Aston University
Birmingham

Estates & Capital Developments

GENERAL ELECTRICAL SPECIFICATION

ECD-PO-370-02-13

Revised: APRIL 2015

[Issue No 6]

Table of Amendments

ISSUE NO	DATE REVISED	ITEMS CHANGED
1.		Original document
2.	January 2013	Update to BS 7671 17th Edition
3.	May 2013	Complete review and update
4.	March 2014	Fire Alarm, Data and Lighting update.
5.	September 2014	General update.
6.	April 2015	17th Edition Amendment 3 update + general update.

NOTE:

This Policy does not contain details on Electrical Appliance 'PAT' Testing. Please refer to Policy ECD-HS-PO-412-12-13 'Code of Practice for In-Service Inspection and Testing of Electrical Equipment
Including PAT (Portable Appliance Testing)'

Contents

NOTE:-
TWIN & EARTH TYPE CABLING IS NOT PERMITTED ON SITE.
ALL INTERNAL CABLING TO BE BASEC LSZH APPROVED.

NOTE:-
ALL ELECTRICAL WORKS (EIC, MEIW, EICR) SHALL BE UPLOADED TO THE 'GUARDIAN TRAQIT' WEBSITE

SECTION 1 - General Requirements

1.01 General

The Electrical Contractor shall be advised to take note of the following:-

i. He shall take into consideration that within existing, operational buildings, the department may have to remain in operation throughout the duration of the works and he shall allow for restricted working conditions and ensure the safety of all occupants as a paramount consideration.

ii. Consultations with stakeholders are essential to ensure smooth running of the University whilst the contract is in progress.

iii. All main changeovers and isolations shall be carried out during periods when it will cause minimal inconvenience to occupants/building users. Any and all changeovers and isolations shall be bought to the Electrical Engineers/ Engineering Supervisors attention a minimum of 14 days prior to the required shut down date.

iv. All portable electrical tools and leads used by the contractor to complete the works shall have been PAT tested to current IEE recommendations and shall be in full accordance with the University's Health & Safety Policies. The University reserves the right to request copies of current certificates for any electrical tool or lead.

v. Fixing to the building structure using wood plugs is not permitted.

vi. Fixings to brickwork mortar courses is not permitted.

vii. The use of University skips to deposit rubbish or debris is not permitted (see Skip Replacement Policy).

viii. Final payment shall only be made when all Minor Works, Completion Certificates, Periodic Inspection Reports schedules of inspection and schedules of test results, and all other associated Commissioning Certificates and any other relevant documentation have been received and that the works are acceptable to the University.

ix. The Supervising Officer has the power to require the Electrical Contractor to remove any of his employees from the University boundaries who are in breach of any Health & Safety Regulations.

x. All operatives working on site must be inducted.

xi. All works shall be carried out in accordance with the most recent version of ALL Aston University Policies.

xii. The Contractor shall ensure all works undertaken can be maintained in a safe and practical manner, the contractor shall provide adequate access hatches and labelling to facilitate such. The Contractor shall, at the request of the Electrical Engineer/ Engineering Supervisor demonstrate that access to equipment is suitable for on-going maintenance and meets all minimum safe working distances as advised by the HSE.

xiii. ALL EXQUIPMENT SHALL BE INSTALLED IN AN ACCESSIBLE MANNER – THE USE OF REMOTE LUMINAIRE DRIVERS AND REMOTE FIRE ALARM TEST UNITS ETC SHALL BE USED AS REQUIRED TO ENSURE MAINTAINABILITY.

1.02 Stripping Out

The electrical contractor shall allow for stripping out all of the redundant electrical installation including luminaries, conduits, cabling, switchgear, fuse boards and their removal from site. Care should be taken to avoid excessive damage to the building structure whilst carrying out this operation. Any redundant wiring which proves impossible to remove shall be cut-back and marked as being redundant.

As part of the above operation electrical isolation shall be carried out as follows, the distribution system including all risers, main switches, busbars and tap-off boxes shall only be isolated by the Electrical Engineer or a member of the Estates and Buildings Electrical Maintenance Section, the electrical contractor shall only isolate at fuse board positions and no further into the distribution system.

The Electrical Contractor shall retain the following stripped out items and hand-back to the Aston University Estates Department (if the equipment is not required by the Estates Department it shall be removed at the Electrical Contractors expense):-

i. Distribution Bus Bar tap-off clamps and Bus Bar chamber clamps.

ii. Copper Bus Bar chambers over 2m in length and all earth bars etc. (or credit the University of Aston) the 'scrap' value.

iii. 'Brass' light switch plates and toggle's (Main Building original installation).

iv. Fire Alarm control panels.

NOTE; All associated cabling, containment and switchgear shall be stripped out.

1.03 Regulations and Statutory Requirements

This specification shall form the basis of design and details minimum working/ quality standards for the conversion and redevelopment of existing Aston University Campus buildings as well as new construction projects on Campus. This specification shall not be deviated from without prior agreement of the Electrical Engineer and Head of Estates (Engineering).

The complete installation shall be carried out in accordance with the latest edition of the following regulations, legislation and ACOP's (all parts):-

I. BS7671 IEE Wiring Regulations.

II. The Electricity at Works Regulations.

III. The Health and Safety at Work, etc. Act.

IV. The Construction (Design and Management) Regulations (CDM).

V. All CIBSE Guidance (Lighting Guides, Codes, Technical Memorandums, Commissioning Codes etc.).

VI. BSRIA Commissioning Codes.

VII. Fire Safety Reform Order 2005.

VIII. The Fire Detection and Alarm Systems in Buildings BS5839.

IX. The Code of Practice for Emergency Lighting of Premises BS5266.

X. The Local Bylaws and Regulations.

XI. The Local Authority Building Control.

XII. All Building Regulations.

XIII. Control of Asbestos Regulations.

XIV. The Workplace (Health, Safety and Welfare) Regulations.

XV. The Control of Substances Hazardous to Health (COSHH) Regulations.

XVI. Managing Health & Safety in construction.

XVII. The Provision and Use of Work Equipment Regulations.

XVIII. The Personal Protective Equipment at Work Regulations.

XIX. The University Safety Code of Practice (Contractors) Manual.

XX. The DDA Regulations/ Codes of Practice.

XXI. The Building Research Establishment (BRE) Good Practice Guides.

XXII. Sport England Design Guidance Notes (where applicable).

XXIII. Health Technical Memorandum's (HTM''s/ HBN's etc. – where applicable).

XXIV. The Industry Committee for Emergency Lighting (ICEL) Guides.

XXV. National Joint Utilities Group Publications.

XXVI. DFES Constructional Standards and Guides.

XXVII. All relevant British Standards and Guidelines.

XXVIII. NACOSS Gold.

XXIX. BS EN 50131/ PD 6662 – Alarm Systems.

NOTE: The above list is not exhaustive; all works shall be carried out in accordance with all relevant legislation, British Standards, ACOP's and the following Aston University Electrical Specification Requirements.

1.04 Electrical Services Design Review

The project Electrical Engineering/ Building Services Consultant shall, prior to production of Tender Documentation, provide a 'RIBA Stage D Report and/or drawings' (to be agreed with the Estates Department Project Manager) for comment by the Estates Department.

The project Electrical Engineering/ Building Services Consultant shall, prior to Tender hold a 'Workshop' to present the Electrical Installation works and agree connections into the site wide infrastructure.

Any deviations from this 'Workshop' meeting shall be notified to the Head of Estates (Engineering) for approval

1.05 Major Projects

As part of all major projects (ALL new builds and major refurbishments) 12 months preventative maintenance shall be provided by the Electrical Engineer, this shall include preventative maintenance and ‘same day’ response to all maintenance/ defective equipment calls.

During the three weeks immediately prior to the end of defects inspection the Electrical Contractor shall complete the following tests/inspections: -

i) Emergency Lighting Discharge Tests.

ii) Fire Alarm Tests.

iii) Lightning Protection System Tests.

iv) Electrical Installation Tests.

v) Call/ Alarm Systems Tests

The above requirements shall be agreed with the Electrical Engineer at the out-set of all projects.

SECTION 2 - Suitability of Materials & Products

2.01 General

Shall be:

1. New unless specified otherwise.
2. Suitable for the services and conditions of use normally expected to apply after the installation is complete.
3. Are able to withstand the testing and commissioning conditions specified.
4. Do not initiate mould growth, support vermin, contain animal hair, contain asbestos or support bacterial life.
5. Are free from objectionable odours at the maximum or normal working conditions of operation.
6. Do not suffer deterioration at the maximum or specified condition of operation.
7. When of a similar type, are made by the same manufacturer.
8. Whenever possible ensure products are manufactured and/or stocked under the following:-

BSI Kitemark Scheme
BSI Safety Mark Scheme

No materials generally known to be deleterious are to be used in, or incorporated into, any temporary or permanent part of the works. In particular, use none of the following:-

- Asbestos products
- Urea formaldehyde

Check with manufacturers and/or suppliers of products and materials that products contain no such deleterious materials. If any specified product contains such material, request an alternative specification of product, material or supplier.

SECTION 3 - Labelling

3.01 General

Labelling shall be provided in accordance with BS 1710 Specification of pipelines and services and the following requirements.

The following labelling format shall be utilised throughout (all sizes are minimums):-

Service	Text Height	Character Width
Distribution equipment	10mm	1.5mm
Final circuit references	4mm	0.5mm
Detector identification labels	4mm	0.5mm
Main Equipment name plates	20mm	2mm
External Lighting	10mm	1.5mm

All text shall be **'Arial Rounded MT Bold'**.

3.02 Mains & Sub-Mains LV Switch Panels/ Panel Boards

A framed LV schematic (minimum A2) shall be provided and affixed adjacent to the panel using a minimum 2 No. nut and bolt fixings. The Contractor shall provide an AutoCAD file of any new and modified schematics to the Electrical Engineer in addition to the hardcopy.

A screw fixed laminated multi-layer phenolic plastic (traffolyte) black text on white background labels shall be provided as follows:-

- On the Panel, detailing:-
    - Panel designation.
    - Details of the supply source.
    - Supply cable type, size and rating.
    - Measured Prospective Short Circuit Current.
    - Busbar Current Rating and kA.
    - Date of installation.
- On each incoming device, detailing:-
    - Device designation and location of the supply.
    - Device rating (A, V, kA).
    - Supply cable type, size and rating.
    - Measured Prospective Short Circuit Current.
    - Measured Earth Fault Loop Impedance
    - Date of installation.
- On each outgoing device, detailing:-
    - Device designation and location of the equipment.
    - Device rating (A, V, kA).
    - Outgoing cable type, size and rating.
    - Measured Prospective Short Circuit Current.
    - Measured Earth Fault Loop Impedance
    - Date of installation.

Provide warning labels where voltages of more than 230V are present. These labels shall be securely fixed laminated plastic yellow on black background.

Provide resuscitation charts adjacent each mains/ sub-mains panel.

On Main LV Switchpanels the internal Busbar layout shall be marked on the external of the enclosure in red, with incoming devices and bus-sections identified.

LV Panel ‘names’ shall be agreed with the Electrical Engineer, however shall generally confirm to the following philosophy:-

‘Building Abbreviation’ / ‘Floor number’ / ‘Board Number’

3.03 Final Circuit Distribution Boards

A screw fixed laminated multi-layer phenolic plastic (traffolyte) black text on white background labels shall be provided detailing:-

- Distribution Board designation.
- Details of the supply source including location and rating.
- Supply cable type, size and rating.
- Measured Prospective Short Circuit Current.
- Measured Earth Fault Loop Impedance
- Date of installation.

Provide a laminated distribution board schedule affixed within the inside of the distribution board door. The distribution board schedule shall be as per the template appended to this specification. The Contractor shall provide word copies of all new and modified schedules to the Electrical Engineer as well as providing the hard copy within the distribution board.

Provide warning labels where voltages of more than 230V are present. These labels shall be securely fixed laminated plastic yellow on black background.

All cabling within distribution boards shall be labelled with ‘over cable’ ferrule markers detailing the circuit reference.

Distribution Board ‘names’ shall be agreed with the Electrical Engineer, however shall generally confirm to the following philosophy:-

‘Building Abbreviation’ / ‘Floor number’ / ‘P – for Power’ OR ‘L – for Lighting’ OR ‘M – for Mechanical’ / ‘Board Number’

3.03 Isolators, Fused Switches & Connection Units fed from Mains Panels

A screw fixed laminated multi-layer phenolic plastic (traffolyte) black text on white background labels shall be provided detailing:-

- Circuit designation.
- Equipment connected.
- Details of the supply source including location and rating.
- Supply cable type, size and rating.
- Measured Prospective Short Circuit Current.
- Measured Earth Fault Loop Impedance
- Date of installation.

Provide warning labels where voltages of more than 230V are present. These labels shall be securely fixed laminated plastic yellow on black background.

3.04 HV & LV Mains/ Sub-Mains Cabling

A tie-wrap fixed cable marker carrier strip shall be affixed to both ends of all HV & LV Mains/ Sub-Mains cabling, the carrier strip shall be populated with alpha-numeric ‘slide on’ ferrules detailing:-

- Circuit designation.
- Cable type.
- Cable current rating.

3.05 Earth Bars & Cabling

A tie-wrap fixed cable marker carrier strip shall be affixed to both ends of all earth cabling connected to the earth bar, the carrier strip shall be populated with alpha-numeric 'slide on' ferrules detailing:-

- At the Earth Bar = Equipment connected.
- At the equipment = Earth Bar reference and location.

A screw fixed laminated multi-layer phenolic plastic (traffolyte) black text on white background labels shall be provided adjacent all earth bars detailing:

- Earth bar reference.
- Installation Date.
- Disconnection test links.

3.06 Wiring Accessories

For all socket outlets, light switches and connection units:-

- A black text on white background self adhesive tape shall be affixed detailing the circuit reference.

For all connection units:-

- A black text on white background self adhesive tape shall be affixed detailing the equipment connected

3.07 Dual fed equipment

For all dual supplied equipment i.e. Central Battery System converted general lighting luminaires a black on yellow self adhesive warning label shall be affixed to the equipment.

3.08 Fire Alarm Equipment

All fire alarm equipment shall be provided with labels detailing the following:-

- Domain.
- Node.
- Loop.
- Address.
- Device Type (M = Manual Call Point, S = Smoke Detector, H = heat detector, MS = Multi Sensor, So = Sounder, B = Xenon Beacon).

All base mounted detectors shall be provided with an integral 'base label'. All sounder/beacon units, interfaces and manual call points etc shall be provided with self adhesive black text on white labels.

All cabling within Fire Alarm panels and interfaces shall be labelled with 'over cable' ferrule markers.

3.09 Emergency Lighting

All emergency lighting luminaires shall be provided with self adhesive black text on yellow labels detailing the following:-

- Self Contained Luminaires:-
  - Self Contained Luminaire.
  - Luminaire Reference Number.

- Central Battery System Luminaires:-
  - Central Battery System Reference.
  - Luminaire Reference Number.

The Contractor shall provide a word file detailing all emergency luminaires reference numbers, location, date of installation and point of testing as well as a drawing showing locations.

3.10 Control Systems and Wiring Centres

All cabling within control panels and wiring centres shall be labelled with ‘over cable’ ferrule markers.

All control panels, main equipment and wiring centres shall be labelled with screw fixed laminated multi-layer phenolic plastic (traffolyte) black text on white background labels detailing:-

- Panel designation.
- Installation date.

3.11 External Lighting

All external lighting shall be provided with a label detailing the following:-

- Light fitting reference number.
- Aston University Logo.
- Estates help desk phone number.

The label shall match the existing site labels, with the exact details to be agreed with the Electrical Engineer.

For wall lights traffolyte labels screwed to the wall shall be provided. For lamp posts labels shall be robust and suitably fixed as to prevent removal by vandalism.

3.12 HV Switchgear

All HV switchgear shall be complete with mimic circuitry painted on the outside of the gear, showing busbars, switches, circuit breakers and shall include ‘flags’ to show operation/ state of each device.

3.13 Miscellaneous Control Panels etc

All control panels/ remote luminaire driver’s etc shall be provided with a local laminated schematic installed within the cabinet and shall be securely fixed.

SECTION 4 - Cable Support/ Containment Systems

4.01 General

Cable containment shall be provided for all electrical services as follows:-

Service	Installation Area	Containment Type
Small Power Distribution.	Service voids and within plantrooms.	Galvanised Trunking.
Small Power Distribution.	Surface mounted within offices/ classrooms.	White plastic.
Small Power Distribution	Surface mounted within corridors/ vulnerable areas.	Galvanised Trunking or White plastic – to be agreed with the Electrical Engineer and project Arhcitect
Lighting Distribution	Service voids and within plantrooms.	Galvanised Trunking.
Lighting Distribution	Surface mounted within offices/ classrooms.	White plastic.
Lighting Distribution	Surface mounted within corridors/ vulnerable areas.	Galvanised Trunking.
Final Circuit cabling	Service voids and within plantrooms.	Galvanised conduit.
Final Circuit cabling	Surface mounted within offices/ classrooms (where surfaces are existing and are not being re-plastered/ within store rooms).	High impact plastic (LSZH) or galvanised conduit/ trunking.
Final Circuit cabling	Within stud partitions/ recessed into solid walls.	Galvanised conduit for non RCD protected circuits, High impact plastic (PVC) for RCD protected circuits.
HV cabling	Within accessible trenches.	All-round clamped to uni-strut.
HV cabling	Within plantrooms etc.	Heavy duty cable ladder.
Mains/ Sub-Mains Cabling	Entering/ exiting switchpanels.	Heavy duty cable ladder.
Mains/ Sub-Mains Cabling	Distribution within service voids.	Heavy duty cable ladder for more than 4 No. 25mm^2 cables (or equivalent).
Mains/ Sub-Mains Cabling	Distribution within service voids.	Heavy duty cable tray for less than 4 No. 25mm^2 cables (or equivalent).
Security cabling	Main distribution routes.	Galvanised Trunking with tamperproof screws (M5 TORX).
Security cabling	Service voids and within plantrooms.	Galvanised conduit.
Security cabling	Surface mounted within offices/ classrooms (where surfaces are existing and are	Galvanised conduit.

	not being re-plastered/ within store rooms).	
Security cabling	Within stud partitions/ recessed into solid walls.	High impact plastic (PVC) or galvanised conduit/ trunking.
Fire Alarm	Service voids and within plantrooms.	Cable tray for 2 cables or more, single cables clipped direct using metal powder coated P-clips.
Fire Alarm	Surface mounted within offices/ classrooms (where surfaces are existing and are not being re-plastered/ within store rooms).	High impact plastic (LSZH) or galvanised conduit/ trunking..
Fire Alarm	Within stud partitions/ recessed into solid walls.	Galvanised conduit or High impact plastic (PVC).
ELV/ Data (Cat 6/ Cat6a)	Main distribution within service voids and within plantrooms.	Cable basket.
ELV/ Data (Cat 6/ Cat6a)	Surface mounted within offices/ classrooms (where surfaces are existing and are not being re-plastered/ within store rooms).	High impact plastic (LSZH) or galvanised conduit/ trunking.
ELV/ Data (Cat 6/ Cat6a)	Within stud partitions/ recessed into solid walls.	High impact plastic (LSZH) or galvanised conduit/ trunking.
On show containment within office/ tutorial rooms/ laboratories	**Dado trunking.** **Ceiling mounted trunking (mounted on the underside of structural concrete beams.** **Header trunking (high level of corridor side walls, within room).**	**Marshall Tufflex, White,** **Two compartment, Sterling Plus,** **210mm x 57mm,**

'Steel banding' is to be fitted within inverted surface mounted cable trunking to retain cables when lids are removed. Proprietary cable retainers are to be fitted on inverted suspended trunking. Cable Pin Racks are to be fitted every 4m in vertical trunking – Cable pins shall be installed between 1m and 2m above floor level and indicated on the trunking lids.

Combined containment systems may be utilised. Voice and Data cabling shall be fully segregated from mains cabling throughout its complete length, segregation refers to suitable separate (and separate containment system/ shielded section of shared containment system) to prevent electromagnetic interference.

All cable containment shall be sized in accordance with the maximum fill capacity of 45% as well as providing a minimum of 25% spare capacity.

The Contractor/ designer shall provide cable containment fill calculations to demonstrate the above.

All trunking shall be a minimum of 50mm x 50mm. All conduits shall be a minimum of 25mm. Oval conduit shall not be permitted.

The Electrical Contractor shall provide all data point back boxes, back boxes shall be of suitable depth for Cat 6/ Cat6a compliance as required by the installation. Cat 6 is the norm provision, with Cat 6a being utilised within Photonics department.

Data (Cat 6/ Cat 6a) and Audio Visual (ELV) cabling may share the same containment system/ compartment.

NOTE; Refer to the Aston University IT Departments Cabling specification for further details/ requirements.

4.02 Distribution Cable Trunking - Steel

Shall be:

i. Manufactured to BS EN 50085.

ii. Galvanised inside and out, including all accessories. All cut ends to be treated with a durable, hydrophobic film spray (galvanising spray).

iii. Sized and installed in accordance with BS7671 IEE Wiring Regulations.

iv. Trunking less than 50mm x 50mm will not be permitted.

v. Free from sharp projections and edges.

vi. Electrically and mechanically continuous throughout, forming a complete bonded system.

vii. Labelled at intervals of 3m to identify the services contained within the trunking.

viii. Multi-compartment cable trunking shall be permitted along major distribution routes only. Steel dividers to be provided within all multi-compartment trunking runs.

ix. LV and ELV services shall not be mixed within cable trunking or multi-compartment cable trunking (separate trunking runs to be provided for LV and ELV services).

Shall be installed:

i. So that the lids are removable along the whole installation.

ii. With copper bonding straps across all joints.

iii. Using manufactured joints, bends, intersections and lids of the same material and type as the trunking. Site manufactured joints, bends intersections and lids shall not be permitted.

iv. Fixed to the building structure at 600mm centres with a proprietary make of wall plug, screws, anchor sockets or rawlbolts of sufficient length to enter the main fabric to a minimum of 35mm. When using trunking where two sides are 200mm or greater, fixings are to be staggered, one at the top and one at the bottom.

v. Fitted with internal fire barriers of 200mm or greater when passing through floors or fire walls.

vi. Where passing through a wall or floor, have lid fitted to project not more than 50mm on either side of the finished surface.]

vii. Fitted with insulated 'pin racks' to support cables on vertical runs in excess of 2.5m, at intervals of not more than 2m.

viii. Cable retainers to be installed within all inverted trunking runs.

ix. All multi-compartment trunking dividers shall include a PVC edge cover.

x. Separate compartments shall be provided for power and lighting circuits.

xi. Fitted with internal fire barriers of 200mm or greater when passing through floors or walls.

xii. Where passing through a wall or floor, have lid fitted to project not more than 50mm on either side of the finished surface.

xiii. Where installed externally shall include a weatherproof gasket seal.

Shall not be:

i. Fitted to the surface of the building by wood plugs.

ii. Fitted on the surface using brickwork courses for fixing.

iii. Fitted having any rust patches or other defects.

4.03 Distribution Cable Trunking - PVC

Shall be:

i. Manufactured to BS EN 50085: Parts 1 and 2, 2005.

ii. Of high impact, white or red.

iii. Sized and installed in accordance with BS7671 IEE Wiring Regulations.

Shall be installed:

i. So that the lids are removable along the whole installation.

ii. Using manufactured joints, bends, intersections and lids of the same material and type as the trunking.

iii. Fitted with PVC fillets when used to carry circuits other than the building structure electrical sub-circuit distribution system.

iv. Fixed to the building structure at 300mm centres with a proprietary make of wall plug, screws, anchor sockets or rawlbolts of sufficient length to enter the main fabric to a minimum of 35mm. When using trunking where two sides are 200mm or greater, fixings are to be staggered, one at the top and one at the bottom.

v. Fitted with internal fire barriers of 200mm or greater when passing through floors or walls.

vi. Where passing through a wall or floor, have lid fitted to project not more than 50mm on either side of the finished surface.

Shall not be:

i. Fitted to the surface of the building by wood plugs.

ii. Fitted on the surface using brickwork courses for fixing.

iii. Fitted having any defects.

iv. Be fitted externally.

4.04 Conduit - General

All steel conduit shall be heavy guage, butt welded and black enamelled for normal locations.

In boiler houses, kitchens, fuel stores, covered ways, launderettes, gymnasium changing rooms, toilets and other damp locations, all conduit shall either be PVC or hot galvanised finished inside and out.

No conduit less than 25mm diameter will be permitted.

All conduit shall comply with BS EN 50086: 1994 and BS EN 61386 : 2004.

i. Sized and installed in accordance with BS7671 : 2008 Requirements for Electrical Installations (17th Edition of the IEE Wiring Regulations) Part 5, Chapter 52 Selection and Erection of Wiring Systems.

ii. Be threaded to length specified in relevant British/European Standard carefully reamered to remove all sharp edges and burrs after screwing, oil and filings being completely removed before erection, and already cut threads cleaned by running dies over them and wiping clean.

iii. Arranged to butt in solidly to boxes, couplers, accessories and jointed with couplings to match the conduit grade and finish.

iv. Electrically and mechanically continuous throughout forming a complete bonded system. The whole of the conduit installation (where possible) is to be completed and tested for continuity before any cables are drawn in.

v. Must be fully protected to prevent ingress of debris, etc. during building work.

vi. Bends and sets must be formed using an approved bending machine with the appropriate formers. All bends and sets being made without restricting the bore.

vii. Fitted with locknuts on all running couplings.

viii. Painted with rust inhibiting paint after erection where screw threads are exposed and where the conduit finish is damaged (galvanising spray).

ix. Held in an efficient vice for screwing. Badly marked conduit or poor threads will not be accepted.

x. Screwed coupling to equipment having tapped conduit entries screwed up tight with no visible threads showing.

xi. Coupled to trunking by coupling and brass male bushes inside the trunking.

xii. Installed using independent systems for the following:
Lighting, general power, radio, telephones, alarm systems, etc.

Shall not:

i. Have more than two right angle bends in any conduit run without provision of a draw-in box.

ii. Be installed in runs of more than 10m without drawing in boxes.

iii. Be fitted to the surface of the building by wood plugs.

iv. Be fitted on the surface using brickwork courses for fixing.

v. Have any rust patches or other defects.

Shall be installed:

i. Using spacer bar saddles spaced at distances not more than 1200mm apart on vertical runs and 1000mm on horizontal runs. Saddles shall be fixed on either side of a joint, bend, or accessory at distances not more than 200mm from the joint, bend or accessory.

ii. With saddles fixed with a proprietary make of wall plug and screws of sufficient length to enter the main fabric to a minimum of 35mm.

iii. In such a manner, that where run in wall chases or concrete floor screeds, no movement takes place when the screed is laid.

iv. Chased into walls and floors shall be so recessed as to be covered by the full thickness of plaster or screeding.

v. For all draw-in points to be readily available for inspection at all times and draw-in, or adaptable boxes, sunk in the plaster of walls/ceilings shall be fitted with oversized box lids.

vi. To lighting points in such a manner that no wiring is taken through the actual luminaire and that each fitting is mounted on two conduit boxes.

4.04.01 Conduit - Galvanised

Shall be:

i. Fixed with galvanised saddles for surface or flush installations.

ii. Fixed with brass or galvanised screws.

iii. Painted with zinc rich paint where exposed conduit threads are left (galvanising spray).

iv. Installed with all necessary galvanised accessories.

v. On external or damp locations, conduit fittings are to be kept to a minimum. All inspection boxes shall be packed with waterproof plastic compound and fitted with gaskets to prevent the egress of moisture. Any terminal blocks

within adaptable boxes shall be filled with a 'none conducting' compound (Dielectric Silicone Grease).

4.04.02 Conduit – PVC/ LSZH

Shall be:

i. All conduit and fittings shall comply with BS EN 61386: 2004. BS4607 and BS6053 BS6009 Part 2, Section 2.2.

ii. All conduits shall be heavy gauge high impact and accessories used shall be of the same grade and manufacture.

iii. All conduits installed on the surface shall comply with the general requirements for the installation of steel conduits detailed in this specification.

iv. All joints shall be made with an adhesive recommended by the manufacturer.

v. All connections to push fit spouted boxes, bends or accessories shall be sealed with a PVC adhesive to ensure a watertight fit.

vi. Conduits shall not be held in a pipe vice.

vii. Fixing on either side of a bend or accessory shall not exceed 150mm.

viii. All accessories used must be of the same manufacture as the conduit.

ix. All accessory boxes must have fitted or have provision for fitting a brass earth terminal.

x. All box lids to be PVC/LSZH, secured with brass or sheridised screws.

xi. Care shall be taken to avoid fracture of the conduit when cold bending.

xii. Any fixed loads imposed on accessory boxes shall not exceed the manufacturers guidelines.

xiii. Conduit shall not be installed externally.

xiv. All surface mounted plastic conduit shall be LSZH type. All conduit within stud walls/ chased into block walls (i.e, behind plasterboard) shall be PVC type.

4.04.03 Conduit - Flexible Metallic

Shall be:

i. Manufactured to BS EN 61386: 2004.

ii. Kept to the shortest length practical, however this shall not exceed 3m.

iii. Connected to equipment using factory manufactured glands.

iv. Installed with an external circuit protective conductor of minimum size 2.5mm^2.

v. Run between the fixed installation and any fixed apparatus (motors, etc.)

vi. Be PVC covered, of ample capacity and mechanically robust.

4.04.04 Conduit - Flexible Non-Metallic

i. **Flexible non-metallic conduit is prohibited on campus.**

4.04.05 Conduit - Accessories

Boxes shall be:

i. Standard, circular, galvanised or PVC where appropriate. Metal types of malleable iron or pressed steel to IEC 670, BS EN 50086 : 1994, BS EN 61386 : 2004, BS6053, BS6099 Part 1.

ii. Of the adaptable black enamelled or galvanised pressed steel or PVC type as appropriate, minimum size 100mm x 100mm x 50mm depth.

iii. Fitted with lids of the same class and finish as the conduit system and secured in place with brass dome or cheese headed screws.

iv. In accessible positions, fixed with a proprietary make of wall plug and screws of sufficient length to enter the main fabric to a minimum of 25mm.

v. Fitted with extension rings in order that the edge of the conduit box is flush with the finished surface.

vi. Fitted overhanging lids on flush installations when using the pressed steel type.

vii. Connected to the conduit system by means of a coupling and male brass bush where non-screwed entry boxes (switch, socket, outlet boxes, etc.) are used.

4.05 Perforated Tray

Shall be:

i. Galvanised to BS EN 61537:2007 and BS EN 61537: 2002.

ii. Medium duty.

iii. Installed with a minimum clearance behind of 20mm.

iv. Installed using fish plates, reducers, inside and out angles, flat bends, equal tees, unequal tees and crosses of the same type, manufacture and finish as the tray.

v. Joined using galvanised or zinc plated dome head slotted roofing bolts, nuts, washers and shake proof washers with the bolt inside the tray clear of any cables.

vi. Installed with fixings/brackets to prevent sagging at regular intervals not exceeding 1.2m and at 225mm from bends or intersections.

vii. Electrically and mechanically continuous throughout forming a complete bonded system.

viii. Bonded to the buildings electrical system.

ix. Filed to remove any sharp edges or burrs and painted with zinc rich paint.

x. Of adequate size as to prevent undue bunching.

xi. Fitted with grommets, bushes or other lining where holes have been cut in the tray to allow passage of cables.

4.06 Wire Basket

Shall be:-

i. Mild steel heavy duty return flange type BS 1449 Part 1 and shall be hot dip galvanised to BS 729.

4.07 Cable Ladder

Shall be:-

i. Hot dip galvanised medium duty type to BS 729.

4.08 Dado Trunking

Shall be:-

i. Multi-compartment type, generally 2 compartments with LV and ELV cabling installed in separated compartments.

ii. White plastic construction, with metallic dividers to ensure electromagnetic segregation between LV and ELV compartments.

iii. DDA/ Part M compliant. All accessories shall be recessed installed and charcoal finish to provide colour contrast.

iv. Compatible with Cat 6 and Cat 6a cabling, and shall not in any form impair the data bandwidth of the cabling.

v. Installed complete with all relevant tees, corners, bends and fixings required to provide a fully complete and operational system.

4.09 Fire Barriers

Shall be:-

i. Installed around all containment passing through fire compartment boudnaries.

ii. Installed within all enclosed trunking passing through fire compartment boundaries. The installation shall eliminate any air gaps around the cables.

iii. Of the ‘Rockwool’ type installed by an accrediated installer. All Fire Barriers shall be labelled/ numbered and dated with self adhesive labels and denoted on layout drawings. The layout drawings shall be provided in AutoCAD format to the Electrical Engineer.

4.10 Data Cabling – General Containment Details

All containment systems used shall be appropriate for use with a cat 6 cabling system and observe all relevant guidelines e.g. bend radius.

Reuse of any existing containment must be agreed with the University prior to commencement of works.

The MK Powerlink dado containment shall not be used to carry the cat 6 cables unless explicitly agreed in advance.

The structured cabling system shall be run within its own dedicated containment (or compartment in multi-compartment trunking systems) provided within the building. Where structured cables are installed and supported on cable tray, cables will be bundled such that a maximum of 96 cables are contained in any one bundle. Where cables run vertically on cable tray the cable bundles will contain no more than 48 cables. In both cases, as a maximum, cables will be secured every 500mm and secured to the containment at 600mm intervals. Where cables are installed within horizontal closed containment these values are relaxed.

The University standard dado containment shall be used, this is:

Marshal Tuflex Sterling Twin Plus, with matching “T” pieces, bends etc

Within this system all internal bend fillets shall be installed in each compartment. All appropriate matching bends shall be used to move around corners and divert vertically. This is a two compartment containment, data cables shall be run in the data section and the outlet mounted on back-boxes in the same compartment as the power sockets.

All back-boxes used to mount outlets (as part of the dado system or direct wall mount etc) shall be more than 35mm deep (non adjustable) to ensure that the cabling system can be installed to observe correct bend radii and be fully warranted.

Other surface Containment must be suitably sized not to infringe cat 6 bend requirements.

The contractors designing/installing containment shall finalise the containment fully with the data cable installers for suitability and to ensure installation practises for the cable are followed and the system can be fully warranted.

The complete Data cabling installation shall as a minimum be in accordance with BS6701 Telecommunications equipment and telecommunications cabling – Specification for installation, operation and maintenance.

SECTION 5 - Cable Types & Installation

5.01 General

The use of cable types ECC 6181Y, 6193Y, 6241Y, 6243Y i.e. Flat twin and earth cable is strictly forbidden in permanent installations.

PVC outer sheafed cables are strictly forbidden within internal areas (including lift shafts).

MICC (Pyro) cabling is strictly forbidden within new installations, with the exception of 'galvanic barrier' installations were MICC (Pyro) must be utilised. Were MICC (Pyro) cabling is to be modified, redundant cabling shall be stripped back as far as reasonably practical and extended using enhanced Firetuff (FP Plus) type cabling.

Final circuit LV cabling shall be Cu/LSZH BASEC approved 'singles' (Low smoke zero halogen) type manufactured to BS6004 (6491B) contained within conduits/ trunking along their entire length.

Where it is not practicable to install singles cabling within conduit systems, LSZH BASEC approved 'flexisheild' cabling may be used with approval from the Electrical Engineer.

All mains/ sub-mains cabling shall be multi-core Cu/XLPE/SWA/LSZH BASEC approved 'armoured' (Low smoke zero halogen) type manufactured to BS6724. All single phase cables shall be 3core and all three phase cables shall be a minimum of 4core with the armour and a supplementary CPC earth wire if required. All supplementary CPC earth wires shall be a minimum CSA of 16mm^2.

Where 3x line conductors of 4mm^2 CSA or above require connecting, this shall be carried out within a proprietary enclosure using DIN rail connector blocks. Connection within electrical accessories (socket outlets, switches etc) shall not be permitted. Connection using 'choc box' or standard 'terminal blocks' shall not be permitted.

5.02 Cable Colours

Single phase circuits will be wired using Brown (live), Blue (neutral) and Green/Yellow Earth. Extensions or alterations to existing single phase installations do not require marking at the interface between old and new cabling providing they are correctly coloured. However a caution notice must be fixed at the distribution board saying:

Three phase circuits will use brown, black and grey as the three phases and blue as the neutral, green/yellow as earth and marked L1, L2, L3 at the live terminations, N at the neutral terminal and E at the earth terminal.

For alterations or extensions to three-phase installations, old and new cables will be marked at the interface L1, L2, L3 for the phases, N for the neutral and E for the earth. The marking should be made to both old and new cables. A caution notice is again required at the distribution board as above.

The caution notice shall be as follows:-

CAUTION

This installation has wiring colours to two versions of BS 7671.

Great care should be taken before undertaking extension, alteration or repair that all conductors are correctly identified.

All cables connected into a fuse/MCB board must be individually numbered and terminated in the correct 'circuit number way' Neutral and Circuit Protective Conductors must also be numbered and terminated in their respective way.

5.03 Cable/ Busbar Sizing

The size of all ELV, mains and sub-main cables and busbars etc shall be to BS7671.

The Electrical Contractor/ Designer (as applicable) shall undertake cable selection in accordance with BS 7671 IEE Wiring Regulations and taking into account any and all existing installation characteristics.

Load	Min. Cable Size	Max. Circuit Breaker Size
Lighting	1.5mm^2	10A
Power (socket outlets Ring)	2.5mm^2	32A
Power (socket outlets Radial)	4.0mm^2	20A
Fixed Loads (up to 4kW)	4.0mm^2	20A
Fixed Loads (up to 6kW) including Supplies to Ring main RCDs)	6.0mm^2	32A

Cable sizes of less than 1.5mm^2 will not be permitted.

A radial circuit rated 20A using 2.5mm^2 cable must not be installed in any area greater than 50m^2.

A radial circuit rated 32A using 4.0mm^2 cable must not be installed in any area greater than 75m^2.

A ring main is to be installed for every area of 100m^2 or multiples thereof, irrespective of the load.

A maximum of 8 No. 13A twin switched socket outlets shall be installed on a 32A ring main circuit.

A maximum of 4 No. 13A twin switched socket outlets shall be installed on a 20A radial circuit.

All cabling/ bus bars shall be sized and selected including a minimum of 25% spare current carrying capacity and volt drop to allow for future expansion.

All mains, sub-mains and Bus Bars shall have full sized neutrals as a minimum.

5.04 Installing Main/Sub Main Cables

Where multi-core, single core and armoured cables are installed, the cables are to be installed using one of the cable management systems listed elsewhere within this specification and are to be installed in main service ducts, ceiling voids or rising ducts.

Cable clipped directly to the building structure is to be neatly clipped, installed in single or multiple runs using cable cleats.

Cable on tray or in cable baskets, heavy duty cable ties will be used.

Cable Fixing Method's

Cable Core Type	Cable OD	Fixing Method
Single Core 3-phase	All	Aluminium trefoil cable cleats.
Multi Core	<= 10mm^2	Plastic tie wraps.
Multi Core	10mm^2 > 40mm^2	Low Smoke PPA coated galvanised steel 'All Round' banding secured with nut and bolts.
Multi Core	> 40mm^2	Aluminium cable cleats

Cable Fixing Spacing's

Cable OD	Horizontal Fixing Centres	Vertical Fixing Centre
<10mm^2	350mm	450mm
10mm^2 > 40mm^2	400mm	600mm
40mm^2 > 60mm^2	700mm	900mm
> 60mm^2	1100mm	1300mm

All LV mains, LV sub-mains and HV cabling shall be suitably spaced, 'touching' cabling will not be permitted, with the exception of singles in trefoil (3-phase circuit) and for parallel cables.

Cables rising out of service ducts or from external trenches shall be protected by a steel trunking or galvanised steel conduit of a suitable diameter to minimum height to 1500mm.

Cable routes are to be selected to avoid undue crossing or interference with other services.

Cabling shall not be installed in close proximity of heating services.

XLPE/SWA/LSZH Cables & XLPE/SWA/PVC Cables

All internal armoured cabling shall be BASEC approved Cu/XLPE/SWA/LSZH type.

All external armoured cabling shall be Cu/XLPE/SWA/PVC type.

Generally internal cables shall be terminated using brass compression glands, locknut, earth tag and LSZH shroud (BW type). Cables terminated in outdoor conditions shall be terminated using the same arrangement with rated IP66 rated (CW type) glands etc. Cables terminated within explosion risk areas shall be provided with suitably flameproof stuffing glands.

Conductors shall be terminated and positioned to ensure that the cable is not pressing against the metal interior of the distribution gear and that there is no bend within the cable shroud.

Armoured cables buried in the ground will be laid in a trench of a minimum 500mm deep, the trench will be lined with a minimum of 100mm of sand, the cable laid on top and covered with 100mm sand. A yellow rot resistant polythene tape with black wording 'Caution: Electric Cable' shall be placed on top before backfilling the trench and at 100mm below the finished ground level. The trench depth shall vary

dependant on ground finish (soft dig/ hard landscape), voltage and service, all depths shall meet the National Joint Utilities Group guidelines.

5.05 Wiring in Conduits and Trunking

For general locations, where the ambient temperature does not exceed 30ºC, all wiring in conduit/trunking shall be carried out using BASEC approved LSZH single core insulated cable. There shall be no joints in the wiring system except at final terminations requiring heat resisting cable connections.

The cable shall be of 450/750 volt grade manufactured to BS7211: 2005 Low Smoke Fume, Type 6491B. At terminations, sufficient insulation shall be removed to make full use of the terminations available, bare copper shall not be exposed within the switchgear.

Cables shall not be terminated directly into a fitting/appliance where the insulation will deteriorate due to heat.

Heat resistant flex to BS6500: 2005/HOFR types 3183TQ, 3184TQ shall be used to terminate directly into a fitting/appliance where the insulation will deteriorate due to heat/ the ambient temperature exceeds 30ºC.

Termination Method's

Service	**Termination Method**
Luminaires within suspended ceiling.	'Greg' roses.
Soffit mounted luminaires.	Adaptable box (where available manufacturers specify AD box)
Power supplies.	Fused connection units/ isolators etc.

5.06 Wiring in Escape Routes

All wiring in escape routes shall be contained within containment systems that include metallic fixings.

Plastic tie wraps, plastic cable clips, plastic trunking/ plastic conduit with plastic fixings shall not be permitted within escape routes.

Where plastic trunking is installed within corridors then metallic 'all round banding' shall be provided within each compartment at 2m spacing's and shall be fixed through the trunking into the structure. This 'all round banding' shall be used to support all cabling within the trunking.

Where mains/ sub-mains cabling are run through escape routes, the cabling shall be affixed to the structure using metallic cleats.

Where conduits are run through escape routes, white PVC conduits with metallic spacer saddles.

All containment fixings shall be all metal construction. All expanding plugs shall be fibre type and not plastic. Expanding metallic anchors, fibre plugs, concrete screws and other mechanical fixings shall be used.

Where metallic cable ties are used and fixed to the building fabric, the cable tie retainer shall be metallic i.e. Partex stainless steel cable tie mounts.

NOTE:- THE ABOVE REQUIREMENTS ARE FOR ALL VOLTAGE BANDS.

5.07 Wring in Existing Conduits

In some instances, the existing conduits may be re-used during rewiring. The Electrical Contractor shall confirm by visual inspection that the condition and age of the conduit is suitable for re-use, any re-use of conduit shall be agreed with the Electrical Engineer.

Where existing conduits are reused, a circuit protective conductor is to be drawn into each conduit.

Under no circumstances shall the conduit be used as the circuit CPC.

Where existing conduits cannot be re-used they shall be fully stripped out. Where conduits are 'cast in' they shall be suitably plugged to prevent future use.

5.08 MICC Cables

MICC (Pyro) cabling is strictly forbidden within new installations, with the exception of 'galvanic barrier' installations were MICC (Pyro) must be utilised. Were MICC (Pyro) cabling is to be modified, redundant cabling shall be stripped back as far as reasonably practical and extended using enhanced Firetuff (FP Plus) type cabling.

Terminations shall be manufactured in accordance with BS EN 60702-2: 2002 (latest edition).

Mineral insulated copper sheathed cables shall be manufactured in accordance with BS EN 60702-1: 2002 (latest edition).

Shall be:

i. Copper sheathed with copper conductors and LSF overall sheath for all locations unless otherwise stated in the project specification.
ii. Fixed using LSF sheathed single hold clips or saddles fixed with screws for all locations unless otherwise stated in the project specification. Clips and saddles shall be fixed to the building surface structure with a proprietary make of wall plug and brass roundhead wood screws of sufficient length to enter the main fabric to a minimum of 35mm.

iii. Fitted with LSF shrouds over the termination glands of the same colour as the cable sheath.

iv. Terminated using screw-on brass pot with integral earth tails, filled with standard plastic compound (-80^{o}C to 105^{o}C unless otherwise stated in the project specification), plastic stub cap and PVC sleeving.

Where terminated in a fuseboard, the individual earth leads are to be extended using a crimped ferrule and connected to the appropriate terminal on the earth bar.

Where passing through walls and floors of brickwork, blockwork, concrete, etc., installed in plastered walls, the cable shall be installed within conduit. Where cables pass through a floor or wall at a position where they may be subject to mechanical damage, they shall be protected with steel trunking or a steel conduit sleeve with stuffing glands at each end of the conduit.

The cable seals shall be of sufficient length for remaking broken connections and the insulated tails are to be fitted with cable end markers to indicate phase and neutral conductors.

Where cables extend to motors or other equipment, subject to vibrations, adjustment or expansion, the cable shall be formed into one complete loop.

Where forming part of a surface installation, be run neatly, unobtrusively and parallel to the general building line. The approval of the Engineer shall be obtained to the proposed layout before the work is started.

Cable ties used to secure cables on horizontal or vertical perforated tray shall be manufactured from stainless steel.

On the installation and termination of all individual lengths of cable either surface, covered or buried, the individual lengths of cable shall be tested for continuity and insulation. On an individual cable the insulation resistance shall be greater than 100 Mega Ohms after a minimum of 24 hours after both ends of the cable have been terminated.

Cable Fixing Spacing's

Cable OD	**Horizontal Fixing Centres**	**Vertical Fixing Centre**
$<9mm^2$	350mm	375mm
$9mm^2 > 15mm^2$	375mm	425mm
$15mm^2 > 22mm^2$	450mm	500mm
$22mm^2 > 40mm^2$	525mm	600mm

SECTION 6 – Distribution Switchgear

6.01 General

Main LV distribution shall be via floor standing switchpanels conforming to Form 4b Type 6 of BS EN 61439-2.

Sub-main LV distribution shall be via floor standing switchpanels conforming to Form 4a Type 2 of BS EN 61439-2 or wall mounted panel boards conforming to Form 3b Type 2.

Bus Bar chambers shall not be permitted within new installations.

LV Bus Bar distribution shall Low Impedance Copper conductor units complete with fire barriers and expansion links as required to suit the installation method/ environment.

All Main LV Panels, Sub-Main LV Panels and LV distribution Bus Bars shall have a minimum fault rating of 50kA.

The use of 'fuse' circuit protection may only be utilised within refurbishment projects where a supply is to be derived from existing distribution equipment. All circuit protection for new distribution equipment shall be 'MCCB' type.

All MCCB's below 200A shall include thermal and magnetic trip adjustment to achieve as a minimum 20% de-rating. All MCCB's 200A and above shall include complete electronic trip adjustment.

Final circuit distribution boards shall be 'MCB' type. The use of 'fuse boards' shall only be permitted where existing equipment is to be re-utilised.

The contractor/ consultant shall bring to the attention to the Electrical Engineer any all distribution equipment over 15 years in age that is proposed to be re-utilised. The contractor/ consultant shall demonstrate that the equipment is suitable for re-use for a minimum period of 10 years prior to undertaking the works.

On all new Main LV Switchpanels the internal Busbar layout shall be marked on the external of the enclosure in red, with incoming devices and bus-sections identified.

All electrical distribution enclosures are to be all metal construction, including blanking elements, where this can not be achieved due to product manufacturer the item shall be agreed with ECD prior to use.

6.02 Switch Disconnectors

Switch disconnectors and switch disconnector fuses must be type tested to BS EN60947-3 and meet the constructional requirements for isolation as specified in BS EN60947-3.

They must be suitable for switching AC or DC.

They shall be fabricated from rust-proof sheet steel with grey paint finish with removable top and bottom endplates incorporating knockouts.

Doors are to be gasketed to IP4X.

Facilities are to be provided for locking off the operating handle.

Switch disconnectors and switch disconnector fuse units will have unswitched neutrals. For the purpose of testing, the neutral link must be accessible for removal.

6.03 Enclosures

Fixing holes for equipment inside buildings may be inside or outside the enclosure. Equipment may be located outside buildings shall have fixing lugs external to the enclosure.

Earthing terminals shall be appropriately fixed to each enclosure, suitable for internal and external connection, to enable the exposed conductive parts of the factory build assembly to be connected to a protective conductor. Where the conductor has a painted finish, provision shall be made for the earthing terminal to be electrically connected to the enclosure without the need to remove any paint from ferrous material.

Adequate spacing shall be allowed for spreading of incoming cable tails and outgoing circuit cabling to avoid stress on the insulation of terminals; if necessary, proprietary extension boxes shall be fitted as standard enclosures.

All enclosures shall include securable covers; covers shall either be secured by screws/bolts or hinged key locked covers.

Appropriate gland plates shall be provided for the type of cable being terminated.

6.04 Bus Bar Chambers

The installation of new Bus Bar chambers on site is forbidden.

The following clauses detail requirements for modifications/ alterations to existing Bus Bar Chambers.

Shall be:

i. Fabricated from rust-proof sheet steel with grey paint finish.

ii. Type tested to BS EN60439-1 1999 with a rated conditional short circuit current rating of 63ka at Ue 550v and a rated short-time withstand current lcw 20 times nominal rated current for one second.

iii. Designed for use in factory-built assemblies to BS EN60439-1: 1999.

6.05 Main Building Distribution Tap-off Boxes

In the Main Building and North Wing of the University, lighting and power fuseboards/ distribution boards are fed via horizontal bus bar trunking running side by side in the central corridor voids. Where new MCB distribution boards are required to be fed from these bus bars, a 63A TP&N switch fuse shall be used for lighting and a 100A TP&N switch fuse shall be used for power.

Isolation of the bus bar systems shall be carried out by arrangement with the Electrical Engineer and are subject to a 'Permit to Work' system.

Installation of tap off boxes to the vertical bus bar systems in the Main Building, South Wing and the North Wing is strictly forbidden.

6.06 Distribution Boards

Shall be:

i. Type ‘A’ to comply with BS5486: part 12 and 13 and BS EN60439-3.

ii. Type ‘B’ to comply with BS5486: part 12 and BS EN60439-3.

iii. Shielded or shrouded to meet at least IP2X standard.

iv. Include separate neutral and earth bars, all ring main CPC’s shall be terminated into separate earth terminals.

v. A multi-terminal bar for the circuit protective conductors shall be provided for both insulated and metal cased distribution boards. It shall be directly connected to the earthing terminal without dependence on the exposed conductive parts of the enclosure.

vi. Identification of each Miniature Circuit Breaker (MCB) way shall be by permanent numbering. Identification on the neutral bus bar protective conductor bar shall clearly relate each terminal to its respective MCB way.

vii. Each distribution board shall be fitted with an integral means of isolation.

viii. Supplied complete with MCBs fitted in all ways (including ‘spare’ ways). A minimum of 25% spare ways shall be provided within each NEWLY INSTALLED distribution board and shall be populated with a range of MCB’s/ RCBO’s to be agreed with the Electrical Engineer.

ix. Installed at a height of 1100mm (bottom) to 2400mm (top – maximum height) above floor level.

x. Fitted with a lockable door.

xi. Distribution boards shall be located within electrical risers and store rooms. Where this can not be achieved and Distribution Boards are to be installed within ‘on show areas’ i.e. student kitchens etc, Distribution Boards shall be provided with ‘clear’ doors.

Where distribution boards are connected to cable trunking or switchgear, a slotted hole is provided for cable access, the edge of the metalwork shall be protected with a paxolin plate or PVC edging channel.

Sub-Mains cables to Distribution boards shall be terminated into galvanised cable trunking within ‘on show’ areas, surface fixed cable tray shall not be permitted within ‘on show’ areas.

For all new installations at least 25% spare capacity shall be allowed within distribution boards and within the sub-main cable feed to allow for future development, they shall be correctly labelled using an engraved plate system to indicate the following:

i. Distribution board designation, building, floor, P or L, number e.g. Library, 3rd floor, lighting, number. LIB / 3 / L / 04.

ii. Supply cable size and type (e.g. 25mm^2 4 core Cu/XLPE.SWA/LSZH).

iii. Origin of supply cable (e.g. from Library sub-station).

iv. Fuse size at origin (e.g. 60A HRC fuses).

v. Earth Fault Loop Impedance.

vi. Date of Installation.

When any addition to, alteration of or refurbishment works been completed using existing distribution boards, the contractor shall obtain the 'word' file of the distribution board schedules from the Electrical Engineer and fully update the record. The 'printed' distribution board schedule shall be laminated and affixed on the inside of the hinged cover.

Final single phase circuits from Distribution boards shall carefully planned to ensure all circuits (power and lighting) within a room are all the same phase.

Where existing Fuseboards are to be re-utilised (with the agreement of the Electrical Engineer) then the above requirements shall be applied.

6.07 Circuit Protection

i. All fuses throughout the distribution system shall be ASTA certified to BS88: Part 2: 1988 or comply with IEC 269 parts 1 and 2 tested to 80ka at 550v AC.

ii. Cartridge fuse links complying with BS 1361 shall be Type 1. Fuse carriers, bases and associated parts shall also comply with BS 1361.

iii. Cartridge fuse links complying with BS 88.BS EN 60268 shall be class gG (or Class gM in motor circuits) unless otherwise indicated. Motor circuit fuse links shall be used only where indicated. Fuse carriers, bases and associated parts shall also comply with BS 88.

iv. MCBs shall comply with BS EN 60898 and clause 2.1. They shall have the voltage and current ratings and the category of duty, and be of the type, as indicated.

v. All miniature circuit breakers shall be of types B, C, D to BS EN60898 (IEC898) with 10kA short circuit breaking capacity.

6.08 Residual Circuit Operated Circuit Breakers RCBO

i. RCBOs shall comply with BS EN 61008 (RCCBs) or BS EN 61009 (RCBOs) as appropriate. The rated breaking capacity shall be as indicated.

ii. Where indicated RCCB/RCBOs shall have electronically amplified sensors. They shall be of the instantaneous, inverse definite minimum time (IDMT) or fixed delay type as indicated.

6.09 Main & Equipotential Earthing

i. The complete installation, including all materials, and testing shall comply with BS 7430, BS 7671, Guidance Notes, BS EN 62305, and ACOP.

ii. All earthing conductors shall be copper or suitable size/ rating to carry the expected fault levels. Where used to interconnect copper electrodes the conductor may be bare but for all other purposes the conductor shall have an extruded Thermoplastic (PVC) sheath.

iii. Main earthing bars shall be hard drawn flat tinned copper bar having minimum dimensions of 50mm x 6mm. The Earth Bar shall be securely fixed, via insulated stand-off brackets, to a high impact uPVC fixing channel.

iv. All Earth Bars shall be appropriately labelled, including labelling of all bonds (at both ends).

v. All Earth Bars shall be provided with test links to allow external earth fault loop impedance testing.

vi. All Earth Bars to be provided with 25% spare connection points (minimum of 4 No. spare).

vii. Joints within main/ equipotential earthing conductors shall not be permitted. Joints within circuit CPC's shall only be permitted within accessory terminals.

viii. All contact surfaces shall be thoroughly cleaned and coated with an anti-corrosive electrical jointing compound suitable for the conductor materials. For bi-metallic joints a separate abrasive shall be used to clean each metal.

ix. Where the steel wire armouring of XLPE/SWA/LSF distribution cables is used as a CPC, provide glands at each end on to gland plates on the equipment. Provide cable glands with built in earthing terminals. External clips on armouring will not be accepted. Provide connections from cable glands to earthing terminals on equipment by means of LSF cables with green and yellow insulation.

x. All final circuit distribution boards shall incorporate additional earth terminals to allow termination of high integrity earthing/clean earth cabling. All socket outlet circuit shall be kept to a maximum of 8 No. twin sockets per ring and shall include dual earth terminals to ensure safe dissipation of earth leakage.

xi. A clean earth system shall be provided to all systems requiring such to ensure correct operation i.e. 'galvanic barriers', 'ICT Equipment' etc. All clean earth requirements shall be agreed with the Electrical Engineer at the outset of all projects.

xii. Supplementary earth bonding shall also be provided using 4mm² LSF/Cu cables from local electrical earths. These shall be contained in conduit up to a point immediately adjacent to the bond position, and shall exit via a stuffing gland (if above ceilings or in a plantroom) or a flush flex outlet plate (if below ceiling). Items requiring bonding are as follows:-
    a) Ceiling tile grids – assume one bond per room or every 10m2 in larger areas.
    b) Stainless steel sinks – bond between taps, waste and drain off back to nearest electrical earth. Make bonds below sink.
    c) Wash hand basins – cross bond between hot, cold and waste (if metal). Link to local electrical earth if one is present within 2.5 metres.
    d) Cross bond between all sections of ladder rack and basket and trunking.
    e) Stainless steel/ metallic fixed furniture – bond between furniture earth tags back to nearest electrical earth.

xiii. Connections shall be made as follows:-
    a) To main earthing bars by integral brass nuts and bolt connections.
    b) To earth rods by gunmetal or copper clamps with phosphor-bronze bolts. Edges of the clamps to be rounded.

c) To earth plates by phosphor-bronze bolts or welding.

xiv. Bolts, nuts and washers for copped conductors shall be of the phosphor-bronze or naval brass and for aluminium conductors they shall be of stainless steel. The minimum provision shall be:
   a) Two M8 bolts for flat strip.
   b) Two M8 bolts for sheet material above 2mm thick. Provide an additional backing to an area of at least 1000mm^2 for material less than 2mm thick.

xv. Termination of cables shall be by connectors jointed to the cable conductor by the exothermic welding process or by compression joints complying with BS EN 61238-1.

xvi. Joints which are indicated as test points shall be bolted or clamped. Joints in tape, other than at test points, shall be made by the exothermic welding process. Overlap of conductors shall be not less than 100mm.

xvii. Joints and connections shall be protected by a coating which will form a seal and exclude moisture in all weather conditions. At connections to earth electrodes the coating shall cover all exposed conductors. Protective coatings shall be of a waterproof, inert material.

6.10 Marking & Notices

i. All diagrams, charts, tables and the wording for labels and notices shall be submitted for approval of the Electrical Engineer before they are installed.

ii. Identification labels shall be fixed to the outside of equipment enclosures. Label format and materials shall be appropriate to the installation and shall be fixed by non-corrosive materials appropriate to the intended application and location.

iii. Characters for labels fixed on the means of isolation at the origin of each installation shall be at least 10mm high and 1.5mm thick. On all other labels characters shall be at least 4mm high and 0.5mm thick.

iv. Where there are two or more incoming supplies this shall be clearly indicated at each point of isolation. Labels on single-phase equipment supplied from a three phase supply shall indicate the phase to which it is connected.

SECTION 7 - Lighting Installations

7.01 Lighting Switches

The mounting height for light switches shall be 1100mm to the centre of the switch assembly from finished floor level.

Plates shall be overlapping type suitable for flush mounting or flush with the box edge of surface mounted switches.

7.02 General Lighting

Lighting within University Buildings shall be of the following types:-

i. Surface mounted luminaries fixed direct to ceiling mounted conduit/trunking installation.

ii. Surface mounted luminaries fixed direct to lighting trunking which is in turn suspended from the ceiling slab utilising threaded rod/ uni-strut and conduit droppers.

iii. Recessed luminaries incorporated within a lay-in tile suspended ceiling with the wiring points fixed to the slab above and final connection to the luminaries shall be via plug-in ceiling roses. Heat resistant flex to BS6500: 2005 / HOFR types 3183TQ shall be used to terminate directly into the luminaries connection block.

iv. Recessed luminaries incorporated within a MF suspended ceiling with the wiring points fixed to a uni-strut down stand within arm's reach of the rear of the light fitting (within the void) and final connection to the luminaries shall be via plug-in ceiling roses. Heat resistant flex to BS6500: 2005 / HOFR types 3183TQ shall be used to terminate directly into the luminaries connection block.

All luminaries within offices, workshops and laboratories shall be high frequency type with optics to meet current LG3 and LG7 standards.

Luminaries shall be supplied complete with all lamps and controllers and shall be installed in accordance with the manufacturer's instructions.

Lighting installations shall be connected to a circuit protective conductor.

Luminaries shall be suitable for continuous operation at 230 volt 50 Hz except for those used for emergency lighting.

The Contractor shall provide 15% spare lamps of each type installed i.e. 50No. T5 35W and 25No. PL 18W lamps are installed, therefore hand over 8 No. T5 35W and 4 No. PL18W lamps as spares to the Estates Department.

LED lighting shall be utilised as far as reasonably practical to minimise energy consumption and ongoing maintenance. However colour temperature (K), colour rendering (Ra) and glare (UGR) must be carefully considered against the environment.

7.03 External Lighting

External lighting within the University Campus is divided into four types:

i. High level building mounted floodlights.

ii. Low-level building mounted bulkheads.

iii. Lighting columns.

The use of bollards shall not be permitted on campus, without permission from the Electrical Engineer.

The external lighting installation shall be installed in accordance with the ILE Guidance for Intrusive Light.

For new external lighting installations the luminaires shall be controlled by a Thorlux SMART wired control system with integral sensors within each fitting. The controls shall facilitate photocell switching, PIR switching, dimming, security hold light levels etc. Wireless controls may be utilised with written permission from the Electrical Engineer.

Where existing external lighting is modified, existing contactor controlled photocell/ time switch/ over rider switch circuits shall be retained and modified as required.

Each column or bollard shall be protected by an integral suitably rated fused cut-out.

All external lighting shall incorporate 'white' light lamps, and shall either be HIT Metal Halide, Compact Fluorescent, T5 Linear Fluorescent or LED. LED light sources shall be used as far as reasonably practical.

7.04 Emergency Lighting Systems

The Campus includes a mixture of 'Maintained 50V Central Battery Systems' (standalone fittings and general lighting converted fittings) and 'Maintained/ Non-Maintained Integral Battery Luminaires' (standalone fittings and general lighting converted fittings).

The existing 'Maintained 50V Central Battery Systems' are primarily wired utilising MICC cabling. Any alterations shall be undertaken utilising soft skin firetuff enhanced cabling i.e. FP Plus or similar. Circuit cables are to be directly terminated into the luminaries. **Any alteration to these systems must be agreed with the Electrical Engineer.**

All new installations and refurbishments shall be provided with the following:-

- Standalone LED maintained/ non maintained emergency luminaires complete with integral 3 hour emergency battery.
- Integral self test/ self diagnostic capabilities.
- **Include a self adhesive label denoting emergency luminaire reference.**
- A local 'Zonal Report Switch' complete with PDA/laptop connection point.
- Connection to a local 'Self Test/ Self Diagnostic' control panel, including addressing of all emergency luminaires. The 'Zonal Report Switch' shall be connected to a maximum of 30 No. emergency luminaires (20 No. for new installation/ refurbishments) and shall be installed within risers.
- A maximum of 30 No. Zonal Report Switch' shall be connected to a single 'Self Test/ Self Diagnostic' panel (20 No. for new installations/

refurbishments). The 'Self Test/ Self Diagnostic' control panels shall be located within risers.

- The complete system shall include 'safe addressing' whereby additional luminaires installed within an existing 'Self Test/ Self Diagnostic' circuit does not affect the 'addressing numbers' of the existing emergency luminaires.
- All 'Self Test/ Self Diagnostic' control panels shall include GSM connection to a secure web based monitoring system. All 'Self Test/ Self Diagnostic' control panels shall be provided with extended aerials such that the aerials are mounted on the roof of each building.
- The contractor shall include for the first 12months licence fees for the web based monitoring system/ 'Self Test/ Self Diagnostic' Panel.
- The complete system shall be Thorlux Platform 3.

The extent of the above 'Self Test/ Self Diagnostic' system and the location of all control panels shall be agreed with the Electrical Engineer and Project Manager at the outset of <u>ALL</u> projects.

All compartments shall be provided with a minimum of 2 No. Emergency luminaires (1 No. of these maybe an illuminated exit sign).

The Electrical Contractor shall provide photoilluminescent 'JayLite' running man exit signs within all plantrooms, comms rooms and crawl ducts.

The Contractor shall request a 'excel file' copy of the emergency lighting luminaire reference sheets for the area concerned and shall fully update the sheet to include all new and modified emergency luminaires within the area. The labelling shall be fully agreed with the Electrical Engineer prior to undertaking the works.

The Contractor shall request a 'AutoCAD file' copy of the emergency lighting layout for the area concerned and shall fully update the drawing to include all new and modified emergency luminaires within the area.

AutoCAD layouts of the Emergency Lighting scheme shall be uploaded by the Electrical Sub-Contractor to the Platform 3 website.

Platform 3 'AT' controllers and 'ZRS' (Zonal Report Switches) units 'names' shall be agreed with the Electrical Engineer prior to programming. Generally the following standardised naming practice shall be utilised:-

- AT Controllers;
  - 'AU – AT No. ? – Building Name – Floor Level – Area'.
  - i.e. 'AU – AT No. 1 – Main Building – 7th Floor – 'C' Corner'.
- ZRS;
  - 'AT No. ? – Circuit ? – arear'
  - i.e. 'AT No. 1 – Circuit A – Corridor'

To enable tracing of CANbus cabling both ends of all CANbus cabling (cabling between DDU's) shall be labelled. The labelling shall state:-

- Name of next connected DDU.
- Location of next connected DDU.

Where the CANbus is 'broken in to' for the installation of an additional DDU, the labelling at the DUDU cables either side shall be updated.

7.05 Emergency Lighting Design

Emergency lighting design shall be provided as follows:-

Area	Lux level at floor level
Corridors	1 Lux on centre line, minimum of 0.5 Lux across the complete corridor.
Stairwells	1 Lux on all treads/ landings.
Rooms over 60m^2	Minimum 0.5 Lux across the complete area.
Rooms forming part of an escape route	Minimum 0.5 Lux across the complete area.
Kitchenettes	Minimum 1 Lux across the complete area.
Kitchens	Minimum 50 Lux above high risk areas and 15 Lux to remaining areas.
First Aid Rooms	Minimum 15 Lux on working plane.
Plantrooms/ Risers (Services Control Panels) etc	Minimum 15 Lux near rotating machinery/ LV panels/ BMS panels/ Distribution Boards and minimum of 2 Lux to remaining areas.
Laboratories	Minimum 1 Lux across the complete area.
Lecture Theatres	Minimum 1 Lux across the complete areas.
Security Office/ First Aid Rooms	Minimum 15 Lux across the complete area.
Canteens/ Café etc	Minimum 1 Lux across the complete space.
Emergency Exit crash bars/ Doors with 'push to exit buttons'	Illuminated exit sign including a downward light distribution to be provided.
Disabled Refuge Points	Emergency light fitting to be provided above the refuge location, Minimum 2 Lux at floor level.

The emergency lighting installation shall be in compliance with BS 5266 (all sections) and Building Regulations.

All emergency lighting circuits shall be installed such that the emergency luminaries can be tested without isolation of supply to general luminaires on the same circuit.

7.06 BAFE Certification

For emergency lighting installations within new buildings and within major refurbishments modular BAFE certification to SP203-4 shall be provided.

7.07 Lamp Types

The following shall be applied to all campus buildings, external spaces, refurbishments and new builds:-

i. Ceramic metal halide (HIT) type with UV filters, 4000K, minimum Ra 60. Where HIT type lamps are used internally, instant re-strike type lamps shall be provided and the Ra shall be increased to suit the application.

ii. Linear Fluorescent lamps shall be Triphoshour T5 type, 4000K, minimum Ra 80.

iii. Compact Fluorescent lamps shall be 4-pin (electronic control gear) 2D or 4-pin (electronic control gear) PL type, 4000K, minimum Ra 80.

iv. All LED sources to be as per luminaire manufacturer's standard and shall be 4000K, minimum Ra 80 for internal luminaires and minimum Ra 70 for external luminaires. All LED chips on a board shall be circuited in parallel. All LED's and control gear shall have a life expectancy of at least 50,000hours based on L70/B10. All LED lamps shall be the 'replaceable type' i.e. the LED 'lamp' can be removed from the luminaire. All LED's shall be selected from a controlled 'bin' range to ensure there is no visual difference in lamp colour.

v. Low voltage tungsten halogen 'LED replacement lamps' shall only be permitted within minor refurbishments and their use must be agreed with the Electrical Engineer.

vi. Low voltage tungsten halogen, dichroic lamps are strictly prohibited.

vii. Incandescent (GLS) lamps are strictly prohibited.

viii. All Fluorescent lamps shall be supplied via high frequency control gear.

ix. All lamps to have a minimum guarantee of 3 years.

7.08 Illumination Levels & Control Philosophies

The following shall be applied to all campus buildings, external spaces, refurbishments and new builds:-

Area	Average Lux Level	Working Plane	Uniformity	Controls
Stairwells	150 Lux	Floor level	0.6	A*
Corridors	100 Lux	Floor level	0.6	A*
Tiered Lecture Halls	500 Lux	Desk level	0.7	B
Standard Lecture Room	500 Lux	Desk level	0.7	C
Classrooms / Tutorial Room	300-400 Lux	Desk level	0.7	C/ C*
Computer Lab	400 Lux	Desk level	0.7	C
Laboratory	500 Lux	Desk level	0.75	C
Office	400 Lux	Desk level	0.7	C/ C**
Plantrooms	200 Lux	Floor level	0.5	D
Risers/ confined spaces	200 Lux	Floor level	0.5	D
Store rooms	100 Lux	Floor level	0.5	C
WC's	200 Lux	Floor level	0.6	A
IT Comms Rooms	300 Lux	Floor level	0.6	D
Entrance Lobbies	200 Lux	Floor level	0.6	E
Reception desks	300 Lux	Desk level	0.7	E
Kitchens	500 Lux	Desk level	0.75	A
Kitchenettes/ Staff rest rooms	300 Lux	Desk level	0.6 0.75 on worktops	A
External walkways	10 Lux	Ground level	0.3	F
External – Building Entrances	50 – 100 Lux	Ground level	0.5	F
Car Parks	10 – 20 Lux	Ground level	0.3	F
Car Park Pay Machines	30 Lux	Ground Level	0.7	F

A – Presence detection and Daylight control (where there are windows/ rooflights).

- 'Switch on' when presence is detected.
- 'Dim' to required light level to compensate for daylight **(Dimming requirements to be agreed with the Electrical Engineer and Project Manager).**
- 'Hold off' if there is sufficient daylight (when natural light within the space is150% above required average lux level).
- 'Dim' to 20% security lighting after 10minutes of no presence detection.
- 'Off' after 20 minutes of no presence detection.

A* – As per 'A', however within circulation areas, after the security level time out, 1 fitting in 3 to remain on at 20%.

B – Scene setting controller to be provided, allowing the selection of a minimum of 4 No. pre-set scenes and the ability to manually 'dim' the pre-set scenes.

C – Absence detection, Daylight control and manual retractive (PTM) switch.

- 'Switch on' by pressing the retractive (PTM) switch.
- 'Dim' to required light level to compensate for daylight **(Dimming requirements to be agreed with the Electrical Engineer and Project Manager).**
- 'Hold off' if there is sufficient daylight (when natural light within the space is150% above required average lux level).
- 'Switch off' by pressing the retractive switch.
- 'Off' after 20 minutes of no presence detection.

C* – As per 'C', however in connecting Lecture Theatre/ rooms with a moveable partition, provide a manual latching switch adjacent the lighting controls which shall link the motionline wiring so that the room lighting operates as one when pressed.

C** – As per 'C', however in open plan offices, a PTB retractive switch switch shall be installed such that there is no manual 'dimming' capability.

D – Presence detection and 'key switch' over ride.

- General use:-
  - 'Switch on' when presence is detected.
  - 'Off' after 15 minutes of no presence detection.
- Maintenance/ Installation works etc:-
  - 'Switch on' when presence is detected.
  - 'Hold on' lighting by operation of a 'key switch' (fishtail type key switch complete with neon indicator to identify when 'Hold on' is activated).
  - Turn off 'Hold on' lighting by operation of the 'key switch'.
  - 'Off' after 15 minutes of no presence detection

E – Manual switching and daylight control.

- Two way switching (or more) to be provided to allow ease of 'switch on/ off' by reception staff and security staff.
  - 'Switch on' by toggling manual latching switch.
  - 'Switch off' by toggling manual latching switch.
- 'Dim' to required light level to compensate for daylight **(Dimming requirements to be agreed with the Electrical Engineer and Project Manager).**
- 'Hold off' if there is sufficient daylight (when natural light within the space is 150% above required average lux level).

F – Photocell, Time Switch and Over ride control.

- 'Hold off' if there is sufficient daylight.
- Switch on based on Time Switch.
- Over ride switch for 'hand', 'auto', 'off'.
  - Individual fitting SMART controls/ photocells preferable.

The exact philosophies shall be agreed with AU Electrical Engineer on each project prior to commissioning.

To fulfil the above requirements fittings are to include integral sensors i.e. SMART+ (Thorlux) controls system.

All sensors/ controls shall include a 'power monitoring' facility which shall monitor the following:-

- The total hours powered.
- The total hours powered since last reset.
- The hours the luminaire has been switched on since last reset.
- The average output level since last reset.
- Log 4,000 hours of operation.

NOTE; Scene setting control plates shall be used within meeting rooms, interview rooms and presentation spaces. The Scene setting control plates shall provide the following functions:-

- Lighting off on entry (absence detection/ daylight control).
  - ECO button
    - Turn lights on to preset level c/w absence detection and daylight dimming/ bright out automatic control.
  - Scene 1 button
    - Adjust light output/ scene to predefined scene (to be specified for each installation) c/w absence detection and daylight dimming/ bright out automatic control.
  - Scene 2 button
    - Adjust light output/ scene to predefined scene (to be specified for each installation) c/w absence detection and daylight dimming/ bright out automatic control.
  - Off button
    - Turn lights off.
  - DIM button
    - Press and hold to dim light levels up and down c/w absence detection.

The location of automatic controls shall be carefully considered to ensure there are no 'blind spots' and that 'strike times' are minimised. It is University practice to incorporate automatic controls in to general lighting luminaires where practical i.e. SMART luminaire versions. The preferred solution is the Thorlux SMART.

The Consultant/ Contractor shall carry out detailed illumination calculations and shall obtain room reflectance's from the Project Manager. The calculation Maintenance Factor shall be based on a 'replace when failed' lamp replacement strategy.

Any and all areas not identified above shall be bought to the attention of the Electrical Engineer and illumination levels agreed at the outset of all Projects.

7.09 Wiring Types

Both hard wiring and pre-wired modular leads are acceptable on campus, as detailed below:-

Installation	**Wiring Method**
Suspended continuous lighting system.	Pre-wired modular (integral)
Modular luminaires (etc) within suspended ceilings.	Pre-wired modular. Cables to be contained within basket.
Surface fittings.	Hard-wired. Cables contained within conduit/ trunking system.
External.	Hard-wired. Wireless SMART communications.

Alternative methods may be utilised subject to approval of AU Electrical Engineer.

All pre-wired leads shall be supplied by the appropriate luminaire/ controls manufacturer and shall comply with the following:-

- Halogen free, low smoke, flexible cord (NOPOVIC-LSOH).
- BSEN 60320-2-2.
- IEC 60332-1
- IEC 61034
- IEC 60754-1, IEC 60754-2

SECTION 8 - Small Power & Ancillary Circuits

8.01 Small Power Outlets

Power circuits using 13A socket outlets shall be protected by an RCD (Residual current device) or RCBO (Residual Current Breaker with Overcurrent Protection) rated at 32A / 30mA. Socket outlets for general internal locations shall either be single or twin gang three pin shuttered, double pole switched, with dual earth terminals to BS1363: Part 2: 1995. Plates shall be overlapping suitable for flush mounting or flush with the box edge of surface mounted sockets. All twin socket outlets shall have outboard rockers.

Area/ Service	**RCD/ RCBO Position**
General office	Distribution Board
Computer Lab	Dado trunking
Laboratory	Dado trunking
Lecture theatre	Distribution Board
Classroom/ Tutorial room	Dado trunking
Cleaners sockets	Integral to the socket

Mounting height shall be 1000mm to the centre of the socket outlet assembly when using a cable management multi-compartment trunking from finished floor level.

Mounting heights shall be 450mm to the bottom of the socket outlet assembly when installed individually from finished floor level.

These mounting heights may alter in a project specification to suit furniture/ equipment. It shall be Contractors responsibility to fully co-ordinate accessory heights/ locations and ensure Part M compliance.

In computer teaching rooms it is not advisable to connect more than six PC's to each individual power circuit. In classrooms/ Tutorial rooms the quantity of sockets per circuit shall be carefully considered against the use of personal laptops/ chargers. This is to prevent nuisance tripping.

Socket outlets for workshop or general industrial locations shall be manufactured to IEC 60309-2 and BS EN.60309-2. These socket outlets shall be supplied with the appropriate plug top and be wired as radial circuits.

The earth terminals of faceplate of all accessories installed shall be connected to the metal recessed back box/ metal surface box via a 'green and yellow' insulated 2.5mm^2 CPC.

All socket outlets shall include outboard rockers and 2 No. earth terminals.

All fused connection units shall include neon indicators.

Each final circuit supplying equipment where the total earth leakage current is expected to exceed 3.5mA shall be provided with a BS EN 60309-2 compliant socket outlet. The Contractor shall provide a suitably rated socket outlet, plug and lead. The CPC of the lead shall have the same CSA as the line conductors. The Contractor shall connect all leads and plugs to the equipment and carry out a PAT test.

8.02 Final Circuits

Ring main circuits for general use socket outlets shall not be used to feed other equipment i.e. spur's off rings shall not be permitted.

Security equipment shall be supplied via dedicated circuits.

Life safety equipment shall be supplied via dedicated circuits.

Separate circuits shall be provided for cleaners sockets and for fridges/ freezers, these shall not be connected to general use ring main circuits.

Power and lighting loads shall not be mixed on the same circuit or the same distribution boards. Separate power and separate lighting distribution system shall be provided.

8.03 Residual Current Devices

All RCD protection shall be in the form of:-

- Active RCBO's within distribution boards.
- Active RCD's within dado trunking modules.
- Active RCD's within cleaners sockets.
- Passive RCD's within sockets for fridges/ freezers.

RCD protection shall be provided to all outlets up to 20A rating. Where equipment needs dictate that RCD protection can not be provided, the outlet shall be labelled stating what can be connected and a specific Risk Assessment shall be produced and appended to the Electrical Installation Certificate and a copy provided within the feeding distribution board.

8.04 Connection Units

All fire alarm panels shall be supplied via fused double pole isolators with 'fish tail' key switch operation'.

All switched/ unswitched fused connection units shall be complete with neon indicators.

All industrial outlets shall be lockable in the off position.

All hand driers, water boilers, VAM units, panel heaters etc shall be connection to the fixed electrical installation via fused connection units, the final connection lead shall be contained within conduit which shall be terminated directly into the equipment/ behind the equipment mounting plate as to negate trailing flexible connections and flex outlet plates. This is to protect the final connection cable/ flex, thereby reducing risks and increasing 'In-Service Electrical Equipment' (PAT) test frequencies.

8.05 Accessory Finishes

The following accessory finishes shall be applied to all internal, external, new and refurbished areas:-

Area/ Service	Construction	Finish
Dado trunking within tutorial rooms/ offices etc.	Brushed Stainless Steel	Albany Plus, MK (on white dado trunking).
Recessed/ surface mounted accessories within lecture rooms/ tutorial rooms/ offices.	Brushed Stainless Steel	Albany Plus, MK (on white painted walls).
Recessed/ surface mounted accessories within circulation spaces.	Metal clad.	Self finish grey metal (on white painted walls).
External	IP66 UV stable thermosetting plastic.	Self finish grey plastic.

SECTION 9 - Fire Alarm

9.01 General

Work required to modify or alter any part of the existing fire alarm system or the fire alarm network shall be first cleared with the Electrical Engineer and shall be carried out in accordance with BS5839.

The University Main campus includes a networked Fire Alarm system with multiple nodes and panels. Any additional Panels shall be connected to the network. The works must be carried out under the supervision of the Electrical Engineer, to allow logging of any faults prior to and following connection of new panels.

A dedicated power supply shall be used to supply the control panel and the integral battery stand-by units. No other circuits are to be connected to this circuit. The power supply shall be derived form a MCCB device, preferably within the Main LV Switchpanel for the building or from a dedicated Fire Alarm distribution system. The final connection shall be via a 13A fused double pole isolator complete with 'fish tail' key switch.

Cable to be used for this supply shall be to the same standard as the fire alarm installation i.e. hard skin enhanced fire tuff cable with a red outer sheaf such as FP Plus/ Enhanced or equal and approved. 'Standard' FP shall not be permitted. All cables shall be PH120 to BS EN 50200.

All new fire alarm equipment shall be Honeywell Building Solutions S-Quad range.

All fire alarm works shall be carried out using 'safe addressing', retaining the address numbers of existing equipment.

All manual call points shall be provided with integral, clip on, clear plastic flip covers to prevent accidental operation.

All powered 'Fire Engineering Solutions' i.e. smoke vents, fire/ smoke shutters/ curtains etc shall include Fire Alarm Interfaces for operation and fault monitoring (including loss of mains supply and battery/ charger failure).

Red fire rated cabling is not UV stable, as such all external fire alarm cabling shall be contained with conduit/ trunking.

All powered 'Fire Engineering Solutions' shall have a minimum back up battery period/ capacity of 5x operations after 24 hours of battery operation (no mains supply).

NOTE; The Main Building Fire Alarm panels, lower ground floor shutters and crawl void aspiration systems are supplied from an LV Panel with Gosta 'B' Substation that has a standby supply from the DRUPS system.

The Fire Alarm network installed on campus is a GENT by Honeywell Vigilon system using 'BS' software. The 'white light' VAD's release in 2014 are not compatible with 'BS' software (insufficient power supply card), as such standard 'RED light visual beacons' shall be used onsite.

Any modifications shall be agreed with the Electrical Engineer as the system software is to be changed from 'BS' to 'EN' over the coming years.

BAFE SP203-1 Modular Scheme for Fire Detection & Alarm Systems shall be provided for all Fire Alarm works. Where M&E Building Services Design Consultants are utilised, they shall undertake a 'preliminary design' with full design responsibility/ certification by Honeywell Building Solutions.

9.02 System Design

All designs shall be agreed with the AU Electrical Engineer and AU Fire Safety Advisor prior to commencing works.

The exact system category shall be determined by risk assessment and shall be agreed with the Electrical Engineer and Fire Officer.

As a minimum the following areas shall be provided with fire alarm detection:-

- All corridors/ stairwells.
- All escape routes (consideration should be given to open plan offices which form part of the escape route).
- High risk areas i.e. plantrooms, laboratories, kitchens etc.
- Sleeping accommodation.

Fire Alarm system annunciation shall be provided via the following:-

- Detector incorporated sounder/ beacon units.
- Surface mounted sounders/beacons.
- Hard of hearing pager systems.
- NOTE: Visual alarms (beacons) shall be provided within all areas.

Manual call points within circulation areas and plantrooms shall include a hinged plastic cover.

As a minimum Fire Alarm interfaces for mechanical plant, laboratory systems (equipment, gasses, ventilation etc) shall be provided with 'over ride switches' for disconnection during routine testing. The exact requirements shall be agreed with the Electrical Engineer and Fire Officer on a project basis.

All void mounted detectors shall be provided with a ceiling recessed visual LED indicator to allow the exact location of a fire to be determined.

Where areas require detection that will cause a maintenance issue i.e. difficult to reach areas then the use of either aspiration systems (with the control panel located in an accessible location) or a 'Skorpion' remote test unit shall be used. The exact solution shall be agreed with the Electrical Engineer.

As part of all Fire Alarm works the Winmag front end PC software/ programming/ graphics shall be updated and the contractor shall ensure that Groups, Master Sectors, Sectors controls are maintained. Any new command builds/ use of sectors etc must be agreed with the Electrical Engineer and all software alterations added to the Fire Alarm Architecture Register.

All domain and domain bridge network cabling shall be designed and installed to ensure routes are diverse and fire protected.

Where multiple panels are installed within a building, then detectors shall be identified by providing a coloured sticker to each device and to the feeding panel. Where this arrangement is already in place, then all new devices shall also be identified in the same manner.

All device labels shall be agreed with AU Security department (all shifts) prior to commencing programming. The Fire Alarm contractor shall provide a

marked up drawings and typed spreadsheet with all devices and label descriptions for approval. Allow 2 weeks for Security to comment on labels.

9.03 System Category

The following table details the Fire Alarm category per building on campus, all modifications/ new installations shall be in accordance with this schedule:-

Building	Category	Comments
Main Building/ North Wing/ South Wing	L4 Enhanced	<u>Enhancements (Detection)</u> LV Switchrooms/ Plantrooms/ Lift Motor Rooms/ Cleaners Rooms/ Kitchens <u>Enhancements (MCP)</u> Laboratories <u>Enhancements (VAD)</u> WC's/ Plantrooms/ Lift Motor Rooms/ Areas without staff supervision
Student Guild	L3	
EBRI	L1	
CA/ ABS	L1	
Library	L3	
ADH/ ABC	L3	
Vision Science / Dentist	L3	
Woodcock Sports Centre	L1	
Boiler House	L3	
Shustoke	L3	

9.04 Documentation

The Contractor shall provide/ update the following information for ALL new build and refurbishment works:-

- List of all devices including location and reference.
- Cause and Effect Schedule.
- Fire Alarm layout Drawings.
- Fire Alarm network schematic and plan.
- Winmag Programming.
- Fire Alarm Architecture Register (Sector, Master Sector, Groups listings)

SECTION 10 - Miscellaneous Systems

10.01 CCTV and Intruder Alarms

Work required to modify or alter any part of the CCTV and Intruder Alarm systems shall be first cleared with the Electrical Engineer and Head of Security.

A dedicated power supply shall be used to supply the cameras and or control panels. No other circuits are to be connected to this circuit. The power supply cable shall be terminated via a non-switched fused spur mounted adjacent to the camera or panel on internal installations. Power supplies to cameras mounted externally shall be lockable 2 pole switch disconnector rated to IP 54 installed within 1m of the camera position.

Work required to connect any part of the CCTV and or Intruder Alarm systems to the University's multi core data cable network (Janus System) shall be first cleared with the Electrical Engineer and Head of Security. If there are any additions or alterations made, the contractor shall update the University record drawings and schedules.

10.02 Voice & Data Installation

Aston University employs a structured cabling infrastructure for PC's and telephones. The data cabling installation shall be in accordance with the Aston University Structured Cabling specification (available from the Aston University IT Department).

The structured cabling shall be installed by approved persons in accordance with the Aston University Structured Cabling specification within the main cable containment installed by the Electrical Contractor. All final circuit conduits shall be installed by the structured cabling installer (this shall be fully agreed between the Electrical Contractor and Aston University IT Department prior to undertaking the works).

LV and ELV cables shall be suitably segregated in accordance with BS 7671 and BS EN 50174-2. LV and ELV (IT cabling) shall be segregated along their entire length with a exception of a maximum of 10m not segregated regardless of the total length of the cable.

10.03 Disabled WC Alarm System

All disabled WC's shall be provided with a 'Part M' compliant assistance alarm.

The system shall include a red pull cord adjacent the WC with 2 No. triangular red handles and an integrated reassurance lamp/ tone unit within the ceiling rose/ base, a wall recessed reset/ call button mounted adjacent the WC, an over door lamp/tone unit (outside the WC) and a link to the site wide Janus System. The Janus system connection shall be programmed to display the call within the security office.

The disabled WC alarm PSU must be fed from a dedicated radial circuit.

10.04 Disabled Refuge Alarm System

All designated disabled refuge locations shall be provided with a flush wall mounted 'outstation' voice call point complete with induction loop, braille, tactile and luminescent text and the unit shall be finished in green.

The 'outstations' shall be connected to a 'Control Panel' within the reception area via loop wired enhanced hard skin fire tuff cabling i.e. FP Plus. The 'Control Panel' shall include a hand set, individual selector buttons per 'outstation' and a 'glass lockable cover'. A 'breakglass box' shall be provided adjacent the 'Main Panel' with the keys

for the ‘Control Panel’ glass door, 4 No. Further sets of keys shall be provided to the Security Department.

The campus comprises of a networked Baldwin Boxall System, with main panels/ handsets within the Security Office. All new outstations shall be connected to the network and additional panels/ handsets provided within the Security office as required so that there is a separate indicator/ button for each outstation. The schedule of outstations, provided within the Security Office shall be updated and an Electronic copy issued to the Electrical Engineer.

The Baldwin Boxall system is interfaced to the Fire Alarm system such that the outstation only become ‘live’ when that building is in fire condition or the over ride key switch within Security Office is operated.

10.05 Audio Visual Systems

Please refer to separate Audio Visual system policies (Aston University IT Department).

10.06 Gas Detection Systems

Gas detection systems shall be provided within all laboratories, healthcare areas, internal gas bottle stores and plant rooms (CHP’s) etc where a there is a risk of a build-up of an explosive atmosphere or oxygen depletion due to a gas ‘leakage’.

The areas shall be provided with a 3 stage alarm:-

- GREEN indicator = Healthy.
- ORANGE indicator = Low oxygen levels, EVACUTE.
- RED indicator = Explosive environment/ dangerously low oxygen levels, EVACUATE IMMEDIATELY.

All detectors to be ‘long life’ type.

Visual indicators and sirens shall be provided both inside and outside the area being detected.

All control panels shall be located outside the area being detected.

10.07 Standby Power Systems

The location of and incorporation of any UPS/ Standby Generator shall be agreed with the Electrical Engineer.

All standby periods shall be fully agreed with the University Project Manager and Electrical Engineer.

All equipment shall be suitably sized for continuous full load running and to cater for the ‘impact load’ at start up.

10.08 Lightning Protection Systems - Structural

All buildings shall be provided with a structural lightning protection system comprising of a NF C 17-102 and IEC/ EN 62305 compliant ‘ESE’ (Early Streamer Emitter) and insulated copper tape (or use of structural steelwork) down conductors.

Each ‘ESE’ shall be connected to earth via a minimum of 4 No. down conductors/ earth electrodes i.e 1 No. per corner of the building. The overall resistance to earth shall not exceed 8 Ohms for new installations and system modifications.

An induction ‘Strike Counter’ shall be installed and shall measure actual lightning strikes only, other atmospheric electrical conditions must not be registered.

All roof tapes shall be bare conductors and all down tapes shall be PVC insulated. All conductors shall be securely fixed to the structure and jointed in accordance with BS EN 62305.

For all new LPS installations/ systems upgrades the Contractor shall update the University’s ‘ESE’ protection area drawing.

For all on-going structural LPS annual inspections the overall resistance to earth shall be maintained at below 10 Ohms.

All ‘ESE’ units shall be selected to provide full coverage of the building, plus a minimum of and additional 10m zone. All ‘ESE’ units shall be manufactured by ‘Safe Strike’.

10.09 Lightning Protection Systems - Electronic

Electronic Lightning Protection shall be provided in accordance with BS EN 62305 for all new builds and major refurbishments.

This shall include, but not be limited to the following:-

- Surge suppression on all incoming and outgoing LV & HV cabling (including external lighting and power supplies etc),
- Surge suppression on all incoming and outgoing communications cabling (including Security/ CCTV cables, Fire Alarm links and BMS links etc).
- Surge Suppression on IT Comms rooms dedicated distribution boards.
- Surge Suppression on all Fire Alarm Panels and other life safety system control panels.

The extent of surge suppression system devices and rating shall be in accordance with a risk assessment carried out by the Contractor and in agreement with the Electrical Engineer and the University’s insures.

10.10 Metering System

Aston University operates an Elcomponent ‘MeterRing MM’ AM&T system. This consists of a PC plus database, which polls all attached electricity, water, gas and heat meters every half hour via the University’s data network and collects data. All newly installed meters must be connected to this system.

Elcomponent’s AEM33P multi-parameter kWh meters shall be provided to meter electricity consumption at all small power, lighting, mechanical services distribution boards, BMS panels and significant loads. All metering provisions shall be in accordance with TM39 and Building Regulations Part L.

No other type of meter shall be permitted on site.

The standard means of communication (meter to PC) at Aston University is via an Ethernet ‘gateway’.

Compact radio modules for pulse data collection shall not be used without authorisation from the Electrical Engineer and the Energy Manager. All batteries shall have a minimum operational life of 10 years. The equipment shall operate on a dedicated frequency to prevent interference. The M&E contractor shall include for all

4 channel pulse loggers for hardwire connections shall not be utilised without authorisation from the Electrical Engineer and the Energy Manager.

The metering manufacturer shall be employed by the Electrical contractor to fully commission the metering system.

The complete metering system shall be demonstrated to the Electrical Engineer prior to handover, the demonstrations shall include a 'known' load test to ensure the CT ratios and meter calibrations are correct.

All electricity meters shall provide the following readings to the AM&T system:-

- Current (A), all phases.
- Voltage (V), all phases and variations.
- Power Factor (PF), all phases and total.
- Real Power (kW), all phases and total.
- Apparent Power (kVA), all phases and total.
- Reactive Power (kVAr), all phases and total.

All metering cables shall be shielded type.

Commissioning guidelines

1. For electricity meters contractors need to install meters that are compatible with the Elcomponent aM&T system. This will mean all sub and main incomers are connected to an Elcomponent gateway device that links to the University's IT network.
2. Contractors need to take note of the MAC address of any gateway device installed – this is typically on the back of the Gateway module.
3. Aston University's IT department need to be aware of any data points being installed that Gateways are linked to – preferably they should manage the data point installation. Please contact Gary Brittain to arrange this on ext. 4446 or email isa_networking@aston.ac.uk.
4. IT need to make any data points live (there is a cost associated with installation and making points live).
5. IT need to be given the MAC address of the gateways and the data point that they are connected to.
6. IT Networking will then provide contractors with an IP address for the purposes of adding the meters to the metering software.
7. The University's default gateway is 172.27.12.254 and its Subnet Mask is 255.255.255.0
8. Once all this is complete then please contact Elcomponent directly on 01279503173 and provide them with the IP address, default gateway, subnet mask (and meter details) given.

All electricity meters and associated CT's shall be installed and commissioned by Elcomponent unless specifically agreed with the Electrical Engineer or Energy Manager.

All meter software licenses/ OFCOM radio transmission licences shall be purchased by Aston University ECD Energy Manager only. The contractor/ designer shall notify the ECD Energy Manager when additional licences are required for a project, a minimum of 2 weeks prior to commissioning.

10.11 Fire Stopping

The contractor shall ensure that the integrity of all walls, floors, ceilings etc through which cables, containment and fittings are installed are re-instated to the same

standard as the whole of the wall, floor, ceiling etc as to not impair the fire resistance of the structure and to minimise the spread of smoke.

All penetrations through formal fire walls shall be made good to the formal fire resistance integrity of the structure i.e. 1 hour or 2 hour.

All penetrations through all other structures shall be made good to a suitable standard as to minimise the spread of smoke.

The contractor/ designer shall review the site/ building Fire Strategy drawings prior to starting works and shall identify all penetrations through fire rated partitions and ensure suitable re-instatement is carried out.

10.12 Mechanical Services Power Supplies

The Electrical Contractor shall liaise with the Mechanical Contractor during the tender period to identify all such power supplies and control wiring as required and shall fully allow for such.

The following details minimum workmanship/ installation requirements:-

Inverters;
An on-load isolator shall be provided before and after all inverters. Circuit CPC's shall be maintained throughout the circuit, including connection of SWA's at all terminations to the CPC/ earth terminals.

Inverter Frequency;
Inverters shall not operate at a frequency above 50Hz.

AHU's
All wiring within AHU's shall be continuous, cable joints are not permitted.

NOTE:- Inverters shall not be operate above 50Hz.

SECTION 11 - Inspection and Testing

11.01 General

i. On completion of additions, alterations or complete new installations, the prescribed tests and inspections must be carried out to verify that the installation conforms to the requirements of BS7671 and associated IEE Guidance Notes.

ii. When work requires a completion certificate of any type, the tests are to be recorded during the construction phase and given to the Estates personnel ordering the work.

iii. Failure to submit the appropriate completion certificate will result in a delay in payment and/or may result in your company being removed or suspended from our approved list. The Electrical Engineer or a member of the Estates & Facilities Electrical Maintenance Section shall be invited to witness any testing carried out.

iv. All Electrical Installation Certificates, Electrical Minor Works Certificates and Electrical Installation Condition Reports shall be uploaded, by the contractor carrying out the works, to the Guardian TraQit website. Refer to the materials schedule for contact details.

v. Inspection shall include a physical check that all equipment has been securely fixed and that all electrical connections are mechanically sound.

vi. In addition to the test at the completion of each installation, certain tests shall, be done during the progress of the Works, as detailed below and by BS 7671.

vii. For equipment supplied under the Contract, the Contractor shall obtain from Manufacturers the time, current characteristics of all protective devices for automatic disconnection of supply and provide copies to the Project Manager and to the person or persons carrying out the inspection and testing.

11.02 Testing Methods

i. The Electrical Engineer shall be notified of the method to be used for each type of test and the notification shall be given not less than 7 days before the tests are to be made.

ii. Testing procedures for continuity of protective conductors and equipotential bonding shall be in accordance with IEE Guidance Note number 3.

iii. Voltage tests on HV cables and, where indicated, on LV cables, type tested and partially type tested assemblies and transformers shall comply with the requirement of site testing in the appropriate British and European Standards.

iv. Alternative methods may be proposed for the approval of the Electrical Engineer, but they shall be no less effective than those set out in the British and European standards.

v. Equipment shall be disconnected for the duration of the relevant tests, where necessary, to prevent damage to components of equipment.

11.03 Power Cables

i. Tests shall be made immediately on completion of the installation of power cables to demonstrate that the phase sequence is correct at all end connections in accordance with 'Inspection and Testing' BS 7671.

ii. The over-sheaths of cables laid underground shall be given a voltage withstand test prior to and after backfilling of trenches is complete, before termination and after termination.

11.04 Alarm, Control, Communication and Monitoring Cables

i. Cables shall be tested as soon as their installation is complete to ensure that the cores are continuous, that they have not been crossed and that the insulation resistance is satisfactory. Insulation tests shall cover all permutations between each conductor, screen, metallic sheath, armour and earth.

11.05 Conduit and Trunking

i. Where conduit is cast in-situ in reinforced concrete it shall be checked for freedom from blockage and steel conduit shall be tested for electrical continuity before casting and as soon as practicable after casting.

ii. Steel conduit and trunking systems shall be inspected and tested before any wiring is installed, under floor trunking and flush floor trunking shall be inspected and tested before screeding.

11.06 Earth Electrodes

i. The resistance of each earth electrode; whether for earthing of protective conductors, lightning protection of an electrical system, shall be checked as described in BS 7430 immediately after installation of the electrodes and the results submitted to the Electrical Engineer.

11.07 Lightning Protection

i. Where the reinforcement of a concrete structure is indicated to form the down conductors, the electrical continuity of the reinforcing bars shall be tested after each pour of concrete is completed.

ii. At the completion of the whole lightning protection installation it shall be inspected and tested in accordance with BS EN 62305.

11.08 Earth Fault Loop Impedance

i. The measured earth fault loop impedance for each circuit shall be checked. Where the maximum value is exceeded, the Electrical Engineer shall be consulted.

11.09 Emergency Lighting Systems

i. Emergency lighting systems shall be inspected and tested in accordance with the inspection and test procedure laid down in BS 5266, this shall include a full 3 hour discharge test.

11.10 Records and Certification

i. Inspection and test results shall be recorded on the NICEIC forms provided by the approved contractor. A copy shall be submitted to the Electrical Engineer within Seven days of each test.

ii. When all inspections and test results are satisfactory, Electrical Installation Certificates shall be given to the Electrical Engineer not later than the date of completion of the Works. The Certificates shall be given in the form laid down in BS 7671 for electrical works, BS 5839 for fire alarm systems and BS 5266 for emergency lighting systems etc.

iii. The type of earthing employed, the value of prospective short-circuit current and earth fault loop impendence at the origin of the installation shall be recorded on the Electrical Installation Certificates.

iv. Hard copy distribution board schedule/ schematics shall be provided within all distribution equipment and electronic word/ excel files shall be provided to the Electrical Engineer.

SECTION 12 - Hand Over Documentation

12.01 General

Refer to separate ‘Handover Documentation Policy’.

SECTION 13 – High Voltage Distribution

13.01 General

The current campus network operates as follows:-

- 2 No. 11kV 'Western Power Distribution' incoming supplies, both supplies are on the same WPD ring circuit fed from Summer Lane Primary Substation.
- The 2 No. incoming supplies terminate into a WPD owned HV CB Panel with 2 No. metered outgoing CB's feeding the campus network.
- The campus wide network operates as an open ring comprising of Schneider RN2c Ringmaster RMU's and LMT OCB's (protection relays on the OCB's are set to maximum and all Unit protection pilot cables are disconnected).

The aspiration is to modify the current campus network to:-

- A private HV CB panel fed from the 2 No. WPD supplies (off existing metered WPD CB's).
- 3 No. open rings on campus.
- All distribution substations to include RMU's with TLF protection of transformers.

All HV works/ designs are to be agreed with AU Electrical Engineer prior to commencement.

13.02 Automation System/ Fault Location

The use of SCADA type automation systems on HV CB panels and fault identification equipment at distribution substation RMU's shall be reviewed on a project basis and agreed with AU Electrical Engineer prior to commencement.

13.03 Distribution Substations

All distribution substations shall be provided with:-

- Super low loss transformer c/w dynamic voltage optimisation.
  - **Cast Resin transformers are prohibited on campus.**
- RMU c/w;
  - SF6 gas level indicator.
  - Circuitry mimic c/w drop flags.
  - Reflex operation handle.
  - Pfisterer Phase comparator.
  - Remote EPO button c/w integral trip coil for the transformer CB.
  - TLF Transformer protection.
  - Freestanding unit, **close coupled units are prohibited on campus.**
- Earth bar and earth matt/ array.
- Network schematic.
- Name plate.
- 13A twin switched socket outlet c/w integral RCD.
- General (manually switched) and emergency lighting.
- Fire Alarm detection (dual optical heat), fire alarm sounder, fire alarm beacon, manual call point c/w plastic cover.
- Resuscitation chart.

13.04 Private Intake Substation

The private Intake distribution shall be provided with:-

- HV CB Panel c/w bus section with castel interlocks.
  - Vacuum breaker c/w removable cylinder.
  - Circuitry mimic c/w drop flags.
  - Reflex operation handle.
  - Pfisterer Phase comparator.
  - Meter – Voltage, Current, kW, kVA, kVAr (all lines).
  - Sepam protection relay c/w fault display.
  - Freestanding unit, **close coupled units are prohibited on campus.**
- Earth bar and earth matt/ array.
- Network schematic.
- Name plate.
- 13A twin switched socket outlets c/w integral RCD.
- General (manually switched) and emergency lighting.
- Fire Alarm detection (dual optical heat), fire alarm sounder, fire alarm beacon, manual call point c/w plastic cover.
- Resuscitation chart.

13.05 Cable Installation

Buried Cables

- All cables beneath paths, roads or other hard standing shall be installed within rigi twin walled ducts.
- All cables (and ducts) to be laid onto a sand bed, with sand cover.
- All cables (and ducts) to be protected by use of concrete cable marker slabs.
- All cables (and dusts) routes to be identified by buried HV cable marker tape.
- All cable routes to be marked on ‘As Fitted’ scaled drawings.
- Where cables are installed closer than 2m to the extremity of a tree canopy (taking into account canopy size at full growth) tree route ‘shields’ (steel plates) shall be installed.

Internal Cables

- All cables shall be installed on either heavy duty cable ladder or, where installed in concrete cable trenches secured using heavy duty cable hooks/ nylon cleats with 2 number bolts.

Cable joints

- For new cable installations, there shall be a minimum separation of 10m between joints.
- For joints to existing cables, there shall be a minimum separation of 10m from existing silicone filled joints.

SECTION 14 – Vertical Transportation

14.01 General

Closed protocol lift equipment is prohibited on site, all lifts shall be purpose built using open protocol components, as such 'own brand' models shall not be utilised i.e. KONE Monospace, OTIS Gen2.

The following details are general only, and complete lift specification to be agreed with AU Electrical Engineer.

14.02 Drive System

All lifts shall be motor room type, utilising a variable speed inverter driven motor. The use of regeneration drives shall be reviewed on a project basis.

14.03 Power Supply

The lift shall be supplied direct from the Main LV distribution panel. Any alternative shall be agreed with the AU Electrical Engineer.

Surge suppression shall be provided local to the lift supply.

The local supply shall be a lockable rotary isolator c/w overload protection.

14.04 Key Switches

The following key switches shall be provided:-

Name	Operation	Position	Switch
Landing Call Key Switch	Landing call (this is to be used instead of a push button)	Disabled platform / stair lift call stations	Lowe & Fletcher, Dewhurst, 37001. Non latching spring return switch.
Hazardous Goods Movement	Priority control of the lift. Ability to travel in the lift unobstructed i.e. de-activating all landing pushes. Ability to send the lift (unmanned) to a selected floor unobstructed i.e. de-activating all	Within lift car, on the COP.	Lowe & Fletcher, Dewhurst, 37002. Latching and key retaining switch.
Landing isolation	De-activates landing call station.	On each landing, adjacent call buttons.	Lowe & Fletcher, Dewhurst, 37003. Latching switch.
Landing Priority Call	Priorities landing call button i.e. over-rides current lift destination, recalling lift to the activated floor.	On each landing, adjacent call button.	Lowe & Fletcher, Dewhurst, 37004. Non latching spring return switch.

Emergency Lighting Test Switch	Test operation of the in-car emergency lighting. Isolates permanent live supply to the battery pack. ON/ OFF/ TEST positions.	Within the lift car.	Lowe & Fletcher, Dewhurst, 37005, Latching and key retaining switch.
Restricted floor access	Call/ send lift to a restricted floor	Restricted landing entrance positions and on COP for restricted floor access.	Lowe & Fletcher, Dewhurst, 37007. Non latching spring return switch. (Exact suite TBC by ECD dependant on department access)
Lift Isolation	Lift out of service status.	Within lift car, on the COP.	Lowe & Fletcher, Dewhurst, 37006. Non latching spring return switch.

14.05 Landing Doors/ Gates

All passenger use lifts shall be provided with centre opening doors.

All goods only lifts shall be provided with lattice gates. Where goods lifts are within 'front of house' areas a set of stainless steel double doors in-front of the lattice gates shall be provided, the door set shall include door retainers, door stops and an ASSA barrel, the doors shall not form part of the lift safety systems.

All doors shall be provided with full height safety edges.

14.06 Communications

All passenger use lifts shall be provided a 'trapped person alarm' autodialler system to contact the main Security office. The connection shall be both voice (utilising the internal telephone system, Cat6 structured cabling network) and text display (utilising the Janus security system, displaying alarms as a 'Priority 1' on the head end PC).

Monocom autodialler sshall be utilised, complete with induction loops within the lift car.

A lift car/ lift pit (shaft)/ lift motor room communication systems shall also be provided to facilitate communication during maintenance etc.

14.07 Landing Presentation

All lift landings shall be provided with a single vertical surface mounted stainless steel enclosure housing:-

- Landing call buttons (up and down).
- Landing key switches (including labels).
- Floor level visual indicator, including:-

        - Floor level, number.
        - Lift direction, arrows.
        - Out of Service Indicator.
        - Fire Service Indicator.
    - Floor level audible indicator.
    - Engraved Aston University logo (detail to be agreed).

A detailed colour drawing of the above shall be provided to AU Electrical Engineer for approval prior to manufacture.

14.07 Lift Car

All passenger lift cars shall be provided with a DDA compliant interior including:-

- Rear handrail.
- All round low level bump rail.
- Rear mirror.
- Coloured glass side walls (top half).
- Textured/ patterned stainless steel walls (bottom half).
- Full height in car control panel, including:-
    - Floor level push buttons, inc raised numerals and brail.
    - Keyswitches inc labels.
    - Trapped person alarm call button, including speaker, induction loop, microphone, operation label.
- 2 No. A3 lockable landscape display panels.
- Vinyl floor covering.

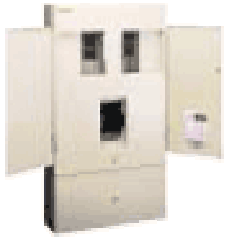
14.08 Fire Alarm

All passenger use lifts shall include a fire alarm recall facility; the facility shall include the recall to 2 No. floors. i.e. recall to ‘escape floor’ and recall to floor above (or below) ‘escape floor’ if the fire is detected within the vicinity of the lift on the ‘escape floor’.

SECTION 15 - Materials Schedule

15.01 Recommended Products & Specialists/ Installers to meet this Specification

Any alternative to the recommended products should be referred to the Electrical Engineer for approval.

Material Item	Manufacturer/ Specialist	Comments/ Image
LV Distribution		
Metering System/ Electricity Meters	AEM-33-P, Multi-functional meter, connected to MeterRing MM AM&T system, Elcomponent, Debbie Burton, debbie@elcomponent.co.uk, 01279 503173,	
Final Circuit Distribution Boards (Type A & B)	Isobar, Acti 9 Isobar, Schneider, Cream finish, Extension box for incomer and meter, Key lock, **NOTE: Separate Power, Lighting & Mechanical Services boards to be provided.**	
LV Panel Boards, MCCB	Powerpack 4 Panel Board, Schneider, **NOTE: Panel Boards shall only be used with permission of the AU Electrical Engineer, the use of LV Switchpanels is preferred.**	 Maximum 400A busbars, Maximum 12No. TPN ways, Cream finish, Extension boxes for incomer and meter(s), Key lock, Floor mounted = Form 4a Type 2 Wall mounted = Form 3b Type 2

Material Item	Manufacturer/ Specialist	Comments/ Image
LV Distribution		
LV Switchpanels	MCH, James Whiteman, sales@mchelec.co.uk, 07506243108, **NOTE: All panel manufacture drawings to be agreed with AU Electrical Engineer prior to manufacture.**	Form 4b Type 6, Schneider protective devices, **Up to 400A;** MCCB NSX thermal magnetic adjustable c/w rotary lockable handle. 230V = 2 Pole 400V = 4 Pole **630A and above;** ACB Masterpact c/w Micrologic control, 4 Pole. All Busbar routes and bus sections to be painted on to the exterior of the panel (circuit mimic). Cream finish. Lockable cable ways/ meter housings. 35 year design life.
Power Factor Correction	Schneider, Verset	Stepped loading, Standalone unit **(units incorporated in to LV panels are not permitted on site),** BMS connection for thermal alarms,
HV Distribution		
Transformers	Power Star HV Max, Energy Management Systems, Mick Meakin, mick.meakin@ems-uk.org 07827 888532,	Amorphous metal core transformer with efficiency of 99.9% or above, Dynamic voltage optimisation within separate enclosure c/w on-board (and remote) controls for disengaging VO and adjusting Voltage output, 50 year design life,
Ring Main Units	RN2c, Ringmaster, Schneider,	TLF Transformer protection, Pfister electronic phase comparator included, **NOTE:- Close coupled (package substations) are not permitted on-site.**

Material Item	Manufacturer/ Specialist	Comments/ Image
HV Distribution		
Circuit Breakers	GenieEvo, Schneider,	Pfister electronic phase comparator included,
Cable		
Fire Alarm Cable	FP Enhanced/ FT120 Firetuff, BASEC approved, Prysmian, Draka,	For loop wiring and fire alarm main feeds. **Red cabling to be enclosed within conduit/ trunking externally for UV protection.**
Fire Alarm Fibre Optic Cable	Fibre to GENT specification, c/w SWA, Prysmian, Draka,	For Domain ring connections. **NOTE;** **Draka Firetuff Fibre SWA to be used where network cables are routed internally within buildings.**
General final circuit cabling	Cu/LSF, 6491B, BASEC approved, Prysmian, Draka,	For steel trunking and conduit installations.
General final circuit cabling	'Flexi-shield' AFUMEX LSX, BASEC approved, Prysmian, Draka,	For use by agreement with AU Electrical Engineer only.
LV Distribution Cables	4c Cu/XLPE/SWA/LSF + CPC, BS6724, BASEC approved, Prysmian, Draka,	Single core cables and HO7 may be used with agreement from AU Electrical Engineer only. **External cables may be PVC sheathed.**
HV Distribution Cables	11kv 3c Cu SWA PVC to BS6622, IEC60502-2, BS7835, Prysmian, Draka,	**NOTE;** **11kv Triplex Cu SWA PVC to BS7870-4 may be used with permission of AU Electrical Engineer.**
Data Cables	Brand-Rex	All components of the data cable installation i.e. outlets, crimped connections etc to be Brand-Rex. Complete installatio to be installed by a registered Brand-Rex approved Partner.

Material Item	Manufacturer/ Specialist	Comments/ Image
Cable Ancillaries		
HV Joints	LoviSil Silicone filled joints, Lovink, **NOTE:-** **Moulded Insulation Resin Protected, Raychem joints may be used with permission of the AU Electrical Engineer.**	A failed joint shall be replaced with 2 No. joints. All new joints shall be a minimum of 10m apart from existing joints.
LV Joints	Resin protected joints, Prysmian, Raychem,	
Cable Markers	k-type, Eland Cables,	For identification of all distribution cables.
Cable Core Identification	Easi-Lok, Eland,	For identification of final circuit cable cores (inc Fire Alarm and other controls systems).
Signage		
Electricity Warning Signage	BCW Office Products Unit 4 Darlington Close Sandy Bedfordshire SG19 1RW 0208 133 6709 Product Code: SSP014 Size: 75mm	 To be provided on the door to all cupboards/ plantrooms etc containing LV or HV Distribution.
Resuscitation charts	Any	To be provided adjacent each LV Switchpanel, LV Panel Board, Transormer and HV Switchgear.

Miscellaneous		
Disabled Refuge System	Baldwin Boxall	
Electrical Installation Certificates, Minor Works Certificates, Electrical Condition Reports,	TraQit, Guardian, Reports Manager, Derek Gabbitas dgabbitas@guardianelectrical.co.uk IT Manager, Steve Greenhalgh sgreenhalgh@guardianelectrical.co.uk Quality Manager, Zoe Taylor ZTaylor@guardianelectrical.co.uk	All certifcates to be uploaded to **TraQit**, including updating (and creation of, as required) database.
Fire Alarm Equipment	Vigilon by GENT control panels, S-Quad devices (dual optical heat), Winmag front end,	
Hard of Hearing Paging System (Fire Alarm)	Deaf Alerter PLC, Paul Knight / Richard Abraham,	
Hand driers	Xlerator, Brushed Stainless Steel, XL-SB Excel Dryer Uk Ltd	

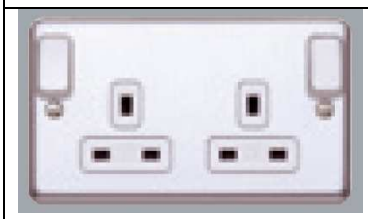
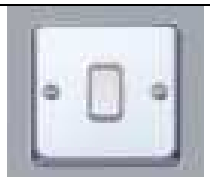
Material Item	Manufacturer/ Specialist	Comments/ Image
Specialist Contractors		
High Voltage Works	Telec, Garry Tummins, 01746 783 565, Western Power Distribution, Mark Phillips, 07703 283084, mphillips@westernpower.co.uk MES Ltd, Steve Jenkins, 07815 581652	
Fire Alarm System	Honeywell Building Solutions, Account Manager – Richard Gomez-Molina, richard.gomez-molina@honeywell.com, 07817 545 719 Service Supervisor – Tom Sleath, tom.sleath@honeywell.com, 07771 506317	HBS to employ the following to carry out installation and commissioning works:- Midland Fire & Security, Gary Silito, 07973 209 215,
Lightning Protection Systems	J Lacey Steeplejacks Jim Lacey, 0121 327 6376,	Utilising HELITA PULSAR Early Streamer devices.
Security Systems (CCTV, Access Control, Intruder Alarm, Panic Alarms)	Access Fire & Security, Martyn Rollins, 07918 734 671,	Janus controls system, Abloy door locks, PELCO cameras,
Disabled WC Alarms	Access Fire & Security, Martyn Rollins, 07918 734 671,	
Data Cabling	Electron, Pete Saxton, 07967 666950, pete.saxton@electron.co.uk,	
Vertical Transportation – Installation	Jackson Lift Group, Les Boden – 0788 705 1452	
Vertical Transportation – Design	SVN Group, Jas Solakovic, solakovicj@svma.co.uk, 07780 114672	

Material Item	Manufacturer/ Specialist	Comments/ Image
External Lighting		
General purpose lamp post luminaire	31W or 62W LED, Roadway or Area Distribution, StarBeam SMART, Thorlux, Matt Hayter, 079039 26368, matthew.hayter@thorlux.co.uk,	
General purpose wall mounted luminaires	32W Forward Thro or 18W Wide Distribution LED, Realta SMART, Thorlux, Matt Hayter, 079039 26368, matthew.hayter@thorlux.co.uk,	
Feature lamp post luminaire	50W Folio SMART LED, *Single or twin head. *6m column. Thorlux, Matt Hayter, 079039 26368, matthew.hayter@thorlux.co.uk,	
Feature wall mounted luminaire	50W Folio Wall SMART LED, Thorlux, Matt Hayter, 079039 26368, matthew.hayter@thorlux.co.uk,	
NOTE; 1 - Lamp post for the StarBeam SMART LED shall be 'lower-able' type via a winch. 2 - For new installations SMART fittings shall be connected by a physical cabled motionline. 3 - For replacement of existing external fittings, wireless SMART controls shall be utilised.		

Material Item	Manufacturer/ Specialist	Comments
General Lighting		
	LightLine 49W LED SMART, (Individual or continuous) *c/w wiring tidy/ connection unit in a white finish with clear SY flex connections. Thorlux, Matt Hayter, 079039 26368, matthew.hayter@thorlux.co.uk, **SY multicore cabling with clear sheaf to be used to connect end feed box to luminaire**	To be used in:- Offices, Meeting rooms, Corridors (to be reviewed on a project basis) **All with ceiling height above 3m.**
	Jubilee 49W LED SMART, Thorlux, Matt Hayter, 079039 26368, matthew.hayter@thorlux.co.uk,	To be used in:- Corridors, WC's,
	Jubilee XL 49W LED SMART, Thorlux, Matt Hayter, 079039 26368, matthew.hayter@thorlux.co.uk,	To be used in:- PC Laboratories, Offices, Teaching spaces,
	VIVA 36W LED SMART, Thorlux, Matt Hayter, 079039 26368, matthew.hayter@thorlux.co.uk,	To be used in:- Offices, Meeting Rooms, PC Labs, Teaching Spaces, **All with ceiling height below 3m/ with suspended ceiling.**
	RADIANCE LED SMART, *38W or 51W Thorlux, Matt Hayter, 079039 26368, matthew.hayter@thorlux.co.uk,	To be used in:- Areas with lay-in grid ceilings, with no VDU usage. Corridors/ Student break out spaces.

Material Item	Manufacturer/ Specialist	Comments
General Lighting		
	DOT HALO 17W LED SMART, Satin diffuser, No backlight, Thorlux, Matt Hayter, 079039 26368, matthew.hayter@thorlux.co.uk,	To be used in:- Stairwells, Corridors (below 3m ceiling height), WC's,
	DOT 17W LED SMART, Satin diffuser, No backlight, No halo, Thorlux, Matt Hayter, 079039 26368, matthew.hayter@thorlux.co.uk,	To be used in:- Store rooms.
	58W A-Line LED SMART, Polycarbonate diffuser, Thorlux, Matt Hayter, 079039 26368, matthew.hayter@thorlux.co.uk,	To be used in:- Wet/ Dry Laboratories, Plantrooms, Covered carparks/ walkways,
	37W KANBY LED CONTROLLER SMART. Thorlux, Matt Hayter, 079039 26368, matthew.hayter@thorlux.co.uk,	To be used in:- Store rooms.
Feature Lighting		
To be Agreed with AU Electrical Engineer and Project Manager.	Wila, Gemma Brown, 07785516462,	
To be Agreed with AU Electrical Engineer and Project Manager.	Compact – FW Thorpe Group,, Thorlux, Matt Hayter, 079039 26368, matthew.hayter@thorlux.co.uk,	i.e:- - Linear, - Pitch SM (LED)
To be Agreed with AU Electrical Engineer and Project Manager.	Thorlux, Matt Hayter, 079039 26368, matthew.hayter@thorlux.co.uk,	Ie:- -Zipline - Clara - Flute Polycarbonate
Signage Lighting		
To be Agreed with AU Electrical Engineer and Project Manager.	Portland – FW Thorpe Group, Thorlux, Matt Hayter, 079039 26368,	i.e.:- -Ecolux II

Material Item	Manufacturer/ Specialist	Comments
Emergency Lighting		
	Surface mounted Emergency LED, Platform 3, *Area and corridor versions Thorlux, Matt Hayter, 079039 26368, matthew.hayter@thorlux.co.uk,	Area or Corridor version dependant on application.
	Recessed mounted Emergency LED, Platform 3, *Area and corridor versions Thorlux, Matt Hayter, 079039 26368, matthew.hayter@thorlux.co.uk,	Area, Corridor or Spot version dependant on application. C/w plasterboard bezel for all installation scenarios.
	LEX, LED, Platform 3, ISO7010 Legend, *c/w relevant bracket Thorlux, Matt Hayter, 079039 26368, matthew.hayter@thorlux.co.uk,	To be used in front of house areas.
	Exit Sign, LED, Platform 3, ISO 7010 Legend, Thorlux, Matt Hayter, 079039 26368, matthew.hayter@thorlux.co.uk,	To be used in back of house and service areas.
	Duospot, 2x3.5W LED, Platform 3 *OR 2W LED Uni-spot version Thorlux, Matt Hayter, 079039 26368, matthew.hayter@thorlux.co.uk,	To be used in plantroom/ stairwells etc.
	ZRS, Zonal Report Switch, Thorlux, Matt Hayter, 079039 26368, matthew.hayter@thorlux.co.uk,	Location to be agreed with AU Electrical Engineer. **NOTE;** Circuit spur units and Dali Distribution Units also required to form a complete system.
	AT Controller Thorlux, Matt Hayter, 079039 26368, matthew.hayter@thorlux.co.uk,	Location to be agreed with AU Electrical Engineer.

Material Item	Manufacturer/ Specialist	Comments
Wiring Accessories		
	MK, Albany Plus Brushed Stainless Steel, 13A Twin Switched Socket Outlet, white inserts, outboard rockers and dual earth terminals	To be used in:- Offices, Teaching spaces, Circulation areas, Front of house areas,
	MK, Albany Plus Brushed Stainless Steel, Light switch (PTM Retractive / Rocker as per lighting requirement)	To be used in:- Offices, Teaching spaces, Circulation areas, Front of house areas,
	MK, Metalclad Plus 13A Twin Switched Socket Outlet, white inserts, outboard rockers and dual earth terminals	To be used in:- Plantrooms, Store rooms,
	MK, Metalclad Plus Light switch (PTM Retractive / Rocker as per lighting requirement)	To be used in:- Plantrooms, Store rooms,
	MK, Albany Plus Brushed Stainless Steel, EURO Plate c/w USB charging points and single un-switched socket	To be used in:- Offices, Teaching spaces, Lecture Theatres,
	MK, Masterseal Plus, Grey finish, 2 gang 13A switched socket outlet, IP66,	To be used in:- External areas.
	Marshall Tufflex Twin Plus 2 Compartment 210mm x 57mm	To be used as dado trunking and ‘on-show’ distribution trunking within all ‘front of house’ spaces i.e. office dado trunking, ceiling mounted distribution trunking in full height lecture rooms.

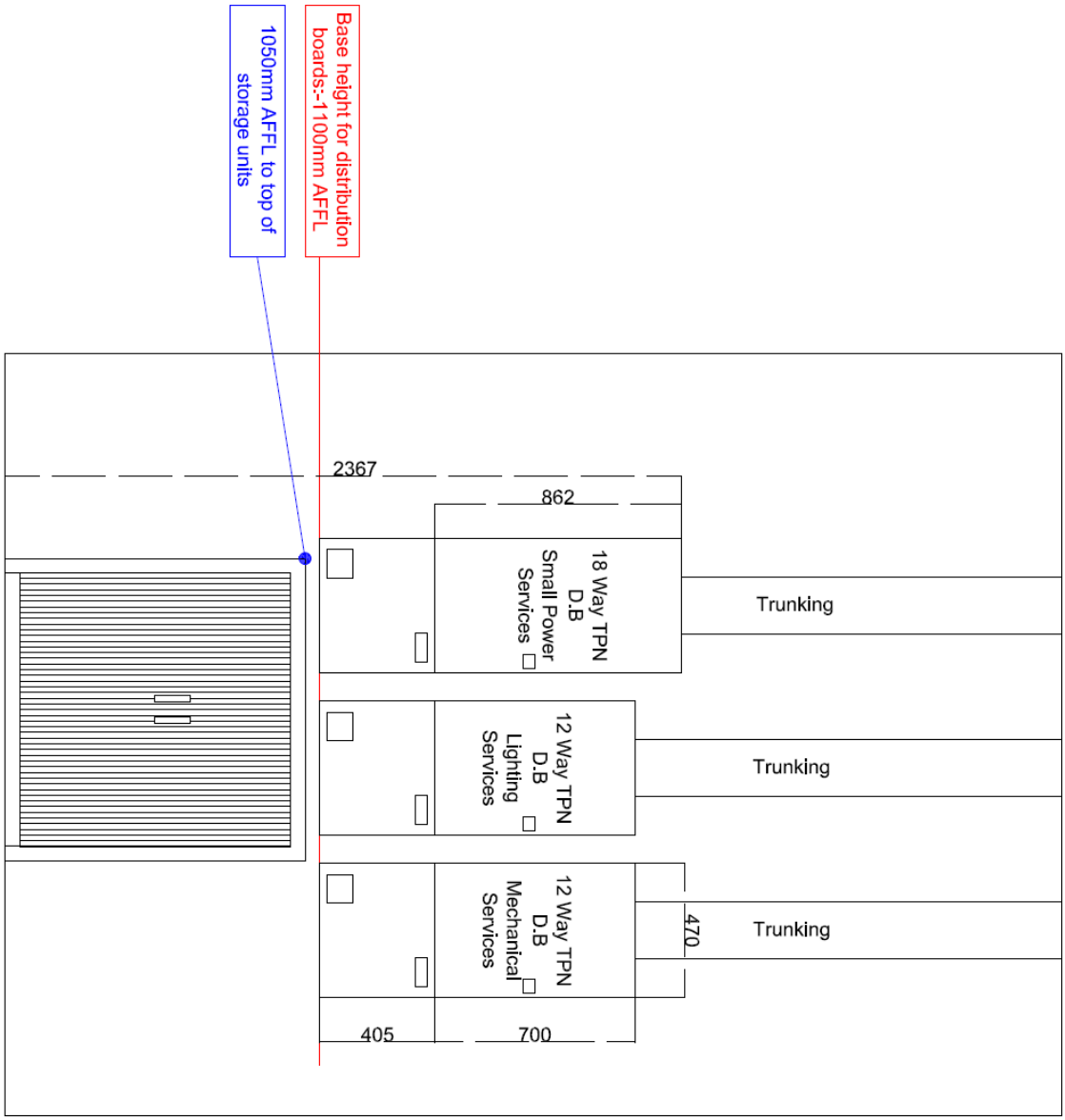
Material Item	Manufacturer/ Specialist	Comments
Wiring Accessories		
Dado mounted RCD unit	MK Sentry RCD within recessed MK sentry enclosure c/w clear plastic cover.	
Steel dado trunking within laboratories/ workshops	Armorduct, Perimeter/ Dado Trunking,	Two compartment, White finish,
Cable Tray/ Basket,	Armorduct,	Minimum thickness 2mm data matting to be provided for data containment.
Metal flexible copex,	ANY	LSF plastic coated.
Conduit,	ANY	Plastic conduit to be LSF.

NOTE: Plastic copex is not permitted on site.

Car Charging Posts		
	Rapid Charging Units, ABB Teaar CJG Elektromotive, David Room, David.Room@elektromotive.com	CHAdeMO, Type 2, CCS connections. Unit 'tag' and CYC operable.
	Wall Mounted Quick Charging Units 21kW TP Compact 305 Range Elektromotive, David Room, David.Room@elektromotive.com	Type 2 connections. Unit 'tag' and CYC operable.
	Post mounted Quick Charging Units 21kW TP 305 Range Elektromotive, David Room, David.Room@elektromotive.com	Type 2 connections. Unit 'tag' and CYC operable.

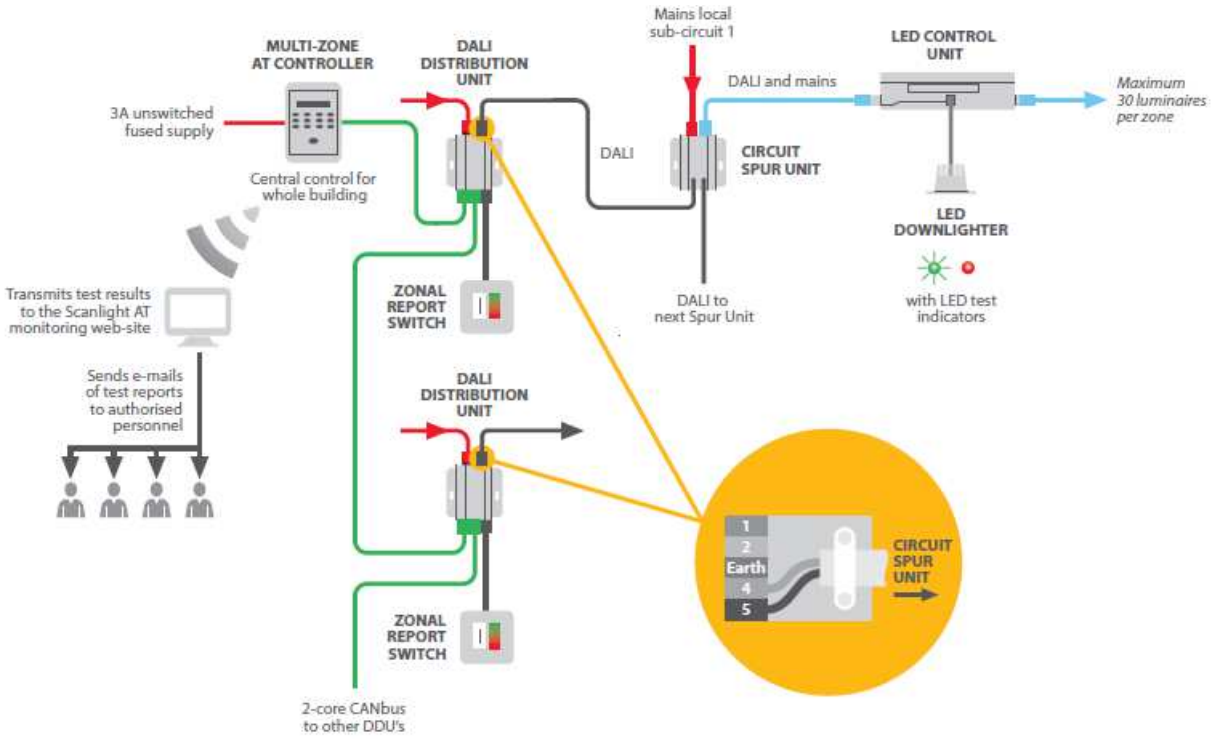
SECTION 16 - Appendices

16.01 Typical Distribution Board Layout within an Office



NOTE: This sketch is not exhaustive and is provided to show how the mounting heights to be achieved.

16.02 Typical Platform 3 Emergency Lighting Schematic



Maximum cable lengths

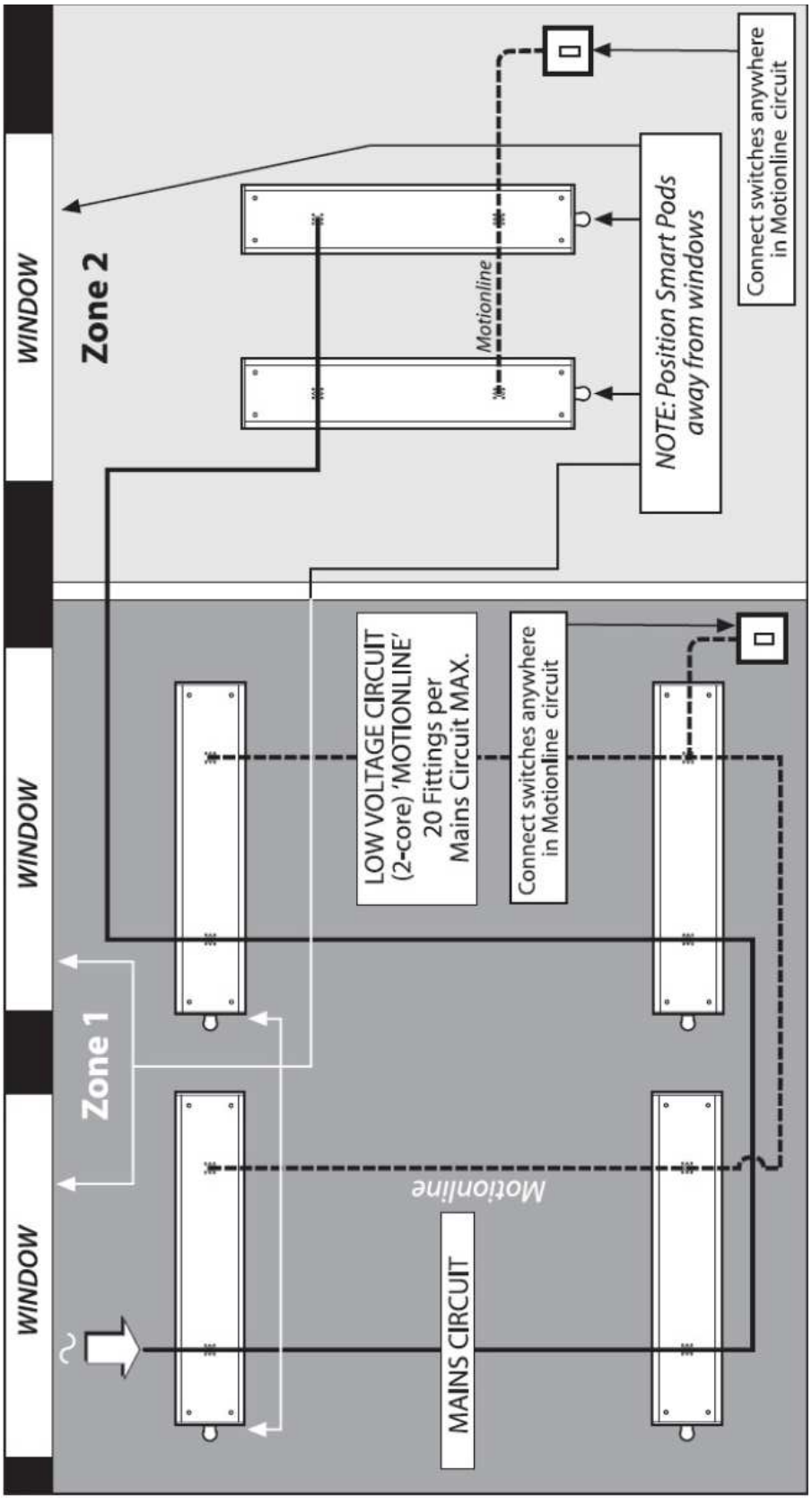
CANbus cabling = 1000m max
DALI, 1.0mm^2 = 200m max
DALI, 1.5mm^2 = 300m max
DDU to ZRS = 6m pre-wired lead

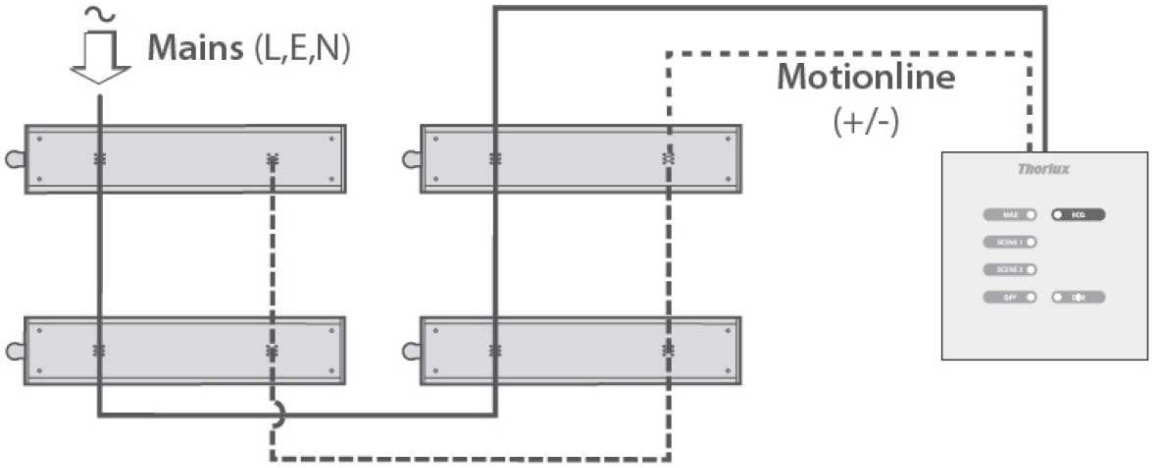
NOTES

The contractor shall detail all CANbus and DALI cable routes on the emergency lighting drawings uploaded to the Platform 3 website. All drawings shall be provided to AU in AutoCAD format.

NOTE; Information is for guidance, all details to be confirmed with Thorlux Technical department.

16.03 Typical SMART Lighting Schematic





Motionline Max. 50 Luminaires

Motionline is polarity sensitive

Modular Wired
Maximum of 20 luminaires per circuit.

Hard Wired
Maximum of 50 luminaires per Motionline group.
Motionline is 5kV isolated from the mains so can be zoned across circuits or phases.

Motionline Cable
Maximum cable length at 1.5mm^2 is 500m (mains rated cable).
Maximum cable length at 1.0mm^2 is 300m (mains rated cable).

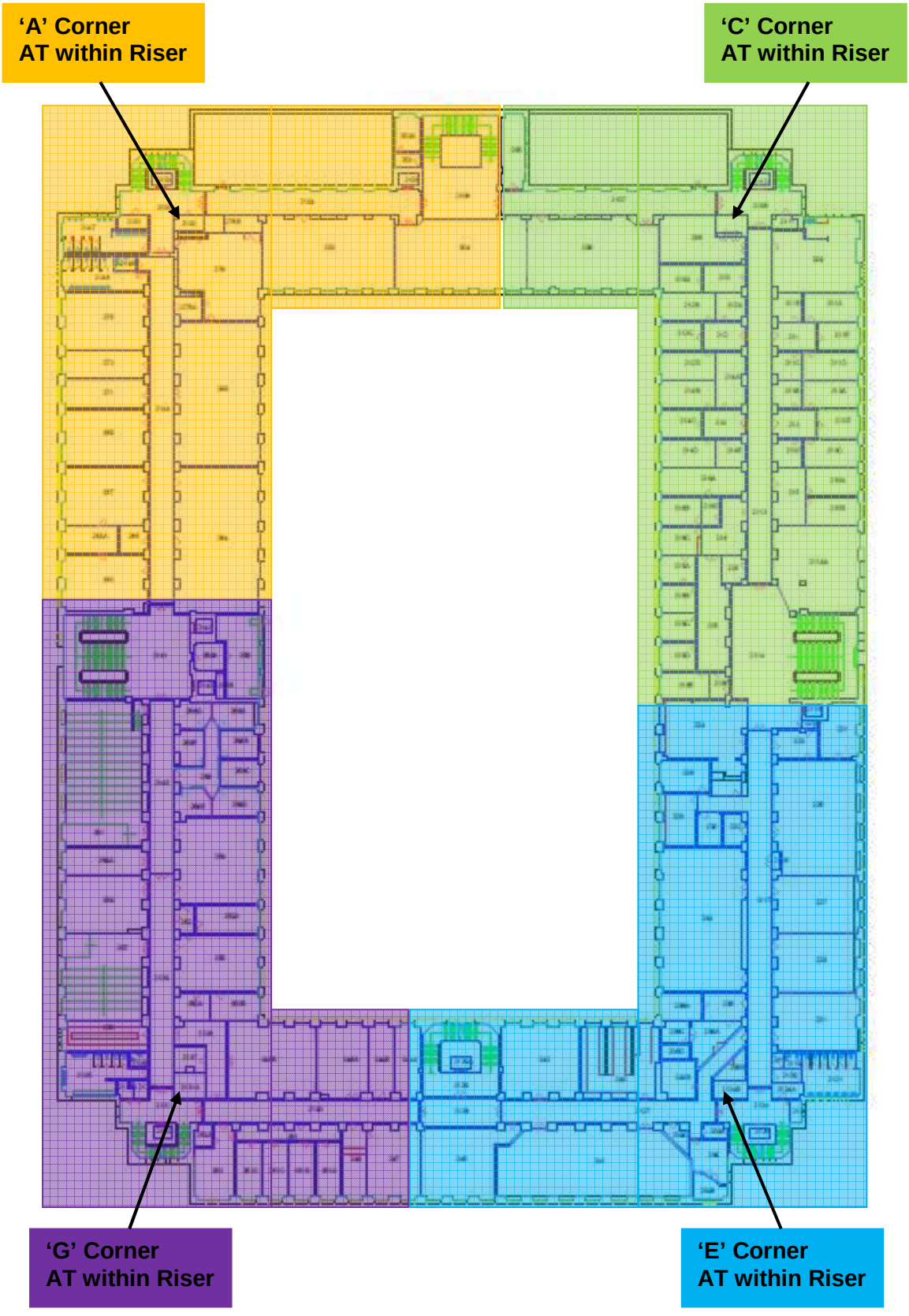
NOTE; Information is for guidance, all details to be confirmed with Thorlux Technical department.

16.04 Typical Outlet Quantities

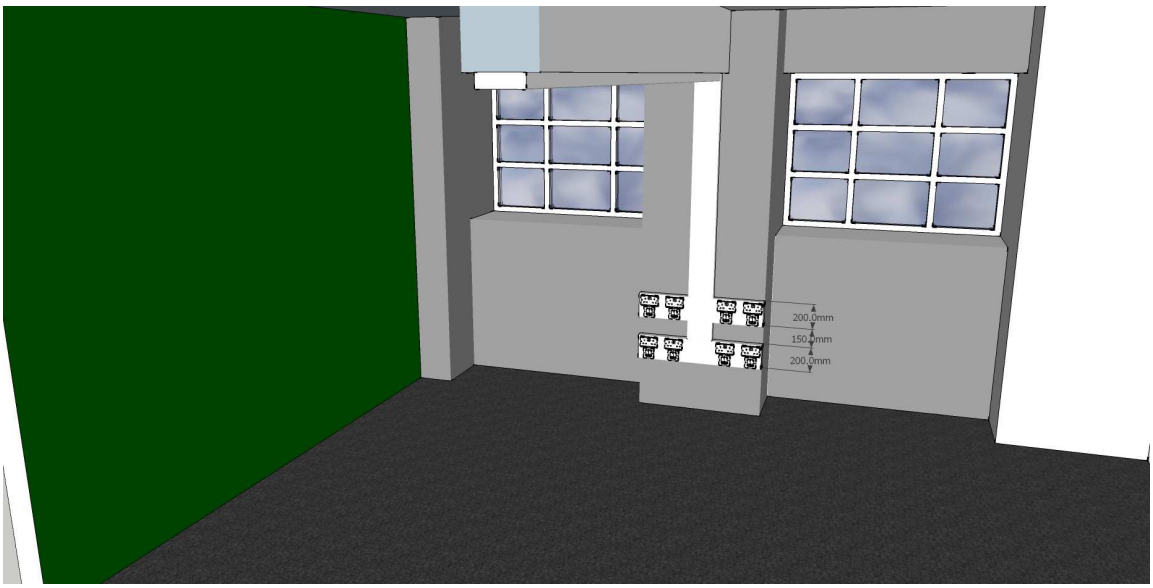
Area	Outlet Type	Quantity
Open Plan Office	13A Twin Switched Socket	2 No. per person
Open Plan Office	Data Point	1 No. per person
Single Office	13A Twin Switched Socket	2 No. by PC, 1 No. by break-out table.
Single Office	Data Point	2 No. by PC, 1 No. by break-out table.
Tiered Lecture Theatre	13A Single Socket	1 No. per 2 seats At least 3 No. rows to be provided with power
Tiered Lecture Theatre	USB 2.0 Charging point	1 No. per seat At least 3 No. rows to be provided with power
Laboratory	13A Twin Switched Socket	2 No. per linear meter of bench.
BMS Panel	Data Point	2 No. per panel.
Cleaners Socket	13A Single Switched socket outlet c/w integral RCD	Based on 8m radius of usage.
PoE WiFi AP's	Data Point *Power supply is not required*	1 No. per 10m radius or per 30 No. people, whichever is the smaller.

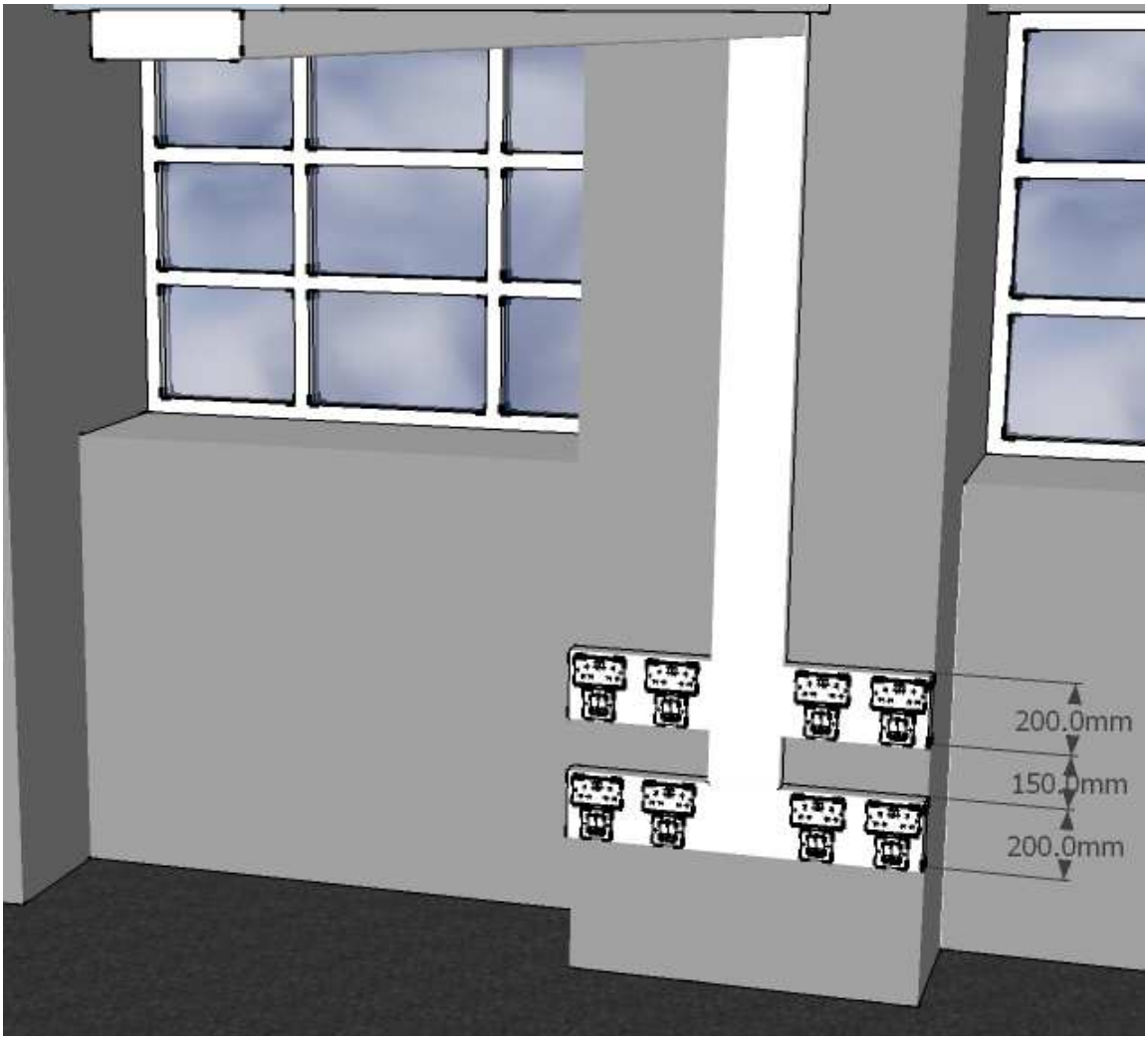
Quantities are for guidance only and shall be agreed with room users and AU Electrical Engineer.

16.05 Platform 3 AT Controller Positions/ Distribution – Main Building



16.06 Typical Dado Trunking Detail





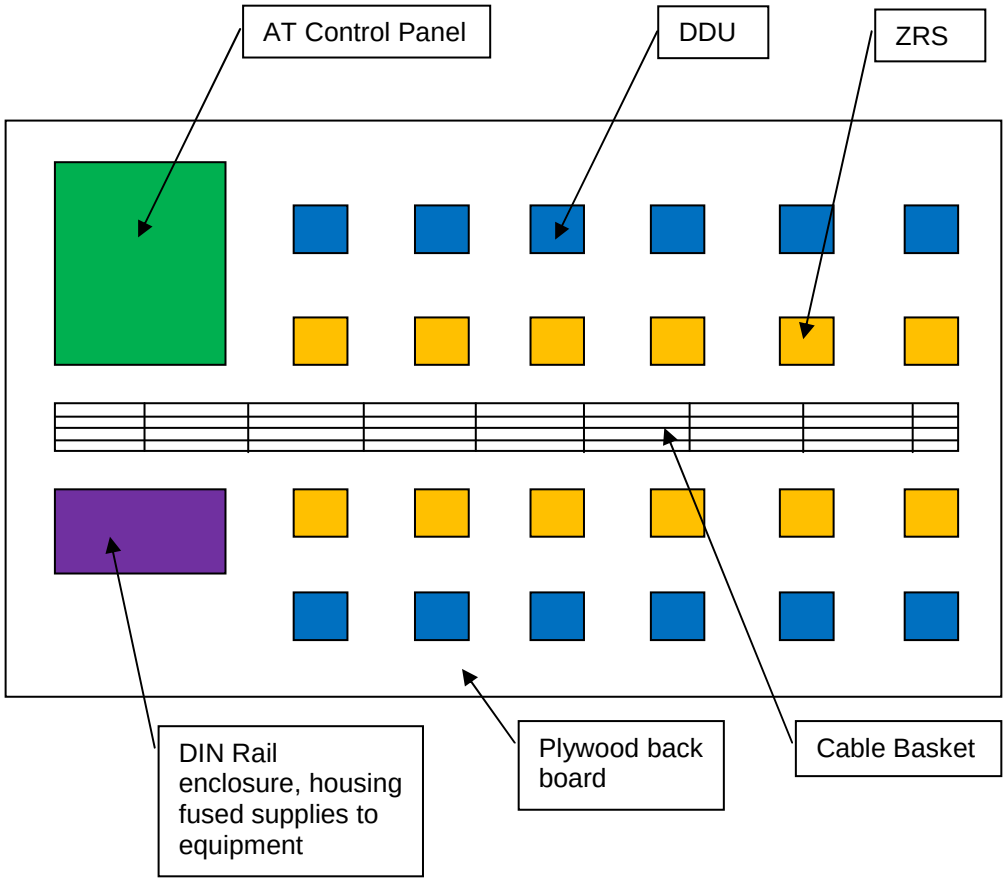
NOTE: Quantity of socket outlets/ data outlets is indicative only, quantity to be as per this specification and users requirements.

16.07 Key Schedule

Item	Key/ Lock Type	Identification	To be provided by
Distribution Boards	LF 92333		Contractor
LV Panel Boards	EMKA		Contractor
Fire Alarm Panel	Camlock Systems 550		Contractor
Fire Alarm Interface Key Switches			Contractor
Fire Alarm Aspiration System isolation/ reset key switch	JD 606		Contractor
Fire Man's Over ride key switch			Contractor
Electrical Switchrooms/ Distribution board Cupboards	ASSA suite 'Electrical'		*A
HV Enclosures	ASSA suite 'HV'	Stamped 'HV'	*A
HV Operational Padlocks	ABUS TT03145	Stamped 'HV1'	Contractor

*A = Lock case to be supplied by AU E&CD. Contractor to review drawings with the 'Building Supervisor' and 'Electrical Engineer' prior to requesting E&CD to order lock cases.

16.08 Platform 3 AT Control Panel – Typical Layout



NOTE: The above detail identifies the principals of the AT Panel installation, when an AT panel is installed, it shall be complete with plywood back board, DIN rail enclosure and cable basket for future use. The quantity of DDU's/ ZRS on 'day one' shall be to suit the 'day one' installation only. The back board shall be suitable sized to house 20x DDU's/ ZRS's.