

University College Dublin

Estate Services



Technical Guidelines for Designers and Specifiers

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Table of Contents

1.	Introduction	8
1.1	Introduction	8
1.2	General Requirements	8
2.	Existing Services: Belfield Campus	12
2.1	Existing Campus Service Infrastructure	12
2.1.1	Water System	12
2.1.2	Gas System	12
2.1.3	Space and Water Heating	13
2.1.4	Medium Voltage Electrical Supply	13
2.1.5	Telephone / Computer Network	13
3.	Energy and Water Metering Overview	14
3.1	Electricity Meters	14
3.1.1	Electricity Meter Specification	14
3.2	Heat Meters (Heat Integrators)	15
3.2.1	Heat Meter Specification	15
3.2.2	Installation Requirements	15
3.3	Gas Meters	15
3.3.1	Primary Gas Meter	15
3.3.2	UCD Check Gas Meter	15
3.4	Water Meters	16
4.	Ventilation	17
4.1	General Design Principles	17
4.2	Fireman's Switch	18
4.3	AHU Specification	19
4.4	Air Intake	20
4.5	Filtration	20
4.6	Fan Section	20
4.7	Fire Dampers	20
4.8	AHU Controls	21
4.9	Exhaust Air Discharge	21
4.10	Special Requirements	21
4.11	Roof Mounted Equipment (Boilers, Fans, Pumps) – Access and Maintenance	21
5.	Boilers & Heat Generators	23
5.1	General	23
5.2	District Heating Heat Exchangers	24
5.3	Pockets Indicators & Test Points	25
5.4	Electrical Aspects of Boiler House/Plant Room Installations	25
5.5	Boilers/ Burners	26
5.6	Flues	26
5.7	Boiler house	26
5.8	Gas Pipework in Boiler house	27

5.9	Alarm Systems	27
5.10	Ancillary Equipment in the Boiler house	27
6.	Heat Distribution	29
6.1	Pipework	29
6.2	Heating Circuit Design	29
6.2.1	Radiators	29
6.2.2	Fan Coil Units	30
6.3	Constant Temperature Circuits	30
6.3.1	Heater Batteries	30
6.4	DHW Circuits	30
7.	Building Management System (BMS)	31
7.1	BMS Controller Architecture	31
7.2	UCD BMS Cabling Specifications	33
7.3	Modbus & Cylon Sub Network Details	34
7.4	BMS Graphics	34
7.5	BMS Programming	34
7.5.1	Specific Programming Points for Contractors	35
7.5.2	Offsite BMS Programming (File Transfer & Global Points)	35
7.6	BMS Field Devices	35
7.6.1	Temperature Detectors	35
7.6.2	Air Velocity Sensors	35
7.6.3	Pressure Sensors	36
7.6.4	Active Sensor Accessibility	36
7.6.5	Active Sensor/Device Wiring	36
7.6.6	PIR Configuration	36
7.6.7	Wiring Installation (PIR's)	37
7.7	Critical Alarm Monitoring	38
7.8	Critical Alarm Commissioning	38
7.9	MCC Panel	39
7.10	Temperature Control & Zoning	40
7.11	Frost Protection & Trace Heating	40
7.12	Urinal Control	41
7.13	External Lighting (BMS Control)	41
7.14	BMS Actuators	41
7.15	Maintaining BMS/HVAC Actuators	41
7.16	Energy Meter Inputs	41
7.17	AHU Control	42
7.18	Miscellaneous Schematics (UFH, AOV, Trace Heating etc)	42
8.1	HVAC Commissioning Plan	42
8.2	HVAC Demonstration	43
9.	Water System	43
9.1	External Water Mains	43

9.1.1	Pipework	43
9.1.2	External Valves	44
9.1.3	Hydrants	44
9.2	Internal Water Mains	44
9.2.1	Internal Water Distribution Systems	44
9.2.2	Water Valves	47
9.2.3	Water Storage Tanks	47
9.2.4	Tank Water Distribution	48
9.2.5	Fire Mains	49
9.2.6	Water Service to Fire Fighting Appliances	49
10.	Domestic Hot Water (DHW)	50
11.	Natural Gas Distribution System	51
11.1	General installation requirements	51
11.2	Laboratory Gas Distribution	51
12.	Wastes, Soils & Sanitary Appliances	52
12.1	External Drains – Existing Infrastructure	52
12.2	Drain Materials	52
12.3	Manholes	52
12.4	Internal Drainage	53
12.5	Drain Materials	53
12.6	Rainwater	53
12.7	Cleaning / Rodding / Inspection Ports / Venting	53
12.8	Laboratories & Chemical Waste	54
12.9	Kitchen Wastes	54
12.10	Manholes & AJ's / Gully Traps	54
12.11	Sanitary Equipment – Toilets	54
12.12	Wash Hand Basins	54
12.13	Urinals	55
	Slab type urinals are not to be used.	55
13.	Fume Cupboards	56
14.	Medium Voltage Network	57
14.1	Primary Switchgear	57
14.2	Secondary Switchgear	57
14.3	Protection Relays	57
14.4	Transformers	57
14.5	Battery Trip unit	58
15.	Electrical Standards & Regulations	59
16.	Internal Lighting	60
16.1	General Lighting	60
16.2	Lighting Control	60
16.3	Theatre / Classroom Lighting	61
16.4	Office Lighting	61

16.5	Laboratory Lighting	62
16.6	Workshop Lighting	62
16.7	Other Lighting	62
17.	External Lighting	62
17.1	Design Principals	62
17.2	Primary and Secondary Pathways & Linkways	64
17.3	Road Lighting	64
17.4	Car Park Lighting	64
17.5	Pedestrian Crossing	65
17.6	Feature Lighting	65
17.7	Flood Lighting	65
18.	Power	65
18.1	Switchgear	65
18.2	General Service	66
18.3	Sundry Items	66
18.4	Motive Power (Fans, Pumps)	66
19.	Emergency Lighting	68
20.	Alarm Systems	69
20.1	Fire Alarm System	69
	Fire Alarm Control Panels	69
	Smoke Detectors	69
	Heat Detectors	69
	Break Glass Units	70
	Alarm Sounders	70
20.2	Intruder Alarm System	70
	20.3 Alarm System Overview	70
20.3	Access/Security/CCTV System Integration	71
20.4	System Strategy	71
20.5	Cause and Effect	71
20.6	Gas Alarm System	72
20.7	Disabled Person Toilet Call System	72
21.	CCTV System Overview	73
21.1	Video Management System Overview	73
21.2	Integration	74
21.3	Network Video Recorder (NVR)	74
21.4	Cameras	75
21.5	Network	77
21.6	Time Management	77
21.7	Resilience	77
21.8	Redundancy	77
22.	Access Control Systems	78
22.1	System Overview	78

22.2	Integration	78
22.3	User Card	79
22.4	User Administration	79
22.5	Network	79
22.6	Doors	79
22.7	Time Management	80
22.8	Resilience	80
22.9	Redundancy	81
23.	Telecommunications & Data	82
24.	Lightning Protection	83
25.	Passenger Lifts	84
25.1	Regulations/Standards	84
25.2	Lift Type	85
25.3	Door Type	85
25.4	Lift Cabin & Landing Controls	85
25.5	Lift Cabin Interior	86
25.6	Landing Architraves	86
25.7	Other Features & Fittings:	86
26.	Matwells and Frames	87
27.1	Doorsets	87
27.2	Door performance compliance:	87
27.3	Ironmongery	88
31.	Renewable Energy Technologies	89
31.1	Solar PV	89
31.2	Heat Pumps	90
(Q)	Appendix 1 - Building Envelope Strategic Technical Specifications	91
(R)	Appendix 2 - Technical Guidance Document Internal Flooring - Slip Resistance Characteristics	97
(S)	Appendix 3 - LED Lighting – Important Points to Note & Questions to be asked of Manufacture	100
(T)	Appendix 4 - Technical Guidance Document - Universal Access in the Built Environment	102
(U)	Appendix 5 UCD Watermains General Requirements	103
(V)	Appendix 6 General Structured Cabling Requirements	110
•	IEC 60603-7-4/41	110
•	IEEE 802.3 applications as outlined in section 2	110
•	Local/National Codes and Regulations	110

1. Introduction

1.1 Introduction

The following briefing document is primarily intended as a guide to Consulting Engineers involved in the design of mechanical and electrical installations at UCD's Belfield Campus. There is also however, guidance provided on a number of building fabric elements, specifically building envelope strategic guidance and floor coverings/finishes specifications/requirements which can be found in Appendices 1 and 2 respectively. It may also be used as a general guideline as to the standards required and the equipment to be used in M&E installations being carried out at other UCD sites and in situations where work is being carried out directly by contractors. It is applicable both to new buildings and refurbishment work in existing buildings.

The document provides background information on the existing mechanical and electrical infrastructure on the Belfield campus and sets out standards to be followed on any project work involving connection to, or expansion of, existing mechanical and electrical services. These standards have been adopted in the light of experience of operation and maintenance of systems and in order to provide a consistency and uniformity of approach. It is not intended that they would cover the provisions of Building Regulations or other statutory requirements, all of which should be incorporated in the overall scheme as part of normal good design practice.

On any particular project these design guidelines will form the basis for detailed discussions which should take place between UCD Technical Services and the Consulting Engineers. It is important that these discussions take place at the earliest possible stage in the project so that an overall design concept and specific technical details can be agreed.

It will be the responsibility of the internal project co-ordinator within UCD to ensure that designers and consultants engaged on any particular project are aware of the requirements of this briefing document and to arrange for the necessary discussion and consultation to take place.

1.2 General Requirements

Drawings/Documentation

All M&E design work should be fully detailed on a comprehensive set of drawings and specifications giving precise details of all aspects of the project, including connections to existing services and any consequential need for interruptions or shutdowns. The use of PC sums will not be accepted as an alternative to detailed investigation of the requirements in any particular area, particularly in relation to connection to existing services. On completion of a project the designer or consultant shall ensure that a full set of as installed drawings, maintenance manuals, safety information, commissioning and test records are supplied to UCD. Drawings should be available electronically in (AutoCAD format) as well as in hard copy format.

Health & Safety

Consultants and designers will be expected to take on the role of Project Supervisor for the Design Process (PSDP) in relation to their own particular area, in accordance with the Safety Health and Welfare at Work (Construction Regulations 2013). Their main duties in this role will be;

- To take account of Health & Safety in drawing up a programme of works for the project
- Where applicable, prepare a preliminary safety plan for the project
- Take account of the general principles of accident prevention as defined in the Act
- Pass on all relevant safety information to the project safety supervisor for the construction stage for inclusion in the safety file
- Co-ordinate the work of their own specialist sub-contractors in relation to other contractors involved in the project
- In the case of retrofits, consideration must be given to the presence of asbestos. UCD maintain an asbestos register which should be reviewed by the consultants and due account taken of this – how it will be addressed, budgetary implications, and how it will be incorporated into the project programme. If asbestos is present, a refurbishment and demolition survey must be carried out by a competent person. Any asbestos related works must be reported to the HSA, no matter what the scale of the project is. Any asbestos removed from site must be disposed of by certified contractors and disposal certs must be issued to UCD.

The M&E design consultants should familiarise themselves with the Estate Services Safety Statement and ensure that all relevant procedures in that document are followed.

Energy Efficiency & Carbon Emissions

Up to 32,000 students, staff and visitors attend the UCD Belfield Campus each day. UCD Estates Services are committed to ensuring that the university community experience a safe, comfortable and environmentally responsible campus environment

UCD is certified to ISO50001 and utilises the ISO 50001 Energy Management System (EMS) as a structured methodology to manage energy and water consumption within UCD.

It is the policy of UCD Estate Services to implement, wherever possible, energy saving measures which can be justified on a life cycle cost basis the life cycle should include both energy and carbon cost. New projects will be subject to Energy Efficiency Design (EED) reviews and full life cycle costing. Projects should include the shadow carbon price for informing project decisions likely to have a significant impact on carbon. See link below.

<https://igees.gov.ie/wp-content/uploads/2018/11/Valuing-Greenhouse-Gas-Emissions.pdf>

As energy unit rates vary please contact UCD for appropriate electricity and gas unit rates.

Due to the carbon impact, direct electric heating (COP =1) may only be permitted in exceptional circumstances.

On each project designers should consider what options exist for improved energy efficiency, and the associated capital cost and full life cycle savings. Among the factors which should be considered at the design stage are:

- Performance of the building envelope - fabric insulation and glazing
- Carbon efficiency, and comparison of standalone heating systems vs. central system
- Low temperature design and designing and commissioning to achieve low return water temperatures.
- Scope for application of heat recovery from ventilation air or waste water
- Use of high efficiency electric motors and speed control of motors
- Demand based control of building services
- Daylight linking of lighting in areas with a high level of natural lighting
- Occupancy linking of lighting and ventilation in Lecture Theatres and classrooms
- The use of LED lighting in all new and retrofit installations is now UCD policy

Particular care should be taken to ensure that heating and ventilation systems are zoned in a way which will allow flexible control in line with the orientation and usage pattern of the space. Control will in all cases be carried out through the Cylon Building Management System and no stand-alone “black box” control systems will be permitted. The detailed requirements for the BMS are included elsewhere in this document.

Design Parameters

For new buildings and major refurbishments, the consulting engineer should, in conjunction with the College faculty or department which will occupy the building and the UCD Estate Services, assemble a set of individual room data sheets for each space within the building detailing the specific requirements for the room under the following headings:

General

Room classification, occupancy details, special functions e.g. biocontainment levels.

Environmental

Temperature, humidity, daylighting, artificial lighting type and levels, special filtration requirements.

Mechanical

Preferred method of heating, requirements for mechanical ventilation, hot and cold water services, drainage requirements.

Special Services

Laboratory gases, compressed air, vacuum, steam, natural gas.

Protective Services

Alarms, fire suppression systems, emergency lighting, requirements for water, dust or corrosion proofing.

Electrical

Sockets outlets, 3-phase supplies, dedicated power supplies, clean supplies; requirements for standby power or un-interruptible power supplies, electricity meters etc.

Internal Gains

Equipment heat gains, heat gains from occupants and lighting.

The following table gives a listing of default design parameters, which may be used in the absence of room data specific to the project.

Design Condition	Design Parameter
Design Internal Temperature - Offices/Administration areas	21°C
Design Internal Temperature - Classrooms, Lecture Theatres	20°C
Air Change Rates	as per CIBSE Guides
Lighting Levels - Offices/Administration areas, Laboratories	350-400 lux
Lighting Levels - Lecture Theatres, Classrooms, Computer Rooms	300 lux

Table 3.1 Design Parameters

2. Existing Services: Belfield Campus

UCD is serviced by a complex and closely managed networks of underground utility services.

The full extent and details of all existing site services must be ascertained by the designer at design development stage through a combination of desktop, GPR, invasive surveys and any other means necessary, and shall be communicated to the main contractor for information purposes before any excavation work commences. The main contractor shall be responsible for protecting and maintaining all existing services within the confines of the site compound (unless noted otherwise in the contract documents). Any disruption to the campus and the cost of repair of any site services damaged during works will be the responsibility of the main contractor. In order to ensure that this does not occur, the main contractor must (under a pre-agreed and signed off RAMS) locate, record and protect all existing services exactly before excavating on site, particularly the depth of the services and the direction of the run. It is imperative that all existing services are kept functioning/live at all times unless agreed otherwise. Any service diversions required must be carried out under a RAMS that has been commented on and signed off by all relevant parties. In general diversions or any works on existing live Campus services must be undertaken outside of Campus normal working hours i.e. 10.00pm to 6.00am.

The designers should detail the modifications required to the existing campus infrastructure in order to service the building / project at the earliest possible stage. In costing a design, the project cost must include the cost of bringing services to the site.

Services include:

- Water (Potable & White Systems)
- Gas (UCD and GNI)
- District Heating (if required)
- Electricity HT or LV (UCD & ESB)
- Fibre/Data (UCD IT Services and external 3rd Parties)
- Telephone Services
- CCTV / Security
- Drainage System
- Foul Sewer
- BMS

Designers should also establish with UCD Estate Services, if the project offers any opportunity to improve or reinforce the existing campus services.

2.1 Existing Campus Service Infrastructure

2.1.1 Water System

The water tower is the reservoir for the Belfield Campus. This reservoir provides a constant pressure head (6 bar) for the gravity distribution of water on the campus through a ring main network.

This water distribution system provides water for general use, mains water and fire water. See Appendix 5 for water main systems.

2.1.2 Gas System

A piped natural gas distribution network exists on the Belfield Campus. The gas pressure on the campus is typically 35 -40 cm H₂O.

2.1.3 Space and Water Heating

Heating on Campus is supplied by the following systems.

- Main ~10MW District Heating (DH) system, this supplies heat to approximately 150,000m² of the Campus building stock.
- Smaller energy centres (<2MW) such as in the SLLS and Science East. These energy centres generally have the capability of importing/exporting to/from the main DH system.
- Local Gas boilers are fitted in several buildings which are not in the vicinity of the DH network.

The general design principles are as follows, design for use of low temperature heat emitters, design for wide delta t's (20K if possible) and low return water temperature. Use low carbon heat generation sources such as Heat Pumps (see also section

The central DH system produces LTHW operating at a flow temperature of 65-80°C (Weather dependant) and a preferred return temperature of 45-60°C. The static pressure in the system is approximately 5 bar.

2.1.4 Medium Voltage Electrical Supply

Medium Voltage 3 Phase electricity is distributed at 10kV on the Belfield Campus. The supply is transformed to 400/230 V for distribution locally.

The Medium Voltage system is designed to offer good redundancy and resilience of supply through balanced use of ring / star topology traditionally employing ring main units. However, this system has limited discrimination under fault conditions. Circuit Breaker technology is been introduced to certain parts of the system to improve continuity of supply.

All medium voltage transformers and RMU's feeders and ring feeders must be fault protected for overload (continuous and instantaneous) and earth fault unless advised.

All critical applications, which require un-interruptible power, supply or mains conditioning should be catered for through the provision of UPS and local standby generation.

2.1.5 Telephone / Computer Network

A central telephone exchange serves the Belfield campus. This is located in the Science Lecture Building.

Voice is distributed from the central exchange to the MDF rooms in the various buildings. The carrier is copper.

The computer network on the Belfield Campus is specified, operated and maintained by Computing Services. The network is Ethernet based with 100 Mbit/s backbone. Typically, all backbones are run on fibre optic cable to the designated hubs. The final distribution system shall conform to the Krone or Systimax standard for Category 6.

The routes for distributing the ELV services are primarily the Walk-In duct on overhead tray, or in buried cable ducts. The adequacy and availability of these ducts should be checked at the early stages of design.

3. Energy and Water Metering Overview

In order to support energy and water management activities in UCD it is necessary to measure significant energy and water users. The following sections provide data on electricity, gas, heat and water meter selection.

Of key importance is the selection and specification and sizing of meters, it is important that meter installations remain accurate throughout their measurement range. This is of particular importance in the selection of water meters where leak detection capability is paramount. Meters should be sized on the min max and nominal flow rates rather than the prevailing pipe size¹. Meters must also be readily visible to permit manual readings, must be readily maintainable and installed in line with the manufacturer's guidelines.

Note in the case of determining minimum flow rates, it is expected that selected meters will be effective at detecting passing taps/leaks etc.

UCD Project Water and Energy Meter Summary Sheet

All proposed energy and water meter technical data sheets must be issued for approval and sign-off by all relevant parties. A summary sheet for all meters should be provided detailing the meter type (water, gas, heat etc) the expected max and min flow rates, turn-down ratios, volume/pulse ratio, parameter measured (eg Calorifier make-up water, etc) meter manufacturer and model no etc.

See "UCD Project Water and Energy Meter Summary Sheet" available from Estate Services.

3.1 Electricity Meters

Every building main in-comer and main board shall be fitted with an electric sub-meter. This meter must be capable of calculating a rolling 15-minute average kW. This value must be available in a Modbus register, the averaging period must also be adjustable.

The meter shall be fitted so that access to the meter will not disrupt power supply to the building. There shall be no exposed live parts in the meter section of the board. Drop links must also be installed on all CT's.

3.1.1 Electricity Meter Specification

Type	Accuracy Required	Note
Electricity Meter	Meter Class.5s, CT Class .5	With Modbus 485 RTU & kWh pulse; Must be able to read rolling 15 min average kW

Note:

- Not all panel meters are capable of delivering the rolling average requirement above and will be rejected if supplied.
- The Socomec Diris A40 with Modbus RS 485 communication option meets the above requirements.

¹ In the case of water meters feeding fire hydrants – pressure drop and sufficient flow takes precedence above low flow meter accuracy.

3.2 Heat Meters (Heat Integrators)

Each heating system over 100kW shall be fitted with a standalone heat meter at point of entry to the building (District Heating) or generation of heat source (Boiler, Heat Pump etc). The heat meter must have a display unit which can be interrogated safely from within the boiler house or plantroom. The unit must be powered by 24 or 230V AC.

3.2.1 Heat Meter Specification

Type	Accuracy Required	Note
Heat Integrator, Ultrasonic, flanged connection	Exceeding Measuring Instruments Directive (MID) standard Class 2 accuracy	Class 2 flow device sized to ensure qp/q impact on accuracy is considered. With Modbus 485 RTU & kWh pulse capability

Note:

- Some potential heat meters which meet this Modbus 485 RTU communications requirement are Kamstrup Multical, Itron CF51 or Endress and Hauser Energy Cal RH33.
- M-Bus (Meter-Bus) is not the same as Modbus 485RTU and is not suitable.

3.2.2 Installation Requirements

- Heat meter and associated components must be installed to manufacturers guidelines regarding, meter orientation, straight pipe runs and protective strainers etc.
- Isolation valves should be provided to permit future flow device servicing/inspection.

3.3 Gas Meters

3.3.1 Primary Gas Meter

A primary gas meter shall be installed where appropriate to GNI requirements. This shall be located externally in an easily accessible location.

3.3.2 UCD Check Gas Meter

In the case where the gas supply is taken from the UCD gas main, the following specification shall be followed.

The gas supply to the independent boiler houses and heating elements shall be metered separately from gas consumed by the occupants of the building.

An impeller type gas meter shall be fitted with a pulse output to the BMS shall be specified. Connection to the BMS must be via a 24V barrier relay for intrinsic safety. Gas meters requiring in-built battery cells to operate should not be considered. The gas meter pulse ratio should be selected to

provide the maximum number of pulses per volume flow. The BMS system can detect a maximum of 20 pulses per second.

The meter display shall record the gas consumption in cubic meters. In the case of a meters installed at higher gas pressures, these meters must be corrected for temperature and pressure variations.

Type	Accuracy Required	Note
Gas Meter	Class 1.5 max error+/- 1.5%	May require Pressure/Temp correction. Meter with high pulse resolution should be selected. Prefer 1pulse/100L rather than 1 pulse/m ³ .

Note: All gas meters must be installed as per specific manufacturers guidelines in relation to strainers, orientation and up and down stream straight pipe lengths.

3.4 Water Meters

On entry into the building the watermain shall be metered.

In addition, water meters will be required for:

- Cold water supply to calorifier
- Rainwater
- Mains water top up to break tank
- Grey (well) water
- Commercial catering units

The meter shall be sized for the expected nominal water flow rate, not line size.

The meter fitted shall be of good accuracy ($\geq 95\%$) and shall have a turndown ratio of at least 50 : 1. The meter shall provide a pulsed output, to be linked into the Building Management System - typically 1 pulse to 10 litres.

Meter must be capable of being installed and operating on all elevations including upside down throughout it's specified service life. The as installed meter dial should be readily readable by maintenance staff.

The meter will be fitted in accordance with the manufacturer's instructions regarding upstream and downstream free diameters.

Isolating valves shall be fitted upstream and downstream of the installation to allow for easy removal, as shown in fig. 1.

The following water meters are approved; any proposed variants must have prior approval.

- >50 mm ABB Magmaster
- <50 mm Kent PST Meters

All bulk meters to be provided with a bypass to ensure ease of future maintenance/replacement.



Good example of water meter installation (readable and accessible for maintenance)

4. Ventilation

4.1 General Design Principles

Where possible, perimeter rooms should be naturally ventilated. Rooms shall be provided with windows that can be opened easily by occupants. Heating shall be provided by perimeter heating.

The energy consumed in heating air should be minimised using such methods as:

- Heat Recovery Devices (Enthalpy devices are preferable)

- Return Air Systems

- Air Transfer Systems e.g. air flows from theatres to corridors to toilets to exhaust.

Note: In the case of any Heat Recovery ventilation systems, as most heat recovery occurs when OAT is $< 15.5^{\circ}\text{C}$ careful consideration should be given to design of ventilation systems which operate during warmer summer months. In these systems, consideration should be given to designing an automated summer bypass of restrictive heat recovery coils. This is particularly relevant for large lab manifold systems.

Before final approval of design, a descriptive summary of the operation and features of the ventilation system should be submitted for approval.

In general, an air handling plant should serve only one space.

It is the policy of the University that mechanical cooling and humidity control is not permitted in general. Exceptions to this will only be made on an individual case on application to the Technical Services Manager.

The ventilation in the building should be closely matched in terms of air volumes supplied and air volumes extracted. In particular, the ventilation rates of each fire compartment should be balanced.

Designers should note that the design should prevent draughts. Designs must also minimise noise disturbance caused by ventilation systems at intakes or exhausts, at fan sections, along ductwork and at grilles.

The design should also take into account the cleaning and maintenance of ductwork and grilles.

Where mechanical ventilation is necessary, the following systems should be included for the relevant space types. (Note ++ denotes that this quantity should be greater, by the order of 10%)

Space Type	Supply	Extract
Lecture Theatres	Yes ++	Yes
Classrooms	Yes ++	Yes
Meeting Rooms	Yes	Yes
Common Rooms	Yes	Yes ++
Kitchens	Yes	Yes ++
Multi-Occupancy Offices	Yes	
Single Occupancy Offices	Yes	No
Corridors	Make Up only	Yes ++
Toilets	Make Up only	Yes ++
Workshops	Yes	Yes ++
Laboratories & Dark Rooms	Yes	Yes ++
Computer Rooms	Yes (+)	Yes

Table 6.1 Mechanical Ventilation Systems

4.2 Fireman's Switch

For fire safety, all ventilation systems should be under the control of a fireman's switch. This switch shall allow the fire-fighting services to control the supply and extract ventilation systems independently.

The fireman's switch should be clearly marked, accessible and located wherever possible close to the main entrance to the building.

4.3 AHU Specification

The AHU shall be located so as to provide convenient and safe access to the unit by maintenance personnel and allow adequate space for the replacement of filters, valves and actuators, dampers, motors components etc. Where possible AHU's should be located in doors or provided with protection from wind/rain etc.

The casing of the AHU shall be double skinned and acoustically lined.

The AHU shall be fitted with a lock-stop at the access door to each fan section.

The AHU should be located internally where possible, this increases the life of the unit and reduces the maintenance costs due to dirty filters etc.

AHU heating and cooling control valves should be readily accessible and be provided with appropriate IP protection.

Externally located should not contain BMS control panels.

4.4 Air Intake

The air intake shall be located so as to prevent the ingress of:

- Boiler Flue Gases
- Exhaust Air, particularly toilet and smoking area exhaust.
- Car Fumes
- Soil and Waste Vents
- Fume Cupboard exhausts
- Gas Vents

Precautions should be taken to guard against the intake of solar heated air, e.g. across flat roofs or through dark coloured, (south or west facing) louvres.

Low air velocities at the intake or some means of prevention of moisture carry over, should be considered.

4.5 Filtration

Three stage filtration is the normal filtration requirement.

- Stage 1: Coarse Filtration, using wire mesh
- Stage 2: Large Particle Filtration, using disposable panel filters
- Stage 3: Fine Particle Filtration, using renewable bag / pleated filters

Each stage of filtration should allow safe access for maintenance staff for inspection and cleaning.

Continuous roll filters should not be used.

Specialist area filtration should be defined as part of the project brief and should be treated individually.

4.6 Fan Section

The supply air fan motor should be of a high efficiency to minimise undesired heat gain to the ventilation air.

Access and clearance shall be allowed in the fan section for maintenance personnel to maintain the fan, motor and drives.

4.7 Fire Dampers

The fire damper shall be activated by smoke/fire detection and be resettable.
An inspection door shall be provided to each fire damper to allow inspection.

4.8 AHU Controls

All control items shall form part of the BMS specification, see the section on BMS controls for further details.

Temperature sensor locations shall be as shown in the accompanying sample schematics of typical ventilation systems. The temperature sensors shall be as specified under the accompanying Controls section.

Velocity sensors shall be provided as shown in the accompanying sample schematics of typical ventilation systems. The velocity sensors shall be as specified in section 7 (BMS).

All cooling and heating coils must be fitted with individual dedicated BMS off coil temperature sensors to ensure that passing valves can be easily detected.

AHU's which incorporate heat recovery must include a temperature detector which allows heat recovery to be verified.

The actuators for the air handling plant shall be as described in section 7 (BMS).

4.9 Exhaust Air Discharge

The location of the discharge from extract systems should be appropriate, taking the following into account:

- Entrances & exits of the building.
- Proximity to air intake.
- Proximity to windows.
- Neighbouring buildings.
- Nature of exhaust discharge.
- Prevailing wind direction.
- Noise of discharge fan.

4.10 Special Requirements

Some air handling systems may demand special requirements, e.g.

- Fire suppression for kitchen extract canopy.
- Stainless steel fan housings and impellers (for chemical extract) and

4.11 Roof Mounted Equipment (Boilers, Fans, Pumps) – Access and Maintenance

All roof mounted plant must be carefully considered to allow provision of suitable post construction access for full lifecycle maintenance repairs and plant replacement. Large extract fans particularly those serving fume hood extract plenums can weigh in excess of 500kg. Consideration must be given to the following.

- Permanent roof platforms to enable maintenance activities to take place without working at height.
- Dedicated and weatherised permanent lifting equipment to allow equipment maintenance.
- Lift access to roof level and specifically designed routeways (no steps), sufficient weight bearing capacity routeway from, lift to roof platforms to allow replacement of large plant items.

Designers must provide UCD with the following information for roof fan installations above 7kW.

- Equipment replacement procedure detailing safe access route, equipment weight etc.

Service intervals and lubricant details must be provided for any motors requiring greasing or other lubrication.



Example of large plenum extract fan

5. Boilers & Heat Generators

5.1 General

Where connection to the District Heating system is not possible.

Multiple modulating boiler installations are preferable to single large boilers, to provide redundancy and efficient operation throughout the working range.

Where a boiler system is serving LTHW space heating as well as all year round DHW demand, consideration is to be made to providing a separate DHW boiler. See section 9.0.

Each floor standing boiler and associated boiler equipment (pressurisation units etc.) should be installed on a plinth.

Pressurisation units are preferable to open feed & expansion systems.

All heating systems should be fitted with a BMS connected static pressure sensor (0-4Bar range). This is independent of the Hi-Low pressure status contacts from the pressurisation unit. The pressure sensor should be fitted with an isolation valve to allow maintenance/repair.

The boilers heat exchanger shall be protected by a coalescing element and dirt separation medium which completely fills the internal volume of the vessel (Spirocross or similar approved). This is to be fitted on the boiler return line. There is to be an automatic air vent at the top of the unit and a drain point at the bottom. Preferably this is to be integrated in a vertical low loss header.

The boilers heat exchanger is to be constructed from 317 stainless steel.

Automatic air vents to be installed at all local high points on pipework. The automatic air vent is to be fitted with an isolation valve to prevent weeping from valve when not required. The automatic air vent should be of all metal construction, e.g. Winn's automatic air vent or similar and approved.

Boiler isolation valves shall be rated for heating system use and of the following construction:

- a) ¼ turn lever action ball valves up to and including 50mm in size
- b) Lever action butterfly valves greater than 50mm

Drain cocks shall be provided as follows:

- 1 per boiler (or heat generator)
- 1 per distribution circuit
- 1 per header

5.2 District Heating Heat Exchangers

Connection to the District Heating should be through low pressure drop, Plate Heat Exchanger(s) (PHE). The secondary temperature should be controlled using a robust reliable 2 port control valve located on the primary side of the PHE. Control should minimise the valve opening time and completely close when there is no heat demand. Buildings with low DHW requirements should use 2 no. heat exchangers, a larger PHE for space heating and a small PHE for hot water services. In exceptional cases such as in buildings with large all year round DHW requirements one PHE may be considered. The secondary heating system should be designed to provide a low temperature (~50-40degC) secondary return temperature to the primary HEX.

PHE Specifications

PHE plates should be .5mm grade 316 stainless steel, they should be piped in counter flow configuration and in accordance with manufacturers specifications.

PHE's must be fully lagged using proprietary removable lagging jackets.

Where possible the plate heat exchanger should be located at basement level.

UCD Plate Heat Exchanger Specifications		
Expected Primary operation Pressure	6.5	Bar
Primary Design Pressure	10	Bar
Primary Test Pressure	13	Bar
Primary Pressure Drop Max @ Full Flow	10	Kpa
Primary Flow Temperature	75	degC
Primary Return Temperature	55	degC
Max Temp Rating	140	degC

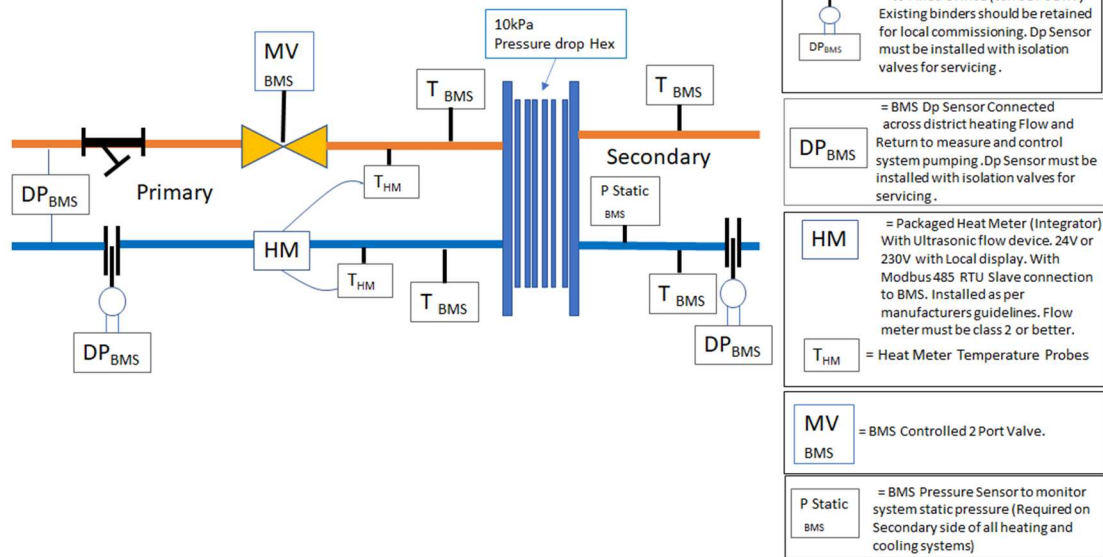
PHE Ancillaries

1. Primary Heat Meter – should use an ultrasonic flow device and be installed to manufacturers guidelines. Also See section 3 and 7 regarding heat meter selection and interface requirements. Flow device static pressure drop should not exceed 3kpa
2. Strainer should be fitted with 1mm mesh and must be 1 size above line size. Binder points should be fitted before and after strainer.
3. Modulating valve (2-10V, or 0-10V control signal) with feedback facility, valve authority should not exceed .5. Consider Siemens, Belimo or Aumo Control valves.
4. Differential pressure transducers are required to measure DH differential pressure and also flow rates through fixed orifices.

Note: DP sensors must all be 10 Bar rated and installed with isolation valves to allow servicing. DP sensors must be installed meeting manufacturers guidelines (bleed screw should be facing upwards).

Note: Fixed orifice devices should be fitted with binders and DP sensors to facilitate both periodic commissioning readings and ongoing BMS flow monitoring.

UCD Heat Exchanger Field Device Design Installation Notes V1.0



5.3 Pockets Indicators & Test Points

Each Heat Generator (Boiler, Heat Pump) to be fitted with a clock type temperature and pressure gauge

Binder test points shall be provided in the following locations:

- Headers: On flow & return headers.
- Pumps: At inlet and outlets of each pump.
- Distribution Circuits: On flow and return of each circuit.

Temperature pockets (1/2" BSP) for BMS sensors shall be situated as follows:

- Boiler: One on the flow and return as close to boiler as possible
- Headers: One each on the flow and return header and on both primary and secondary sides in the case of low loss headers.
- Distribution circuits: On flow and return of each circuit

BMS temperature sensors shall be located at each of these positions.

The exact positions of the indicators, pockets and test points should be agreed with UCD.

5.4 Electrical Aspects of Boiler House/Plant Room Installations

Local isolators suitably IP rated to be provided on:

- Each boiler (Heat generator)
- All electrical plant, pumps, fans etc

Status monitoring of the following alarm conditions shall be carried out by the BMS.

- High Temperature stat (if fitted) E.g. on UFH or DHW
- Burner/Boiler Lock Out/ Heat Pump Fault
(May require a 230V relay to provide volt free BMS contacts)

- System Hi - Low Pressure
- System Static Pressure (0-4 Bar)

The cabling system shall ensure that all cables are protected in metal trunking, conduit\ flexible conduit as appropriated.

All power cables shall be heat resistant at the final connection to plant items.

5.5 Boilers/ Burners

Boilers should be spaced adequately to prevent overheating and fire hazards.

Adequate space should be provided for safe access to the boilers by the maintenance staff for inspection and servicing.

Ensure sufficient space is allowed for removing the boiler burner / casing as per the manufacturer's specification.

Boiler casings should not be drilled to run electrical cabling.

All boilers shall be designed for remote BMS setpoint control and must be capable to receiving a 0-10V variable temperature setpoint signal from the BMS.

All burners over 300 kW shall be provided with efficiency monitoring equipment, i.e. a gas meter connected to the BMS and a Heat Meter. See section 3.0 for further details.

5.6 Flues

All flues to be twin wall insulated.

Flue gas analysis points to be provided at the back end of each boiler.

Consider individual flue runs for each modular boiler.

The flue installation and designed system pressure drop and fall should prevent the possibility of condensation returning to the boiler or into an offline boiler in a boiler array and must allow means of draining off any condensate.

In the case of retrofits in boiler houses where a masonry chimney is used to exhaust gases, a stainless-steel liner must be fitted.

5.7 Boiler house

Each boiler house shall be adequately sized and ventilated to allow for combustion.

All service openings in the floor should be adequately banded (especially if the boiler house is on the upper floors) and the floor must be painted / sealed. All such areas must be flood tested prior to handover. Fire proofing of openings in the floor must have additional structural protection if the area is accessible to pedestrians.

The boiler house shall be provided with an adequately sized floor drain(s) and be connected to the soils/wastes system.

The boiler house shall be provided with a floor drain.

The boiler house design should provide for ease of maintenance of the plant within, and for ease of access into the boiler house itself.

Sufficient space shall be provided for the removal and replacement of plant items in the future. Safety measures (hooks / hoists) should be installed to allow for the safe removal/replacement of large plant items at a later stage.

Hard labels should be installed on all service items, e.g. pumps, fans, pressurisation units, boilers, A/D Separators, AHUs etc with identification no.

Sticky labels are not acceptable, the numbering scheme should be agreed with UCD.

The lighting in the boiler house shall be vapour proof fluorescent fittings, with provision for emergency lighting as required.

The boiler house shall be treated as a separate fire compartment. All floor and wall openings shall be fire-stopped to the appropriate compartmentation level.

5.8 Gas Pipework in Boiler house

All gas pipework within the boiler house to be sleeved and vented in accordance with GNI Standards. All gas pipework shall be painted yellow.

All pipework shall be labelled and marked according to BS standards.

5.9 Alarm Systems

Fire alarm detectors in the boiler house shall be rate of rise heat detectors.

The boiler house shall be fitted with gas sensors, which when activated alarm at the main gas alarm panel and operate a slam shut valve local to the boiler house.

A gas-reset button with a "supply restored" indicator lamp shall be provided and suitably labelled on the control panel front.

The gas detection panel shall signal the main house fire alarm panel in the event of detection and similarly the main house fire alarm shall signal to shut the gas off in the event of fire alarm.

The gas slam shut valve must be an automatic reset unit and should not require manual reset after an electrical power outage or fire alarm reset.

5.10 Ancillary Equipment in the Boiler house

Power Supplies shall be provided as follows:

50V for portable lighting

110V for portable tools

220V for test equipment

using the respective standard outlet type(s).

Fire extinguishers shall be provided appropriate to the identified fire risks.

A service water supply shall be provided.

A system schematic should be mounted on the wall.

Draft Issue D2.0

6. Heat Distribution

6.1 Pipework

All pipework should be mild steel pipework to the appropriate BS standard. Copper pipework is not acceptable. Pipework shall be supported adequately.

Heat distribution circuits shall be designed to prevent pipework from air-locking.

Where automatic air vents must be fitted on distribution mains, the mains shall rise to the vent. The automatic air vent shall be of high quality and fitted with a lever action isolating valve.

The design of the heat distribution shall avoid underfloor pipework. Pipework encased in floor slabs is not permissible, all pipework must be accessible.

Pipework shall not enter the comms room of a building.

Allowances should be made for binder test points on flow and return of each circuit, and across each pump, control valve and balancing valve.

Visual temperature and pressure gauges shall be installed on the flow and return of each circuit, to allow for visual inspection by the maintenance staff.

½" BSP BMS temperature sensor pockets should be provided on the flow and return of each circuit.

The design of heating circuits should be based on a design delta T of 20 degrees C.

Where possible, heat loads should be based on 2 port control and the distribution pump speed should ramp to maintain a differential pressure at the index run of the circuit to reduce pumping volumes.

6.2 Heating Circuit Design

All secondary heating systems should be designed to provide a low temperature (~40degC) secondary return temperature to the heat generation header system.

6.2.1 Radiators

Radiators are the preferred method of providing perimeter heating.

Radiator circuits shall be controlled on a weather compensation basis to take into account the solar gains on the aspects of the building. A circuit / zone shall be provided on each aspect of the building ie North, South, East and West Zones

All radiators to be fitted with thermostatic radiator valves, with 2 port zone valves where practical. To reduce return water temperatures radiators must be installed in "top entry, bottom opposite exit" configuration.

Radiators shall be positioned to allow best flexible use of space and take account of possible future uses. Radiators to be sized and positioned to ensure they do not become an alternative seating location (i.e. low level deep radiators)

The radiators on campus shall be pressure rated to operate at 5 bar minimum.

Public areas of buildings e.g. lobbies and entrances should not present a risk to the public from high temperature surfaces. LSTs shall be employed where such risks exist.

Radiators are not required in WC's.

6.2.2 Fan Coil Units

Fan coil units are generally not to be used. Wherever possible in refurbishment situations, fan coils shall be replaced with appropriately sized radiators.

Control of fan coil units shall be through room sensors via the BMS.

6.3 Constant Temperature Circuits

6.3.1 Heater Batteries

Filter banks to be fitted before any heater batteries in air handling units.

'Pre-heat' battery to be fitted with frost protection stat, linked to BMS.

All batteries to be fitted with two port lift and lay motorised valves. These valves shall be fitted with actuators as described in Control Section 9.8. The valves shall be positioned so as to be accessible for maintenance or inspection.

Each heater battery to be fitted with regulating and balancing valves.

6.4 DHW Circuits

The DHW primary circuit to be fitted with two port lift and lay motorised valves at each calorifier. These valves shall be fitted with actuators as described in Control Section 9.8. The valves shall be positioned so as to be accessible for maintenance or inspection. Each circuit to be fitted with a regulating and balancing valve.

The DHW system shall be designed to supply hot water all year round at minimum operating cost. Separate DHW boilers should be considered where space heating incorporates a low LTHW return temperature (condensing boiler) high energy efficient strategy design.

DHW calorifiers must be fitted with electric immersion sets for emergency back-up as well as appropriately located immersion pocket(s) and a return water temperature pocket to enable the BMS to monitor DHW storage temperature.

Visual temperature and pressure gauges shall be installed on the DHW circuit to allow for visual inspection by the maintenance staff.

7. Building Management System (BMS)

A Cylon Controls BMS system is the main tool used by UCD to centrally control, diagnose and monitor all building services including HVAC, internal lighting, windows, water services and external lighting. The BMS system also supports a significant energy and water meter installation, this includes electricity, heat, gas and water meters. In addition, the site BMS is used to monitor the status of alarms such as lift, gas and fire alarms. This large centrally controlled BMS installation utilises a dedicated campus wide fibre channel network to maximise system resilience. The single site BMS network currently has over 160 communications controllers and over 30,000 hardware points. Wireless communication links are used to link UCD satellite sites back to the central BMS network.

There is a strong emphasis on BMS design and programming for reliability and ease of maintenance to ensure safe, efficient, and reliable building and outside lighting services. Continually improving energy and water efficiency is a key UCD goal, all reactive and preventative maintenance activities is carried out in unison with the UCD ISO 50001 energy management system.

No stand alone “Black box” controllers or time switches shall be used. The BMS shall perform all standard controls functions directly (no intermediate gateways or protocol converters to be used).

7.1 BMS Controller Architecture

UCD uses a single Building Management System exclusively for all building controls and ancillary equipment, the Unitron system, manufactured by Cylon Controls Ltd., Ireland.

The control strategy for the BMS and plant operation shall be approved by UCD. An operating strategy, wiring diagram and points list for the plant items shall be submitted to UCD for approval to facilitate this. The wiring and point structure should be designed to reduce the use of wide output globals. The Unitron system supplied to UCD should comprise of the following main elements.

Entity	Purpose / Description
UC32.Net	Communication Controller
UC32/24	24 I/O point controller
UC32/16	16 I/O point controller
UC32/12	12 I/O point controller
UC32/08	8 I/O point controller
UC16DI	16 digital input point controller
RP8*	8 way relay pack for switching small loads
RL4*	8 relay outputs from 4 points

Each UC32Net must be supplied complete with one Modbus RTU master 485 port plus RS232 serial port and Ethernet board. Keypad controllers are not to be used. Each UC32Net must be capable of communicating with up to 63 controllers, i.e. the LC or ELC model is not acceptable.

The UC32.Net for each project should be installed in the building BMS Fibre panel (BMS Comms Panel). This panel is reserved for the building BMS Industrial Ethernet switch e.g. (MOXA) switch, 24V battery back-up hardware, BMS communications controllers and BMS outstation address no.1 which monitors the status of the Fibre to Ethernet switch and the battery status.

See diagram below illustrating the UCD BMS network configuration.

UCD BMS Architecture Overview

Fibre Comms Panel

Contains

- 24V battery back-up
- BMS network (.Net)Controller(s)
- BMS Outstation no. 1 to monitor system health
- Fibre Industrial Ethernet switch

Building XYZ

Typical Building

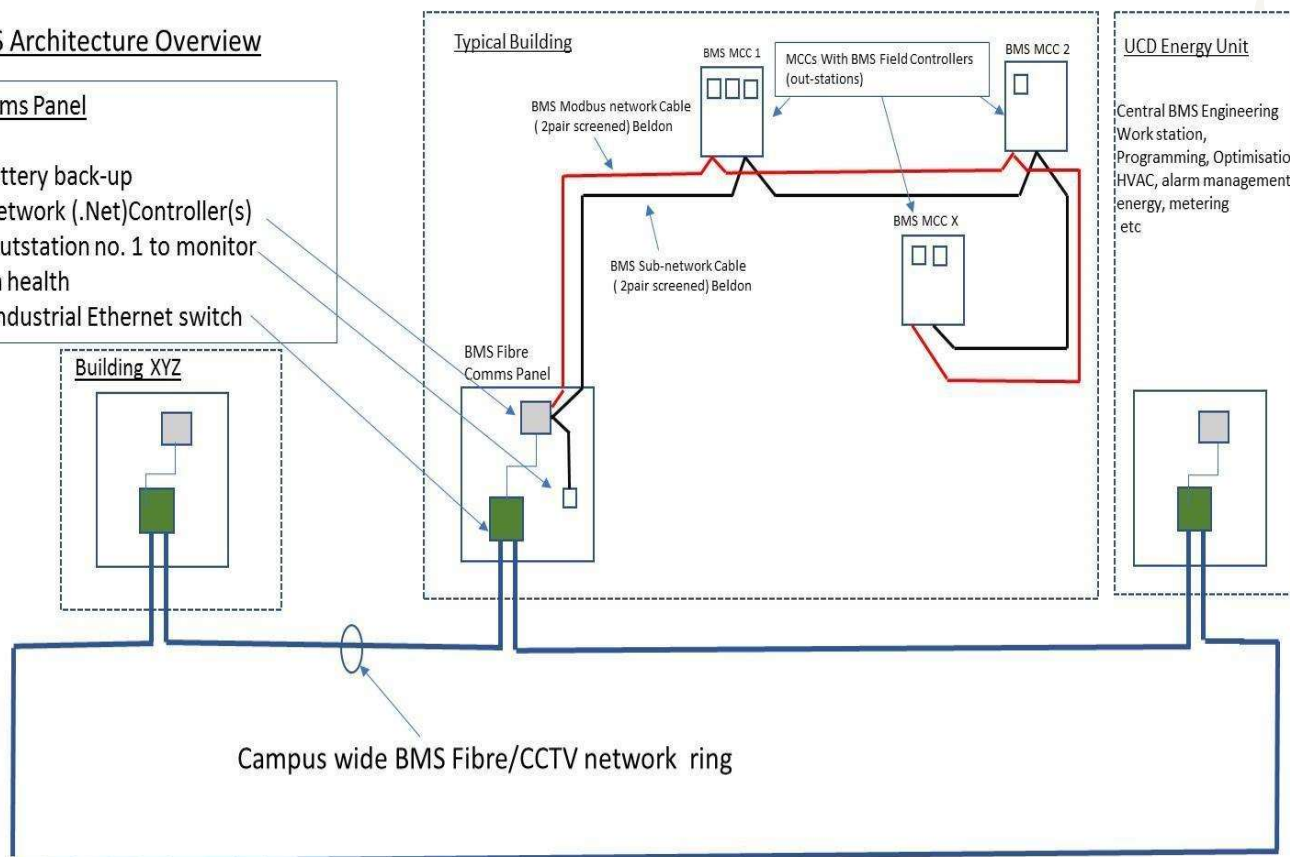
BMS MCC 1

MCCs With BMS Field Controllers (out-stations)

BMS MCC 2

UCD Energy Unit

Central BMS Engineering Work station, Programming, Optimisation, HVAC, alarm management, energy, metering etc



7.2 UCD BMS Cabling Specifications

Subnet/Modbus/Field Device Cables

Manufacturer	Part Number	Application	No. of Pairs	Armouring	Impedance	Shielding	Twisted Pair	Stranding	Cable Thickness (AWG/mm)
Belden	9842	RS485	2	None	120Ω	Foil + TC Braid Shield	Yes	7x32	24/0.51
Belden	7201A	RS485	2	Industrial PVC	120Ω	Foil + TC Braid Shield	Yes	41x40	24/0.51
Belden	9842LS	RS485	2	Galvanised Steel Wire Braid	120Ω	Foil + TC Braid Shield	Yes	7x32	24/0.51
Armada	M244402P 18F4	RS485	2	Galvanised Steel Wire Braid	120Ω	Foil + TC Braid Shield	Yes	-	24/0.51

Note: Armoured cable is required for exposed external/external ductwork cable runs.

Fibre Cables

Network Cable Type	Fibre mode Structure	Cladding Diameter	Core Diameter	No. of Cores	Terminated Cores	Armoured Cables
OM4	Multimode	125 µm	50 µm	12	8	Galvanised Steel Wire Armour/Kevlar may be acceptable

7.3 Modbus & Cylon Sub Network Details

A belden SWA twisted pair cable (2 pair) shall be used to connect the BMS field controllers (out stations) to the BMS communications controller (UC32NetKm), and shall be referred to as the sub network cable "subnet".

The BMS subnet is wired from the BMS Fibre communications panel to connect to the various building BMS outstations. In the event of a power cut this comms panel and BMS outstation no. 1 will remain operational through the 24V battery back-up.

A belden SWA twisted pair cable (2 pair) shall be used to connect all Modbus devices to the UC32/NetKm and shall be referred to as the Modbus Network, with no more than 31 field devices connected (Baud 9600, Parity 0, Stop bits 2, Word Length 8).

Modbus cables should be looped between devices – not star connected (to reduce cable length).

7.4 BMS Graphics

UCD uses standardised BMS graphics for Boiler plant, Pumps, AHUs, Lighting etc. Sample template graphics are available on request for sub-contractor use. BMS floor plan drawings must indicate graphically the appropriate radiator or AHU/reheat zones serving each space.

All BMS graphics must remain fully editable using the Cylon CC draw program to permit future changes/amendments. Bitmap based BMS graphics should not be used except for initial launch page where Architects drawing/photo may be used.

7.5 BMS Programming

BMS strategies must be presented and programmed in an intuitive and block efficient manner that facilitates trouble shooting and avoids unnecessary complexity. BMS strategies must be laid out with inputs on left and outputs on right.

Unnecessary Boolean blocks or latches must not be used. BMS alarms blocks are only to be used for critical alarms, not for HVAC or maintenance alarms. UCD has developed multiple responsive, energy and programming block efficient strategies for ventilation, lighting, water and HVAC control and can meet with and provide these strategies to ACSI BMS contractors for use at UCD.

7.5.1 Specific Programming Points for Contractors

- Space heating boiler setpoints (not DHW) should be dynamic and calculated using maximum required weather compensated or internal temperature requirement.
- Direct 0-10V boiler setpoint control cannot be implemented using a PID block and must use rescale blocks to achieve dynamic setpoint (see above).
- DHW control should not be based on valve position – must use immersion and return water sensor and wide dead band control. Discuss wideband DHW priority mode with UCD.
- Pumps should use weekly flag for weekly changeover – no auto changeover on pump failure to be programmed.
- Meter modules, meter accumulator to be synced with meter display using an analog virtual block, only the last 15 min reading is to be data-logged. No reset or daily, weekly monthly accumulators are required.
- PIR input points must include PIR reference from floor plan/electrical schematic.
- PIR controlled lighting should not use time schedules

7.5.2 Offsite BMS Programming (File Transfer & Global Points)

As the UCD BMS network is large and serves a wide variety of services, BMS strategies are adjusted and optimised on an almost daily basis. It is not permitted for contractors to carry out “CC Restores” to the UCD BMS network.

In advance of any BMS project is advised to meet with UCD to agree BMS network addresses, and controller numbers etc.

The site global file is also a live file which is updated regularly. BMS global points can only be added from the main UCD BMS workstation located in the UCD Energy Unit. Access to this workstation must be agreed in advance with UCD.

7.6 BMS Field Devices

7.6.1 Temperature Detectors

Space and immersion temperature sensors shall be Cylon 10K3A1 type NTC resistive sensors. For overall system reliability, where possible active (0-10V) temperature sensors should not be used, particularly for space heating.

In the case of combined Temp/CO2 sensors, the temperature element should be resistive. All room temperature sensors should be installed using an insulative backing and care must be taken to ensure the sensor is not influenced by airflow leaking through the wall cavity.

7.6.2 Air Velocity Sensors

Air velocity sensors to be ABB or Sontay sensor or equal and approved with range selected to suit application. Air velocity sensors must not be installed in an attenuator section and should be installed in a duct section with low turbulence, the duct CSA should be measured at the sensor location and BMS graphic noted with this CSA.

7.6.3 Pressure Sensors

BMS air pressure sensors may be used to control ventilation based on maintaining a positive or negative pressure in an area.

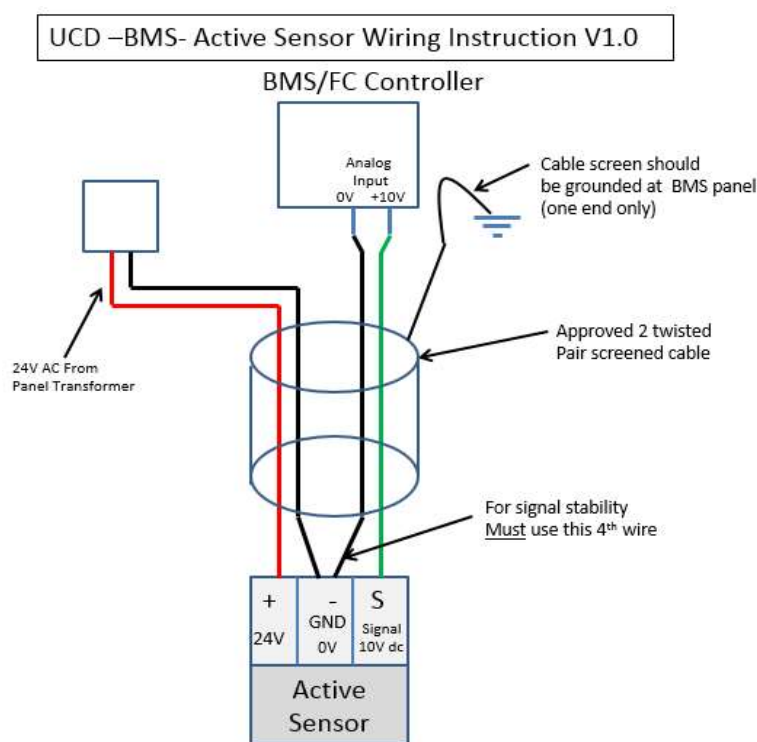
Liquid static or differential pressure sensors may be required at hydraulic index run locations or at end of system headers. Pressure sensors should be Huba Controls or equivalent and sized appropriately.

7.6.4 Active Sensor Accessibility

All active sensors e.g. combined Temp/CO₂ detector, PIR's must remain accessible for maintenance/replacement. The use of hoists, scaffolding or other specialist should not be required under normal circumstances.

7.6.5 Active Sensor/Device Wiring

All active sensors/devices (not supplied by UCD) in general shall use 24V ac power supply and provide 0-10V or (2-10V) output signal to the BMS. Sensors shall be wired in 2-pair belden cable in accordance with the diagram below. To reduce signal noise the 0V signal return must be connected at the device (all 4 wires connected). See diagrams below. Combined active/passive sensors may need to be wired with a 3 pair cable to provide correct signal integrity.

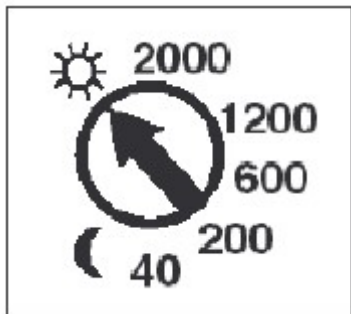


7.6.6 PIR Configuration

All BMS PIRs should be configured appropriately on installation, the following applies to BMS PIRs intended for lighting/HVAC control and not for 230V mains PIR (standalone) lighting control.

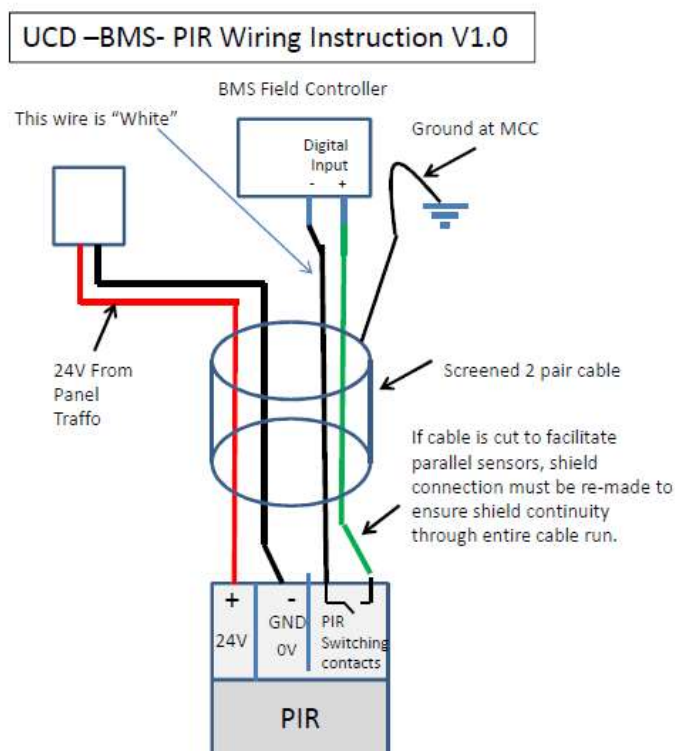
As the site BMS fully controls the lighting delay off time each BMS PIR(s) should be adjusted to give a short ON time (e.g. 5seconds) or an appropriate pulse length. This assists with future de-bugging and testing of BMS PIR(s). The typical lighting delay OFF time is 15minutes (adjustable by the BMS).

As the site BMS also controls light level control, local light level control should be disabled on the BMS PIR(s), see illustration below.



7.6.7 Wiring Installation (PIR's)

All wiring for BMS PIR(s) must be screened, in the case where PIR(s) are installed in parallel the cable screen must be maintained throughout the cable run. Additional relays (potential points of failure) should not be used in conjunction with PIR(s). PIR(s) must be fitted with an identification label, this reference should be included on floor plan drawings, electrical drawings and on BMS input name.



7.7 Critical Alarm Monitoring

BMS alarm blocks must only be used for critical alarms, Fire, Gas, Lift, disabled WC etc.

Noncritical alarms such as HVAC filters/pump alarms are not permitted and must be included in BMS control Strategy regardless if the blocks are unconnected.

Note: Critical alarm points should be wired directly to BMS controller outstations and not to BMS DI controllers.

The status of the following alarm conditions shall be monitored by the BMS by means of a normally closed (N/C) relay contact opening on alarm detection. The alarm points listed below must be wired directly from the main panel to a BMS outstation (not using a BMS DI encoder).

Alarm System	Alarm Point	Fault Point	Other
Fire	Fire Activation	Common Fault	Alarm BGU
Disable Refuge	Common Alarm	Common Alarm	
Disabled W/C	Call Button Activated		
Lift	Lift Car Alarm	Lift Fault	
Gas	Gas Alarm	System Fault	
Intruder	Alarm Activation		
Lab Gas Alarm	Lab Gas Alarm	System Fault	

Note: BMS alarm priority numbers and text strings will be assigned by UCD to the BMS contractor.

7.8 Critical Alarm Commissioning

Prior to project hand-over all BMS alarms must be demonstrated and verified. A test completion form is available from UCD Estate Services Energy Unit. This must be completed by BMS contractor.

UCD Capital and Minor Works Project - BMS Critical Alarm Monitoring Check Sheet						 UCD Estate Services Seirbhísí Eastáit UCD	
(To be completed and handed over to UCD Estate Services BMS Office following any new build projects (Capital) or Minor Works Projects (MWP) which relate to or have any potential impact on critical alarms)							
Date							
Project Title							
Works Description (e.g. Boiler House Refurb)							
Location (Building Name, Block, Floor etc)							
BMS Details							
BMS Contractor (Organisation Name)							
BMS Engineer (Name)							
		BMS Point Details				SMS Alarm Message to UCD Estate Services Demonstrated/Verified	
Alarm Details	Details - N/A if Not Present	Net	Controller	Hardware Point	Alarm Priority No.	Date	Comment
Building Fire Alarm							
Gas Alarm							
Lift Car Alarm (1)							
Lift Car Alarm (2)							
Disabled WC Alarm (1)							
Disabled WC Alarm (2)							
Intruder Alarm Activation							
Misc							
Misc							
Misc							
Note [1]: Alarms must use Normally Closed (NC) contacts. The contacts should open on Alarm Activation. Note [2]: A BMS event driven datalog should be added to alarm hardware inputs. Note [3]: Return this form to UCD Estate Services Energy Unit on completion or email scan to to bms@ucd.ie. Form Ref: UCD-BMS-18-01 V1.0 07/03/18							

7.9 MCC Panel

The details below illustrate UCD specific requirements for MCC panels, additional requirements to be advised by project consultant. MCC panels must be located in doors in an accessible location to facilitate maintenance in all weather conditions.

- Must be “hard” labelled with MCC Ref, manufacturer, project number and construction date.
- Hand/Off/Auto switches to be provided for each command point.
- Indicator lights to be provided, Green for Run & Red for Trip.
- Status points to indicate a run status shall be via current switch type Veris Hawkeye 800 (0.5 - 200 amps) or equal and approved or pump status contacts.
- Panel indicator lights to use LED bulbs, 100,000-hour rating 24V ac.
- Passive vents to be fitted (1 each at low and high level) to allow passive ventilation.
- An appropriately selected protection device should be used to protect MCC inductive loads such as the main 24V transformer.
- BMS multiple relay units must be Cylon RL4 or RP8 units.
- BMS field controller address must be labelled on the controller in the format NNN_AA
E.g. Controller no. 6 on subnetwork no. 98 = “098_06”
- BMS section must allow space for a minimum of 1 extra UC32.XX Controller and 1 RL4 Relay pack

7.10 Temperature Control & Zoning

Internal Flow Temperature Compensation.

In order to maximise the benefits of such control strategies, a significant number of internal temperature sensors shall be required for averaging purposes. As a guideline at least three sensors shall be used per circuit. The location of these should be agreed with UCD at the preliminary stages of the design.

Space Temperature Control.

The following table should be used as guideline for the selection of sensors for control.

Room Type	Sensors Required
Office requiring emitter control.	1 sensor with local set point control.
Space (> 60 m ²) without ventilation.	2 sensors minimum.
Mechanically ventilated spaces.	2 sensors and 1 duct exhaust sensor.

7.11 Frost Protection & Trace Heating

The operation of pumps and boiler plant for frost protection shall be initiated by the BMS.

The external temperature is available on the existing Belfield BMS as a global point. External temperature sensors should not be included as part of the controls package. Frost protection will be 2 stage

Stage 1 - Outside Air Frost Protection

The Outside Air Frost Protection setpoint is 3°C

If the Outside Air temperature falls below the Outside Air Frost Protection setpoint when the heating system is "Off" because of BMS Time schedule, the BMS will enable the distribution pumps.

The distribution pumps will continue to run until the Outside Air Temperature rises 1°C above the Outside Air Frost Protection setpoint, or the heating system is enabled on its schedule.

Stage 2 - Immersion Frost Protection

The BMS monitors the return water temperature.

If the return water temperature falls below the immersion frost set point of 2°C. The circulating pumps will be run via software interlock to ensure circulation through the system and prevent damage to pipe work due to ice build-up.

The boiler shall be run via software interlock. The boilers shall continue to fire until the return water temperature reaches 10°C.

Electric Trace Heating

Trace Heating installations to protect, water, chilled water or other system pipework must be monitored by a dedicated BMS connected Current Transformer (CT), Current Switch, or a dedicated BMS connected electricity meter. This is to ensure that operation of trace heating can be monitored to ensure it operates when required and doesn't operate when inappropriate. This can have a significant impact on energy consumption, particularly for chilled water systems.

A control narrative and commissioning settings (setpoints, kW load etc) must be provided for each system, witnessing the operation of this system will be required by UCD.

The trace heating system should form part of an overall frost control strategy including consideration of the standard BMS frost response and any other hardwired frost/immersion thermostat response.

The controlling sensor should also be installed in an appropriate location to accurately determine when pipe protection is required.

7.12 Urinal Control

All urinals or urinal banks shall be fitted with 24V A/C normally closed solenoid valves, for flushing control (i.e. the miser valve opened fully, fill time of the cistern measured on full opening and the solenoid used to control each cistern fill time). The solenoid shall use a 24V ac power supply and shall be capable of closing with pressures of 150mbar. Power to the solenoid shall be controlled through the BMS relay pack (ref Cylon RP8).

7.13 External Lighting (BMS Control)

All control of outside lighting and external building lighting shall be via the BMS. A BMS controlled relay should be used to activate outside lighting contactors.

At the Campus BMS can provide outside light level as a global point to all BMS controllers, additional external light level sensors are not required.

The external lighting (lamp standards) shall be wired over 3 phases, i.e. 3 consecutive lights on 3 different phases. Each phase of lighting to be provided with its own contactor, which shall be a heavy-duty type.

7.14 BMS Actuators

All actuators shall be solid state and use 24V ac power supply with positional control via a 0-10V or a (2-10V) input signal from the BMS. The actuator must also be capable of providing a 0/2-10V positional feedback signal to the BMS. (No pneumatic actuators shall be used).

Actuators shall be Siemens SQS type or equal and approved with a 5 year minimum warranty.

7.15 Maintaining BMS/HVAC Actuators

BMS actuators are service item, as such they must remain readily accessible (without disruptive dis-assembly works or working at height) post installation. This requires careful consideration at design stage. Consider installation in risers or other suitable locations.

7.16 Energy Meter Inputs

As far as practicable, Modbus 485 RTU Slave interface shall be provided to all energy metering devices (electricity, Heat). Where Modbus output is not available the BMS shall allow pulse input points for metering utilities. These shall be pulse inputs of maximum frequency not greater than 10 hertz.

7.17 AHU Control

The amount of conditioned air being supplied and extracted from a building should be kept to a minimum and wherever practical control strategies which reduce air change rates must be employed.

Where possible, the AHU strategy should include fan speed control based on CO₂ levels in the room. There should also be a temperature and ventilation setback mode activated at times where no occupancy is detected. This strategy should be used in a lecture theatre for example, and anywhere else there is a variable occupancy profile.

For spaces such as labs with variable volume requirements consideration should be given to differential air pressure control.

A duct mounted BMS velocity sensor provides maintenance staff with useful information when dealing with issues and should be included on the main supply and extract ducts.

Temperature sensors should be included directly before and after each side of the heat recovery device where applicable (4 in total before and after on the supply and extract).

2 – port control on the heating coil valves should be considered to reduce return water temperatures to the boilers and to reduce pumping costs, as the pumps will ramp back based on pressure at the index run.

It is important to ensure that AHU design specifications are appropriate for UCD installations, for instance the use of high and low pressure switches interlocks, unless very carefully considered and commissioned and use high quality field devices can result in very poor reliability. Use of same should be considered very carefully in terms of what they are designed to protect and if they are actually required.

7.18 Miscellaneous Schematics (UFH, AOV, Trace Heating etc)

As built site-specific schematics for all systems including AOV/EOV, underfloor heating systems must be provided, these should be site specific and refer to appropriate room numbers, facades, actuator, manifold numbers etc, rather than generic factory schematics. The schematics should fully detail terminal numbers and connection details and be equivalent to BMS standard of detail.

8. HVAC Commissioning & Demonstration

8.1 HVAC Commissioning Plan

With the advent of advanced in-built controls within plant such as circulation pumps, PIC valves, venturi valves etc. It is ever more important that system commissioning ensures completion of both traditional flow rate measurement as well as demonstrating the operation of these advanced control features.

UCD Requires that the design team should develop a project HVAC system commissioning plan.

The commissioning plan should be designer generated and system based rather than individual technology based. This ensures that the appropriate interaction and response between the typical plant

items (listed below) can be demonstrated for varying heating, cooling and ventilation demands in a time efficient manner.

- BMS
- Heating and Cooling generators
- Pumps
- Fans
- Control Valves & dampers (Pic, venturi and traditional 2 port)

The traditional HVAC commissioning report (with air and water flow rates) must also include all pump/valve software settings e.g. Pic setpoints, Pump – inbuilt setpoints, operating curves etc.

These settings are programmed during installation or commissioning and therefore must be included in hand-over documentation. This will ensure that any future replacement valves/pumps etc can be commissioned appropriately on install.

8.2 HVAC Demonstration

As part of the Client HVAC demonstration, sample air and water flow rates should be demonstrated by the commissioning engineer at part and full load. It is also important that the overall hydraulic design is also witnessed, this should include the overall flow-return delta t, in some cases this may require a future winter demonstration.

The BMS is the ideal tool to simulate potential seasonal requirements and to help demonstrate system response (temperatures, pressures, delta t etc) in addition to physical witnessing. BMS datalog files can also be used to demonstrate building warm-up cycles etc.

9. Water System

9.1 External Water Mains

9.1.1 Pipework

All materials shall be suited for operation at the normal campus pressure of 6-6.5 bar.

Acceptable materials for external water mains are as follows:

Pipe Size	Material	Comments
>= 100 mm	HDPE Pipe	Preferred for New Works
>= 100 mm	Ductile Iron	On Approval by UCD
< 100 mm	HDPE Pipe	Preferred

All mains to be laid as per services co-ordination drawing shown in Appendix 1.

Warning tape to be laid above the main. White water main maker/warning tape to be labelled as “Non-Potable Water”.

All plastic main to be laid with tracer cable, which shall be bonded to each metallic fitting.

All interconnecting branches on ring mains to be provided with a nest of three valves.

A Fire main shall be laid around each new building.

9.1.2 External Valves

All underground valves to be located in a constructed chamber with the valve head $\leq 300\text{mm}$ below the chamber lid and frame to facilitate ease of access.

Underground valves to be clockwise opening, square bayonet heads

Valve positions to be clearly marked with tombstones and cast iron identification plates.

9.1.3 Hydrants

All hydrants to be located in a constructed chamber to facilitate access as per current relevant BS standards.

Hydrants to be anticlockwise opening. Valve heads to be square bayonet heads.

9.2 Internal Water Mains

Material Selection

Material	Comments
Copper	Standard use
ABS	Chemically Corrosive Areas

Designers to be aware that water pressure on the Belfield campus is 6 bar (87 psi), appropriate grades of materials to be chosen to suit.

Pressure reducing valves may be required.

9.2.1 Internal Water Distribution Systems

The water services within the building to be separated as follows:

- Fire Water
- Potable / Mains Water
- Whitewater

- Tank Water

The potable water supply to be taken from the rising mains to the tanks. All drinking fountains must be located within 2m of the rising mains. An appropriate number of drinking points shall be provided in each building.

The fire main to be separated from all other supplies for distribution within the building. See detail in fig 10.1 for a suggested method of separation of the supplies.

Designers shall take account of maintenance access. The design of the water distribution shall avoid underfloor pipework. Pipework encased in floor slabs is not permissible, all pipework must be accessible.

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Draft Issue D2.0

9.2.2 Water Valves

All valves internal to the building < 100 mm to be ¼ turn lever action ball valves. All internal valves >= 100 mm to be ball / butterfly valves with lever action handles.

Each distribution main is supplied with a main isolating lever action valve and an isolating lever action valve at each branch from the distribution main.

All final connections to sanitaryware, lab equipment, kitchen equipment & drinking fountains shall have individual lever actions valves to facilitate the maintenance of individual items.

The location of valves and the pipework shall be repeatable on each floor. All valves shall be accessible. Their position should be clearly marked. The number and location of valves to be agreed with UCD before completion of tender documentation.

All valves shall be reference tagged and a valve chart shall be provided.

9.2.3 Water Storage Tanks

All water storage tanks to be sectional fiberglass insulated Format 30 tanks to current BS and water by law requirements. All tanks to be covered, vented and protected.

Tank shall be situated and fitted with a lid which permits:

- Inspection
- Access for Maintenance of valves & ballcocks
- Cleaning

Tanks to be fitted with equilibrium float valve (similar to the Keraflo Aylesbury type) Multiple float valves preferable to a single valve. Maximum size 1¼" (30mm).

Where possible valve housing to be fitted above the level of the tank cover - allowing the level control mechanism to be mounted at a higher level than would otherwise be possible, increasing the capacity of the tank.

Warning pipe to be exposed.

Tank outflow and delivery to be arranged to ensure good mixing and turnover of water.

Tank to be situated in a properly sealed tank room or with a tray, with an overflow to drain.

All internal tank fittings to be stainless steel.

Access ladders / safety railings where required to be provided for safe maintenance of the tank.

White water storage tanks are used for the supply of white water to WC's & urinals. White water storage tanks shall be installed with the same safety requirements as the cold-water storage tanks. The white-water storage tank shall be fitted with two water supplies - a primary white-water supply & a backup mains water supply. Ensure the white-water supply is the primary supply to replenish the white-

water tank. The mains water supply should only be activated if there is an issue / loss of white-water supply.

9.2.4 Tank Water Distribution

The outflow from the tank to be provided with valve supply to a distribution header.

Each service from the header shall be valved at the take off.

Individual supply from tank to feed DHW (provision should be left for possible future metering of DHW consumption).

All tank water distribution mains shall be valved at each take off / landing point.

9.2.5 Fire Mains

Fire main to be separated from all other water supplies at point of entry in the building. A mains pressure indicator and flow switch to be provided on the fire main.

A lockable isolating valve (leather thong & lock) to be fitted around isolating valve on the fire main, to maintain the valve in an open position.

The installation of the main shall include a spool piece for the installation of a temporary meter for the purposes of testing the fire hose reels for commissioning and for future testing.

The fire main shall be constructed of copper pipework.

9.2.6 Water Service to Fire Fighting Appliances

A clearly visible isolating valve (1/4 turn lever ball valve) shall be fitted locally to each appliance.

A minimum 25mm supply shall be provided each fire hose reel.

The siting and housing of fire hose reels to be approved by UCD.

10. Domestic Hot Water (DHW)

The design of the domestic hot water system shall follow normal good practice. Every application is different, but below are some approved strategies for consideration which may be adapted where necessary.

Having a DHW system linked to a weather compensated heating circuit can reduce the potential for energy efficient condensing in boiler systems, if appropriate control strategies are not in place which allow condensing but also take into account legionella regulations. Where DHW and LTHW systems are linked, a DHW priority mode should be enabled. This strategy involves boosting the calorifier temperatures to 65 degrees C for at least 1 hour, once a day. After this a weather compensated strategy is implemented until the calorifier temperature drops below 50 degrees C. The temperature of the calorifier is then boosted up to 65 degrees C again, and the cycle repeats. The boilers must be suitably sized for summer DHW operation and/or must have a good modulation range and a control strategy to enable modulation. The LTHW and DHW systems should have good hydraulic separation in so that the boilers are not heating LTHW distribution pipework as well.

Where electric immersion heaters are used for summer hot water heating in residential apartments, for example, these must be controllable from the BMS to limit the times of operation, with local controls for on/off/boost functionality.

If the building is connected to the campus district heating system this can provide an economical source of heat, however the flow temperature in the district varies and so it may be necessary to provide a means of boosting DHW temperatures to achieve the requirements.

When considering a separate DHW boiler to space heating boilers, a life cycle costing exercise should be carried out, i.e. does the efficiency improvements of a separate system warrant the additional capital and maintenance costs of a separate one.

If the hot water demand is for wash hand basins only, then under-sink electric water heaters should be considered.

The cold feed to any calorifier should be metered and monitored on the BMS to establish water usage patterns and to help detect hot water leaks.

11. Natural Gas Distribution System

11.1 General installation requirements

All gas installations must comply with present GNI Standards.

Gas entry to the building shall be provided with two isolating valves, one internal to the building for normal operating shutdowns, one remote to the building for emergency shutdowns e.g. fire etc.

A main slam shut valve shall be provided for the building, linked to the fire alarm system and gas alarm system as appropriate. A relief vent shall also be provided to high level. Attention must be paid to the location of the discharge point.

Persons engaged in alterations to gas systems must be competent approved gas installers.

Gas pipework shall be red band GB pipework, all joints shall be welded.

Pipework shall be painted yellow.

All pipework shall be accessible, shall not be run in voids where gas may accumulate. Gas mains shall be sleeved and vented as per current regulations and standards.

Gas pipework on entry to each room shall be fitted with an isolating valve and electro-solenoid valve. The electro solenoid valve shall be operated by a local fail-safe lock switch to be approved by UCD. The design should allow for the connection of the local valve to alarm systems (gas and fire).

The purging procedure for the building shall be agreed with UCD early in the design.

11.2 Laboratory Gas Distribution

All laboratory gas distribution systems shall be designed to IS .820:2000

A gas proving valve (GPV) shall be provided for each laboratory, GPV shall as Krom Schroder available form C & F Quadrant or equal and approved.

GPV's must be manually reset following an electrical power outage.

12. Wastes, Soils & Sanitary Appliances

12.1 External Drains – Existing Infrastructure

The campus is provided with a two-pipe drainage infrastructure.

- Surface / Storm Water Drainage
- Foul Water Drainage

New buildings must make provision for linking into the existing drainage infrastructure. New connections to existing Campus drainage systems can only occur after the newly installed systems have been fully CCTV surveyed/tested and signed off by UCD and the relevant parties. Any new connections will require a permit from UCD prior to commencing the works.

CCTV survey requirements for new drainage systems will be required in two phases as follows:

Phase 1 - During install on an ongoing basis as pipes are laid and before the trench is backfilled.

Phase 2 - Before substantial completion the complete pipeline network including all branch lines are to be jetted, surveyed and recorded and issued to the relevant parties for review/comment and sign off.

12.2 Drain Materials

The following materials are acceptable for drains under normal circumstances:

Vitrified Clay
Concrete
uPVC

Unless agreed otherwise the pipe material shall be as follows:

Pipe diameter $\leq 100\text{mm}$ - Use uPVC pipework within buildings and for branch connections (not for main drainage runs)

Pipe diameter $> 100\text{mm}$ & $\leq 375\text{mm}$ - Use vitrified clay pipework for all foul lines

Pipe diameter $> 100\text{mm}$ & $\leq 375\text{mm}$ - Use vitrified clay pipework or concrete (subject to availability and certification) for surface water lines

Pipe diameter $> 375\text{mm}$ - Use concrete pipework

Exceptional circumstances such, as chemical and or hot effluent shall be treated on an individual basis.

12.3 Manholes

Manholes shall be constructed to allow safe access for inspection or maintenance.

Manhole covers shall be hinged/ circular, and capable of withstanding normal road loads i.e. D400, unless otherwise agreed. This also applies to manholes located in landscaped areas. If manhole covers are required to match hard landscaping finishes they need to be of a type that are easily and safely openable by two people.

All manholes should be integrity tested to the relevant standards to ensure they are constructed adequately to resist exfiltration and infiltration.

12.4 Internal Drainage

Soils, wastes, chemical wastes and rainwater are examples of internal drainage systems within buildings in UCD. Each system must be piped separately, and pipework must be labelled accordingly when visible above ground.

12.5 Drain Materials

The following are examples of materials previously used on Campus:

Material	Comments
uPVC	General Purpose
Stainless Steel	Hot effluent
Vulcathene	Chemical Effluent
HDPE	Rainwater
HDPP	Chemical Effluent
Vitrified Clay	General Purpose
ABS	General Purpose

All below slab drainage lines in uPVC shall be fully encased in concrete.

12.6 Rainwater

All rainwater systems shall comprise a fully welded / sealed installation in HDPE or similar and approved. Siphonic systems are not permitted. All rainwater stacks to have an easily accessible rodding port at 1.000m above FFL (quantities may vary depending on building heights etc). Horizontal pipe runs above ceiling level are to be avoided or kept to a minimum.

Rainwater outlets at roof level to be of cast aluminium type and comply with rainwater design parameters as set out in Appendix 1. Rainwater outlet connection to the pipework system to be a robust compression connection that will withstand an air and water test. It is necessary that there is a single line of responsibility for the rainwater system from the floor pop-up including connection to the rainwater outlet connection at the roof level, inclusive of stack testing. A full fill water test is the preferred method of testing. This test should extend from the external AJ / manhole to roof level. Rainwater stacks must not be encased in concrete columns.

12.7 Cleaning / Rodding / Inspection Ports / Venting

Adequate access for maintenance and cleaning / rodding must be provided for all internal drainage systems.

The soils at the back of toilets shall be provided with a cleaning port at the end of the waste. The port shall be situated to prevent backflow through the inspection port on opening. The provision of inspection and rodding ports etc. shall follow standard good practice.

Soil stacks to be separately vented at high level, away from points of air intake into the building

12.8 Laboratories & Chemical Waste

Chemical wastes shall be separated from general wastes within the building.
Catch-pots are not to be used, suitable sized traps are to be provided under laboratory fixtures.
All laboratory sinks must be asset labelled to assist in managing maintenance and flushing regimes the labelling format is to be agreed with UCD.

12.9 Kitchen Wastes

Grease traps are to be provided outside of the building.

The construction of the grease trap shall allow for the incorporation of a treatment system.
External grease traps to be located so as to be easily accessible by the relevant machinery (Tanker) for routine maintenance. This access route should be included in the Maintenance Access Plan for the building.

12.10 Manholes & AJ's / Gully Traps

Manholes and access junctions should be located outside the footprint of the building. If a manhole has to be located within a building the following principles should be adhered to:

The manhole/AJ cover and frame shall be double sealed type that is easily and safely removed by two people. The installation / pointing and sealing of these covers and frames shall be detailed by the Designer to ensure against the possibility of odours escaping through the system.

The manhole shall be located in an area that can be easily accessed by maintenance personnel while not causing any disruption to normal building operations.

12.11 Sanitary Equipment – Toilets

A floor drain shall be incorporated into each toilet floor, and the floor laid to falls to suit.

The toilet pan shall be low flush high efficiency pans, using cisterns.
Access to the cisterns and drains shall be from the front using removable panels in accordance with existing details at UCD.
The pan shall be P type.

The pans shall leave provision for toilet seats.
The supply to the cistern shall be valved locally. If recessed behind the panel, this shall be ¼ turn lever action ball valve, if exposed this shall be ¼ turn screw type valve.
The cistern siphon shall be capable of being dismantled for ease of maintenance.

Note:

Radiators are not permitted in Toilets

12.12 Wash Hand Basins

Single hole wash hand basins to be provided.
WHB should be fitted with electronic mixer type taps, with spray outlets e.g. "rada tap" type .
Plugs are not required on the WHBs unless specifically requested.
Screw type isolating valve to be provided under sink for isolating purposes.

12.13 Urinals

Slab type urinals are not to be used.

Individual urinals bowls only to be used with exposed urinal bottle traps for maintenance.

Urinal Cisterns shall use BMS operated 24V A/C normally closed solenoid fill valves operated from BMS. Stand-alone urinal control systems are not required.

Draft Issue D2.0

13. Fume Cupboards

All fume cupboards shall be manufactured and installed to comply with British Standard BS 7258 Parts 1-4.

Particular attention shall be paid to the installation with regard to:

Location:

- In stable air pattern.
- Not adjacent to another fume cupboard.
- Not adjacent to doors or openable windows.
- Not along primary circulation route of laboratory.

Make - Up Air:

- Sufficient air shall be provided to replenish air extracted.
- Air shall not be introduced close to the fume cupboard.
- The make-up air shall be controlled based on a pressure differential between the lab and an adjacent area to maintain the required negative pressure.

Containment:

- All fume cupboards must be certified to the British Standard test for fume cupboard containment in situ before acceptance. This test shall be carried out by an independent body. The cost for this test shall be included as part of the fume cupboard installation cost.

Scrubber

- The fume cupboard shall be fitted with a scrubber unless otherwise specified.

Flue Discharge

- The flue shall be constructed of uPVC chemical resistant ducting.
- The flue shall be fire stopped at each fire compartment.
- Flues from fume cupboards may not be combined unless a manifolded fan system or equal is used in conjunction with a fast-acting venturi valve system.
- In a manifolded system, heat recovery shall be incorporated with a summer bypass to reduce the system resistance when no heat can be recovered.
- Fixed Balancing dampers are not to be used on un-combined discharge systems.
- Flue discharges must observe height of discharge requirements.
- All exposed fan motors shall be fitted with a weathering shroud.

Use of Fume Cupboards

- All fume cupboards must be clearly labelled as to their intended use.

The construction of the fume cupboard shall:

- Be resistant to chemical attack
- Include a horizontal sash
- Incorporate an air flow indicator and audible low flow alarm

Electrical connection to be provided with each cupboard:

- Local mains isolator
- ELV 24V AC signal to roof top fan motor starter
- 13amp socket outlets (2 twin switched min).
- Integral luminaire controlled via a 5A switched spur outlet
- water (optional)

Gas shall not be provided to a fume cupboard unless specifically requested.

14. Medium Voltage Network

New Power Transformer(s) and associated Switchgear shall be housed in a purpose- built building or within a dedicated MV room which forms part of a building. Adequate space shall be provided to ensure the safe operation and service of transformers and switchgear.

14.1 Primary Switchgear

The following switchgear shall be provided unless otherwise advised.

Metalclad arc proof, air-insulated, compliant with all relevant IEC standards 12kV to 24kV 630A. Minimum Isc 16kA rating.

SF6 fully withdrawable circuit breakers on ring feeders and transformer feeds.

Note: a minimum of 1 No. spare way shall be provided c\w circuit breaker.

14.2 Secondary Switchgear

Secondary switchgear, if applicable shall be:

Metal enclosed, gas-insulated, compliant with all relevant IEC standards 12kV to 24kV 630A. Minimum Isc 16kA rating.

SF6 fixed circuit breakers on ring feeders and transformer feeds.

Note: a minimum of 1 No. spare way shall be provided c\w circuit breaker.

14.3 Protection Relays

GOOSE enabled IEC 61850 compliant, Overcurrent and Earth Fault with determination of earth fault/ over current direction.

B.M.S Modbus compatible communication via RTU Slave RS485.

14.4 Transformers

Transformers shall be Liquid Filled.

DNY11 50Hz 10kV/24kv, 400V/230V

Protection: DGPT

- 1) The accumulation of gas
- 2) Over pressure
- 3) Over temperature

Note: the above trip conditions shall be linked to the B.M.S.

14.5 Battery Trip unit

Provide a 48V dc battery unit.

Note. The following alarms \ status shall be linked to the B.M.S

- Mains healthy
- Battery voltage

Under ground Cable Type:

Single-core 24kV 185sq.mm (minimum CPC size) SWA LS0H Rated copper conductor. Underground cables to be installed in dedicated suitably sized PVC ducting.

Note: Connection, including Testing and Commissioning to the 10kV Network must be included in the Building Service Engineers Tender Documentation.

15. Electrical Standards & Regulations

The Installation shall comply with all relevant (up to date) statutory instruments and current regulations and in particular with the following:

- (B) ISO10101 National Standards for Electrical Installations under the Electricity Act of 1999
- (C) IS3217:2013 Code of Practice for Emergency Lighting
- (D) IS3218:2013 Code of Practice for Fire Detection and Alarm Systems for Buildings-System Design Installation and Servicing
- (E) Code of Practice for the Design, Selection and Erection of Low voltage Switchgear assemblies
- (F) IS EN 50131-1:2006 and A1:2009 - Private Security Regulations
- (G) Building Control Regulations including Building Control (Amendment) Regulations 2014 (BCaR)
- (H) The Chartered Institution of Building Services Engineers (CIBSE) Guides and Technical Memoranda
- (I) 89/392/EEC: Machinery Directive
- (J) 73/23/EEC The Low Voltage Directive
- (K) 89/336/EEC The Electromagnetic Compatibility Directive
- (L) IS EN 81: 2014 European Lift Directive including EN 81 -20/50 (applicable after September 2017)
- (M) IS EN 81: 2015 Safety Rules for The Construction and Installation of Lifts
- (N) SI 299, 2007 Safety, Health and Welfare at Work (General Application) Regulations
- (O) Any special regulation issued by the local Electricity Supply Authority
- (P) Any special regulations issued by the local Fire Authority

16. Internal Lighting

16.1 General Lighting

The design shall be in accordance with CIBSE code for interior lighting and energy efficient ($<10 \text{ W/m}^2$), without compromising effectiveness or colour rendering. All lighting should be based on L.E.D high efficiency lighting within the 3000 to 4000 kelvin colour temperature range generally. Particular attention should be given to the selection of the L.E.D fitting and in particular the L.E.D module and driver, see appendix 3 for a list of question which should be put to the proposed lighting vendors during the approvals process. Where dimming is required (theatre lighting for example) then the L.E.D. and driver must be able to be dimmed on a 0-10V basis or Dali KNX via the Cylon BMS. The fixture should incorporate a removable driver in case of failure, to allow repair without replacing the entire fixture.

Wiring shall be 2.5sq mm PVC single cable (in accordance with ISO10101 National Standards for Electrical Installations) in galvanised steel trunking and conduit. Final connections to luminaires shall be plug and socket units e.g. MK Link System or similar.

Luminaires shall generally be 600x600mm L.E.D. flat panels. Where reflectors are required high efficiency reflectors must be employed. All luminaires and components shall have a minimum 5 year parts and labour warranty. Emergency lighting batteries shall have a minimum 3 years parts and labour warranty.

Extra low voltage halogen/incandescent or fluorescent lighting shall not be used.

All lighting to be connected to lighting circuits using appropriate non-fused disconnect arrangement.

16.2 Lighting Control

The lighting control strategy for the building shall be developed in line with the above general lighting principles:

- a) In principle, all indoor lighting shall be automatically controlled via standalone mains operated PIRs, Cylon BMS or KNX/Cylon BMS. Manual light switching shall be used in plant rooms, service risers or where these are likely to be rotating hazardous mechanical equipment. Office PIR control shall incorporate manual switching so that the occupant can switch off the lights whilst working in the office, if desired. The use of proprietary lighting systems is to be avoided. Only open source, open protocol lighting systems, such as Dali KNX are to be used. Such lighting systems must be fully compatible (if integration required) with Cylon BMS.
- b) The default lighting control shall be PIR mains standalone. When it is required, the Cylon (building management system) BMS or Dali/KNX shall be used to control the lights in public, student services and university societal areas by means of access level lighting, occupancy sensing, time schedules, global daylight linking and local control where necessary or a combination of both. Parameters such as time schedules (to be avoided unless absolutely necessary) and PIR delay to off periods etc shall be fully adjustable through the Cylon BMS graphical interface. All automated lighting controls shall be designed for failsafe and the system shall have manual override key switches. The key switch locations are to be agreed with UCD Technical Services. In all aspects of lighting control whether BMS, Dali KNX or standalone mains PIRs the PIR shall always be configured as Master and switches shall be configured as Slave devices.

Consideration shall be given for the need to provide safe access lighting in large atrium or concourse areas where there may be a delay between PIR detection and lights switching on. This may be overcome by including some supplementary low-output LEDs in strategic locations which switch on during unoccupied periods and switch off when PIRs are triggered.

Simple day-light saving control shall be incorporated into the Cylon automatic lighting control system. Lighting zones and light fittings adjacent to glazing zones and other naturally lit areas shall be switched progressively (depending on outside light-levels via BMS global); inwards into the space, with the outermost perimeter lights switching off first and vice-versa. Occupancy control shall continue but lights shall be held-off by the BMS if the outside light level is sufficient to naturally light the area.

16.3 Theatre / Classroom Lighting

The following categories of lighting are required as shown on the table below:

Lighting Requirement	Typical Lighting Type
Access / Note Taking Lights	L.E.D Dimmable (0-10V)
General	L.E.D Dimmable (0-10V) where required
Emergency Lighting	Combination of L.E.D. Exit Signs and standalone escape LED Lighting

Theatre Lighting Requirements Table

Lighting Control shall be carried out through the BMS. The lecturer's podium shall be fitted with selector switches for full lighting or note taking lighting. The first switch shall select full lighting level, the second switch shall provide note taking lighting level and the third switch shall switch the lights off/on (access level lighting to remain on when the lights are switched off during material times (adjustable via BMS). A PIR fitted over the lecturer's podium shall detect the presence of a lecturer, enabling full lighting control. The BMS will revert the lighting to access lighting (adjustable/controlled via the BMS) if no presence is detected after 15 minutes.

The PIR detector shall be a combination PIR activated with either Microwave or Infra-Red. The sensitivity on the microwave must be adjustable.

In tiered theatres the design, including PIR location, should consider access and servicing requirements. The use of hoists, scaffolding or other specialist should not be required under normal circumstances.

16.4 Office Lighting

Office Lighting shall be designed to CIBSE code for office lighting LG7 and shall be composed of the following:

Full Lighting: For general lighting within the office to a standard level of 350-400 lux.

Task Lighting: May be required for specific tasks.

16.5 Laboratory Lighting

Dry / Non Chemical laboratories shall use LED lighting as described earlier.

Wet Laboratories shall be suitably IP rated L.E.D luminaires.

Other laboratories with hazardous environments should be provided with lighting appropriate to suit, e.g. explosion proof lighting.

The switching of lighting within laboratories shall be arranged to provide flexible use of the space with minimum energy consumption.

16.6 Workshop Lighting

Lighting in workshops shall be surface mounted L.E.D. fittings and shall be suitably IP rated. L.E.D Task lighting may be provided where necessary.

16.7 Other Lighting

Other lighting used within buildings for architectural effect or otherwise shall be energy efficient, low maintenance and offer low cost for replacement of lamps and or luminaires. Lighting to be avoided includes fluorescent, halogens and GLS lamps.

17. External Lighting

17.1 Design Principals

The Lighting Strategy for the University Campuses has been developed in line with the following lighting principles:

- a. The University has adopted an LED lighting strategy for all its campuses.
- b. Luminaire output shall be 4,000 Kelvin generally, external feature lighting may require different outputs
- c. Accentuate main gateways and entry-points into the area.
- d. Use lighting to enhance legibility, orientation and safe movement through the area.
- e. Use high colour rendering base lighting to provide a unifying element across the Campus.
- f. Use Enhanced Base lighting for pedestrian areas and public spaces to reduce fear of crime and so promote a sense of wellbeing.
- g. Adopt a “warm white light” policy for pedestrian routes, to create a more relaxing & comfortable environment.
- h. Use Special Area lighting to indicate prominent open spaces, routes and city markers.
- i. Provide Feature lighting for key buildings & art works, and so create drama & spectacle.
- j. Integrate the illumination of buildings with the lighting of walkways and areas of congress.
- k. Achieve levels and types of illumination to improve CCTV camera imaging.
- l. Ensure all specifications and installations reduce energy use, light pollution, light spillage and glare.
- m. Use lighting equipment & fittings which are well designed, suitably located, appropriate to local character, and selected for ease of maintenance.

- n. Avoid conflict with architectural forms.

The CIBSE code for The Outdoor Environment LG6:1992 or most recent publication shall also form part of the overall design requirements for all UCD external lighting applications.

The following categories of external lighting and illuminance levels (LUX) are required as shown in Table 22.1 below:

Area, Location or task	Average illuminance (LUX)	Minimum point illuminance (LUX)	Notes
Roadways, general movement	5-10	2.5	Column heights between 7 to 10 meters
Car parks and bicycle racks	10-15	2.5	Column heights between 10 to 15 meters
Primary pathways & linkways	15-20	5	Column heights between 4 to 5 meters
Secondary pathways, amenity & security	10-15	2.5	Column heights between 4 to 5 meters
Pedestrian crossings	20-30	15	Max column height 3 meters
Covered walkways	60-70	5	Location dependant
Feature Lighting	75-100	N/A	Location dependant
Notice boards	100-150	N/A	Location dependant

Table 16.1 External Lighting and Illuminance Levels

All external lighting standards to be wired using three phases 5-core 10.0sqmm PVC SWA or 3-core 4.0mm PVC SWA LSF cable. Each phase of the 3ph cable shall have an individual MCB protective device. In general, each third standard shall be fed from the same phase, with the following critical lighting fed from the critical phase (L3):

- Lighting at steps.
- Lighting at road junctions.
- Lighting at pedestrian crossings.
- Lighting at entrances to buildings.
- 1/3 general outside lighting.

The control of the lighting shall be through the Building Management System (BMS). Each phase of the lighting to be controlled through a separate contactor, except in the case of the 2/3 lighting which can be controlled by a single/group of single 3 pole contactors. The critical phase shall be maintained 'on' during all hours of darkness through by BMS time schedule. The non-critical two phases shall be switched as required by BMS using a separate time schedule.

Contactors shall be suitably rated non-modular for AC-3 utilisation.

Hand/Off/ Auto switches shall be fitted to external lighting distribution centres panel fronts. The auto function shall be controlled via the BMS.

Standalone time clocks or photocells are not required, as this control is offered by BMS already.

Each lighting standard to be fitted with a 'Lucy Lighting' 3ph fused cut-out, typically surge rated at 6A.

Each standard shall be numbered and labelled in accordance with UCD's external lighting labelling scheme.

Outside lighting control gear must not be located within manholes or other areas prone to water ingress and must be located in internal spaces such as plantrooms.

Note:

- Outside lighting must not be integrated into KNX or any non UCD BMS lighting control system.

17.2 Primary and Secondary Pathways & Linkways

Light fittings shall be similar to Thorn Avenue F2 LED. Alternative low energy technologies, such as LED lighting, should be considered, and agreed with UCD Technical Services on a project by project basis.

Lamp standards shall typically be 4-5m tall, hot dipped galvanised painted grey complete with a waist-high control gear pole door and with a 60 mm diameter post top.

17.3 Road Lighting

Light fittings shall be similar to Thorn CiviTEQ 128w LED with suitable optics as required. Alternative low energy technologies may be considered and agreed with UCD Technical Services on a project by project basis.

Lamp standards shall typically be 6-10m tall, root mounted, with a 1.0-meter straight arm, hot dipped galvanised steel, complete with a waist-high control gear access post door and with a 79 mm diameter post top.

17.4 Car Park Lighting

Lamps to be situated where possible around perimeter of car park, not in islands.

Light fittings shall be similar to Thorn 200w LED floodlights. Alternative low energy technologies may be considered and agreed with UCD Technical Services on a project by project basis.

Lamp standards to be 10m – 15m tall, root mounted, hot dipped galvanised steel, complete with a waist-high control gear access post door and t-bar flood light mounts.

17.5 Pedestrian Crossing

Pedestrian crossing lights are to be fitted with poly-carbonate 'Pelican Crossing' beacon spheres and flashing amber LED traffic light signals.

Standard height to be 2.5 metres. Hot dipped galvanised painted in black and white 'Pelican Crossing' stripes, complete with a waist-high control gear access post door.

Note: Supplementary road/path lighting may be required to illuminate pedestrian crossings (minimum of 20 LUX) for a distance of 3-4 meters either side of the crossing.

17.6 Feature Lighting

Care shall be taken when selecting feature lighting on campus. Designers shall liaise directly with UCD Technical Services to agree suitable LED solutions and product selections. Particular care and attention shall be given to the robustness, maintainability and overall quality of products. The use of bollard lighting solutions is to be avoided.

The control of feature lighting shall be through the Building Management System (BMS). Each feature lighting zone or exhibition area is to be controlled separately from the general external or internal building lighting systems.

17.7 Flood Lighting

In general flood lighting is to be provided using LED area flood lights on complete with vandal proof wire guards or similar approved. Care is to be taken to prevent unwanted/unnecessary glare to adjacent roads, structures and properties.

Flood light columns to be 10m – 15m tall, hot dipped galvanised, complete with a waist-high control gear access post door and t-bar flood light mounts.

18. Power

18.1 Switchgear

Power factor for any new installation to be not less than 0.96 lagging.

Main switchgear shall be Type Tested Assembly (TTA), sheet steel cubicle type construction, suitable for floor mounting, bottom cable entry and top and bottom cable exit and suitable for front access to terminations, all in accordance with I.E.C Form 4b.

Distribution Centres switchgear shall be sheet steel cubicle type construction, suitable for wall mounting, bottom cable entry and top and bottom cable exit and suitable for front access to terminations, all in accordance with I.E.C Form 2/3 depending on the particular application.

All circuits, isolators, and circuit breakers and final outlets to be labelled clearly, using laminated labels black on white. The labelling system shall be agreed with UCD.

A clearly marked circuit diagram to be displayed at the main board. Emergency lighting shall be situated at, and along the route to, the main board. All distribution centre cupboard to have a luminaire and an emergency luminaire.

All new electrical installations and all electrical alterations must be tested to conform to ETCI National Rules for Electrical Installations. A copy of this certification must be submitted to the Technical Services Department, otherwise the installation shall not be accepted.

18.2 General Service

Individual RCD/MCB protective devices on radial circuits shall protect all General Services socket circuits to comply with current ETCI Rules. Wiring shall be 4.0sq mm PVC single cable (in accordance with ISO10100 National Standards for Electrical Installations) in galvanised steel trunking and conduit.

RCD units shall be the thermal/magnetic protection as Type 1,2,3,4 as required, rated at 30mA with a short circuit breaking capacity of 9kA, and shall be combined with the final sub-circuit MCB as an MCB/RCD (RCBO) protective device. All RCD units shall be equipped with a test button to simulate operation of the device. All RCBOs shall be A type.

Socket outlets shall be switched Metal Clad in Plantrooms and WHI or Matt Chrome in all other areas, as MK or similar and approved.

Cleaner sockets shall be adequately provided for, and shall be feed from separate radial circuits.

Provide a 13A socket outlet within 2 meters of a toilet facility external door.

LV sub-mains cables and sub-distribution cables shall be 4-Core LSZH Cu-PVC XLPE SWA with separate CPC's for cables over 16.0sq.mm, and 5-Core LSZH Cu-PVC SWA for cables of 16.0sq.mm or less. All main & sub-mains cables shall be BASEC approved.

18.3 Sundry Items

Individual MCB/RCD units shall be provided for hand dryers circuits.

Hand dryers shall be the fully automatic type as ATC Panther High Speed in stainless steel finish or equal and approved.

18.4 Motive Power (Fans, Pumps)

All motive power to be fitted with hand/off/auto switches at the MCC panel. The auto function shall be controlled via the BMS.

Local isolators to be provided for each piece of equipment. All pumps and fans should be hard labelled with identifier (numbering scheme to be agreed with UCD). Sticky labels will not suffice.

Flexible conduit shall be provided from each local isolator unit to all items of mechanical plant, as Kopex or equal & approved.

Emergency Lock stops shall also be provided where danger to personnel from machinery exists.

High efficiency motors should be considered where possible. If the load on the motor is variable, then speed controllers must be considered. (Note the input signal to the speed controller should be provided from the BMS)

All motors greater than 0.5 kW shall be provided with overloads for the protection of the motor.

Contactors shall be as follows:

Schneider Electric Telemecanique non-modular 3-pole for category AC-3 utilisation.

No sealed / enclosed contactors to be used.

Final connection from local isolator to equipment shall be made off as follows:

- Lugged connections at isolator and motor.
- Cables shall be either SWA or protected in Electroflex or similar.
- All cable entries shall be glanded.
- Grommets to be fitted where cable passes through casing / ducting etc. to avoid cable damage from vibration.

Motor rated MCBs to be used.

MCC panels shall incorporate run and trip indicator lights. Use 24V AC L.E.D cluster lamps in the panel lighting.

Frequency Converters shall be as ACS 400/600 series by ABB with Modbus RS485 communication and installed according with EMC Directive.

19. Emergency Lighting

Where alterations are taking place within a building, the emergency lighting scheme shall be designed in accordance with the existing emergency lighting system in the building. All luminaires and components shall have a minimum 5 year parts and labour warranty. Batteries shall have a minimum 3 years parts and labour warranty.

All Exit Signage shall be maintained/sustained type.

In new build and refurbishment project designs, all emergency lighting shall be self-contained stand-alone units. Final connections to luminaires shall be plug and socket units e.g. MK Link System or similar.

The design of the emergency lighting system shall be to Irish Standard IS3217:2013 and A1 2017. The installation shall be certified to comply with this standard before final acceptance.

The design shall place particular emphasis on the maintainability of the system including:

- Central Test Facility
- Access to light fittings and battery packs
- Access to status LED

LED type exit signage shall comply with requirements for Type 1 Running Man legends.

All emergency lighting shall be installed and commissioned by a NASI registered specialist contractor.

20. Alarm Systems

20.1 Fire Alarm System

All new fire alarm systems shall be open protocol analogue addressable type.

The fire alarm shall provide automatic detection of:

- Alarm
- Pre-Alarm
- Fault

All new buildings should be equipped with a system to L1 standard in accordance with IS 3218:2013.

The system shall be installed and commissioned by an approved contractor. A list of suitable contractors is available on request from UCD.

Fire Alarm Control Panels

The control panel should be manufactured in accordance with IS / EN 54. Fire alarm panels shall be as "MX 4400" by Advanced Electronics Limited, or equal and approved.

The control panel should incorporate an integral walk test unit.

The main fire control panel should be capable of providing a relay status output to the Building Management System (BMS), see relevant controls section for further details.

The alarm control panel shall be located in an accessible position, close to the main entrance.

Smoke Detectors

Smoke detectors shall be optical type, and conform to IS / EN 54.

Smoke detectors should be of one of the following types:

- Apollo
- Hochiki

All detectors located in voids shall be provided with remote activation LED.

Heat Detectors

Rate of rise and fixed heat detectors should conform to IS / EN 54

Heat detectors should be of the following types:

- Apollo
- Hochiki

Break Glass Units

Break Glass Units shall conform to BS 5839 Part 2, and should be capable of testing by key without removal of glass.

The break glass unit should incorporate a red Led to signal its activation.

Alarm Sounders

Alarm sounders should be Cybertone type.

Wiring

Detectors and sounders to be wired using PH120 rated cables. Cables shall be properly protected, preferably in conduit, trunking or on cable tray.

All wiring should comply with current ISO 10101 regulations.

20.2 Intruder Alarm System

An Intruder Alarm System shall be installed for all new buildings. Intruder alarm system must be an open protocol, compatible and integratable system. Systems should be designed, installed and maintained in compliance with EN50131/1:2006. System shall be installed by PSA approved installer only.

20.3 Alarm System Overview

System must be an intuitive system, that is easily navigable with clearly identifiable features and an easy interface to work with.

- System must have functionality to operate with both wired and wireless devices.
- All monitoring devices on new building system installations should be wired.
- The control panel should be located in the main Comms Room. The keypad should be located close to the entry/exit door.
- System should be a combination of magnetic door contacts, dual tech PIRs and point-to-point infrared beams. All perimeter doors must be equipped with a magnetic door contact.
- Fire exit perimeter doors should have a local sounder bell and a wired shunt that can be operated via a key. All shunts should be keyed alike.
- System should have one internal and one external sounder bell with a 15 minute cap on the sounder.

The alarm panel should be capable of and wired to provide a n/c, open on alarm relay status output to the Building Management System (BMS), see relevant controls section for further details.

- All critical hardware components must include a battery backup with a capacity of minimum 8-12 hours.
- Door contacts should be robust and fixed to the highest point of the door to prevent tampering. Entry/Exit doors should, where possible, have contacts installed internally in the frame.
- System must be configured with an engineer's code of UCD's choosing prior to building handover

20.3 Access/Security/CCTV System Integration

A high level of integration is required across the systems that comprise the security management systems, namely; CCTV, access control and intruder alarm. Examples of the integration required include, but are not limited, to:

- Perimeter access control doors will be monitored by a static CCTV camera. The Access Control system must have the functionality to trigger the CCTV system to take a CCTV snapshot every time a user enters/exits through an access control door.
- The Campus Services Operations Room operator should be able to set/unset the intruder alarm via the CCTV system
- The Campus Services Operations Room operator should be able to lock/unlock access control doors via the CCTV system
- If an access control door is forced/help open, the monitoring static CCTV camera must 'pop-up' on the videowall or generate an alert
- Events recorded on the access control or intruder alarm system should trigger PTZ rotation to a pre-defined preset location

20.4 System Strategy

- Entry/exit door contacts, dual tech PIRs and point-to-point infrared beams should set/unset when the intruder alarm is armed/disarmed.
- Fire exit perimeter doors should be alarmed 24/7.
- Entry/exit door contacts should be integrated with the access control system to facilitate out of hours access to the building not requiring deactivation of the intruder alarm. If the door does not close within a set time period, the intruder alarm must activate.

20.5 Cause and Effect

When alarm is set:

- Activation of any monitoring device triggers BMS message, internal and external sounder bell. Activation of devices associated with fire exit perimeter doors should also trigger the applicable local sounder

When alarm is unset:

- Activation of monitoring device at fire exit perimeter door triggers local sounder bell and BMS message. Internal and external sounders do not activate

20.6 Gas Alarm System

Gas alarm systems shall be designed for all buildings or parts of building consuming natural gas or other hazardous gases. See also boiler house section 5.9.

The gas detection panel shall signal the main house fire alarm panel in the event of detection and similarly the main house fire alarm shall signal to shut the gas off in the event of fire alarm.

The gas slam shut valve must be an automatic reset unit and should not require manual reset after an electrical power outage or a fire alarm reset.

The gas panel should be capable of and wired to provide a n/c, open on alarm relay status output to the Building Management System (BMS), see relevant controls section for further details.

20.7 Disabled Person Toilet Call System

Disabled person toilet distress call system shall be designed for all buildings or parts of buildings with disabled toilet facilities.

The system shall include the following:

Power supply Unit (PSU):

50VA power supply unit incorporating 230V/50V transformer incorporating full wave bridge rectifier and smoothing circuit for solid-state use. Units to be enclosed in ventilated, sheet steel enclosure. The PSU shall be located in an accessible position for maintenance purposes with the exact location being agreed on site. The Contractor shall provide bracketing or fixings, as required.

Wall mounted call buttons:

The unit shall comprise a brushed stainless-steel finish push-button with integral call reassurance light mounted at 900mm AFFL. The final positions shall be agreed on site with UCD prior to installation. An additional call button shall also be provided at 200mm AFFL.

Call Reassurance/Reset Unit:

The unit shall comprise a brushed stainless-steel finish reset button with integral call reassurance light. This unit shall normally be located adjacent to the door inside the room in full view of the occupant.

Outside Call Unit:

A combination lamp/tone generator shall be located above the entrance door to the room which the call system is located. The unit shall contain a bleep tone generator and an amber lamp. This lamp shall be of adequate size to be conspicuous even in daylight.

Back plates on all devices shall be brushed stainless steel finish.

All disabled toilets in the building shall be wired back to a master disabled alarm control panel located in Reception or as agreed with Technical Services.

The refuge alarm panel should be capable of and wired to provide a n/c, open on alarm relay status output to the Building Management System (BMS), see relevant controls section for further details.

21. CCTV System Overview

The current UCD Estate Services CCTV system uses the structured IT cabling switched to connect cameras to the comms room. From the comms room CCTV is connected to an Industrial Ethernet switch in the BMS/CCTV Fibre comms panel from where it is managed by Estate Services.

All new builds and retrofits should allow for future use of the IT fibre network via the IT Fibre cisco switches as an alternative transport arrangement.

A CCTV system shall be provided for all new buildings. The CCTV system must be an open protocol, compatible and integratable system. System must be compliant with ONVIF standards and installed in line with I.S. EN 50132-7, CCTV surveillance for use in security applications standard. System shall be installed by PSA approved installer only.

21.1 Video Management System Overview

- The Video Management System must be a Windows based, intuitive system, that is easily navigable with clearly identified features and a pleasing interface to work with.
- Client PC software, web browser and mobile device interfaces must be secured by a username and password, which only an Administrator can change. Login statistics for each Administrator and Super User must be available to Administrators in the VMS event logs.
- The client PC software and web browser should auto logout upon the passing of a period of time with no user activity.
- Client PC software interface should contain a floor plan viewing interface, within which the VMS infrastructure can be marked using relevant icons. This graphical interface should be interactive, particularly in indicating faults and alarms to users.
- The VMS should support an application for mobile and tablet use using a network connection that allows for actions such as live view, playback, PTZ control, take snapshot, archive footage, view health system overview. Access to the app must be protected by individual user password credentials of at least 128bits encryption.
- The VMS must allow for hierarchical user levels in an enterprise environment e.g. Administrator, Super User, User, etc.
- The access rights including camera viewing permissions for each user level should be configurable by an Administrator.
- The VMS should be able to display a graphical system health overview to include device power on/off, device communication status, camera activity, camera recording, current camera bitrate.
- The VMS should be able to disperse configuration, software or firmware updates to system infrastructure from a central point.
- The VMS should be able to support minimum 3 video outputs.
- The VMS should be able to support a videowall of minimum eight screens, each configurable to display 1 – 16 camera feeds.
- VMS Video outputs should include a number of the following: graphical interface, alarm management, live video, playback, system health overview.
- The VMS must be able to archive high quality footage in both .avi and a system specific watermarked time-stamped format that requires a system media player to view.

- Saved video footage must be searchable by time/date, motion, and alarms.
- The VMS should allow transmission of live and pre-recorded audio messages via static camera audio outputs.
- The VMS should contain a pre-installed, or modular add-on for high level analytics, such as line crossed, item removed, person/item tracking, intrusion detection, number counting, unattended item, heat recognition, smart motion detection.

21.2 Integration

A high level of integration is required across the systems that comprise the security management systems, namely; CCTV, access control and intruder alarm. Examples of the integration required include, but are not limited, to:

- Perimeter access control doors will be monitored by a static CCTV camera. The Access Control system must have the functionality to trigger the CCTV system to take a CCTV snapshot every time a user enters/exits through an access control door.
- The Campus Services Operations Room operator should be able to set/unset the intruder alarm via the CCTV system
- The Campus Services Operations Room operator should be able to lock/unlock access control doors via the CCTV system
- If an access control door is forced/help open, the monitoring static CCTV camera must 'pop-up' on the videowall or generate an alert
- Events recorded on the access control or intruder alarm system should trigger PTZ rotation to a pre-defined pre-set location

21.3 Network Video Recorder (NVR)

NVR should be located in a sufficiently ventilated Comms Room with enough room in the rack to fit 24" monitor with wireless keyboard and mouse.

Minimum NVR requirements

- Minimum 30 cameras capacity
- Minimum 30 days footage recording retention [11]
- Intel Core i7 based system with 16gb or DDR4 RAM
- Flexible user interfaces, Local Client (latest Windows OS), Web and Mobile applications for Live Viewing
- Comprehensive suite of self-diagnostic functions to detect and report hardware and software issues
- Solid state operating system drive
- Compact NAS or flat UI rack mountable style design

- Server grade hard drives in removable hot-swap caddies accessible from the front panel
- Storage up to 96TB configured as RAID (one HDD failover redundancy minimum)
- Server grade PSU (80plus gold standard)
- Quality materials, excellent design and construction
- Minimum 2 years comprehensive hardware warranty

21.4 Cameras

Only two types of cameras shall be use on the external perimeter walls, dome or bullet style. Only dome style cameras shall be used on internal walls. Height of the camera shall not exceed 3m from the ground. Angle and location of the cameras should be agreed during planning stage with Estate Services Security Management Systems Team.

Minimum static camera requirements:

- POE/POE+
 - Support TCPIP V4 and V6
 - 4MP minimum
 - Bullet or Dome style design
 - Back boxes if not in the box with the camera
 - Varifocal cameras lens with manual focus i.e. not motorized
 - Lens range 2.8mm-8mm with field of view of:
2.8 mm, horizontal FOV: 104°, vertical FOV: 58°, diagonal FOV: 124°
4 mm, horizontal FOV: 83°, vertical FOV: 44°, diagonal FOV: 99°
6 mm, horizontal FOV: 51°, vertical FOV: 28°, diagonal FOV: 58°
8 mm, horizontal FOV: 39°, vertical FOV: 21°, diagonal FOV: 45°
 - Demisting functionality
 - Min 50m IR range
 - Min IP67 weather resistant
 - 3 no. data streams available
 - Adjustable Bit rate / Bandwidth

- H.265+/H.265/H.264/H.264+/MJPEG
- WDR
- RJ45 100M Ethernet interface
- Built-in Micro SD/SDHC/SDXC slot, up to 128GB
- Event triggers to record including 24/7, time schedules, configurable motion recording, alert prompted
- Motion detection recording should be configurable in multiple zones across one image stream. Zones should be selected by shape, grid, or specified granularity.
- Analytics capabilities with an appropriately integrated CCTV enterprise system like;
line crossing, intrusion detection, motion detection etc.
- Vandal proof housing with tamper alarm
- ONVIF compatible
- 3-year warranty. If extended warranty available at a cost include as a line item option

Minimum PTZ camera requirements

- POE/POE+
- Support TCPIP V4 and V6
- 4MP minimum
- Minimum optical zoom x30
- Demisting functionality
- Minimum 150m IR range
- Minimum IP67 weather resistant
- Minimum 20 no. presets
- 3 no. data streams available
- Control via joystick or keyboard/mouse
- Adjustable Bit rate / Bandwidth
- H.265+/H.265/H.264/H.264+/MJPEG
- WDR

- RJ45 100M Ethernet interface
- Built-in Micro SD/SDHC/SDXC slot, up to 128GB
- Event triggers to record including 24/7, time schedules, configurable motion recording, alert prompted
- Analytics capabilities with an appropriately integrated CCTV enterprise system like; line crossing, intrusion detection, motion detection etc.
- Vandal proof housing with tamper alarm
- ONVIF compatible
- 3-year warranty. If extended warranty available at a cost include as a line item option

21.5 Network

- Depending on operational requirements, the system will operate on the IT Services fibre network or Estate Services BMS/Camera fibre network
- The MAC address of any controller/hardware that must be placed on a network must be provided 2 weeks in advance of installation commencement
- The installer will be required to engage with IT Services as appropriate to register devices on the network prior to installation
- A one-page completed registration form per device is required

21.6 Time Management

- All managed devices of the system must be synced to a device that will maintain a universal time.
- The system should automatically adjust to account for Daylight Saving Time changes throughout a calendar year.

21.7 Resilience

- All critical hardware components must include a UPS backup with a capacity of minimum 8-12 hours to permit normal continued operation in the event of mains power failure. This includes VMS PCs and NVRs.
- In the event of a loss of communication with the NVR, cameras must have the functionality to failover to SD card slot recording. Upon restoration of communication to the NVR, the camera must be able to restore the missing data to the NVR.

21.8 Redundancy

- VMS PCs and NVRs must be able to export their configuration to a pre-selected file path.
- Should an NVR fail, there must be an automatic failover to a back-up NVR via a hard-wire or networked connection

22. Access Control Systems

An Access Control System shall be provided for all new buildings. The Access Control System must be an open protocol system, compatible and integratable system. System must be compliant with ONVIF standards and installed in line with I.S. EN 50131. System shall be installed by PSA approved installer only.

22.1 System Overview

- The Access Control system must be server(s) based, with a front end that is operated via a web browser or PC thick client.
- The Access Control system must be a Windows based, intuitive system that is easily navigable with clearly identifiable features and a pleasing interface to work with.
- Client PC software and web browser interfaces must be secured by a username and password, which only an Administrator can change. Login statistics for each Administrator and Super User must be available to Administrators in the system event logs.
- The client PC software and web browser should auto logout upon the passing of a period of time with no user activity.
- The web browser interface should contain a floor plan viewing interface, within which the Access Control system infrastructure can be marked using relevant icons. This graphical interface should be interactive, particularly in indicating faults and alarms to users.
- The Access Control system must support an application for mobile and tablet use using a network connection that allows for actions such as assigning a user, suspending a user, editing time zones, and the emergency release of an Access Point. Access to the app must be protected by individual user password credentials of at least 128bits encryption.
- The Access Control system must allow for hierarchical user levels in an enterprise environment e.g. Administrator, User, etc.
- The access rights for each user level should be configurable by an Administrator.
- The system must be integrated with the building fire alarm system so that in the event of a fire alarm activations all doors will release. The installer will be required to liaise with the UCD approved electrical and fire alarm system contractors to achieve this.

22.2 Integration

A high level of integration is required across the systems that comprise the security management systems, namely; CCTV, access control and intruder alarm. Examples of the integration required include, but are not limited, to:

- Perimeter access control doors will be monitored by a static CCTV camera. The Access Control system must have the functionality to trigger the CCTV system to take a CCTV snapshot every time a user enters/exits through an access control door.
- The Campus Services Operations Room operator should be able to set/unset the intruder alarm via the CCTV system

- The Campus Services Operations Room operator should be able to lock/unlock access control doors via the CCTV system
- If an access control door is forced/help open, the monitoring static CCTV camera must 'pop-up' on the videowall or generate an alert
- Events recorded on the access control or intruder alarm system should trigger PTZ rotation to a pre-defined preset location

22.3 User Card

- To ensure consistency for current access control users, the system must operate with MIFARE/DESFIRE technology and function with the UCD Ucard.
- In the event that UCD has to provide a temporary card to a user, the Access Control system must have the function to temporarily assign a generic MIFARE or DESfire card to a user for a set duration of time.

22.4 User Administration

- There must be flexibility to choose expiration dates of access rights.
- It should be possible to export and/or filter the list of Access Control system users by name, card number, role, expiration date, event etc.
- The Access Control system must be able to retain user logs for a period of time that can be set by the administrator. This time period must be minimum 30 days.
- The Access Control system must have the functionality to provide a building occupancy roll call report by user request. The roll call must be available in various formats including pdf and Microsoft Excel and emailed to programmed email addresses.
- It should be possible to generate reports based on filters such as users, doors, door groups and buildings.

22.5 Network

- It is intended that the systems will operate on the UCD IT Services network
- The MAC address of any controller/hardware that must be placed on a network must be provided 2 weeks in advance of installation commencement
- The installer will be required to engage with IT Services / Ucard Office as appropriate to register devices on the network prior to installation
- A one-page completed form per device is required

22.6 Doors

- All doors should be wired or wireless online doors. The use of offline doors in scenarios will require express permission from UCD.

- All doors should be operate from a mains power source. The use of battery powered doors in scenarios will require express permission from UCD.
- The Access Control system must be able to work with a full range of lock and door operation hardware – maglock, electronic door lock, sliding door, lifts, etc.
- The Access Control system should allow for scheduling doors individually or as groups.
- The Access Control system will include doors whose function is to facilitate emergency exit from a room or building.
- Except in cases where written notification from UCD is received that states otherwise, entry/exit perimeter access control doors must be equipped with both an entry and exit card reader.
 - Reader in, Reader out locking with acoustic and optical signalling, dual colour green/red to indicate access authorisation or denial
- Except in cases where written notification from UCD is received that states otherwise, internal access control doors must be equipped with an entry card reader and an exit push button
- Users may have to enter/exit a building via an access control door when the building perimeter alarm is active. The access control system must have the capability to be programmed to momentarily unset the intruder alarm to facilitate door opening and closing. If the door does not close within a set time period, the intruder alarm must activate.
- Perimeter access control doors may be automated for universal access. The Access Control system must be able to work in conjunction with the automation hardware, providing a signal to the door to open upon the presenting of an approved card to the door reader, and prompting the door to close after a set time period. In this scenario, the user must not need to trigger door automation by pressing the door push button.
- Green BGUs must come equipped with a plastic see through cover

22.7 Time Management

- All managed devices of the Access Control system must be synced to a device that will maintain a universal time.
- The Access Control system should automatically adjust to account for Daylight Saving Time changes throughout a calendar year.

22.8 Resilience

- All critical hardware components must include a battery backup with a capacity of minimum 8-12 hours to permit normal continued operation of the Access Control system in the event of mains power failure.
- Door controllers and servers should engage non-volatile memory to ensure that downtime is kept to a minimum in the exceptional event of both mains and battery power loss.

- It should be possible to export the access control configuration so a safe back up that can be kept elsewhere.
- In the event that a door controller experiences a loss in communication with the Access Control system, door controllers should have the capacity to retain a log of door activity which will be downloaded by the Access Control system and incorporated into the log database once communication is re-established.

22.9 Redundancy

- Should the Access Control system server PC fail, there must be an automatic failover to a back up located in either a partitioned virtual drive, or a networked PC
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23. Telecommunications & Data

Refer to Appendix ???

Draft Issue D2.0

24. Lightning Protection

A Lightning Protection system shall be provided where required by a risk analysis study. The Consultant shall engage a Lightning Protection specialist to determine the risk associated with the building and install all LPS system components and commissioning to BS EN 62305:2006, Parts 1 to 4.

Down conductor tapes will be concealed behind downpipes where possible of the building. Structural column rebar will be used where possible in the new parts of the building. Down conductors shall be PVC covered and fixed at intervals of 1.0m. The RAL colour shall be agreed with the architect prior to installation.

Documentation to be provided at time of submission of tender proposals, is as follows:

1. Project specific, BS EN 62305-2 Risk Assessment printout.
2. Manufacturer's certification for each of the proposed lightning protection components.
3. Identified Service Entries and the proposed SPD types and classifications for same.
4. Confirmation of proposed earthing system type and method.
5. Confirmation of proposed lightning conductor size and type.
6. Confirmation that mixed manufacturers components will not be employed (BS EN 50164).
7. Confirmation that the completed installation will be fully compliant with all aspects of BS EN 62305:2006. Parts 1 to 4 inclusive.
8. Confirmation that only trained and certified electrically qualified lightning protection installers will be employed for the installation.

25. Passenger Lifts

25.1 Regulations/Standards

All new passenger and goods/passenger elevators shall be designed to meet the requirements of the current European, National and Local Regulations and Standards including the Lift Directive 2014/33/EU and the latest editions of the Harmonised Standards EN81 series inclusive of the requirements of EN81-20 and EN81-50.

Goods only elevators and wheelchair platform lifts shall be designed to meet the requirements Of the current European, National and Local Regulations and Standards including the Machinery Directive 2006/42/EC and the latest editions of the Harmonised Standards EN81-41:2010 Vertical Lifting Platforms.

The following regulation and standards shall apply depending on chosen lift design:

- 2014/33/EU European Lift Directive
- 2006/42/EC Machinery Directive
- EN81-20:2014 - Construction & Installation
- EN81-50:2014 - Testing & Examination
- EN81-70:2018 - Accessibility to lifts for persons including persons with disability
- EN81-71:2018 - Vandal Resistant Category 1
- EN81-72:2015 - Safety Rules for Construction & Installation of Fire Fighting Lifts
- EN81-73:2016 - Behaviour of lifts in the event of fire
- EN81-28:2018 - Remote Alarm Monitoring
- EN81-41:2010 – Special lifts for the transport of persons and goods
- ISO 12100 - 2010 Safety of Machinery – General principles for design
- I.S. 3217:2013 +A1 2017 NSAI – Code of practice for emergency lighting
- I.S.10101:2020 - National Rules for Electrical Installations
- Current Part M - Building Regulation 2012.
- CIBSE Transportation Systems in Buildings Guide D where applicable.

25.2 Lift Type

All passenger lifts shall be 'Machine-Room-Less'. The hoist machine shall be located at the top of the shaft and the maintenance access panel incorporated within the landing door frame at the top level.

Passenger lifts shall be fully automatic with minimum capacity of 10 person (800 kg). Nominal speed shall be 1.00 m/s up to 12-meter travel and 1.60 m/s above 12-meter travel unless otherwise specified.

Passenger lifts located within students residences and all goods lifts shall comply fully with EN81-71:2018 - Vandal Resistant Category 1 as a minimum requirement with internal cabin height of 2300 mm unless otherwise specified.

25.3 Door Type

Landing and cabin doors shall be fully automatic, heavy duty brushed stainless steel. The doors shall be centre opening with minimum dimension of 900 mm wide x 2100 mm high unless otherwise specified. Fire rated to minimum 2 hour and current Building Regulation.

Door operators shall be heavy duty variable frequency linear drive with four adjustable speeds. Door protection shall be full height electronic detector 2D with minimum 194 beams. The units shall be located at the rear of the car door panel to protect against interference or damage unless 3D detector is specified. A pressure sensitive device shall also be provided.

25.4 Lift Cabin & Landing Controls

The lift cabin shall be provided with a full height stainless-steel push button control station. Dual panels shall be provided on lifts above 13-person 1000 kg capacity.

Floor designations shall be defined as '0' for the main evacuation level and 1, 2, 3 etc above and -1, -2 etc below.

All push buttons shall be tactile, braille and dual illuminated. The alarm push button shall have emergency battery backup supply.

Flush mounted up and down call buttons shall be provided at each landing level. A separate key switch shall be provided at the main level to disable each lift by UCD staff.

A 'DO NOT USE LIFT IN THE EVENT OF FIRE' engraved notice shall be fixed on or adjacent each landing call station.

Position indicators shall be LCD in the cabin and with direction allows and chime on landing levels. Single lifts shall have combined position indicator and directions arrows on all landings. When more than one lift in a group, combined position indicator and directions arrows shall be located on the main landing and all landings below and direction allows and chime all other landings.

An open protocol autodialer shall be incorporated flush within the control panel activated by pressing the alarm button and engraved accordingly. Also a secondary alarm alert shall be provided in the form of a volt free, n/c, open on alarm signal to UCD's BMS system.

A bilingual voice annunciator in Irish and English language shall be incorporated within the control panel and not on the cabin roof. The following announcements shall be programme and in local accent.

- Floor levels
- Doors opening
- Doors closing
- Lift going up
- Lift going down
- Emergency announcements

An induction loop shall be located within the car push station or underneath suspender ceiling.

25.5 Lift Cabin Interior

The standard cabin interior shall be designed as follows unless otherwise specified and minimum 2200 mm clear height.

- Walls: Pattern stainless steel (non-reflective)
- Doors: Brushed or satin stainless steel (non-reflective)
- Ceiling: Brushed or satin stainless steel
- Lighting: LED down lights minimum 6 incorporation 2 no. emergency lights
- Floor: Heavy duty linoleum.
- Skirting: Brushed or satin stainless steel on all walls and front returns.
- Bump rails: Two rows brushed or satin stainless steel on all walls - Goods lifts only.
- Handrails: Stainless steel on one side wall up to 800 kg capacity and all three walls for 1000 kg and above.
- Mirror: Half height and full width on rear wall within 800 mm x 20 mm stainless steel frame.

Note: Front and rear serving lifts shall have mirror dome located above each cabin door.

25.6 Landing Architraves

Full depth wrap-around 'Stone Hench' satin stainless-steel architraves shall be provided for all landings.

25.7 Other Features & Fittings:

- Water sensor located in pit area.
- Counterweight painted yellow.
- Testing facility (key switch) for cabin emergency lights.
- CCTV traveling cable.

26. Matwells and Frames

Matwells to have efficient moisture removing performance carpet system. All frames to be flexible to allow adjustments at any point. Rolling load capabilities to be equal or in excess of 500Kgs/wheel to avoid bumps during its lifespan. All Matwells to be double sided meaning it can be reversible where the configuration of the mat allows. All mats to allow for expansion where required.

27. Doors and Joinery

27.1 Doorsets

Design and selection of doors, windows and glazing shall take account of location and planning requirements.

Where doors to rooms containing a bath or WC have a securing device, it should be of a type capable of being opened from the outside in an emergency.

Timber and wood-based materials shall be of the quality and dimensions required by the design. Items to be considered include:

- Drying shrinkage to minimise drying shrinkage, the moisture content of joinery, when fixed, should not exceed the following:
 - Internal joinery in:
 - Intermittent heating 15% MC
 - Continuous heating 12% MC
 - Near to a heat source 9% MC

When joinery is stored on site, precautions should include:

- Avoiding wetting during unloading
- Stacking external joinery on bearers off the ground and covering with waterproof material
- Storing internal joinery in a weather protected condition.

Joinery which is not properly stored or protected when delivered to site may be rejected.

Door leafs should be covered with polyethylene or original wrapping. Door frames and linings should be protected with timber strips or plywood to at least 1m above skirting level. Thresholds and window sills should be covered. Scaffolding and walkways should be kept away from frames. Joinery should be protected from paint splashes and other damage. All temporary coverings should be removed after all other work has been completed before handover.

27.2 Door performance compliance:

- Third party Certification: Verify the doors are correctly tested. Third party testing verifies that the doors construction quality design and performance has been tested. The management and the production process are audited to ensure consistent manufacturing standards are adhered too

Fire door sets must be manufactured and installed in line with the up-to-date Global Fire Resistance Assessment relevant to the selected door core. The assessment must be carried out by way of established extrapolation and interpretation techniques in order to extend the scope of application by determining the limits for the design based on the tested constructions and performances obtained. The assessment is an evaluation of the potential fire resistance performance, if the elements were to be tested in accordance with BS 476: Part 22: 1987.

27.3 Ironmongery

All ironmongery/ancillary items must be:

- Fit for purpose
- Of life cycle and duty rating suitable for installation within 3rd Level Campus i.e. life cycle: 1,000,000+ & Duty: Heavy (at a minimum)
- Mechanically fixed to background, i.e. “stuck-on” fixings will not be accepted
- Achieve/Exceed all relevant and up-to-date Building Regulations and DAC requirements

Fire Tags must consist of metal tags mechanically fixed to the hinged edge of the door leaf, and should depict:

- Fire Rating & Performance
- Year of Manufacture
- Doorset Supplier (Joinery details)

Lockset Cylinders must achieve Campus Continuity with regard to master keying requirements and as such will be from the Union Assa Abloy DTEC Range (5 & 6 Pin depending on security/location requirements) throughout.

Joinery

All joinery elements should conform to the following wherever possible:

- Prefinished
- Hardwood
- Maintenance Free
- Mechanically fixed to background
- Mitred jointed at all interfaces e.g. internal corners in skirting board

28. Personal Fall Protection Equipment

Where a parapet or suitable edge protection is not available on a roof or height, fall protection systems shall be designed as “Fall Restraint” where possible and must conform to EN 795:2012.

In exceptional circumstances and only by prior agreement can a system be designed as “Fall Arrest”.

This design must be accompanied by a full rescue plan outlining details of equipment required and locations for access. This must also be included in the buildings “Maintenance Access Plan”.

29. Steps and Stairs

A tolerance of 1% on a rise and 2% in a going is acceptable.

It shall be a requirement of the Contractor to confirm these parameters by way of an issued survey once the structure has been installed and also on completion of all finishes and prior to substantial completion.

30. Internal Partitions and Screens

The Contractor's proposed system provider shall issue site specific details for the co-ordination and installation of the system. These details shall be issued in a timely manner which will allow workshops relating to this element to be progressed with the relevant parties from the Design Team. Mock-ups / sample areas, at an early stage in the process have proven hugely beneficial to all and provide a valuable point of reference as the project progresses.

The system provider shall carry out and report on routine site inspections. These reports shall be actioned (if required) by the contractor and signed off reports shall be included in the O&M's / Safety File.

In the case of stud partitions and the like, a full inspection of all aspects of the partition including mechanical and electrical services incorporated within, should be carried out by the relevant parties prior to the partition being closed up. Any matters arising will then be actioned by the contractor. The partition shall then be photographed prior to closing and recorded images shall be included in the O&M/Safety File.

UCD requires a full skim finish to all plasterboard walls and ceilings unless otherwise agreed. This provides a more durable and easily maintained system for the Campus maintenance team.

31. Renewable Energy Technologies

31.1 Solar PV

All solar PV Inverters should be fitted with a standalone BMS connected electricity meter. See section 3 for details relating to electricity meter selection.

All solar arrays should be physically mounted with at least a 5deg pitch to enable water run-off and prevention of water pooling on top of solar panels (see illustration below).

To facilitate PV maintenance (cleaning) a tap should be made available in the nearest plant room to facilitate hose connection.



PV Panels not mounted with a pitch

31.2 Heat Pumps

With the advent of NZEB it is expected that air and water source heat pumps will play a large part in providing future space and water heating requirements at UCD. Please note, in line with UCD energy management practices an Energy Efficient Design (EED) exercise may be required to maximise the potential of each Heat Pump installation.

Design Notes

All heat pump installations must include a dedicated BMS connected heat meter and electricity meter to allow COP and SCOP to be monitored and tracked. The Heat Pump specification document must include the minimum SCOP requirement as a specification which must be reached.

The following information must be provided to UCD for prior approval.

- Heat pump objective (e.g. space/water heating etc)
- Back-up heating requirement (if any)
- Ground source water survey (if required)
- Expected operating temperatures (both heat source and heat sink)
- Rated Heat Pump COP, provide the temperatures this COP is based on
- Expected seasonal COP
- Refrigerant type
- Expected refrigerant availability (based on Green House Gas
- Noise levels
- Service access and major component replacement procedure
 - Must include crane access requirements etc
- Local maintenance support & spare part availability
- Warranty details

(Q) Appendix 1 - Building Envelope Strategic Technical Specifications

1. Introduction

Recently completed projects within UCD have highlighted the weathering problems which can occur without full communication and co-ordination between the client, design team members and construction team members. In addition, it is recognised that Irelands climate is changing rapidly and that more extreme weather events are predicted to become a prominent feature of our future climate.

Weathering construction technology has changed away from traditionally established practices to more specialised techniques, in many instances using proprietary systems procured and installed by specialists as domestic sub-contractors to the principal contractor. This has led to a dilution of traditional lines of responsibility. This method of construction inevitably requires more communication and co-ordination of the details of construction to ensure that the design intent can be constructed to deliver a functioning and compliant building.

This purpose of this document is to identify to Design Teams, Contractors and Developers the strategic technical requirements of UCD in relation to building enclosures and as a result achieve improved performance of the building without adding to project cost.

This document is not intended to be definitive or exhaustive and in no way relieves the relevant parties from their normal professional design, procurement and statutory responsibilities to deliver a building envelope which is fit for its long-term institutional purpose and in accordance with all relevant building regulations and codes of practices.

Sustainable and robust design strategies are to be adopted to deal with the different conditions that buildings designed for today will have to cope with in their lifetime due to the predicted effects of climate change. These include increased winds on building facades, increased driving rains, high temperature extremes and higher wind speeds. The choice of construction and weathering methods during construction need also to be considered to avoid potential delays to projects.

The Design Team and Contractor shall take into account what is described in this document and with their specialist skills and knowledge develop their designs specifications and installations to deliver a robust compliant building enclosure that is supplied, installed, tested and commissioned prior to practical completion.

It is essential that these issues are addressed at concept stage without having to revisit the design at a later stage. The design team will be expected to indicate how they have addressed these questions in report format and will be required to develop their preliminary report as the project progresses.

2. The Building Envelope

The building envelope is required to provide safe, dry, temperate and comfortable conditions under all predictable climatic conditions that can be reasonably anticipated.

Its walls facades and roofs are expected to withstand the deleterious and degrading effects of radiation from the sun, weathering, rainwater, atmospheric pollution, vandalism, fungi and other growths for their required service life described herein without maintenance in excess of routine cleaning and minor repairs.

UCD requires that the design team shall undertake to develop and present to UCD a design and construction risk assessment at the project concept stage indicating the measures undertaken to mitigate these risks.

In addition UCD require that the design team engage with an independent building envelope specialist at concept stage to advise on all technical issues associated with the façade and roof. This service should be maintained throughout the tender and construction stage until project completion and sign off.

An assessment of the building envelope prior to detailed design should include the following;

- Energy considerations including insulation specification, air permeability limits and solar gain.
- Aesthetic and functionality considerations including choice of façade materials, assessment of all building openings including doors, windows and smoke vents in relation to wind direction, opening mechanisms and the requirements for building entrance lobbies.

3. Design Life

It is required that all principal components of the building will have a design life of 60 years. If a particular design cannot meet this requirement prior approval must be granted by UCD. The design life of the Building Structure should be a minimum of 100 years unless otherwise agreed.

4. Design Stages

The following summarises some of the principal inputs required from the design team at the various stages during the life of the project.

Outline Design -Principles of design to be agreed with UCD through workshops, design reports and risk assessments.

Planning - Ensure implementation of design principals.

Tender - Provide fully detailed pack at 1:25 & 1:50 scale.

Construction -Approval of shop drawings, ensure adherence to design details and inspections of interfaces. Ensure contractor appoints façade co-ordinator.

5. Service Life

The whole of the building envelope shall perform for a required service life, in excess of 25 years, without maintenance in excess of routine cleaning, lubrication and minor repairs.

Materials and components which under normal service conditions cannot meet the specified service life will not be acceptable unless approved by UCD at an early stage of the design development phase. If approved these shall be detailed in a specific schedule in the Operations and Maintenance (O&M) manual together with a method statement for replacement. UCD will not accept site applied repairs to factory coatings on metal elements, internally or externally.

Materials and components that under normal service conditions will meet the service life of the cladding without loss of performance but require servicing and maintenance to do so, ie “maintainable items”, shall be identified in a specific schedule in the O&M manual with detailed recommendations for the servicing and maintenance.

All structural fixings, frames, angles, or other load bearing components (i.e. “lifelong elements”) shall remain in position and meet structural stresses and loadings for the building design life without maintenance or replacement.

6. Warranties

Warranties from the Contractor are required for all aspects of the building enclosure.

Warranties and letters of certification are required from all principal suppliers confirming that their systems/components/materials are being used in accordance with their recommendations.

All warranties and associated certification must be enforceable under Irish Law.

In certain cases, consideration should be given to the use of bonded or insurance backed warranties.

7. Interface Responsibility

The Design Team shall have overall responsibility for specifying and detailing all interfaces at tender stage at 1:50 or 1:25 scaled drawings and shall employ suitable experienced contractors to develop their design. These technical details should provide clear indication of design intent and define performance criteria, intended geometry of exposed surfaces, joint positions and provide detail regarding the required principal materials and visible finishes. Strategies for connecting the external envelope back to the primary structure should be clearly detailed at tender stage.

The Design Team shall ensure that there is a single point of responsibility for the detailing and construction of an interface between two systems or zones of responsibility. This in no way relieves the Design Team from their role or responsibility in ensuring that a robust successful detail is achieved on site. The production of interface mock-ups or samples will be required to demonstrate compatibility and buildability of components and systems.

8. Cladding Systems

A warranty period of 25 years is preferred. No less than 12 years of warranty period will be accepted and will require the prior approval of UCD.

All cladding systems shall;

- Be designed as pressure equalised
- Comply with all relevant fire safety standards.
- Incorporate a fully bonded secondary line of defence behind the weathering seals that can drain freely to the external.
- Incorporates an internal air seal.
- Incorporate isolation devices to minimise thermal bridging
- Have an Irish Agreement Certificate or equivalent
- Have all brackets/fixings/framing outside the vapour line fabricated from aluminium or stainless steel, unless agreed otherwise. If specifying stainless steel, the designer shall note UCD’s proximity to coastal conditions which will have a bearing on grade selection and maintenance.

- Incorporate suitable mechanisms to provide adequate run-off to prevent staining or streaking to façade elements.
- Be proven and recognised complete systems with previous use in similar projects.
- Be designed and installed by contractors with proven experience and certification in the specified system. Proposed contractors may require vetting to determine their capabilities. Site visits by the team to factory and previously completed projects have proven beneficial on past projects.
- Have minimum low cost maintenance requirements.

9. Roofs

All roof systems shall have a minimum of 20-year warranty period.

All roofs shall:

- Have an Irish Agreement Certificate or equivalent
- Be designed and detailed to minimise roof penetrations.
- Have fully enclosed and weathered plant rooms where building plant must be located at roof level.
- Have all gutters or flat roofs designed with overflow gargoyles (these must discharge onto an area where it will be visible to staff at ground level)
- Incorporate drainage systems designed to account for increased future rainfall intensity events (Category 4 design, 1 in 225 yr -2 minute event) BS EN 12056-3.
- Incorporate a minimum of 2No. rainwater outlets for each roof area.
- Incorporate gravity drainage systems. See note 11.2.3 on rainwater drainage. Siphonic systems will not be permitted.
- Incorporate access for rodding of rainwater systems.
- Incorporate perimeter drainage outlets as the primary means of removing water and avoid large areas of roof space draining to centralised roof valleys.
- Have fully visible, easily accessible and maintainable rainwater outlets with built in redundancy.
- Rain water outlets shall be of cast aluminium construction.
- Have sufficient falls to avoid ponding (1 in 60 to 1 in 80 minimum).
- Have falls detailed and constructed to transfer water away from roof penetrations.
- Have all upstands at a minimum of 150mm.
- All secondary lines of defense, EPDM's and the like are to be capable of freely and fully draining out under gravity.
- Use aluminium construction where standing seams roof systems are provided.
- Have gutters lined and also incorporate a free draining second line of defence.
- Incorporate fully waterproofed parapets and upstands. The design development of parapet cappings and the like requires careful management by the design team from the outset. This element of the works has posed major challenges on previous projects.
- Have minimum penetrations. The use of proprietary support systems are preferred for any roof plant.
- Provide access for plant maintenance and cleaning via defined walkways (i.e. paving, metal walkway etc.). Risk of accidental puncture or damage to roof surfaces should be minimised.
- Utilise materials with excellent fatigue properties so as to account for future higher thermal movements.
- Be proven and recognised complete systems with previous use in similar projects.
- Be installed and design developed by contractors with proven experience and certification in the specified system. Proposed contractors may require vetting to determine their resources and

capabilities. Site visits by the team to factory and previously completed projects have proven beneficial on past projects.

- Have suitable aesthetic finishes if viewable from higher adjoining buildings.
- Have minimum low cost maintenance requirements.
- Have a clearly defined cleaning and access strategy.

10. Glass & Glazing Systems

Where glass is to act as a barrier, as defined in BS6180 it shall be laminated safety glass class A.

Toughened glass shall not be permitted where heat strengthened, or laminated glass can be designed and supplied as an alternative.

In overhead or inclined construction, the inner pane of glass shall always be laminated.

For roof glazing systems the outer pane shall be toughened, and the inner pane heat strengthened laminated.

All glazing systems (unless frameless systems are adopted) shall:

- Have robust interface details with minimal penetrations.
- Have secondary drainage to the outside.
- Have an internal drainage hierarchy from tertiary to secondary to primary framing members.
- Have ventilation to the edges of the double-glazed units.
- Incorporate isolation devices to minimise thermal bridging.
- Have no surface applied sealants as a means of defence unless prior approval is granted.
- Have agreed demonstrated and documented glass replacement strategies.
- Have clearly documented low cost maintenance requirements with an agreed access strategy for cleaning.
- Incorporate suitable mechanisms to prevent staining or streaking to façade elements.
- Incorporate top hung openable windows with secure restrictors (in preference to side hung).
- Avoid the use of trickle ventilation in buildings classified as non-domestic buildings unless otherwise required and agreed with UCD.

11. Testing

All testing shall be carried out by an Independent testing authority.

The building shall be subject to a building air pressure test carried out by an ATTMA approved testing authority, or equivalent.

A project specific CWCT weather performance test for each cladding type (where applicable) unless relevant test certificates are available.

Each cladding and glazing system (where applicable) shall be subjected to a minimum of 20% CWCT standard hose testing carried out on site by an approved independent testing authority.

Integrity testing of overhead glazing (on full size project specific systems) shall be carried out unless it can be demonstrated (through previous test certificates or similar) that the glass when broken shall remain in place.

Where leaks are identified during the testing process (arising from problems with the glazing system or installation) that entire section of glazing where the leak occurred should be tested and a further 10% added to the overall area to be tested.

All gutters and flat roofs shall be flood, spark (where deemed a suitable test), and thermographically tested.

Where a roof is to be flood tested, the contractor must make access provisions at the underside of the roof for regular inspections while the test is in place. Flood testing on roofs should be programmed so that no test is left in place overnight.

All roof plant rooms shall be flood tested (see note 5.6)

12. Operations and Maintenance Manual

UCD shall be supplied with an Operations and Maintenance manual for the Works. Two hard copies and an electronic version of the complete manual will be required.

The manual shall include, but not be limited to, the following information:

- The name, address and telephone number of each firm and/or Contractor involved in the supply or fabrication of materials, components, assemblies and finishes.
- A clear and concise description of the construction used to form the various elements within the Works. It shall be set out in chapters dealing with each element in turn. Its contents shall be comprehensively tabulated and its text cross-referenced. It shall be illustrated with sketches and Trade Literature and shall refer to the 'as-built' drawings.
- Copies of material, components and finishes certification and test reports as required by the Contract Documents.
- A method statement showing the means of access to all parts of the Works with recommended safe loading.
- A method statement covering the procedures for replacement of damaged or otherwise defective materials or components, and materials and components that have a design life less than the design life of the Works and will therefore require replacement during its life.
- Quality management record sheets including records of repairs to coatings.
- Recommendations and procedures for inspections, routine maintenance, lubrication, cleaning, suitable cleaning agents and painting.
- A full set of as-built construction drawings, updated to include any changes made up to the time of completion.
- The terms and conditions of any Warranties. Note that all Warranties for finishes shall be valid for periods of one year between cleaning.
- Confirmation of all thermal performance criteria for the installed cladding systems and products.

Following hand over of the Building at Completion, the Contractor & Design Team shall allow for providing an experienced member of staff to familiarise the Facilities Manager of the Building with the use of, and information contained within, the Operations and Maintenance manual.

Where an intelligent façade system is provided, (encompassing motorised vents, blinds, louvres etc.) to control the buildings heating and cooling, the primary commissioning of the façade/building management system shall be carried out during the 3 month period prior to practical completion.

The successful operation of the façade/building management system with the preliminary control settings shall be demonstrated to UCD Facilities management team prior to Practical Completion by the

commissioning agent. This commissioning agent shall be available to UCD for optimising the façade system over the course of the defects liability period.

Following hand-over the main contractor will be responsible for maintaining and updating a leak register throughout the defect's liability period. This should include details of leak cause, leak location indicated on an A1 drawing and any remedial action carried out.

13. Maintenance

All areas of the building, internal or external, which require maintenance, cleaning or replacement shall be accessible using purpose-built access ways or proprietary

methods and equipment such as MEWP's, scaffolds, cradles, gantries etc and these access methods should be documented in a detailed "Maintenance Access Plan". This document should be prepared and agreed with UCD prior to tender issue and updated during the construction phase.

14. Spares

A spare parts catalogue shall be developed at design development stage. UCD will select the items and quantities they wish to carry as spares. This catalogue should be updated during the construction phase as selected spare items go through the submittal sign off process.

End of Appendix 1

(R) Appendix 2 - Technical Guidance Document Internal Flooring - Slip Resistance Characteristics

Introduction

Designers owe a duty of care to the patrons of UCD to ensure that the slip resistance of the selected flooring is fit for purpose. This document is intended for the use of designers in designing and selecting materials for flooring at UCD, and to make designers aware of the issues surrounding selection of flooring. This or any UCD guidance document in no way relieves designers of their design duties. Where a designer becomes aware of a conflict or a deficiency in this guidance document, they shall bring it to the attention of the UCD Technical Services Manager.

There is currently no EU/ISO harmonised standard for evaluating and grading the slip resistance of flooring, nor a harmonised approach towards testing of slip resistance of flooring. UCD therefore has produced this guide to establish a consistent approach to the design and selection of flooring based on a methodology of risk assessment. This guide is based primarily on the guidance issued by the UK Health and Safety Executive

Further Guidance

This UCD Technical Guidance Document is not intended to be comprehensive on all aspects of slip resistance. Designers may wish to seek further guidance as to best practice. Please be aware that UCD's

insurer's are guided by UK practice. The UK Health and Safety Executive website provides useful information (www.hse.gov.uk).

Designers may use data based on Coefficient of Friction collected as per BS 5976 or manufacturer's data referencing other European standards e.g. DIN 51097; DIN 51097. As there is no harmonised / EU standard, UCD prefers the Pendulum (Coefficient of Friction) Test, --- (as per BS5976) over Ramp (Coefficient of Friction) Tests, as used for example by DIN 51097 and DIN 51130 standards. However, as manufacturer's data is often presented on the basis of the above ramp test, UCD accepts the use of the ramp test data but with the caveat that the designers supplements the ramp test data with surface roughness data to inform their recommendations.

Manufacturer's Data

Please be aware that it is UCD's experience that R numbers produced by manufacturers based on the DIN standards do not provide sufficient information to assess the slip resistance for all applications. If designers wish to use this method, they should satisfy themselves that they have sufficient information to assess the suitability of or specify the flooring for its application. For example, designers should look for surface roughness information to compliment R numbers to help assess the likelihood of the material behaving differently in the wet or dry. It is also UCD's experience that the R Scale can be misinterpreted. Again, designers are drawn to the guidance on this matter contained within the HSE Guidelines¹ referred to below.

'The R scale runs from R9 to R13, where R9 is slippery when wet, and R13 the least slippery.'¹

The understanding of the DIN information can be misinterpreted if surface roughness is not taken into account. In UCD's experience many floor surfaces that were classified by the DIN 51130 standard as R9 (or in some instances R10) become

unacceptably slippery on occasions when floor conditions became moist/wet/greasy during normal / regular use¹. As previously indicated designers must select appropriate flooring to the application/likely risk of surface moisture in an area when selecting the flooring.

Risk Based Approach towards selection of suitable flooring

Designers shall evaluate their design to identify by drawing or otherwise the potential risk profile of areas of their design. For example:

- Low risk – low risk of water on floor and / or low footfall areas, e.g. offices, classrooms, etc
- Medium risk – heavy footfall with low risk of water e.g. circulation routes, certain laboratories etc.
- High risk – heavy footfall and / or high risk of water on floor e.g. entrance zones, toilets, certain laboratories, food prep & servery areas etc.

On larger/more complicated projects greater categories of risk may be appropriate e.g. 1 (lowest risk)-5 (greatest risk) scale may be more appropriate.

Designers shall firstly identify approaches to minimising or eliminating risk, e.g. that design of lobbies and entrance mat-wells are appropriate for the applications. Designers shall consider the likelihood of the tracking of pedestrian-borne water in the vicinity of entrances and how to contain and reduce the likelihood of same.

Designers shall select appropriate flooring to the risk -by way of guidance -it is UCD's experience that the following material characteristics are the minimum necessary for the levels of risk:

- Low risk areas – R9/R10 flooring acceptable based on manufacturers specification
- Medium risk – R9/R10 acceptable only if accompanied by pendulum tests showing moderate slip potential when wet; otherwise R11/R12/R13 acceptable with appropriate surface roughness
- High risk areas – R11/R12/R13 acceptable with acceptable surface roughness; less than this i.e. R9/10 must be accompanied by a slip resistance report with results at the upper end of moderately slippery when wet

Table 1 Slip potential classification, based on pendulum test values (PTV)

Pendulum Test Values (PTV)

High Slip Potential 0-24

Moderate Slip Potential 25-35

Low Slip Potential 36+

On Site Testing

It may be beneficial for designers to have their selected flooring material PTV tested (wet & dry) on site prior to accepting the material within the submittal process.

For in-situ flooring, designers should allow for a sufficient number of independent on-site tests of the flooring at various stages of finishing to ensure that the flooring is not over polished / finished. In order to ensure timely decision making in relation to in-situ flooring choices, designers shall arrange for sample panels to be tested at design stage before finalisation of the specification. Pendulum Coefficient of Friction Tests are preferred for in-situ tests.

Coatings

Designers must select materials which do not rely on periodic coatings / etching etc., the use of proprietary cleaning products or other high maintenance methods to provide the necessary slip resistance.

Cleaning and Maintenance

The designer must provide explicit cleaning and maintenance instruction for each flooring type/application in order that the slip resistance can be maintained throughout the life of the flooring. Please note earlier comment on coating / maintenance. Designers should also be aware that excessive cleaning may reduce the slip resistance over time, and therefore a sustainable approach towards cleaning and maintenance of flooring is necessary.

References

1. Assessing The Slip Resistance Of Flooring, HSE (2012).

Date: January 2013

End of Appendix 2

(S) Appendix 3 - LED Lighting – Important Points to Note & Questions to be asked of Manufacture

General

- How has the light fitting been designed to conduct heat away from the diodes?
- How is LED life defined? Life should be quoted at L 90, L 80, or L70 (time to lumen depreciation to 90%, 80%, or 70% of initial output as opposed to failure). These are defined as Cat 1, 2, or 3.
- LED's should be tested at 21°C to comply with European Standards. LED life will be extend significantly as ambient temperature drops, but will shorten significantly as Ambient Temperature rises. LEDs love cold but hate heat, so it is important to understand the application they are to be used.
- LED life should be tested at 100% output. It is legal to quote life based on an assumption that luminaires will be dimmed to 50%, which will increase life significantly. Life should also be for the whole luminaire, not just the LED component.
- With certain Manufacturer's LED light fittings, if the LED or driver fails, the whole fitting has to be replaced. Only the large Manufacturers that have put a lot of research into the design can produce light fittings that can have individual components replaced. The fittings that can replace components will however be significantly more expensive.
- How stable is the colour temperature? With cheap manufacturers, there may be noticeable differences in the colour of the LEDs, due to inconsistencies in manufacturing quality of the electronic components.
- As LEDs become more powerful, it is important to remember that the higher the power of the LED, the shorter the life will be.
- The Colour Rendering Index (CRI) of the LED should be quoted.
- What is power factor for the LED circuit? This should be 0.90 or better.
- If dimming has been specified, confirm that the LED driver can be dimmed via a 0-10v signal, and what is the 1-10v power consumption of the LED driver?

Emergency Exit Signage

- LED circuits should be wired in Parallel so if you lose one you will still have emergency lighting. When they are wired in series, when one fails, they all do.
- Blade Signage should have a fixed or screen-printed legend. Adhesive legends are not accepted under EN60598-2-22 and IS 3217-2013.
- For better uniformity of the light distribution with LED blade signage, a silver foil reflector should go around the edge of the legend. Because LEDs are so directional, if

you do not have this foil, most of the light goes straight out the bottom of the legend.

- It is important that standalone emergency LEDs should have Polar Curve charts provided. This proves that the spacing distances have been properly tested in a lighting test station. (If you cannot acquire this information from a supplier, do not use it).
- Exit sign LEDs should be mounted at the top of the fitting, when fitted at the back or the middle, a straight-line strip is all that appears on the legend which is not uniform as required in EN60598-2-22.

End of Appendix 3. 29th January 2015

Draft Issue D2.0

(T) Appendix 4 - Technical Guidance Document - Universal Access in the Built Environment

Introduction

Access is now seen in terms of Universal Access which means that accessibility issues are dealt with in terms of our entire population, including people with disabilities, our aging population and other users, such as mothers and toddlers.

Designers owe a duty of care to the patrons of UCD to ensure buildings, related products and services are designed to meet the needs of all people who wish to use them. In addition to Part M compliance, Designers are required to incorporate into their designs the principles of Universal Access, as set out by the National Disabilities Authority 'Building for Everyone' guidelines, and other current best practice guidelines.

Accessibility should be addressed at all stages of projects and in particular, at the early planning stage, whether it relates to a new build or a refurbishment project.

Regulations and Guidance Documents

- Disability Act 2005
- Building Regulations, specifically, Technical Guidance Document Part M (January 2011)
- National Disabilities Authority – The 7 Principles of Universal Design, <http://universaldesign.ie/What-is-Universal-Design/The-7-Principles/>

Further Guidance

- National Wheel Chair Association – www.iwa.ie
- Other

Date: November 2014

End of Appendix 4

(U) Appendix 5 UCD Watermains General Requirements

General

1. All watermain materials shall be PE, ductile iron or stainless steel.
 - PE pipes must conform to BS 6572, IS EN 12201 parts 1-3, and UK Water Industries Specification (WIS) 4-32-(all parts).
 - Ductile iron pipes must conform to Class K9 of EN 545. Ductile iron fittings must be either Class K9 or K12. All ductile iron pipework and fittings shall be coated internally with a centrifugally applied cement mortar lining containing a sulphate resistant cement. External protection shall include a zinc coating to EN 545 under bitumen based coating to BS 3416: 1991.
 - Stainless steel pipes must conform to IS EN 10216.

2. All service pipes and fittings shall be of type PE-X-80, have an SDR rating of 11 and shall be blue or black in colour. They shall conform to UK Water Industry Specification No. 4-32-02 and/or BS 6572 for pipe sizes up to 63mm OD and No. 4-32-04 for fusion joints and fittings.

3. Pipe laying shall be carried out in accordance with the following requirements:
 - Open trench installation with imported bedding - the pipe material shall be PE100 SDR 17, or PE 80 SDR 11, colour – blue, whichever specified.
 - PE pipe shall be joined using butt welding methods in accordance with manufacturer instructions and as specified overleaf. Only in exceptional circumstances if PE pipe joints which have to be carried out in the trench may be joined using electro-fusion welding methods (subject to prior approval from UCD Estate Services).
 - Mechanical scrapers must be used for all electro-fusion jointing for pipes greater than DN90 (hand scraping not allowed);
 - Ductile iron pipes shall be joined using flanged joints and rated NP 10 or NP 16.
 - All new sluice valves shall be anti-clockwise closing. They shall be in accordance with EN 1074 and have third party independent accreditation. The no. of turns to open/close (n) shall be: $n = 2N+1$, where N is the equivalent diameter in inches.
 - All new hydrants shall be clockwise closing. They shall be in accordance with BS 750 and have third party independent accreditation. They shall be the underground “guide in head” type with Dublin Bayonet head outlets and false spindle. They shall be supplied with ductile iron outlet dust caps, chained to the main hydrant bodies.
 - Marker post and plates shall be erected for all new fittings (sluice, air, hydrant, scour, etc.). Marker plates shall be coloured – yellow plates with black lettering for hydrants and white plates with black lettering for all other fittings. Marker plates shall be fixed with stainless steel non-retractable screws. Marker plates shall be cast aluminium, grey iron or ductile iron plate at least 5mm thick having 4 No. elongated fixing holes 15mm x 8mm each. Marker plates should be mounted at 450mm to the plate centre above the surrounding finished ground level. Hydrant marker plates should show the diameter of the watermain in millimetres on the upper part of the plate and the distance in metres of the marker from the hydrant on the lower part of the plate.
 - The service pipe must not contain any break or joint between the watermain and boundary box.

4. Electro-fusion and butt-fusion jointing shall be carried out in accordance with WIS 4-32-08 using equipment specified in WIS 4-32-16. Contractor’s personnel carrying out the jointing procedure must have at least 5-years relevant experience and an appropriate qualification (City and Guilds - Utility

Operations Certification Scheme 5831 Units 152, 153 and 234) or similar. Contractor will be required to produce evidence of the above.

Polyethylene pipes and fittings shall be from a single manufacturer for warrant purposes. They should be jointed using the following techniques:

- i. Adjacent lengths of pipes shall be butt fused using only automatic butt fusion equipment with integral data retrieval detailing values of parameters for fusion welding pertinent to each completed joint. The conditions of the Water Research Council specification WIS-4-32-08 for site butt fusion jointing should be strictly adhered to except that the heater plate temperature should be increased to 230°C with a tolerance of +5° and -10°C. It is essential that heating plate surfaces are kept clean at all times. The first two joints of each welding session shall be considered dummy joints to be discarded to ensure that the heater plate has been cleansed of any grease, dead materials or dust before being used to make a permanent joint.
- ii. Coupler fittings shall be electro fused at branch tee connections, in-trench joints and at consumer connections. The equipment and methods shall strictly adhere to the conditions of the Water Research Council Specification WIS-4-32-08 for site electrofusion jointing. The packaging containing these electrofusion couplers and saddles shall not be removed until immediately prior to jointing so as to prevent contamination of jointing surfaces.

Wherever possible, butt fusion jointing of high-performance polyethylene pipe shall be carried out in advance of the trench excavation stage of the contract and subsequently lowered into the excavated trench. This sequence of jointing and laying pipe will help reduce contamination of pipe to be tooled and fusion jointed.

Throughout the course of the works the contractor must ensure that all open pipe ends are suitably capped off to mitigate against possible contamination by ingress of vermin, site generated dirt or any other potential contaminants.

Butt fusion of high-performance polyethylene shall not commence until the Contractor submits to UCD's satisfaction:

- i. A list of relevant parameter values, from the pipe as listed in Appendix F of WIS-4-32-13, which must be attained for correct fusion welding procedure;
- ii. Completed servicing and calibration records (similar to those contained in WIS-4-32-08) for each item of fusion equipment to be used on the Contract. These records shall show that the equipment was serviced and calibrated immediately prior to dispatch to site by an independent laboratory. Calibration shall be carried out in accordance with BS 5781 Part 1;
- iii. The names of persons, employed by the Contractor and/or any specialist subcontractor, who will undertake and supervise the butt fusion and electrofusion of pipes and fittings;
- iv. In date certification from the pipe manufacturer and/or an approved training organisation that the persons nominated in (iii) above have been trained in the techniques of butt fusion and electrofusion in accordance with the training objectives as set out in WIS-4-32-08. The certification shall also state that the persons nominated are proficient to joint high-performance polyethylene in accordance with the procedures as set out in WIS-4-32-08.

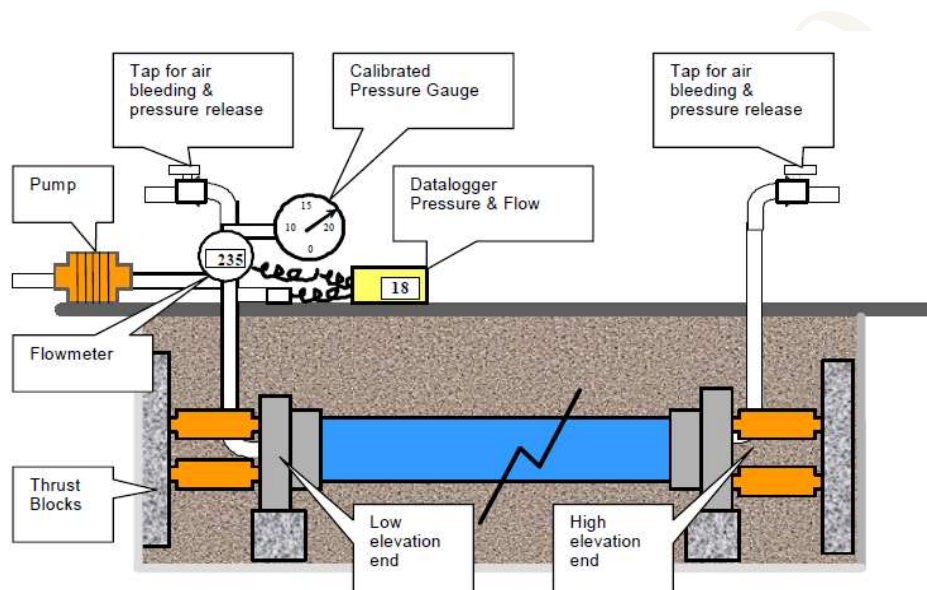
The Contractor shall operate a quality assurance system, preferably to EN ISO 9000/9001, which includes procedures (WIS 4-32-08) and equipment (provision and maintenance) for fusion jointing of PE water mains.

Pressure Testing of Watermains

Pressure testing of PE watermains shall be undertaken in accordance with IGN-4-01-03 Guidance Notes: Pressure Testing of Pressure Pipes and Fittings for Use by Public Water Suppliers. The following summarises the key steps involved in undertaking a proper pressure test on a PE watermain:

Test Procedure

The following illustration provides a guide as to the typical equipment required to undertake the test.



Pump - Where available a pump of capacity to raise pressure smoothly to System Test Pressure (STP) in a time period of approximately 10-20 minutes should be used where practical. For smaller volume tests the pressure rise time should be at least 2-5 minutes, this may be more suited to a hand pump.

Flow meter – A calibrated flow meter, ideally with a resolution of 1 litre, to measure the volume of water taken to pressurise the main and capable of being logged.

Pressure Gauge – A calibrated conventional circular pressure gauge, minimum 200mm diameter, or a digital pressure gauge with a 0.01bar resolution should be available to view the pressure in the pipeline.

Data Logger – This should comprise of a pressure transducer with an accuracy 0.2% of full scale. The transducer should be connected to a logger which can record data at fixed time intervals (20s intervals are normally suitable unless the test is unusually long or short) or at fixed pressure decay increments (a minimum of 0.1bar).

The Standard **Test Procedure (STP)** should be the lowest of:

- 1.5 * PN
- or
- PN + 5 bar
- or
- 1.5 * Maximum Operating Pressure

Mains Testing Set-Up

- The main to be tested should be isolated with end load bearing end fittings with sealed plates. End fittings should have pressure ratings of at least 1.5* STP.
- Closed valves or 'squeeze-off' seals (for PE) should NOT be used to hold the water.
- Service pipe connections using tapping tees may have been bolted/welded to the main, but the tapping hole should not have been made.
- The main pipeline with the exception of all joint locations should have been backfilled and compacted prior to the test. This prevents any axial movement or thermal effects on a sunny day. The opening around each joint should be used to periodically check for leaks during the test period.
- Air valves should be located at all high points to facilitate the removal of air during charging of the main. Air valves should not be closed during the test but non self-sealing air vents should be closed.

Charging of Main

- Water for testing of potable water mains should be taken from the existing supply.
- There should be no physical connection between a live portable water main system and a untested uncertified newly installed water main system to avoid contamination of the live system.
- The main should be charged from the lower end with all air valves open and an open valve at the highest elevation. After charging the main and bleeding air from the system the valve at the highest elevation should remain open to ensure there is no residual head at that point.
- Any attempt to shorten the pumping phase by increasing the initial pressure to local mains pressure using an adjacent main is forbidden and may result in the test being classed as invalid.
- The following points should be noted by contractors tempted to save on pumping by pre-charging:
 - It will be obvious from input volumes and elevations that pre-charging has occurred.
 - There is a greater likelihood of the test failing the specified criteria.

Once the air has been removed from the main, the data logger should be connected and all information logged.

Preliminary Conditioning of Main

- There should be no conditioning of PE mains, any such conditioning will result in the test being classed as invalid and a retest will be required.

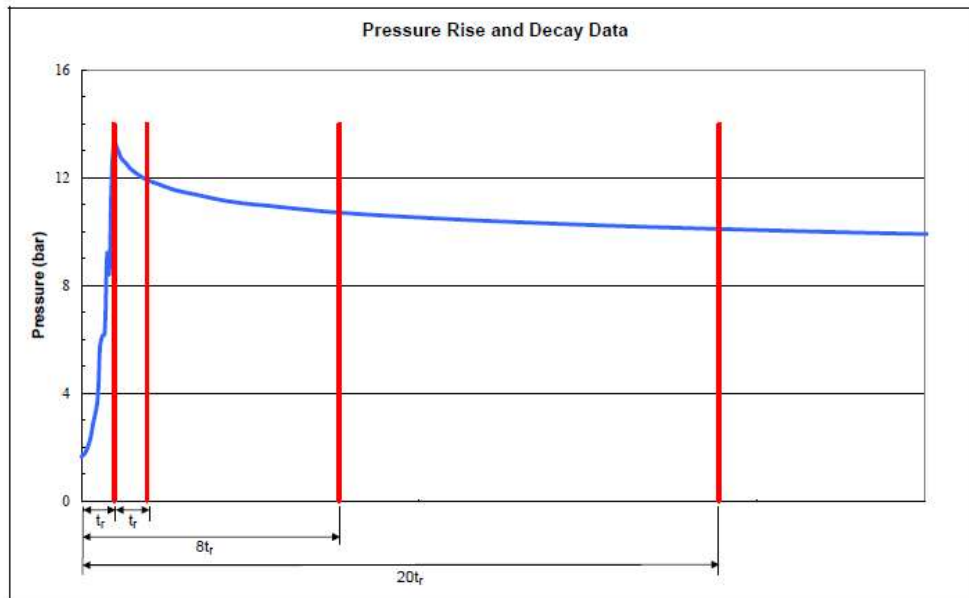
Raising Pressure

- The pressure should be raised to the test level (STP) by pumping in a controlled manner.

Pressure Decay Phase

- After the test pressure (STP) has been reached the system should be isolated and the pressure allowed to decay.

- A minimum test duration of one hour or twenty times the rise time, whichever is the greater, should be allowed.
- The pressure loading time or rise time to achieve test pressure (t_L) is used as a reference and the natural pressure decay readings are recorded at pre-determined times (multiples of t_L). These time intervals are between t_L and $8 t_L$ (t_1 to t_2) and between $8 t_L$ and $20 t_L$ (t_2 to t_3).



Diagrammatic illustration of a sequence of pressure readings

Take a first reading of pressure P_1 at t_1 , where t_1 is equal to the pressure loading time t_L .
Take a second reading of pressure P_2 , at a decay time of approximately $8 t_L$ this is time t_2 .
Take a third reading of pressure P_3 at a decay time of not less than $20 t_L$ this time is t_3 .

Where there is a significant static head on the pipeline, then this can affect the results of the test and consequently pressure values used in the following calculations, should be those referenced to the initial start pressure (P_0).

$PA = \text{Current Pressure (P)} - \text{Start Pressure (P}_0\text{)}$

$PA_1 = P_1 - P_0$

$PA_2 = P_2 - P_0$

$PA_3 = P_3 - P_0$

Also, a correction to the decay times is required to account for the time spent raising the pressure.

Where t_1 corrected $t_{1C} = t_1 + 0.4 t_L$

t_2 corrected $t_{2C} = t_2 + 0.4 t_L$

t_3 corrected $t_{3C} = t_3 + 0.4 t_L$

Calculate the slopes (n) of the decay curve between the two-time intervals. As the pressure decay is of exponential form the use of logarithms is necessary when comparing readings but the use of a pocket calculator is all that is required for 'on site' calculations.

$$n_1 (t_1 - t_2) = \frac{\log PA_1 - \log PA_2}{\log t_{2C} - \log t_{1C}}$$

$$n_2 (t_2 - t_3) = \frac{\log PA_2 - \log PA_3}{\log t_{3C} - \log t_{2C}}$$

The general rule of thumb is:

if $n_2/n_1 \leq 1.25$, then the test is a **pass**.

It is to be expected that the individual pressure decay (n) values should be between 0.07 and 0.09. Values of (n) may sometimes range between 0.06 and 0.10 influenced to some degree by backfill compaction and air content. Values of (n) below 0.06 could indicate excessive pre-charging.

Where there is an increase of slope with time, then leakage is indicated and if the longer term slope exceeds 0.13 then the decay rate is exceptionally high.

No great significance should be given to the values for (n) stated above which are given as a guide. Pipeline leak tightness may only be confirmed by assessment of the decay profile. For a secure pipeline the pressure will decay with a **constant logarithmic slope** and any consistent increase in slope during the test would indicate leakage.

If the values are significantly less than the minimum identified, then there is too great a volume of air in the pipeline. This air will have to be removed before a satisfactory test can be performed.

If at any stage during this pressure test an unacceptable leak is indicated, it is advisable to check all mechanical fittings before visually inspecting the welded joints. Any defect in the installation revealed by the test should be rectified and the test repeated. If a test fails and a leak is found to have arisen for any reason other than loose mechanical fittings or third party damage e.g. damage during backfilling, the section in question along with 1m of pipe to each side should be cut out and taken to a suitably certified lab for testing.

On completion of a test sequence the remaining pressure should be released slowly until the pipeline is under its pre-test conditions.

In the event of a further test being required on the pipeline, such a test should NOT be attempted before sufficient time has elapsed for the pipeline to recover from the previously imposed conditions. This recovery time will depend upon individual circumstance but a period equivalent to 4 times the previous test period may be taken as a guide.

Sterilisation & Water Quality Testing of Watermains

- Watermain pipes shall be sterilised after testing, by use of Foam pigging, flushing, proving and scouring. An approved sterilant such as gaseous chlorine, sodium hypochlorite or calcium hypochlorite shall be used.
- Chlorine solution shall be applied at the charging point as each watermain section is being filled and dosing shall be continued until each section is full and **at least 25mg/l** of free chlorine is available therein. Chlorine gas shall not be injected directly to pipelines from a chlorine cylinder other than through an approved chlorinator and water pump system. No backflow into any preceding section of chlorinated pipeline shall be permitted.

- The sterilised water shall be left in the pipe section for a period **not less than 4 hours** but not exceeding 24 hours and all in-line valves in the systems shall be operated at least once during this period.
- Chlorine residual tests shall then be taken at the end of the pipe section furthest from the point of chlorine injection. The injection of sterilant shall be repeated if and as necessary until the chlorine residual at that end section reaches a level not less than 10 mg/l.
- The Contractor shall dispose of the waste chlorine or sterilant solution by one of the following methods:
 - i. Neutralizing and discharging to a nearby foul line or,
 - ii. By tanker storage and disposal to an accredited and approved disposal facility
- Following sterilisation of watermain pipes, the Contractor shall, only if directed, open the service connections and shall flush these with water having an available free chlorine residual between 5 and 10 mg/l. Flushing of any service connection shall be carried out only subject to prior agreement with the consumer being served and in accordance with a work schedule acceptable to the consumer.
- Following sterilisation, the main shall be refilled and a sample of the water taken and tested at an approved accredited laboratory for **bacteriological and chemical quality** and shall show the absence of coliform organisms and the presence of a free chlorine residual. Samples shall be taken in the presence of UCD personnel. Samples shall be tested within 6-hours of sampling. The new section of watermain shall not be commissioned (put back into service) until the Employers Representative is in receipt of a compliant bacteriological test report indicating that the new watermain is free of coliform bacteria contamination and the water quality is equal to or better than the bacteriologic water quality in the existing distribution system. (No physical connection can be made between the new watermain and the existing campus system until a compliant bacteriological test report has been issued to and approved by all relevant project team members)
- Any ancillary pipe fittings necessary to complete the final tie-ins between the new watermain and the existing campus system should be suitably spray chlorinated or similar approved before connections take place.

End of Appendix 5

(V) Appendix 6 General Structured Cabling Requirements

General Structured Cabling Requirements

New buildings or substantial extensions (new comms room) must be CAT6A. In such instances, for any existing builds old/obsolete or non-conforming cabling must be decommissioned and removed. The current cabling system employed by UCD is "Systimax or NetConnect standard", using Category 6A UTP cabling to comply with EIA/TIA 568-B, IS11801, and EN50173-1, EN50288-11. The cabling system shall be installed and commissioned by a System Supplier approved contractor with a demonstratable track record of 10 years' minimum experience in the Irish Market.

CATEGORY 6A/ CLASS E UTP CABLING SYSTEM REQUIREMENTS

The Structured Cabling Contractor shall furnish and install, test and commission, complete with all accessories, a Category 6A in New Buildings and/or substantial extensions, Unshielded Twisted Pair (UTP) Structured Cabling System (SCS). The SCS shall serve as the transport infrastructure for data, video and voice telephony signals throughout the network from designated demarcation points to outlets located at various Desktop, Workstation, Data Centre, Intelligent Building facilities or other locations as indicated on the tender/contract drawings and described herein.

1. STANDARDS COMPLIANCE

The Structured Cabling System (SCS) shall comply with the following requirements:

- ISO/IEC 11801, ISO/IEC 11801:2010
- EN 50173 Part 1 through Part 5: 2010 and 2011
- ANSI/TIA-568-C
- **IEC 60603-7-4/41**
- **IEEE 802.3 applications as outlined in section 2**
- **Local/National Codes and Regulations**
- Euroclass Regulations (CPR)
 - o Cat6a - Cca, s1a, d1, a1
 - o Cat6 - Dca, s2a, d2, a1

- RoHS 2011/65/EU Environmental Standards

2. Manufacturing Requirements

All products shall be manufactured in facilities that are compliant with the following standards.

- ISO 9001 Certified Manufacturer
- ISO 14001 Certified Manufacturer
- ISO 45001 Certified Occupational Health and Safety management System to control the hazards associated with the manufacture, distribution, field support and central function of telecommunication products and services.

Manufacturers must demonstrate cable manufacturing or significant supply capability in Ireland to guarantee short lead times for copper and fiber cables.

Manufacturers must be able to offer a copper and fiber intelligent infrastructure Solution and design capabilities for consideration within the University.

3. Category 6 & 6A UTP SCS Components

The SCS must consist of individual components provided by the same manufacturer.

“Mix and Match” products are not permitted as there is no guarantee that the overall channel will meet Channel requirements if constructed with components from different vendors.

The components provided shall consist of;

- Horizontal cable
- Information Outlets
- Ganged adapter style patch panel
- Patch-cords
- Zone cords (outlet-to-plug)
- Pre-Terminated cable assemblies
- Intelligent option available from manufacturer

4. UTP HORIZONTAL CABLE

- When configured in worst-case 100 metre channels with full cross-connects and consolidation points with the other products proposed, the cable shall be capable of delivering the minimum guaranteed channel performance specified in section 1.0

The length of each individual run of horizontal cable from any comms room on each floor to the telecommunications outlet shall not exceed 90 metres and shall be continuous without any joints or splices.

- Contractor shall observe the bending radius and pulling strength requirements of the 4-pair UTP cable during handling and installation.

- The cable shall be round in construction, with a maximum nominal diameter of 7.24mm for EN50575 CPR Cable EuroClass, Cca, s1a, d1, a1 for Cat6a and Dca, s2a, d2, a1 for Cat 6 Cabling.
- The minimum bend radius for the 4-pair UTP cable under no load shall be 29 mm.
- The cable will consist of eight 23 AWG copper conductors. Copper-clad aluminium is not permitted.
- The cable and cordage shall be available in Plenum, Non-Plenum and Low-Smoke, Zero Halogen (LSZH) compatibility.
- The LSZH version must comply with the following Fire Safety standards:
 - ISO/IEC 60332-3-22: Vertical Flame Spread
 - ISO/IEC 60754-2: Acidity
 - ISO/IEC 61034-2: Smoke Density
- EN50575 CPR Cable EuroClass, - Cca, s1a, d1, a1 New Builds, Dca, s2a, d2, a1 for Existing Buildings with full DoP's made available.
- Third Party verification of the Fire Safety / Environmental tests listed above must be provided as part of the bid response.
- The cable and cordage shall be UTP components that do not include internal or external shields, screened components or drain wires.
- The horizontal cable shall have a unique print string on the cable jacket. This unique identifier shall also be used for on-line reference to a full set of factory tests that were performed on a sample from the same master reel. The test parameters shall include NEXT, PSNEXT, Return Loss, Attenuation, ELFEXT and PSELFEXT. The on-line reference must be available on the SCS vendor public website, such that it can be accessed at any time.
- The print string will also include markings in both meters and feet.
- The Cat6/6A horizontal cable shall be available to order in the following options:
 - Cardboard box in 305 meter (1000 foot) lengths
 - Reel in 914 meter (3,000 foot) lengths
 - Reel in 305 meter (1,000 foot) lengths

5. INFORMATION OUTLETS / MODULAR JACK

- Information outlets shall consist of 8-pin modular (RJ-45) jacks which are labelled with both the T568B and T568A wiring schemes.

§ T568A pin assignment

T568B pin assignment

- The 8-pin modular (RJ-45) jacks shall comply with IEC 60603-7-41
- The information outlet shall have a Current Rating of 1.5 A at 20°C
- When configured in worst-case 100 metre channels with full cross-connects and consolidation points with the other products proposed in this tender, the outlet shall be capable of delivering the minimum guaranteed channel performance specified in section 4.
- Third Party Verification test certificates shall be provided to show compliance to ISO/IEC 11801 Amendment 2 testing for Cat 6A components.
- The information outlet will have insertion life of 750 cycles minimum.
- Information outlet caps with integrated strain relief shall be available as an option.
- The information outlet shall be available in multiple colours.
- The information outlet must be able to accept termination of solid conductors with nominal diameter of between 0.40 mm to 0.64 mm (26 to 22 AWG).
- The information outlet must be able to accept termination of stranded conductors with nominal diameter of between 0.51 mm to 0.64 mm (24 to 22 AWG)

6. INTELLIGENT GANGED ADAPTER STYLE PATCH PANEL

- Consideration will be given to manufactures that can offer an intelligent patching option, either as a fully intelligent system at initial installation, or as an in-service upgradeable system at a later date for both Copper and Fiber Solutions.
- The contractor must provide details of this and shall be submitted with the tender response.

7. MODULAR RJ45 PATCH CORDS

- Shall be sourced from the same vendor as the other products specified within this tender document.
- Cords shall be equipped with 8-pin modular plugs on each end.
- All cords shall be round, and consist of copper conductors, tightly twisted into individual pairs.
- Nominal cordage diameter shall not exceed 7.24 mm. Cat6a, 6.0mm Cat6
- Reduced diameter options required shall not exceed 4.95mm Cat6A, 4mm Cat6.
- Plugs shall be designed with an anti-snag latch to facilitate easy removal during move, add and change processes.
- The cordage must consist of 8 solid 23 AWG copper conductors. Copper clad aluminium is not permitted.
- The cordage shall be available in Plenum, Non-Plenum and Low-Smoke, Zero Halogen (LSZH) compatibility. The LSZH version must comply with the following Fire Safety standards:

- ISO/IEC 60332-3-22: Vertical Flame Spread
- ISO/IEC 60754-2: Acidity
- ISO/IEC 61034-2: Smoke Density

· Third Party verification of the Fire Safety/ Environmental tests listed above must be provided as part of the bid response.

· The cordage shall be UTP components that do not include internal or external shields, screened components or drain wires.

· The cordage shall have a unique print string on the cable jacket. This unique identifier shall also be used for on-line reference to a full set of factory tests that were performed on a sample from the same master reel. The test parameters shall include NEXT, PSNEXT, Return Loss, Attenuation, ELFEXT and PSELFEXT. The on-line reference must be available on the SCS vendor public website, such that it can be accessed at any time.

· Third Party Verification test certificates shall be provided to show compliance to ISO/IEC 11801 Amendment 2 testing for Cat 6A components.

· The patch cords will have insertion life of 750 cycles minimum.

· When configured in worst-case 100 metre channels with full cross-connects and consolidation points with the other products proposed in this tender, the patch cords shall be capable of delivering the minimum guaranteed channel performance specified in section 4.

8. ZONE CORDS

· The Category 6 and 6A SCS shall provide an option for factory-terminated zone cabling

· The cordage used in the zone cords shall meet all requirements specified.

· Zone cord connector types shall be an unshielded modular 8-pin connectors compliant with IEC 60603-7-41.

· Zone cables shall consist of solid 23 AWG copper cabling with factory terminated plug on one end and a factory terminated information outlet on the other end.

· When configured in worst-case 100 metre channels with full cross-connects and consolidation points with the other products proposed in this tender, the zone cords shall be capable of delivering the minimum guaranteed channel performance specified in section 4.

9. Fibre Cable and Connectivity

· BS 6701:2016+A1:2017 deals with telecommunications cabling and has been revised to accommodate the CPR requirements.

- In summary, Section 5.1.3.1 calls for a minimum classification for telecommunications cables of EuroClass Cca.
- For all new installations Class OM4 Multimode indoor cabling shall be used
- 12 core and 24 core cables where appropriate
- OM4 Fibre specifications as per table below;

Standards Compliance	IEC 60793-2-10, type A1a.3a IEC 60793-2-10, type A1a.3b TIA-492AAAD (OM4)
Attenuation, maximum	1.00 dB/km @ 1300 nm 3.00 dB/km @ 850 nm
Differential Mode Delay Note	Superior to TIA-492AAAC and IEC 60793-2-10 at 850 nm
Index of Refraction	1.479 @ 1300 nm 1.483 @ 850 nm
1 Gbps Ethernet Distance	600 m @ 1300 nm 1110 m @ 850 nm
10 Gbps Ethernet Distance	550 m @ 850 nm 1804 ft @ 850 nm
Bandwidth, Laser, minimum	500 MHz-km @ 1300 nm 4700 MHz-km @ 850 nm
Bandwidth, OFL, minimum	500 MHz-km @ 1300 nm 3500 MHz-km @ 850 nm
Differential Mode Delay	0.70 ps/m @ 850 nm 0.88 ps/m @ 1300 nm
Backscatter Coefficient	-75.7 dB @ 1300 nm -68.0 dB @ 850 nm
Regulatory Compliance/Certifications	

RoHS 2011/65/EU	Compliant
ISO 9001:2015	Designed, manufactured and/or distributed under this quality management system
CENELEC	EN 50575 CPR Euroclass Cca s1a d1 a1 compliant, Declaration of Performance (DoP) must be available

Termination of Multimode fibre cables

- All fibre cores shall be terminated on LC duplex OM4 pigtails by fusion splicing. Mechanical splicing techniques are not permitted
- LC pigtails to be housed in LC bulkhead couplers/adapters with internal shutters.

External Singlemode Fibre

- Duct grade indoor/outdoor fibre
- EN50575 CPR Cable EuroClass Cca | s1b | d2 | a1
- Corrugated steel tape armour
- Gel-Free, Stranded Loose Tube Cable
- ITU-T G.652.D and ITU-T G.657.A1 (Zero Water peak and Bend Optimized OS2 Fibre Type)

Zero Water Peak (ZWP) provides lower loss in the E band of the fibre spectrum (1360-1460nm) this results in longer reach distances for any given application over standard non-optimized SM fibre.

Fibre Shelves

Fibre pigtails to be housed in enclosed shelves with following features;

- 1U rack Unit
- Capacity up to 96 cores per shelf with appropriate LC adapters
- Sliding mechanism allowing forward travel of shelf

- Access to pigtail terminations via removable lid

10. Cable Identification

For quality & tracing purposes the cable Vendor should also provide;

- Easily identifiable manufacturing batch information printed directly on cable Jacket
- Access to web-based system for viewing factory test results of individual cable batch numbers

11. TESTING

Before testing is conducted, the cabling system must pass a detailed visual inspection to verify that the installation complies with all design and installation guidelines. In the event that the installation does not comply with all design and installation guidelines, any deviations must be corrected, before any performance test will be accepted as proof of installation quality.

Field testers do not substitute for checking over-stressed cable, over-scoring into copper, conductor insulation damage, foil screen damage, cable jacket damage and other improper installation methods. Hence field testing is neither complete nor a replacement for good visual inspection. They do provide some enhancements to the physical inspection process and a degree of comfort to the client.

Wire Map Testing

100% of all twisted pair copper cable runs, including Horizontal, Riser and Campus shall be wire map or continuity tested. 4-pair cable wire mapping shall consist of the following checks:

- End to end continuity
- Shorts
- Reversed pairs
- Split pairs
- Transposed pairs
- Presence of AC voltage
- Any other wiring errors

Category 6 and 6A Performance Testing

Performance Testing will be required. These tests must be performed with the use of a Level III tester (or higher level) correctly calibrated, utilising the latest software/firmware and configured for the Channel or Permanent Link under test.

The Category 6 and 6A performance testing shall consist of the following:

- Length
- Insertion Loss

- NEXT Loss
- PS NEXT Loss
- ACR-F Loss
- PS ACR-F Loss
- Return Loss
- Propagation Delay
- Delay Skew

In accordance with the field test specifications defined in ANSI/TIA-568-C.2 “Commercial Balanced Twisted-Pair Telecommunications Cabling and Components Standard”.

The complete, end to end, test results, tested to 550mhz in a four connection channel must be submitted to UCD net@ucd.ie covering All points installed or existing points moved. Points will NOT be made active on the UCD network until test results are provided. Where more than 5 points are installed IT Services must be informed prior to the commencement of the work to make sure active equipment is available. A lead time of 16 weeks can be expected if equipment needs to be ordered by IT Services.

POE must meet current standards:

- o IEEE 802.3at (Type 1) PoE up to 15.4 watts
- o IEEE 802.3at (Type 2) PoE+ up to 30 watts
- o IEEE Draft 802.3bt (Type 3) PoE+ up to 60 watts
- o IEEE Draft 802.3bt (Type 4) PoE+ up to 100 watts
- o Cisco Universal Power Over Ethernet (UPOE) up to 60 watts
- o Power over HDBaseTTM (POH) up to 100 watts

Fibre Testing.

Fibre testing should be done in accordance with Manufacturers guidelines and according to relevant standards in order to qualify for vendor 25year warranty as outlined above.

Fluke Networks optical loss test equipment should be used for testing and all results supplied in native electronic format or with PDF summary.

12. TENDER DOCUMENTATION

- Any proposed Category 6 or 6A Class EA Twisted Pair (UTP) Structured Cabling System shall include a complete set of documentation such that the design, installation and commissioning of the proposed system can be properly reviewed to ensure completed compliance.
- This documentation shall consist of the following, to be included in the bid response:
 - The design drawings showing the proposed patch panel or Administration Subsystem layout within the racks or cabinets.
 - The design drawings showing the proposed Backbone drawing to include the connection between the various Telecommunication Rooms.
 - The design drawings showing the cabinet or rack layout within the various Telecommunications Rooms.
 - The installation or termination guidelines for each of the components included in the SCS.
 - Statement of compliance to the required testing and commissioning as indicated in the Testing Section and that on completion of the installation, all drawings as detailed above will be updated to reflect "As Installed Drawings".
 - Power separation guidelines.

13. WARRANTY

- The completed SCS must be designed and installed so that it can be completely covered under the Cabling Solutions Vendor Product and Applications Warranty. The contractor must provide evidence of this and shall be submitted with the tender response.
- Manufacturer shall be able to provide five authorised installers on their Partner Program with a turnover over €1.5 million.
- All installer staff shall have completed Design/Engineering and Installation training required by the manufacturer within the last two years as part of an Accredited Partner Programme.
- The Cabling Solutions Vendor system and applications warranty must cover a period of twenty-five (25) years.
 - The warranty shall apply to the products and solutions installed in the Structured Cabling Systems, which has been installed and maintained by a Certified Installer

- The Vendor Product and Applications Warranty is provided to assure that:
 - All products are free from material and workmanship defects
- A properly designed, installed, tested and registered structured cabling system will support any application designed to communicate via media specified by ANSI/TIA/EIA-568-C series standards for a period of twenty (25) years from the date of Registration.
- Manufacturer or country agent will provide design ratification and periodic installation inspections with client to ensure quality of proposed and installed solution
- Service-Level agreement, a 24-hour SLA for any technical issue during or after project to be guaranteed by the manufacturer as part of the 25-year warranty

14. Disposal of Waste

All working areas must be kept clean and clear of rubbish, packing, cable ends and general waste. No waste material whatsoever must be stored in comms rooms.

15. Wifi Point Requirements

All new buildings and refurbishments must contain high level points for Wi-Fi, a minimum of dual data outlet should be installed for each wifi location. All staff corridors must contain a wifi point every 50 feet, in the case of lecture theatres, labs, meeting rooms etc., a wifi point must be provided for every 40 seats. A physical site survey to ascertain the suitability of the proposed location of the wireless access points should be performed and the results provided to IT Services, prior to high level point installation. Clarification on location of wifi points can be made to IT Services via net@ucd.ie mailing address by any contractor.

Wifi points and associated network points should be located 2.4metres above floor level or 300mm below ceiling height, whichever is **LOWER**.

16. Labelling Requirements

All cabling must be labelled with permanent labels at the faceplate and the patch panel end. Labels must be permanent and last until warranty expires. Labelling must conform to UCD labelling format of comms room number/floor/point number i.e. CR1/G/001 for a point 1 on ground floor located in Comms Room 1. CR2/1/120 for point 120 on first floor of comms room 2. Any queries on labelling should be referred to net@ucd.ie

17. Comms Room Layouts

All cabling must terminate on Frames. UCD standard layout is the following: F/O on top, Voice on Bottom, UTP/CM/Active equipment in the middle. The format Patch Panel/Cable Mgt/Switch/Cable Mgt/ Patch Panel.

The main comms room must have 24 core SM fibre back to the Daedalus Datacentre and Computer Centre. As well as fibre links between all main comms rooms, any UTP links must be a minimum of Cat6a.

IT Services must be provided with a key to comms rooms once complete.

18. Cable management and containment

Cable Basket

Cable basket for the use of telecommunication services shall be dedicated to telecommunication services only. The cable basket shall not be shared with other services. Where it is not possible to have separate containment systems for power and data cables the single containment system shall provide the correct power separation distance by using two parallel rows of metallic fillets. The two rows of fillets shall be spaced according to section 4.16 above.

When calculating the capacity of cable basket, it shall have at least 25% future capacity. All cable baskets shall be calculated to cater for category 6a cable. The maximum depth of cables on a cable basket is 100mm. Allow 7.24 mm for the overall diameter of a category 6a cable.

Cables in the following areas shall be in bundles of no more than 24 and tied together with Velcro straps every 300mm:

- Horizontal containment within telecom rooms
- Vertical containment within telecom rooms
- Vertical risers outside of telecom rooms
- From entering cabinets to the rear of the patch panel
- All areas that are visible to the naked eye outside of telecom rooms (relaxed to 400mm)

All cables outside the telecom rooms shall be loose laid. All cables inside the telecom rooms shall be bundled.

The general rules for all high- and low-level horizontal data and telecom containment are:

- Category 6 Cables shall not exceed 150mm in depth and Category 6A may not exceed 230mm in depth. Basket or containment accommodating both types must be organised/segregated where appropriate to avoid intermingling of different category cabling.
- All cables to be installed in bundles of 24 cables. This shall only apply within the telecom rooms.

- The cables shall be tram lined and shall not cross over. This shall only apply within the telecom rooms.
- All cable bundles of 24 shall be tied with Velcros at 300mm centres
- Shall not be shared with other services i.e. mains, fire detection, BMS etc. shall be on its own cable basket and the copper shall be on its own cable basket for its entire length
- Copper and fibre data cables/tubing shall not share the same containment i.e. the fibre cabling shall be on its own cable basket and the copper shall be on its own cable basket for its entire length
- Trunking may share services, but it shall be multi compartment and the data/telecom cables shall not share services within their compartment
- Shall not be used as a support for other systems i.e. strapping cables to outside of the containment, structural support for lighting pendants etc.
- Data/telecom cables shall not be supported by any other Mechanical and Electrical fittings/supports. It is not acceptable to strap cables to HVAC ducting, BMS, cables, ceiling tile supports etc.
- Cables shall not be stacked above the height of the cable basket side walls i.e. if the cable basket has side walls of 100mm then the cable depth shall not exceed 100mm
- All cable baskets and metal trunking shall be earth bonded to BS 7671
- There shall be no discontinuation between sections of cable basket or trunking unless compliant with BS 7671 i.e. earth bond 4mm² connecting containment systems
- All cable baskets and trunking shall be jointed together with the manufacturers fixings
- All sections of containment, bends, joints, clamps, bonding etc. shall be from a single Manufacturer. It is not acceptable to mix and match containment products from different Manufacturers
- Cable trunking shall have manufactured bends – it is not acceptable to change direction by butting together two sections with no manufactured bend
- Cable basket external and internal bends shall be $\geq 200\text{mm}$ radius
- Cable basket right angle bends shall be $\geq 200\text{mm}$ radius
- Cables entering a riser at low level shall immediately enter a wall mounted cable basket riser
 - o Vertical cable basket supported by 41mm Unistrut bars
 - o Vertical Unistrut bars to be spaced at 1000mm centres
 - o Lowest Unistrut bar to be within 50mm of the cable basket end
 - o Highest Unistrut bar to be within 50mm of radius to horizontal cable basket
 - o There shall be a cable basket with a radius of $\geq 200\text{mm}$ between the vertical and horizontal cable basket
- Where cables penetrate walls or fire barriers the containment shall penetrate completely through
- Fire barriers shall be sealed to the fire rating of the penetrated barrier
- Where cable baskets cross power cables they shall be bridged at 900.

- Where there are multiple tiers of cable baskets the most accessible position shall be reserved for data cable basket i.e. for suspended floors the data cabling basket shall be the top most and for suspended ceilings it shall be the bottom most
- The cable basket shall be labelled at $\leq 1800\text{mm}$ centres with a Traffolyte engraved label of dimensions ≥ 150 (length) x 50 (height) x 1.6mm (depth). The label shall be tied on at both ends of the label. The label shall be yellow with black lettering. The text shall read 'IT COPPER Data Cabling ONLY' or 'IT FIBRE Data Cabling ONLY'.
- Tight/unnecessary bends in trunking/basket shall be avoided.
- Minimum cable bend radius to be adhered to at all times
- Draw wires to be installed in all empty conduits $\geq 50\text{mm}$ ID.
- Changes in cable containment i.e. basket to riser ladder, basket to conduit or copex etc. shall be within 150mm of each other
- Changes in cable containment from vertical to horizontal and vice versa shall be within 150mm of each other
- The Unistrut bar shall be fully de-burred with end caps installed as required
- Cable baskets shall not be installed upside down or flat against a wall. The only exception is vertical risers.
- Cable baskets can be mounted with the base of the basket against walls but only where they form a riser i.e. vertically
- Cable baskets mounted on walls in a horizontal aspect shall be mounted on wall brackets that keeps the base of the basket at 900 to the wall
- Plastic trunking shall not be mounted on walls or ceilings within escape routes.

19. Earthing

- Ensure earthing and bonding compliance to NSAI ETC TC2 and BS EN50310
- Bonding shall be in accordance with NSAI ETC TC2 and BS 7671

CABLING VENDOR CHECK LIST – in progress, to be filled out for each numbered item

Section	Compliance (Yes/No)	Notes
Standards Compliance		
Application Support		

Channel Performance		
Component Requirements		
Installer Program		
Local Manufacturing and Support Program		
Documentation		