formal Walks	10	5
Steps	10	5
Informal walk	5	2
Covered lighted Ways	10-25	8

Table 3.2.1

It has to be noted that for compatibility with the CCTV Surveillance Cameras, lighting should be as uniform as possible to comply with the latest Australian Standards with maintained vertical illuminance. For CCTV Surveillance operation, a minimum of P1 classification of 2 lux vertical illuminance shall be maintained.

No area is to be lit to a standard less than P3.

Consultant is required to confirm in writing with UNSW EM Engineering for the lighting category for each area during the concept design stage.

E.3.2.1.10. Control System

The UNSW has a central lighting control system for external lighting which will control all light fittings that provide lighting for pedestrians. This system shall be controlled via the External Lighting Automatic Control. This shall be part of the whole Campus Building Automation and Control System (refer to **UNSW Design Guideline Appendix 1 - Automation and Control Systems Rev 6**).

Where external lighting is to be installed in an area that is controlled by BACnet system the new circuits shall be connected to the system.

Where there is no BACnet node for the control of the new external lighting an additional node shall be installed as part of the project.

The lighting circuits shall be configured so that two levels of illumination can be selected.

Lighting of paths, roads and general safe movement lighting shall not be connected to the same control circuits as decorative lighting. Landscape lighting, façade lighting and decorative lighting shall have individual control circuits.

Where decorative lighting is to be installed and the current BACnet control only has pedestrian lighting control the new lighting shall be run back to the BACnet controller as a separate circuit so that it can be reconnected should the controller capacity be increased in the future.

Flood lights which are installed in buildings, under soffits, etc. and are part of the external lighting system shall be connected to the BACnet system.

If it is decided by the UNSW EM Engineering that it is impractical to use BACnet in a specific area, the circuits shall still be configured for BACnet, however the circuits shall be controlled by a combination of photoelectric switch and time switch operating contactors.

Where both, photoelectric cells and time switches are used in combination, the switches shall be configured so that the lighting is switched on by the photoelectric switch and if the light is not required to operate until dawn, then this is switched off by the time switch. The circuit shall be configured so that the photoelectric switch does not switch the power to the time switch. Timers shall be 7-day digital clocks with a minimum of 100 hours Nickel-Cadmium or Metal-Hydride battery back-up.

E.3.2.1.11. Connection of Control System

The distribution board for the control system for all external lighting in any building shall be located at the main switchboard for that building.

E.3.2.1.12. Environment, Trees and CCTV

Where required for security and/or practical consideration, planting including trees shrubs etc… shall be kept pruned regularly so as not to impair the effectiveness of campus external lighting

As with other visual task, external lighting for security is a complex requirement

Refer: Section B - PLANNING CONTROLS - Crime Prevention Through Environmental Design (CPED Principles)

Lighting for Security CCTV Surveillance Cameras shall be a minimum of P1 classification as stated in the AS1158.3.1. In addition lighting shall be located with respect to the camera so that the light does not represent a glare source nor significantly alter the exposure level of the camera.

E.3.2.2. Internal Lighting

E.3.2.2.1. Scope

This document outlines the UNSW's minimum requirements for:

a) The extent and quality of lighting that is to be provided in each space

b) The quality of the lighting equipment to be used

c) The energy efficiency of the installation

d) Lighting control

The requirements shall apply to all new, refurbished and modified installations on UNSW property.

E.3.2.2.2. Verification

As part of the design and installation process the following verification shall be provided throughout the various stages of the project:

E.3.2.2.3. Design verification

The consultant, designer or design and construct contractor shall document the equipment and control that will be provided, prior to construction commencement and submit a *statement of design compliance* to the UNSW EM Engineering stating that the documents comply with these requirements. If there are any deviations from these requirements they shall be attached as a schedule listing how it does not comply, and the extent of the non-compliance. The written approval by the UNSW EM Engineering for each non-compliance, shall be attached to the schedule prior to any proposed departures being implemented

E.3.2.2.4. Construction Verification

The Builder or Design and Construct Contractor shall provide a *statement of specification compliance* stating that the specified equipment is to be installed. If approved deviations are proposed, the statement must clearly identify each deviation and be accompanied with evidence that UNSW EM Engineering approval has been given. Deviations without approval will not be accepted. Equipment that is installed contrary to the statement of specification compliance shall be replaced, within 12 weeks of notification, at no cost to the UNSW.

E.3.2.2.5. Installation Verification

At the completion of the installation, and before payment is made the Consultant or Design and Construct Contractor shall provide a *statement of installation compliance* stating that the specified equipment and approved variations (if any) has been installed.

E.3.2.2.6. General Requirements

The lighting design shall meet all the applicable requirements of the Building Code of Australia and other statutory requirements.

The lighting design shall provide the visual conditions required for the task with minimal energy usage and without excessive maintenance. The lighting design shall meet the qualitative and quantitative recommendations of AS1680 Interior lighting code.

The following specification sets out the minimum requirements for the design of interior lighting within the UNSW. Deviations will only be allowed in circumstances where the specific function of the building requires an exceptional lighting solution.

Before any deviations from these requirements are incorporated into the documentation or installed, written approval is required from the UNSW EM Engineering.

Requests for a departure or variations of the requirements shall be in writing and provide the following information:

- The nature of the proposed departure or relaxation of the requirements
- The extent that it applies to the project
- An assessment of the impact to long-term energy consumption and maintenance
- The reason the proposed departure or relaxation of the requirements is required.

E.3.2.2.7. Light Sources

The UNSW's preferred light source is LED and T5 fluorescent lamp.
LED or T5 fluorescent light sources shall be used for all internal applications except in the following situations:

- LED and Metal Halide luminaires to be used in areas with high ceilings or where high illuminance is required
- Where strong directional lighting is specified
- Downlights and Wallwash luminaires may be fluorescent, metal halide or LED depending on the lighting function required
- Display lighting

In most situations where dimming is required it is only required to dim to 10% output. In these situations, fluorescent lamps with dimmable electronic ballasts shall be used.

Where the function of the space requires uniform dimming to and from extinction (e.g. a performance auditorium) LED lighting may be used.

E.3.2.2.8. Luminaires

Luminaires shall be high efficiency, quality luminaires with the following minimum performance:

Luminaire type	Minimum Light Output Ratio	Minimum Downward Light Output Ratio
Surface Mounted Linear Fluorescent	0.82	0.72
Recessed Linear Fluorescent - Prismatic	0.80	0.80
Recessed Linear Fluorescent – Low Brightness	0.65	0.65
Recessed Linear Fluorescent – Suspended Fittings	0.65	0.45
Recessed Compact Fluorescent	0.45	0.45
Wall Wash fittings	0.4	0.4
Recessed Metal Halide	0.55	0.55
High Bay Luminaires	0.8	0.75
Low Bay Luminaires	0.75	0.7

Table 3.2.2 Minimum Light Output Ratios

Where a fitting is built into an enclosure, the light output ratio for comparison with the table above shall be adjusted to include the effect of the enclosure as well as the luminaire.

E.3.2.2.9. Low voltage and mains voltage tungsten halogen fittings

Low voltage (and extra low voltage normally referred to as low voltage) and 240 Volt tungsten halogen fittings, including spotlights, downlights and directional downlights may be used where there is the need to highlight specific objects or areas, or to create a special lighting effect.

Tungsten halogen lamps are not to be used for general illumination unless there is a specific requirement in the brief to dim to extinction, or for display lighting. Tungsten halogen fittings are not to be on the same circuit as other light sources.

All circuits with tungsten halogen fittings shall have a dimmer with a soft start and an upper limit set to 85% of mains voltage.

Tungsten halogen fittings shall be provided with UV shields and glass covers unless low pressure, UV-stop lamps are used.

Dichroic lamps shall be minimum 5000-hour rated life and be manufactured and branded as one of the following brands:

- BLV
- GE
- Osram
- Philips
- Sylvania

Luminaires for low voltage tungsten halogen shall be manufactured with a heat sink area to remove the heat from the back of the lamp. The heatsink shall be made of cast aluminium and shall have minimum overall dimensions equivalent to 50mm diameter and 20mm deep.

E.3.2.2.10. Glare Control

Luminaires shall be selected to achieve the appropriate glare control specified in Table 3.2.6, while still illuminating the vertical surfaces. Supplementary lighting in the form of wall washing should be used to reduce gloom rather than increasing the illumination over the entire area.

Glare control shall be achieved by reflector and refractor design rather than methods that significantly reduce the light output of the luminaire.

Low brightness fittings shall use semi-specular, high purity aluminium reflectors

Prismatic fittings shall combine an acrylic extruded of injection moulded lens panel of K12 or K19 pattern, with a high reflectance internal reflector.

“Soft tone” luminaires maybe used provided that they achieve the required light output and glare control

Eggcrate and silvertint refractor panels are not acceptable.

The Glare Index values specified in Table 3.2.6 shall be calculated as specified in AS1680.1 Internal Lighting Part 1: General principles and recommendations. The reference points for calculation shall be confined to locations where students or staff are reasonably expected to be located to undertake the task required in the room. The glare will not be calculated for lecterns, daises or positions where lecturers or performers normally occupy.

E.3.2.2.11. DALI Control Gear

Electronic DALI control gear shall be used for all LED, linear fluorescent lamps and compact fluorescent lamps greater than 11 Watts. Electronic ballasts shall have the following characteristics:

a. Warm or soft start period of > 0.8 seconds
b. Power factor > 0.95
c. Switch off of defective lamps and automatic restart after lamp replacement
d. Internal overvoltage protection
e. Dimming electronic ballasts shall only be used where dimming is required.

Electronic Ballasts shall be limited to the following brands:

a. Helvar
b. Osram
c. Philips
d. Tridonic-Atco
e. Vossloh-Schwebe

Conventional copper iron ballasts shall only be used where a specific luminaire is required that is only available with a conventional ballast or for high-pressure discharge lamps. All conventional ballasts shall be low loss.

The maximum power consumption and losses for ballasts are listed in Table 3.2.3

Lamp controlled	Circuit power consumption at rated lamp flux
Electronic	
Linear Fluorescent	
T5 Lamps	
14 Watt	17 W
2 x 14 Watt	33 W
28 Watt	33 W
2 x 28 Watt	63 W
28 Watt	33 W
2 x 28 Watt	63 W
Conventional Ballasts	Hot Water Loss
Compact Fluorescent	
<18W	3.5W
18W	6W
>18W	5.5W

Metal Halide	
35W	9W
70W	14W
150W	20W
175W	16W
250W	20W

Table 3.2.3 Maximum Control Gear Losses

E.3.2.2.12. Quality of Luminaires

All luminaires shall be good quality fittings with good quality control gear and fittings designed for a minimum life of 20 years.

All luminaires shall comply with the following standards

- AS/NZS 60698.1 – 2001 Luminaires – General requirements and tests
- AS/NZS 60698.2 – 1998 Luminaires – Particular requirements – Fixed general purpose luminaires
- AS/NZS 4251 and 4252 Electromagnetic compatibility.

Fittings used in damp or aggressive environments shall be manufactured of non-corrosive material, UV stabilised with an IP Rating appropriate for the area. All fittings used in external environments shall have a minimum rating of IP54, above and below the ceiling.

E.3.2.2.13. Preselection of Luminaires

The UNSW has preselected luminaires for the common types of luminaires used throughout the UNSW's facilities. The luminaires covered by the preselection process are:

- Surface mounted linear fluorescent luminaires
- Recessed, linear fluorescent fittings with refractive diffuser for T-bar and plasterboard ceilings.
- Recessed linear fluorescent fittings with semi-specular low brightness reflectors for T-bar and plasterboard ceilings

The preselected luminaires are listed by brand and catalogue number in the Schedule of Preselected luminaires available from the UNSW EM Engineering. There are multiple fittings listed in each category. The UNSW has no preference for any fitting and the designer may select any appropriate fitting from the Schedule. The Electrical Contractor must install the luminaire selected by the designer

E.3.2.2.14. General Luminaire Quality

Luminaire bodies shall be fabricated form zinc coat steel or pressure diecast aluminium.

Sheet steel bodies shall be folded to give rigidity. Ends shall be folded to give a minimum overlap of 20mm and shall be either spot or seam, welded. The body shall be formed to exclude light leaks. All edges of all openings of the fittings shall be folded. Corners of the trim that are visible shall have mitred joints that are seam welded or fabricated in a manner that the joint cannot open or move out of alignment.

Luminaires shall either have a minimum thickness of 1.0mm or shall be double folded and ribbed to achieve rigidity.

The fittings shall not have more than 12 holes in the back of the body.

Following fabrication, the fitting shall be degreased and powder coated inside and out. The inside of all fittings shall be white.

Fittings fabricated from pre-painted sheet will not be accepted. The powder-coat finish shall have a minimum thickness of 100µM. The inside surfaces shall have a minimum thickness of 80µM and reflector surfaces, 100µM.

E.3.2.2.15. Surface mounted Luminaires with wraparound prismatic diffuser.

The fitting shall be provided with a purpose made prismatic wraparound refractor panel of minimum 2.5mm thick acrylic. The base of the refractor shall be K12 or K19 pattern prisms and the sides shall be horizontally reeded. Of the refractor is injection moulded the side panels can be prisms.

The refractor panel shall held in place by clips or springs. Fittings that rely on the end caps for retaining the refractor will not be accepted.

E.3.2.2.16. Recessed luminaire with prismatic refractor panel

The fitting shall have a lay in prismatic refractor panel. The panel shall be a clear acrylic with a minimum thickness of 2.8mm. The panel shall be a K12 or K19 panel. The fitting shall be constructed so that the fitting returns an all sides behind the T-bar so that the refractor panel is fully supported by the fitting body and not the T-bar lip. Recessed fittings shall be provided with a 1.5-metre lead and three-pin plug.

Fittings designed for installation in plasterboard ceilings shall provide uniform pressure between the trim and the ceiling so that there is no sagging or gaps.

E.3.2.2.17. Recessed luminaire with semi specular reflector

The fittings shall have a specially designed semi specular reflector to provide a batwing type distribution while achieving a cut off above 35 degrees. The reflector and cross blades shall be fabricated from min 0.5mm high purity anodised aluminum manufactured specifically for luminaire reflectors by Alanod. The aluminum shall have the following minimum requirements:

- Purity >99.8%
- Total reflectivity >84%
- Diffuse reflectivity <70%, > 64%
- Anodising thickness >2.5μm
- Low iridescence when used with triphosphor lamps

The reflector and cross blades shall be designed so that there is no visible image of the lamp in the reflector when viewed above the shielding angle

E.3.2.2.18. Decorative Fittings

The use of decorative fittings will be limited to the following areas:

- Building entrance lobbies
- Foyers of auditoria or primary lecture theatres
- Board Rooms

All decorative fittings shall use lamps with a minimum efficacy of 65 Lumens per Watt, where the Watts are the circuit input watts Decorative fittings shall have a minimum light output ratio of 0.45 and be designed so that the fitting does not collect dirt and insects on the inside of the diffuser Fittings must be proprietary fittings from published catalogues. Specially designed and manufactured fittings shall not be used.

E.3.2.2.19. Illuminance

Lighting levels shall be designed to achieve the illumination levels specified in Table 3.2.6.

There is a strong preference for direct illumination. However, an upward component may be used to improve the appearance of a space and to reduce gloom. In these circumstances, the total upward flux shall not exceed 20% of the downward luminous flux in a room. In any case up lighting should be avoided in areas with ceiling reflectance of less than 70%.

In spaces with large windows or where there is a potential for sky glare, measures should be taken to reduce the transmission of the glass and the direct penetration of sunlight. Vertical surfaces of the rooms should be specifically lit in preference to increasing the general illumination in the space to compensate for external glare sources. The room layout shall be arranged to minimise the effect of window glare.

Designers shall use the following light loss factors in their calculations:

Luminaire Type	Light Loss Factor
Recessed Fluorescent	0.75
Surface Mounted Fluorescent	0.7
Downlights	0.7

Table 3.2.4 Design Light Loss Factors

Lighting designs should be based on the best information available. Lighting designs must be based on the photometric data for the specific luminaire and lamp combination proposed and reflectance of room surfaces based on the actual colours proposed.

Irrespective of the room colours used, the reflectance used in the calculations shall not be higher than the following unless approved by the UNSW:

Space	Maximum ceiling reflectance	Maximum wall reflectance	Maximum floor reflectance
Computer Laboratories	0.75	0.6	0.1
Meeting Rooms	0.75	0.6	0.1
Offices	0.75	0.6	0.1
Auditoria and Lecture Theatres	0.5	0.3	0.1
Lecture Rooms	0.75	0.6	0.1
Laboratories	0.75	0.6	0.1
Workshops and Plant Rooms	0.5	0.5	0.1

Table 3.2.5 Maximum Design Reflectance

E.3.2.2.20. Avoid over-illumination

The lighting design shall avoid under or over-illuminance. While it is acknowledged that physical limitations require some tolerance in illuminance, excessive over-illuminance is not acceptable.

The acceptable range for the average illuminance in a space, after compensation for the light loss factor, is –5%, +10% or the minimum number of additional lights that can be added within the limitations of the luminaire layout, whichever is the lesser.

Where a relatively small portion of the space has higher illumination requirements, task lighting should be used rather than increasing the general illumination of the space.

E.3.2.2.21. Lighting Control

Building Lighting Control System

The work shall include design, supply, installation & commissioning of automated Building Lighting Control System.

The Building Lighting Control System is employed to maximise energy saving from the building lighting system, satisfying codes and comply with green building and energy conservation programs. The Building Lighting Control System shall be connected directly through the V-LAN 350 communication network and the Dynalite server to the Campus Building Automation Control Systems (CBACS) – refer to **UNSW Design Guideline Appendix 1 - Automation and Control Systems Rev 6** for details.

The new Building Lighting Control System shall generally compatible with the existing campus Dynalite Lighting Control System.

Motion Detection

Spaces indicated in Table 3.2.6 as requiring “Motion” detection, shall be fitted with a passive infrared, ultrasonic or microwave detector. The type of detector shall be selected to suit the space and application, in accordance with the following specifications.

The detectors shall be a stand-alone, mains voltage unit designed specifically for the switching of lighting. The contacts in the detector shall either be rated to switch the inductive load connected, or the detector shall control a contactor rated for its duty.

The detector shall cover all locations where people may normally be expected to occupy. Additional detectors are to be provided where the room shape or obstructions will restrict the coverage of the detector.

High Level Interface to motion detection sensors shall be via BACnet or approved HLI. Refer to **UNSW Design Guideline Appendix 1 - Automation and Control Systems Rev 6** for occupancy control details.

The selection of detector types shall be based on the cost of the detectors and the coverage achieved.

Where ultrasonic and microwave detectors are to be used in laboratories the designer will check that the operating frequency of the emissions will not affect the laboratories function.

The detectors shall be as follows:

Passive infra-red

To be used in small rooms and rooms that are subdivided with obstructions.

The detectors shall be selected based on the design range of the detector. Where a space requires more than three detectors to cover an open area a unit with a larger range should be specified.

PIR detectors should not be used in areas with areas of rapidly changing temperature.

Detectors may be ceiling mounted or corner mounted to achieve the best coverage of the room.

The location of the detectors should take into account permanent obstructions.

The detector shall be located so that it is not triggered by external activities

The detector shall have a switch off delay between 15 and 25 minutes. If the delay is adjustable it shall not be able to be adjusted above 30 minutes.

The detector shall have a photoelectric switch incorporated into the sensor. The photoelectric switch shall switch off the lights when the illumination level exceeds a predetermined level. The level shall be adjustable between 50 and 2000 lux.

If the delay time is not adjustable there shall be a walk test setting with a rapid reset.

Ultrasonic detectors

Ultrasonic detectors shall be used in rooms that are of sufficient size to require more than three PIR detectors. They shall also be used in rooms with extensive divisions and obstructions. In some circumstances the ability for an ultrasonic detector to monitor the space immediately behind it will improve the coverage.

Ultrasonic detectors shall not be installed adjacent to air conditioning registers or in areas subjected to air movement or moving objects such as machines or ceiling fans.

- The detector shall be located so that it is not triggered by external activities
- The detectors shall have adjustable sensitivity in the on and off mode.
- The detector shall have a switch off delay between 15 and 25 minutes.
- If the delay is adjustable it shall not be able to be adjusted above 30 minutes.
- The detector shall have a photoelectric switch incorporated into the sensor. The photoelectric switch shall switch off the lights when the illumination level exceeds a predetermined level. The level shall be adjustable between 50 and 2000 lux.

Wide and narrow distributions shall be provided to suit special requirements of the room.

Microwave detectors

Microwave detectors to be used in large areas (typically detection distances between 15 and 60 metres) and areas medium areas with high air movement

The detector shall be located so that it is not triggered by external activities including transmission

The detectors shall have adjustable sensitivity in the on and off mode.

The detector shall have a switch off delay between 15 and 25 minutes.

If the delay is adjustable it shall not be able to be adjusted above 30 minutes.

The detector shall have a photoelectric switch incorporated into the sensor. The photoelectric switch shall switch off the lights when the illumination level exceeds a predetermined level. The level shall be adjustable between 50 and 2000 lux.

Wide and narrow distributions shall be provided to suit the special requirements of the room.

Microwave detectors should not be used in areas where the frequency of the emission may interfere with equipment in laboratories.

Microwave detectors should not be used in areas with lightweight walls or large expanses of glass as they can detect outside the area.

E.3.2.2.22. Switching

Irrespective of the presence of motion detection all rooms shall be fitted with switches at the door. Where a room is larger than 40m^2 the switching shall be subdivided so that there is no area >50m^2 per switch.

All switches shall be designed to switch inductive loads and shall switch no more than 70% of their rated current.

Consultation with the UNSW Facilities Project Manager is required prior to selection of light switches as some switches installed on campus have exhibited undue carbonizing and arcing resulting in minor electric shock when operated. Assurance must be given that the operating mechanism is robust enough to prevent arcing and carbonizing.

In lecture theatres and spaces that are likely to be blacked out, the switches are to be fitted with integral neon indicators or LEDs that illuminate when the switch is in the off position.

Separate lighting circuits and controls, including dimmer channels, shall be provided for all supplementary lighting schemes including demonstration areas, bio box, dais lighting and wall washing.

E.3.2.2.23. Multifunction Spaces

Where the multiple functions of a space require several lighting systems superimposed, the control shall be mutually exclusive so that only one system can be used at a time.

Lighting controls shall be clearly labelled to indicate the lighting function of each control. i.e. House Lights, Exam lights, Lectern lights.

E.3.2.2.24. Dimming

Where dimming is required, the dimming shall be provided by centralised dimmer units in bundles of 4 or 12 dimmer channels of a rating to suit the loads. All dimmers controlling the one space shall be linked by a common control network. The dimmers shall be capable of a minimum of 4 programmed preset levels. The dimmer shall have a self-monitoring function for the activation of the emergency lighting in the case of dimmer failure. After re-energisation the dimmers shall revert to the levels prior to disconnection.

Dimming that is not required to dim below 10% of input voltage, shall use fluorescent fittings with dimmable electronic ballasts.

Dimming systems in auditoriums shall be operated by the local control network and DMX protocols.

The dimmer system shall have the following features:

Capability of controlling fluorescent, low voltage tungsten halogen and incandescent loads

Control of the output voltage of the dimmer to a maximum of 240 volts

E.3.2.2.25. Integration

Where required, integrate the lighting controls with other services:

Interface with UNSW Cardex Security Services (refer Section B - Security) or Building Automation and Control System (BACS) to allow for programmable time of day operation (enabling room controls within defined time periods).

Lighting control systems shall be stand-alone systems with programming and presets being set and stored at the local level. Interface with the security and BACS systems shall be limited to the remote control of off and on commands and where required, selection of presets.

E.3.2.2.26. Daylight integration

Automatic integration of artificial lighting, using dimming or multilevel switching, shall only be used in spaces with skylights or windows on opposite sides of the room. The consultant shall demonstrate to the Project Officer the projected payback for the system and the sensitivity of the result to the accuracy of the daylight prediction, before the scheme is included in the project.

E.3.2.2.27. Scheduling of Lighting Controls

Where multi-channel dimmers are used, the output circuits shall be included on the switchboard schedules as if they were circuits on the distribution board.

E.3.2.2.28. Installation

Where luminaires are mounted greater than 3.5-metres above the ground, or above an uneven floor or above fixed furniture or equipment, the design shall specify the method of lamp replacement. The method must be safe and efficient, not require the use of scaffolding or more than two people, and be in accordance with WHS requirements

Table 3.2.6
Schedule of Lighting Requirements

Space	Area	Types of Luminaire	Designed Maintained Illuminance	Uniformity	Glare	Dimming	Maximum Power Density	Control	Notes
Computer Laboratories		Recessed Fluorescent with glare control	N/A	N/A	N/A	N/A	9 overall		
Background			80	0.5	19	No	4	PIR or US	
Workstations			320	0.6	N/A	no	N/A	Pir or Us	
Meeting Rooms									
Conference and committee Rooms	<50m^2		320	0.5	19	>10%	10	PIR	
	>50m^2		320	0.5	19	>10%	9	PIR or US	
General meeting rooms	<50m^2	Enclosed fluorescent Recessed fluorescent	320	0.5	19	>10%	10	PIR	
	>50m^2	Enclosed fluorescent Recessed fluorescent	320	0.5	19	>10%	8	PIR or US	
Offices									
Executive			320	0.5	19	No	10	PIR	
General	<50m^2	Enclosed	320	0.5	19	No	10 Overall	PIR	

Space	Area	Types of Luminaire	Designed Maintained Illuminance	Uniformity	Glare	Dimming	Maximum Power Density	Control	Notes
offices and academic rooms		fluorescent Recessed fluorescent							
Background			80	0.5	19	No	4	PIR	
Workstations			320	0.6	N/A	No	N/A	PIR	
General offices and academic rooms	>50m^2	Enclosed fluorescent Recessed fluorescent	320	0.5	19	No	8	PIR or US	
Background			80	0.5	19	No	4	PIR or US	
Workstations			320	0.6	N/A	No	N/A	PIR or US	
Corridors									
		Main entries and thoroughfares	160	0.4	22	No	6	PIR, US or Micro	
		Enclosed fluorescent Recessed fluorescent	80	0.4	22	No	4	PIR, US or Micro	
Lecture Rooms									
Auditoria and Lecture Theatres – raked floor									
General Lighting			320	0.4	19	>10%	12	PIR, US or Micro	
Performance Venue (seating area)			160	0.4	19	>0%	25	PIR, US or Micro	
Supplementa			500	N/A	N/A	>0%	N/A	PIR, US	

Space	Area	Types of Luminaire	Designed Maintained Illuminance	Uniformity	Glare	Dimming	Maximum Power Density	Control	Notes
ry lighting for bench or dias								or Micro	
Lectern Lighting			100	N/A	N/A	>20%	N/A	PIR, US or Micro	
Lecture rooms and tutorial rooms - with audio visual provisions									
General lighting	>50m^2	Enclosed fluorescent Recessed fluorescent	320	0.5	19	>10%	9	PIR, US or Micro	
Supplementary lighting for bench or dias			500	N/A	N/A	>0%	N/A	PIR, US or Micro	
General lighting	>50m^2	Enclosed fluorescent Recessed fluorescent	320	0.5	19	>10%	10	PIR	
Lecture rooms and tutorial rooms – without audio visual provisions									
General lighting	>50m^2	Enclosed fluorescent Recessed fluorescent	320	0.5	19	No	9	PIR, US or Micro	
Supplementary lighting for bench or dias			500	N/A	N/A	No	N/A	PIR, US or Micro	
General lighting	>50m^2	Enclosed fluorescent Recessed	320	0.5	19	No	10	PIR	

Space	Area	Types of Luminaire	Designed Maintained Illuminance	Uniformity	Glare	Dimming	Maximum Power Density	Control	Notes
		fluorescent							
Laboratories									
Practical Work Rooms (Teaching Laboratories)									
General lighting	>50m^2	Enclosed fluorescent Recessed fluorescent	320	0.5	19	No	12	PIR, US or Micro	
General lighting	<50m^2	Enclosed fluorescent Recessed fluorescent	320	0.5	19	No	12	PIR	
Research Laboratories									
General lighting	>50m^2	Enclosed fluorescent Recessed fluorescent	320	0.5	19	No Note 1	12	PIR, US or Micro	
General lighting	<50m^2	Enclosed fluorescent Recessed fluorescent	320	0.5	19	No Note 1	12	PIR	
Workshops and Plantrooms									
Plantrooms		Dependent on environment	240	0.5	28	No	8	PIR, US or Micro	
Workshops									

Space	Area	Types of Luminaire	Designed Maintained Illuminance	Uniformity	Glare	Dimming	Maximum Power Density	Control	Notes
General		Dependent on environment	240	0.5	22	No	8	PIR, US or Micro	
Workbench		Dependent on environment	To suit task	N/A	N/A	No	N/A	N/A	

Notes
1 Dimming may be used where it is a particular requirement of the research being carried out in the space.

2 Operating and clinical areas shall comply with the recommendations of AS1680.2.5 - Interior Lighting Part 2.5 Hospital and medical tasks

3 Lighting in workshops and production related areas shall comply with the recommendations of AS 1680.2.4 Interior Lighting Part 2.4 Industrial tasks and processes

Designs should comply with the requirements of AS/NZS 2982.1 Laboratory design and construction - General requirements

PIR = Passive infrared occupancy sensor
US = Ultrasonic occupancy sensor
Micro = Microwave occupancy Sensor
N/A = not applicable or no additional requirement

E.3.2.3. Emergency Lighting

E3.2.3.1 General Requirements

Emergency and exit lighting shall be provided with sufficient numbers throughout the building to comply with:

1. Building Code of Australia,
2. Australian Standards (latest edition) and
3. UNSW site Specific Requirements.

UNSW Site Specific Requirements

A design of the emergency lighting system shall also to ensure that the following site-specific parameters are met:

1. Emergency lighting shall be fully compatible with the existing campus wide remote monitoring and testing system i.e. FAMCO Master Minder remote monitoring system.
2. Local Manual/Auto/test facilities completed with a 90-minute time clock shall be provided for local manual testing.
3. Emergency and exit lights shall be addressable, monitored single point luminaires, incorporating with power line carrier controls and complete with associated network devices of FMX series light fittings by FAMCO.

E3.2.3. Remote Monitoring System

The UNSW has a central emergency lighting monitoring system which will be eventually monitoring all emergency and exit light fittings within the campus.

Generally, the campus wide monitoring and testing system is consisted of the following:

- A “front-end” central PC computer located at UNSW EM Engineering office at F23 Mathews Building is dedicated for the monitoring of the campus wide emergency and exit lighting system. This computer is in operation and it will provide access to individual building to be monitored.
- Each monitored building shall consist of Supervising Control Unit (SCU) and network interface unit (Lantronix devices) in a lockable wall mounted enclosure completed with a double GPO and an RJ45 socket for connection to the UNSW communication network.
- Intelligent Transponder Units (ITUs) strategically located in electrical distribution switchboards to service each section of the building.
- All internal interconnection communication cables between ITUs and SCU shall be “Yellow” colour Cat5E shielded communication cables.

Note that: - In addition to the remote monitoring system, a manual over-ride by-pass key switch completed with 90 minutes timer shall also be provided in each electrical distribution switchboard where emergency and exit lights are connected.

Where new emergency lighting system is to be installed in an area that is controlled by Remote Monitoring system the new light fittings shall be connected back to the monitoring system.

Where there is no Remote Monitoring System is located within the building a new remote monitored emergency lighting system shall be installed as part of the project.

Details of networking requirements to be discussed with the UNSW EM Engineering. The whole emergency lighting system shall be fully commissioned, updating existing computer system in UNSW EM Engineering office at F23 Mathews Building this shall be undertaken prior to final commissioning

E.3.2.3.3 Connection of Remote Monitoring Communication

New emergency lighting system shall be connected back to the “front-end” monitoring PC located at UNSW EM Engineering office at F23 Mathews Building. Completed system shall be fully tested from the “front-end” monitoring PC.

For connection to remote monitoring, coordinate and arrange with UNSW communication group for access, allocation of IP port number and connection to campus wide network.

E.3.2.3.4 Emergency Lighting System – Database

All new installation and modification to existing system details shall be programmed and added to the existing database at the “front-end” PC computer.

E.3.2.3.5 Commissioning

On completion of the installation, engage and pay all charges to C.V.G. Lighting Pty Ltd (Telephone No. (02)9708-4455) to commission and update database of the FAMCO emergency and exit lighting system.