University of Otago

Building Technologies – Standards Suite

CHAPTER 2: CABLING INFRASTRUCTURE PATHWAYS STANDARD

DOCUMENT CONTROL

1) Document Identification

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2) Preparation

Action	Name	Role / Function	Date
Prepared by:	Phil Earl, Cas Olckers	Torque IP	2021-Jun-11
Reviewed by:	Mike Stacey, Douglas Harre	Torque IP	2021-Aug-05

3) Release

	Date Released	Change Notice	Remarks
0.1	11 June 2021	Pathways separated out from cabling standard v5-02 as a standalone chapter in the new UoO BTSS, to service all cabling installations including GCS, Security, AV etc.	Drat for client review and issue as full release.
1.0	01 November 2021	Close out of review comments	Final release
1.1	14 December 2021	Minor updates to clarify manufacturer product sets	For Release
1.2	21 March 2022	Add reference to the Labelling Standard Chapter (Chapter 8)	For Release

4) Contribution (C) and Distribution (D) List

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BUILDING TECHNOLOGIES STANDARDS SUITE INDEX

This document is only one chapter of the University of Otago Building Technologies Standards Suite.

The Building Technologies Standards Suite consists of the following chapters (chapter highlighted refers this document):

CONTENTS

Acknowledgements

The University of Otago acknowledges with thanks the assistance and contribution of the following organisations, institutions, statutory bodies, and individuals in the preparation of these Standards. In particular, the assistance of the following parties is acknowledged:

Torque IP, CommScope and University of Otago IT Staff

1. DOCUMENT PURPOSE

The purpose of this document, CHAPTER 2: CABLING INFRASTRUCTURE – PATHWAYS STANDARD is to provide a reference document for design and construction of cabling infrastructure pathways for all University of Otago facilities in New Zealand. It outlines the minimum standards required to ensure consistency, compatibility and compliance of all new pathway systems installed in facilities owned by the University of Otago.

The installed pathways shall support current and future needs. Campus wide standardisation is important in meeting the scalability and serviceability requirements of the University's IT Infrastructure.

This document will be periodically updated, with copies and details of changes being issued to the holders of the document as listed in the document control register.

This document provides guidance on minimum technical standards in the following areas:

i. Technical requirements for cabling system pathways

ii. Design and installation

iii. Labelling, administration and documentation.

1.1. Document sponsor

This document has been developed and is controlled by the University of Otago.

The contractor or designer shall adhere to the latest published edition of all standards and technical documents for all responses and construction work. Should a conflict exist between the standards or any scope of work, the contractor shall notify the consultant or University of Otago Head of IT Infrastructure of any conflict and seek clarification prior to continuation.

All queries, errors, omissions or suggestions related to this document are to be directed to:

The Head of IT Infrastructure

University of Otago

PO Box 56
Dunedin 9054
New Zealand

Email: its.infrastructure.networking@otago.ac.nz.

1.1.1. Outcome statement

By using this document and relative standards, designers and contractors will meet the University of Otago's minimum standards for the safety, design and installation of pathways to support of cabling systems and information and communications technology environments that the University manages and operates under the Building Technology Standards Suite.

2. USING THIS DOCUMENT

This document is CHAPTER 2: CABLING INFRASTRUCTURE - PATHWAYS STANDARD and forms part of a suite of documents under the University of Otago building technology standards. This document shall be read in conjunction with CHAPTER 1: INTRODUCTION TO BUILDING TECHNOLOGY STANDARDS and any other applicable standard to the work being undertaken.

3. REFERENCED DOCUMENTS

Reference is made in this document to the following:

3.1. New Zealand Standards

NZS 3604	Timber framed buildings

3.2. Joint Australian/New Zealand Standards

AS/NZS 3000	Electrical installations (known as the Australian/New Zealand Wiring Rules). The cited version of AS/NZS 3000 as per the Electrical (Safety) Regulations 2010.
AS/NZS 3084	Telecommunications installations – Telecommunications pathways and spaces for commercial buildings
AS/NZS 3085.1	Telecommunications installations – Basic requirements
AS/NZS 4296	Cabling trunking systems
AS/NZS 14763.2	Telecommunications installations – Implementation and operation of customer premises cabling - Part 2: Planning & Installation
AS/NZS 61000.6.3	Electromagnetic compatibility (EMC) - Part 6.3: Generic standards - Emission standard for residential, commercial and light-industrial environments
AS/NZS CISPR 22	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement

3.3. Australian Standards

AS 3996	Access covers and grates
AS/CA S008	Requirements for customer cabling products
AS/CA S009	Installation requirements for customer cabling (Wiring Rules)

3.4. Other Publications

New Zealand Building Code	Compliance document for New Zealand Building Code – Clause C Protection from Fire (including amendments 2 and 3) Compliance document for New Zealand Building Code – Clause E2 External Moisture (including all amendments) Compliance document for New Zealand Building Code – Clause G9 Electricity (including amendment 6)
Building Industry Consulting Service International, Inc (BICSI) - TDMM	Telecommunications Distribution Methods Manual (TDMM), 14th Edition
Building Industry Consulting Service International, Inc (BICSI) - OSP	Outside Plant Design Reference Manual (OSPDRM), 6th Edition
Otago University Campus Passive Fire Guide	Volume 1 – General Volume 2 – Product Selection Volume 3 – Basic Solutions

3.5. Websites

http://www.legislation.govt.nz/
http://www.otago.ac.nz
http://www.telepermit.co.nz/PtcSpecs.html

3.6. Latest Revisions

The users of this document shall ensure that their copies of the above -mentioned New Zealand Standards and the New Zealand Building Code are the latest revisions. Amendments to referenced New Zealand and Joint Australian/New Zealand Standards can be found on http://www.standards.co.nz.

4. DEFINITIONS AND ABBREVIATIONS

For the purposes of this document the following definitions and abbreviations shall apply.

4.1.1. Definitions

Term	Definition
As-built	Final set of drawings produced at the completion of a construction project, including all changes made to the original construction drawings
Campus	An area or site which contains several University buildings, and includes the grounds in which a cabling system is installed
Category 6_A (Cat 6_A)	A definition of cabling components which provide a permanent link that, when tested, meet AS 11801.1 Class E_A performance
Catenary wire	A wire supported at two points kept under mechanical tension to provide a support to which cabling may be fastened.
Clear working spaces	A ventilated working space allowing quick unrestricted egress or escape in the event of emergency
Contractor	Where the term "Contractor" is used within this document it shall be interpreted as the Contractor providing the specific ELV service.
Designer	A person who plans the look, or workings, or both, of something prior to it being made, by preparing drawings or plans
ELV services	Extra Low Voltage services include Generic Cabling Systems, Security Cabling, Building Management System Cabling and Audio-Visual Cabling.
Enclosure	A housing for accommodation of equipment and cabling that includes mounting rails and protective panels
Equipment footprints	The vertical and horizontal planes occupied by a piece of equipment in normal operation
Generic cabling system	Structured telecommunications cabling system, capable of supporting a wide range of standardised applications. Standards based design

Term	Definition
Horizontal cabling	Cable connecting the floor distributor to the terminal equipment outlets
HDMI	HDMI stands for High-Definition Multimedia Interface, a standard for simultaneously transmitting digital video and audio from a source, such as a computer or TV cable box, to a computer monitor, TV or projector.
Installation Contractor	A person that places or fixes equipment or machinery in position ready for use. The party(s) responsible for the supply, installation, testing and warranty of cabling systems
Manufacturer	A person or company that makes cabling goods for sale
Service Outlet (SO)	Equivalent to a TE Outlet in AS 11801.1
Site	See Campus
Structured Cabling System	Specific cabling solution designed with a set of cabling and connectivity products that are constructed (engineered) according to standardised rules to facilitate specific connectivity requirements e.g. Nurse Call (Staff Assist). Legacy design.
Suitably qualified person	A person with the professional qualifications and experience in the industry to undertake the design and supervision of the works
Terminal Equipment Outlet (TEO)	Fixed connecting device which provides and interface to the terminal equipment. N.B. The term telecommunications outlet is used in some other parts of the AS 11801 series, while the term terminal equipment outlet is used within AS 11801.1 and this document.
Velcro™	A proprietary form of Hook & Loop fastener/cable tie

1.1.1 Abbreviations

AFFL	Above Finished Floor Level	ODF	Optical Distribution Frame
BD	Building Distributor	OFCS	Optical Fibre Communication Systems
BTSS	Building Technology Standards Suite	PE	Polyethylene
CAD	Computer Aided Design	POL	Passive Optical LAN
CD	Campus Distributor	RU	Rack Unit
CES	Communications Earth System	SCS	Structured Cabling System
CoC	Certificate of Compliance	SEC	Security
DB	Electrical Distribution Board	SO	Service Outlet
ELV	Extra Low Voltage	TEO	Terminal Equipment Outlet
EMC	Electromagnetic Compatibility	TO	Telecommunications Outlet
FD	Floor Distributor	TR	Telecommunications Room
F/UTP	Overall screened cable with unscreened twisted pairs (often referred to as FTP)	UoO	University of Otago
GPO	General Purpose Electrical Outlet	uPVC	Unplasticised polyvinyl chloride
GCS	Generic Cabling System	UTP	Unshielded Twisted Pair
IT	Information and Communications Technology	UV	Ultraviolet
LAN	Local Area Network	WA	Work Area
MAC	Moves Adds Changes	WAP	Wireless Access Point
MATV	Master Antenna television		
MER	Main Equipment Room		

5. GENERAL CONDITIONS

The Designer and Contractor shall refer to the UoO BTSS CHAPTER 1: INTRODUCTION for all general conditions required by the University when installing pathways to support other services covered by the standards suite of documents.

6. DESIGN CRITERIA

6.1. Criteria for use

The Designer and Contractor shall refer to sources and publications outlined at the beginning of this document for general design guidance.

The following systems and peripheral components should be considered in conjunction with the design and implementation of the cabling system:

a) False floor (raised flooring) in server/communications rooms to facilitate cable routing to floor mounted racks and cabinets

6.2. Environmental considerations

The designer shall refer to UoO BTSS CHAPTER 1: INTRODUCTION for all environmental requirements regarding the installation of pathways.

6.3. Fire requirements

The designer shall refer to UoO BTSS CHAPTER 1: INTRODUCTION for all fire requirements associated with the installation of pathways.

6.4. Electrical installation works

The designer shall refer to UoO BTSS CHAPTER 1: INTRODUCTION for all associated Electrical work requirements for the installation of pathways in any University site or facility.

7. PATHWAYS

7.1. General requirements

The following section outlines the designer and contractors obligations to meet the University of Otago's need for consistency of all pathway installations throughout their sites and facilities.

All pathways associated with the installations of the following sections of the standards suite shall utilise this document:

University of Otago Building Technology Standards Suite

CHAPTER 3: IT INFRASTRUCTURE – GENERIC CABLING SYSTEMS STANDARD

CHAPTER 4: IT INFRASTURTURE – PASSIVE OPTICAL LAN CABLING SYSTEMS STANDARD

CHAPTER 5: SECURITY STANDARD

CHAPTER 6: CCTV

CHAPTER 7: AUDIO VISUAL STANDARD

CHAPTER 8: LABELLING STANDARD

7.1.1. Fixings

Fixings shall be entirely suitable for the situation in which they will be used:

a) Where fixings are to be used externally or exposed to the weather stainless steel shall be used. Plain and cadmium plated steel is not acceptable.
b) Where fixings are used internally, cadmium plated steel is acceptable.
c) All fixings, fastenings and supports shall be of adequate strength and size and arranged to avoid mechanical failure under normal prevailing conditions at the University.
d) Cables shall be held firmly by the securing device without undue pressure being exerted on the cable sheaths.
e) Cable ties used externally shall be UV resistant and only used to secure conduit to a catenary wire.
f) The use of plastic cable ties shall not be permitted even for temporary fastening or support of cables during the construction phase.
g) All cables shall be tied to catenaries and any other pathway or cabling loom using Velcro™ ties.
h) Cables shall not be secured to beams or any other structure by pin clips, staples, stapled cable ties or stapled Velcro ties.
i) Where pathways are required, catenary wires, trays or trunking shall be provided.

j) When transitioning from a tray or catenary wire less than two (2) metres from the outlet location, the use of one stapled Velcro tie for support is permissible.

7.2. Internal catenaries and above internal cable support systems

Internal cabling supported by catenaries or above-cable trays shall be installed in accordance with AS/NZS 3084, and the following:

a) A main cable route shall be chosen such that the cable path is accessible and conforms to the segregation requirements.

b) Horizontal cabling and backbone cabling shall be installed on separate catenary wires.

c) The catenary wire shall be anchored at a maximum of 3m spans. Turnbuckles and steel eyelets shall be used to tighten the catenaries so that there is no more than 150 mm sag between catenary supports when fully loaded.

d) A maximum of 24 x 4 pair cables may be tied to a single catenary, All cables shall be secured at regular intervals of 300mm using Velcro™ ties.

e) Any cable leaving the wire shall not have an unsupported length greater than one (1) metre before its next fixing, access, or dropping down a wall.

f) ELV services shall not be supported on catenary wires that are used for electrical services, fire services or security services and vice versa.

g) Catenary wires shall be run square and true with no deviations to avoid other services. They shall be run parallel to the major axis of the building.

h) Any cable runs under buildings shall use catenary wires or trays. Where cables transition from underground ducts to catenary wires the duct exit point shall be plugged or sealed using some form of removable material. Rodent resistant polyester insulation wool may be used for this. Expanding foam is not permitted.

i) Cables installed under decks shall be installed in a conduit to protect the cable from the environmental elements.

j) Cables supported on catenary wires shall have a minimum ground clearance of 500mm where possible for serviceability and to reduce potential rodent damage. For all instances where 500mm clearance cannot be maintained from the natural ground level it shall be protected by a conduit, or external cable may be used.

k) When vertical drops of cable exceed two (2) metres, catenary wire shall not be used as the means of support. The contractor is to use tray or chain with appropriate fixings to prevent cable from slipping.

There is a need to address cable tray fill ratios to attend to cable bundle heat management on cable trays. Management of cabling on cable trays can ensure cable bundles do not overheat and avoid data loss in increasing the life cycle of cabling use. The contractor shall comply with ISO/IEC TS 29125 and the manufacturer requirements regarding heat rise and obtaining a 25-year warranty.

7.3. Penetrations

Designers and contractors shall ensure the following is adhered to when needing to provide building penetrations to support cabling infrastructure pathways:

a) The designer shall allow for infrastructure inspections, in relation to existing buildings, prior to any core drilling activities. This is to highlight any asbestos related areas and to ensure that associated risks will be mitigated before any further works (including further design) is actioned.

b) The designer is to allow for a minimum of 4No 100mm diameter floor penetrations per building level and then 1No 100mm diameter for each additional 3716m2 of usage floor space. This will be required to ensure the floor penetrations will allow for other ELV services cabling.

c) Ducts that pass-through walls, roofs, or floors shall be sealed to the manufacturer's specification with an industry-standard duct sealing device to prevent the ingress of water.

d) Where the cabling exits an external underground conduit and enters the structure, the penetration shall comply with the New Zealand Building Code Clause E2 External Moisture. Mechanical shrouds shall be used to weatherproof all external penetrations to the structure, with the use of sealant deemed a secondary means of weatherproofing.

e) Any low-level shroud used to protect a building penetration shall be constructed to ensure that the top surface is angled at approximately 20 degrees. For low level building penetrations, the underground duct shall terminate in an appropriate weatherproof enclosure of minimum L300mm x W200mm x D150mm. Cabling transitioning through the rear of the enclosure shall pass through a section of 50mm conduit inclined at a downwards angle of approximately 10 degrees.

f) All shrouds shall be manufactured from stainless or hot dip galvanised steel and designed to meet the New Zealand Building Code Clause E2. Other materials may be used, with written approval for these from the University to be received prior to installation. Shrouds shall aesthetically match the building as far as practicable (colour to be determined on site prior to ordering and installation).

g) The contractor shall ensure all installed shrouds avoid health and safety issues, for example sharp edges, or pathway and access obstruction.

7.4. Building Entry

Underground conduit shall terminate tidily in a suitable service area of the building with prior agreement from the Property Services Facility Manager.

A method that allows the duct to enter the building with no duct visible externally is preferred. Such methods include:

a) A duct passing from below ground level directly through the wall of a basement or garage space.

b) An angled core drill through a floor slab to a pit or duct bend.

c) A duct emerging in an underfloor cavity or crawl space.

d) A duct installed in a new slab with a duct bend presenting directly in a comms room or service space.

e) Where possible the duct shall run in a continuous length into the main comms room or the comms room nearest to the duct entry. This is generally only achievable in a new build situation where a new slab is poured. Where a comms room is not on the ground floor the extension of the comms duct up a riser to the comms room shall be considered as the preferred backbone path method.

f) An exemption to a non-visible duct entry to a building can only be sought following careful investigation into the feasibility of any of these methods.

7.5. Metal pathways

All metal pathways shall be earthed or bonded and shall be carried out in accordance with AS/NZS 3000.

7.6. Pathway Route

Cable pathways shall be selected and designed to:

a) Minimise multiple building dependencies for backbone fibre cabling.

b) Provide physical path diversity to each data centre for high volume backhaul fibre cabling.

c) Avoid areas of potential future disruption to service.

d) Maintain minimum segregation from other services as mandated by AS/NZS 3000 in accordance with AS 11801 and AS/CA 009.

e) Minimise interference in accordance with AS 11801.

f) All backbone cabling shall be documented in accordance with Section 10 and submitted to the IT Infrastructure Head for approval.

g) Horizontal copper cabling shall be approved by the ITS Infrastructure team.

7.7. Inter-building pathways

7.7.1. General

Inter-building pathways shall be constructed to accommodate the cabling between buildings. Inter-building pathways may consist of underground, overhead, and aerial pathways.

Inter-building pathways shall be as follows:

a) Street based ducting is preferable for inter-building links.

b) Underground pathways shall be used in all instances where no suitable connecting structure exists.

c) Cable shall be protected within a conduit if there is less than 500mm ground clearance. Factors to be considered include dampness, flooding, UV radiation, vermin, Health & Safety and future access.

7.7.2. Cost

Due to the cost and intrusion of creating inter-building pathways contractors are advised to confirm the requirements of other trades and where possible co-exist in pathway or trenches to minimise cost.

7.7.3. Specifications

Underground pathways are preferred wherever practicable however above ground routes may be necessary in some circumstances.

The pathway shall be fully covered and the cabling shall be installed within a protective, correctly specified UV stabilised conduit or ducting for the entire external section of the cable route.

a) Externally rated cabling shall be used in all inter-building pathways.

7.7.4. Crawl space

Open and unsecured crawl space under elevated buildings shall be considered as an external environment and proper consideration shall be given to the choice of components used in this space. Cable pathways in this area shall be protected as per external pathways.

7.7.5. External pathways

All external pathways including junction boxes, ducting, trunking and conduits entering a building shall be protected against damage or vandalism for their entire length to a minimum height of 2.0m above the ground.

Protection shall be in the form of a robust metal shroud of minimum 1mm thickness. The shroud shall be constructed of either stainless or hot dip galvanised steel. Other materials may be used, with written approval for these from the University to be received prior to installation.

If the duct or conduit then continues up under the eve of the building, then it shall be protected all the way to ensure aesthetics are maintained and that it blends into the existing building structure.

Where the new duct to be protected is directly adjacent existing plastic cable ducts following the same path, these ducts shall also be covered within the shroud.

7.7.6. Damage resistance

All inter-building pathways may be prone to vandalism and shall be protected against identified risks.

7.7.7. Manufacturer's approval

All IT cabling pathway components shall be approved by the GCS manufacturer as suitable and approved within the warranty requirements of the vendor's system.

7.7.8. Underground Pathways - General Design

Underground pathways shall be designed and constructed in accordance with AS/NZS 3084, pit provision and spacing shall be in accordance with *section 9.3.1.3.*

Where underground pathways enter the interior of the building, they shall be rodent proofed and sealed from the ingress of water to meet New Zealand Building Code Clause E2 External Moisture.

7.7.9. Trenching and Drilling

Trenches for communication cabling shall:

a) Be constructed to provide a minimum depth of 450mm cover between the natural ground surface and the top surface of the communications conduit.

b) Be constructed such that installed conduits or duct shall always maintain a minimum longitudinal grade of 1 in 150. A longitudinal grade of 1 in 100 is preferred where practicable in accordance with AS/NZS 3084.

c) Only have ducting installed by directional drilling providing the minimum cover to the natural ground surface can be maintained.

d) Have a suitable warning marker tape with tracer wire installed directly above a duct or conduit installed in a trench, at the appropriate level, for the entire length of the trench prior to backfilling to deter possible mechanical damage to communications pathways by diggers and to permit detection when scanning for services.

e) Have backfilling performed with due care to avoid distortion of the cable inspection pits and the duct or conduit shall be supported firmly and evenly on all sides. Suitable fine grit material shall be used to surround pits and conduit prior to backfilling trenches.

f) Have all trenches backfilled with fine grit up to the duct level and original excavated material removed from site or disposed of in accordance with the University's requirements.

7.7.10. Duct and Conduit fill ratios

Fill ratios shall be approved by the designer but shall not exceed 60% fill-rate on first installation, and 80% on subsequent MAC works, without the written authorisation of the University or its representatives.

7.7.11. Underground Ducts - General

For all ducts, the following requirements shall be followed:

a) Ducts shall be 100mm diameter between pits and between pits and large building entrance facilities. 50mm conduit is permissible for spurs into campus buildings with a floor area of less than 200m2.
b) Ducts and accessories shall be green uPVC or PE.
c) Outdoor duct shall meet the minimum classifications in accordance with Clause 5 of AS/NZS 2053.
d) Sweeping bends shall be used to allow for cable bending radii and be green communications type PVC.
e) Any section of duct that may be exposed to direct sunlight shall be UV stabilised.

f) All ducts shall be installed with a draw wire consisting of a 1mm conduit wire, a 3mm nylon cord, or a 12mm nylon ribbon. A draw wire shall be left following all cable installation works.

g) Underground ducts be sized to accommodate backbone cables such that the conduit is not greater than 60% occupied at the time of installation.

7.7.12. Conduit - Underground

For all underground conduits the following additional requirements shall be followed:

a) The conduit shall extend into the pit for approximately 50mm through a close-fitting hole.
b) The minimum size of conduit shall be 50mm and it is strongly recommended that a spare 50mm diameter, PVC, communications conduit be installed along the complete route of the underground inter-building pathway system for future installations. A single 100mm conduit may be considered an acceptable alternative to two 50mm conduits

7.7.13. Underground conduit - building access

Where transitioning into a building, underground conduit shall either:

a) Continue up and be fixed to the outside wall of the building to enter the ceiling space through the eave, or
b) Finish above ground level and the cable(s) fastened to a vertical perforated cable tray fixed to the outside wall of the building.

The cable tray shall be continuous from the conduit top to an access hole at ceiling space level. The access hole shall be sealed with a moisture and fire-retardant material as per UoO BTSS CHAPTER 1: INTRODUCTION requirements.

The perforated tray, access hole, and cable(s) shall be protected by a steel top hat section.

Both conduit and top hat sections shall be painted to match other building fixtures such as down pipes.

Where underground cable enters a building, access shall be fit for purpose, comply with New Zealand Building Code Clause E2 External Moisture, and be protected from damage.

7.7.14. Conduit – above ground

a) All conduits and accessories used shall be UV stabilised i.e. UPVC or PE.
b) All conduits and accessories shall be suitably manufactured and coloured for telecommunication cabling use i.e. and white, green or grey.
c) Sweeping bends shall be used to allow for cable bending radii.
d) Conduits shall be sized to ensure the haul tension of the cable is not exceeded under installation.

e) Conduits shall be installed in areas where there is a requirement for added protection and/or to aid the ease of installation for any telecommunications cabling.
f) If conduits are installed in exposed areas then they shall be installed on parallel paths and change direction utilising appropriate bends and accessories required to form a right angle
g) Draw wires shall be installed in all conduits that have spare capacity (Including conduits not currently in use). A minimum of 500mm of draw wire shall extrude from each conduit end and be fixed so as not to become unusable. Draw wires shall consist of a 1mm conduit wire, or a 3mm nylon cord, or a 12mm nylon ribbon.

7.7.15. Pits – General

Communications pits shall be selected from the University of Otago approved products list.

Pits shall be installed at suitable locations to facilitate installation and maintenance of cabling.

Where pits are installed in areas having traffic (this includes grass and field areas maintained by a groundskeeper using a tractor or similar), a traffic-able "D Class" pit shall be used.

Pits shall have non-slip surfaces and shall not be placed in or near designated recreation areas E.g. sports fields. Pits and pit covers shall be rated for their environment in accordance with AS 3996.

Care shall be taken when pits are in common walking areas or vehicle access roads. Where pits are installed in areas having traffic (this includes grass and field areas maintained by a grounds keeper using a tractor or similar), the correct approved strengthening ring for the pit lip shall be used. Pit lids shall have non-slip surfaces and be correctly rated for the expected exposure to heavy vehicles.

7.7.16. Pits – Dimensioning

The contractor shall comply with AS/NZS 3084 (section 9.2.7.5), pits shall be selected based on overall fitness for purpose and to address the following:

a) Ground conditions such as stability around the pit and pressure on side walls

b) Lid loading criteria arising from placement location

c) Lid finish and security locking criteria

d) Cable hauling access and radius

e) Cable slack and joint accommodation

f) Depth of cover, conduit entry and drainage

7.7.16.1. Pits shall have the following requirements:

a) Pit dimensions will generally be 1200mm x 600mm.

b) For pit applications off major ducting routes the minimum pit dimensions shall be 600mm x 600mm x 600mm deep.

c) All pit lids shall be lockable, keyed alike and of aluminium or metal construction.

d) Communications pits shall be of robust construction and suited to the conditions.

e) Shall be installed at distances not exceeding 250m along underground cable pathways.

f) Shall be installed where a significant change of direction to the route occurs

g) At road crossings or culverts

h) Sharing of service pits with other services (e.g. gas, power, and water) is not permitted.

7.7.17. Pits – Accessories

Pits shall have the following accessories:

a) Secured and correctly rated (lockable) pedestrian covers

b) Secured and correctly rated (lockable) trafficable covers where applicable

c) Bushes (PVC) for conduit entry

d) Gaskets and seals (T-Dux or equivalent).

7.7.18. Overhead pathways

7.7.18.1. Overhead support systems

Overhead pathways may be considered where buildings are linked by covered walkways or gantries and shall conform to the following:

a) Cables shall be installed within protective enclosures such as metal conduits or PVC ducts for the length of the pathway if there is not adequate protection from the elements.

b) Spare tray or ladder capacity of 20% shall be provided.

c) Catenary wire may be used where adequate protection from the elements is afforded by the building structure.

d) Stainless steel saddles and stainless steel screws shall be used for direct fixing of conduit and pathways to an external structure. Saddles and fixings shall be spaced at no more than 1m apart.

e) For all fixed conduit pathways, the conduit shall not be greater than 60% occupied at the time of installation.

f) For all new buildings, overhead pathways shall not be permitted.

7.7.19. Use of existing service ducts

Existing service ducts housed in walkways between buildings or structures, that are designed for the purpose of routing services around the University unobtrusively, shall be used where they are present and when there is enough spare space.

Catenary wire may be used where service duct is enclosed. Externally rated cabling shall be used, and it shall be supported by catenaries installed in accordance with AS/NZS 3084.

Backbone and horizontal cabling may be installed within conduit of 50mm minimum diameter provided that the pathway is fully covered. The cabling shall be installed within protective conduit or ducting for the entire external section of the cable route. Externally rated cabling shall be utilised.

All external pathways including junction boxes, ducting, trunking, and conduits entering a building shall be protected against damage or vandalism for their entire length to a minimum height of 2.0m.

Contractor note:

If the duct or conduit then continues up under the eave of the building, then it shall be protected all the way to ensure aesthetics are maintained and that it blends into the existing building structure.

Conduits or ducts installed under covered walkways shall be positioned to prevent anyone from swinging on them.

Contractor note:

When multiple ducts or conduits are installed under covered walkways or within a building, an accessible and aesthetically pleasing boxing shall be installed around them and painted to blend the pathway into the surroundings.

Stainless steel full saddles and stainless steel screws shall be used for direct fixing of conduit and pathways to an external structure where applicable. Full saddles and fixings shall be spaced at no more than 1m apart.

7.7.19.1. Aerial pathways

Exposed aerial pathways shall not be used other than providing temporary connectivity to portable structures. Temporary is defined as having a known removal date at the time of installation.

Aerial pathways shall meet the requirements of AS/NZS 3084 and AS/CA S009, and the following:

a) Aerial pathways shall be selected to avoid crossing power lines.

b) Where aerial pathways are indicated on the site plans, the contractor shall install UV resistant, PVC-coated, flexible metal conduit between buildings. In this instance the length of conduit may be greater than 1m.

c) The use of gel filled cables in aerial installations shall not be permitted as per AS/CA S009 due to the increased health and safety risk.

d) The conduit shall be sized such that fill at the time of installation does not exceed 60% rated capacity.

e) The catenary wires shall be terminated and sized to support the load of the conduit with 80% fill of cables under extreme weather conditions.

f) Catenary wires shall be PVC coated galvanized steel and in no circumstances shall be less than 3.4mm diameter. Catenary wire shall be fixed to the buildings using eyelets and turnbuckles and bonded to the protective earth as required.

g) The conduit shall be tied to the catenary with stainless steel cable ties.

7.7.20. Tunnels

This Standard does not address the requirements for tunnels. If tunnels are available or are required, the design and appropriate specifications shall be prepared by a suitably qualified civil engineer.

7.8. Intra-building pathways

All pathways shall be installed with the expectation that they will be reused during the lifetime of the University. While it is accepted that the pathways inside the walls are more difficult to reuse, they can be made more accessible by ensuring cable is run vertically rather than horizontally.

Intra-building pathways shall be constructed to accommodate the cabling within a building or blocks.

In multi-storey installations, cabling between floors shall be routed via an approved communications cabling riser or duct.

All IT cabling pathway components shall be approved by the GCS/SCS manufacturer as suitable and approved within the warranty requirements of the vendor's system.

7.8.1. Horizontal cabling pathways

The contractor shall apply the following to all horizontal cabling pathways:

a) All cables shall be concealed in walls or ducts except where run on cable trays in equipment rooms, basements, garages, risers and attics. An exception to this requirement is buildings such as the Information Services Building where cable tray is exposed as an architectural feature. Cables shall be run in neat lines and perpendicular to the structure.

b) Aesthetics are important. All installations are to be unobtrusive and blend in with the existing surroundings. Aesthetic considerations and concealment devices shall never compromise product installation specifications. This is of particular importance in the case of cable bend radius specifications.

c) All fixed horizontal cabling shall be concealed from view within occupied workspaces.

d) All cabling shall be installed in conduits, on cable trays in under floor or above ceiling cavities. Velcro™ cable fasteners shall be used at intervals as specified in AS/NZS 3084.

e) All cabling shall be concealed by installation in ceiling, floor, or wall cavities. However, it may be necessary to surface mount cabling within trunking where no cavity exists or where concealment would prove to be inordinately expensive, disruptive, or impracticable. Two-compartment trunking shall be used to segregate power and communications cabling in these situations.

f) All trunking shall be run in an inconspicuous manner. Excess cabling shall not be stored in the trunking.

g) Where cable bundles of fewer than six UTP copper cables are run in a false (suspended) ceiling they shall be suspended from fixed non-movable structural features. Fixed, non-movable features exclude water pipes, sprinkler systems and trunked electrical power.

h) All fibre cables and cable bundles of greater than six cables shall utilise installed cable trays or catenary wires.

i) Cables shall not be laid on ceilings or ceiling tiles or attached to any suspended ceiling support structures.

j) Plastic capping shall not generally be used in new building and construction projects and low-profile ducting shall be considered where cable numbers are low. Any capping used shall be UV rated.

k) Perimeter trunking shall be considered for use in environments where frequent moves, adds and changes are made and where aesthetic considerations allow a highly conspicuous cable pathway feature. When using perimeter trunking preformed bends, tees and caps shall be used. The perimeter trunking pathway shall extend all the way to the main cable pathway at full capacity, rather than being fed from an in-wall pathway of a smaller conduit. The use of perimeter trunking in a new build shall be specified in consultation with the architect and the electrical engineer.

7.8.2. Horizontal cabling pathway components

All IT cabling pathway components shall be approved by the GCS/SCS manufacturer as suitable and approved within the warranty requirements of the vendor's system.

7.8.3. Horizontal cabling supports

Horizontal IT cabling infrastructure shall be supported by an approved method and shall be installed in accordance with the following:

a) Where exiting cable tray, catenary wire or other continuous pathways, cabling shall be installed such that there is a maximum spacing of 1 meter between supports or fastenings:
b) No more than 24 cables of any type shall be tied to a catenary wire.
c) Cables shall be tied to catenary wires at 300mm intervals using a Velcro™ (minimum of 12mm wide tape).
d) Cables installed on cable trays shall be loosely laid and secured not more than every 1.5m using Velcro™.
e) Catenary wire shall be supported at a minimum of every 3m using hooks or other appropriate fasteners.

7.8.4. Cable trays

Cable trays shall:

a) Be dedicated for ELV services cable on all installations with more than 200 outlets in the building. Smaller sites can utilise a single low voltage tray with ELV services cabling co-located with low voltage services, providing segregation is maintained.

b) Be perforated galvanised mild steel sheet. Minimum steel thickness for cable tray shall be:

   i. 1.0mm for trays up to 150mm wide and

   ii. 1.2mm for trays up to 300mm wide

c) Have folded edges with minimum height of 20mm Electrical continuity shall be maintained along the full length of cable trays.

d) Be galvanised, sheet steel type such as Multistrut MT Series or Unistrut LT Series type or equal approved.

e) Be supported in such a manner to restrict sag between supports to 11mm or less along the entire length of the installation and shall be no more than 1.5m apart.

f) Where cable tray is to be suspended from the slab above it shall utilise low profile supports.

g) At each communications cabinet location, be installed vertically from floor to ceiling / roof, wall mounted above the frame / cabinet for the support of field cabling to and from the frame / cabinet.

h) Be an appropriate solution to avoid cable crimping at the point of transition, where cable trays transition from a horizontal to vertical positioning.

i) Where the cable tray is used as an earthing medium, electrical continuity shall be maintained along its full length.

All installation requirements of AS/NZS 3084 7.3.7 shall be followed.1)

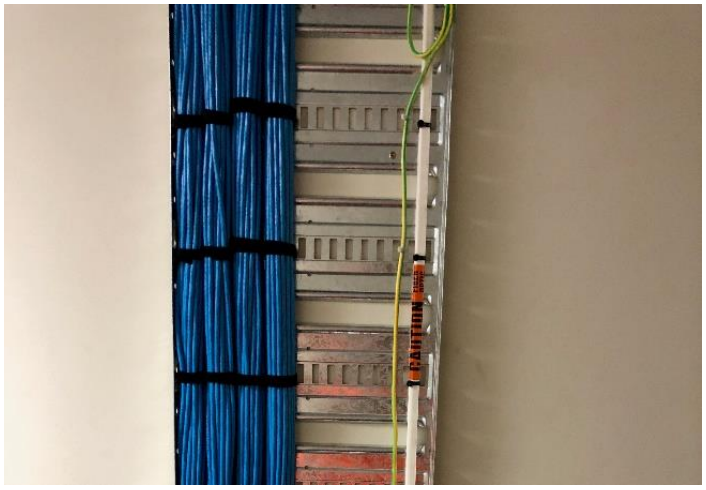

Figure 7.8.4-1

7.8.5. Cable trunking

Trunking is used primarily to provide a pathway and expansion for TEOs and GPOs and shall comply with the following:

a) Outlets shall be installed directly on the trucking utilising a standard face plate.

b) If trunking is installed on a concrete or block wall, it shall be installed at 750mm above the floor where fixed desks are to be installed and as skirting trunking in all other locations.

c) When new trunking is required to provide a pathway for new TEOs or GPOs, any existing services that utilise this pathway and existing pathways shall be removed, for example, mini trunking or conduit.

d) Where twin compartment trunking is utilised for mounting TEOs and power outlets, the top compartment shall be used for GPOs and these are not to be installed directly above a TEO.

e) All metal and plastic trunking shall support the required bend radius for CAT 6A and any fibre cable installed to ensure all products maintain their warranty and comply with AS/NZS 4296.

f) All trunking bends, tees and elbows that are installed onsite shall be prefabricated by the manufacturer or be a factory manufactured part.

g) Compliant plastic trunking shall be paint absorbent, with a minimum UV stabilisation warranty of 10 years. The colour of any trunking shall be specified by the Architect, in the absence of an Architect, the University IT Infrastructure team shall advise the colour.

h) Trunking shall be screw-fixed to walls using suitable fixings (E.g. cavity fasteners for cavity walls and masonry anchors for concrete walls) at approximately 1m intervals when run vertically and approximately 600mm intervals when run horizontally. Fixings shall not cause undue distortion to the trunking when tightened.

i) Surface mounted trunking shall follow the natural vertical and horizontal lines of the room structure. It is preferable to install vertical trunking where possible in a corner if it is close to the outlet location or in a location to make it look as aesthetically pleasing as possible while maintaining expandability and flexibility.

7.8.6. Cable Basket

Basket permits the cabling to drop out of the basket anywhere along its length.

Cable Basket shall be:

a) Utilised where appropriate.

b) Cable basket bends, tees, crosses, risers and reducers shall utilise preformed components installed to the manufacturer's specifications.

c) Cable basket supports shall be installed as per the manufacturer's specification.

7.8.7. Cable Ladder or Ladder Rack

Cable ladder shall:

a) Be used in areas such as major cable pathway junctions where a higher capacity cable support method is required.

b) Be used where a span requirement exceeds the specified support requirement of cable tray or basket.

7.8.8. Ducting and Conduits

GCS cabling (structured cabling and field node signal cabling), leaving ceiling spaces, and required to be surface mount, shall be routed in conduit suitable for the environment it is installed i.e., UV rated conduit for external use etc.

All ducting and conduits shall:

a) Be selected to provide capacity for the minimum bend requirements.

b) Use pre-formed bends, tees, crosses and caps throughout the installation.

c) Be selected to aesthetically match the building as far as practicable (colour to be determined on site prior to ordering) and sized to suit the number of cables.

d) Have all newly installed ducts and conduits with a minimum 40% spare capacity after completion of the works.

Conduit sizing and design considerations

Where plastic conduit is utilised to reticulate any cabling it shall:

a) Unless specifically detailed on design layouts, be generally sized to accommodate cabling such that the conduit fill at the time of installation does not exceed 60% of the rated conduit capacity.

b) Have accessories rated for high impact and be white in colour.

c) Use sweeping bends to allow for cable bending radii

d) Not have conduit elbows installed.

e) Have no more than two ninety-degree bends in each conduit run.

f) Before cabling is installed within conduits, be completely cleared of dust, dirt, construction debris and moisture.

g) Have any cabling that has been subject to immersion in liquid or extensive moisture replaced completely.

h) Be fastened using suitable rated half or full saddles.

i) Have any saddles installed in an exterior environment be stainless steel in construction.

j) Have all conduit joints glued with PVC cement.

k) Have conduit ends fitted with a conduit flare (bell-mouth) installed flush with the wall surface.

l) Have conduit ends cut square and all burrs removed to minimise damage to cabling.

m) Have any section of conduit likely to be exposed to direct sunlight exhibit a high level of UV resistance and be rated for external installation and UV exposure.

n) Have all conduits embedded within the building structure e.g., floor slabs, be clearly marked on as-built drawings. This requirement also applies to conduits installed by other parties for the reticulation of GCS, Fire, Security, BMS or Audio-Visual cabling.

o) Not exceed the follow number of cables per conduit.

Conduit inner diameter (mm)	Maximum Cat 6A shielded Cable Count on Installation
25	2
32	3
40	6
50	9
80	23
100	37
(Note Calculations above assume a fill ratio of 100% on installation and cable outer diameter (OD) is 8mm) and 2 bends in the conduit pathway	

Table 1 Conduit and Ducting Cable Filling Capacity Schedule

a) Have a separate conduit for the communications cabling and AV to each floor box, apart from the LV conduit, and not allow floor boxes to be daisy chained by the same size conduit.

b) Allow daisy chaining between floor boxes if the communications and AV conduits to the first-floor box is double the capacity of the conduit between floor box 1 and 2.

c) Have no more than 2No floor boxes in a daisy chain connecting communications and AV cabling.

d) Have conduits to floor boxes approved with a structural engineer to ensure the conduits do not negatively affect the structural load bearing integrity of floor slabs.

7.8.9. Internal Catenary

Catenary wires shall be installed to support internal cables within ceiling spaces and under floors. Internal cabling supported by catenaries shall be installed in accordance with AS/NZS 3084 and the following:

a) The maximum size bundle of 4-pair cables supported by a catenary wire shall be 24.

b) The catenary wires shall be sized, terminated and supported to sustain the load of attached cables without exceeding the maximum sag requirements of AS/NZS 3084.

c) Cabling shall be fixed with Velcro strips (minimum width of 20mm) to the catenary at 300mm intervals.

Catenary sizing and design considerations

Catenary wire pathways shall meet all of the following requirements:

a) Where catenaries are being used within the ceiling space, ELV services catenaries shall be separated by a minimum of 150mm vertically from electrical catenaries. The ELV services catenaries shall be the lower of the two sets.

b) PVC insulated steel wire of diameter 3.2mm (black type).

c) Securely fixed to structural members of the building and tensioned using heavy duty commercial grade turn buckles.

d) The maximum size bundle of ELV services cables supported by a single catenary wire shall be 24.

e) Cables shall be loosely fixed with a minimum of 9mm wide Velcro cable ties every 300mm.

f) Catenary wire supports shall be spaced at distances not exceeding 3 metres.

g) The catenary wires shall be terminated and supported to sustain the maximum possible load of attached cables (E.g. 24no Category 6_A shielded F/UTP for GCS).

h) A maximum sag of 50mm for any catenary run, shall not be exceeded between any two supports when the catenary wire is fully loaded.

i) For horizontal cabling installed to service workstation pods, a dedicated catenary wire shall be installed to each group or block of respective telecommunications outlets.

j) Install catenary wires so that a cable leaving the wire shall not have an unsupported length greater than 1m before its next fixing, access or dropping down a wall.

k) Communication services shall not be supported on catenary wires that are used for electrical services.

l) Catenary wires shall be run square and true with no deviations to avoid other services. They shall be run parallel to the major axis of the building.

m) Any cable runs under buildings shall use catenary wires or tray. Where cables transition from underground ducts to catenary wires the duct exit point shall be protected by using T-Dux or similar.

n) Cables supported on catenary wires shall have a minimum ground clearance of 500mm where possible for serviceability and reducing potential rodent damage.

o) When vertical drops of cable exceed 2m, catenary wire shall not be used as the means of support. The contractor use cable tray or other suitable support with appropriate fixings to prevent cable from slipping.

7.8.10. Cable tray/basket sizing and design considerations

The provision and installation of primary cable pathways and support systems shall be provided by the electrical contractor, these include:

a) Vertical and horizontal cable trays, cable baskets, perimeter etc.

b) Conduits or ducts cast or embedded into the building structure E.g., floor slabs.

c) Penetrations required through the floor slab and structural concrete beams.

d) The ELV contractor shall verify that their cable pathways provided by the electrical contractor are correctly sized and shall inform the project of any changes prior to pricing or installation.

The following situations shall require the applicable ELV contractor or communications contractor to install their own cable trays (vertical and horizontal):

a) All secondary cable pathways

b) When insufficient cable trays have been allowed inside the comms room or IT riser locations.

c) When there is not adequate separation between other ELV services and IT Infrastructure cabling on a shared cable tray.

The contractor responsible for the installation of the specific ELV service shall provide all fixings required to secure cabling to primary support systems.

Cable pathways shall be concealed wherever possible and shall be selected to:

a) Ensure that backbone and horizontal cabling is supported for a distance greater than 1 meter.

b) Maintain minimum segregation from other services as mandated by AS/NZS 3000, AS/NZS 3084 and AS/CA S009.

c) Minimise EMI in accordance with AS/NZS3000, AS/NZS ISO/IEC 14763.2, AS/CA S009 and/or as per specific manufacturer's instructions in relation to their specific product

d) Consider locations of other services to avoid disruption to other utility services.

e) Consider the future development plans for the site to ensure, where possible, the pathway provides for future cabling capacity and location of new facilities.

Where cable trays are designed and installed to reticulate GCS:

a) Cable basket or tray shall be utilised where provided and marked on layouts.

b) Cables placed in a cable tray or cable basket shall be loosely placed and secured minimising long parallel runs between cables

c) Physical separation of a minimum of 50mm is to be maintained at all times from other extra low voltage (ELV) services that may be sharing the tray e.g. access control and security cabling.

d) The GCS designer/contractor (if no designer has been allowed for) shall communicate as early as possible to the UoO project manager on any specific GCS manufacturer requirements surrounding the sharing of GCS cable basket/tray pathways with other ELV services.

e) Under no circumstances shall GCS share cable basket/tray with fire alarm or low voltage (230v/400v) mains cabling.

f) Cable tray fill shall not exceed maximum values as stipulated below without prior approval of the UoO project manager or nominated representative, as a guide the table below indicates the maximum numbers of category 6_A cables per given tray on installation.

Tray size (Width(mm) x Height(mm))	Maximum Cat 6A shielded Cable Count on Installation
50x50	28
100x50	57
150x50	85
200x50	113
300x50	170
400x50	277
500x50	283
600x50	340
100x100	113
200x100	227
300x100	340
400x100	454
500x100	567
600x100	680
(Note calculations above is based on a fill ratio of 100% on installation and cable outer diameter (OD) is 8mm)	

Table 2 Cable trays and baskets Filling requirements

Cable trays shall be sized to have no more than 60% occupancy on day 1 and to allow to accommodate an additional 40% in future.

7.8.11. Cable pathways and cable management inside the MER/CD Room

The following shall be required in relation to the cable pathways inside the CD (Campus Distributor Room) / Data Centre to allow for reduced operations costs (reduced downtime), a reliable network and a functional and practical network.

The cable raceways and cable management shall provide:

a) Fibre bend radius protection

b) Logical and practical cable routing

c) Easy access to the connectors

d) Physically protecting the fibre cabling

The fibre bend radius protection shall include and limited to using bend insensitive fibre cabling G.657.A2.

The logical and practical cable routing shall be achieved, and not limited to the following:

e) An updated MER room layout drawing providing information in relation to the various distribution points and equipment frames within the room

f) Basic diagram of the cable routes between the distribution points, including frame and race way labels

g) Cable managers will allow for cable slack and reducing pull tension on cabling with MACs (Moves, Adds and Changes)

Easy access to the fibre termination panel and distribution frames shall be implemented for the following and not limited to:

a) Removable connectors to allow for safe disconnecting and re-connecting of patch leads to mating connectors

b) Schedules inside the patch panel enclosures for easy identifying of specific connectors and destinations

Physical protection of the fibre shall be achieved by the following and not limited to:

a) Dedicated cable troughs for the fibre and separate cable trays for the copper cabling

b) Corners and cable drops will be routed over trough systems allowing for the minimum cable bend radii requirements

c) Cable slack channels shall be provided to securely allowing storage of excess patch lead slacks, but also allows for future growth

d) In a typical cable raceways services stack the ELV raceways shall be located at the bottom of the stack for unrestricted access. The raceway access shall ensure that the technicians do not put tension on the cable raceway hangers, due to limited access.

The following table provides a summary of the maximum number of fibre optic patch leads that dedicated fibre optic cable channel guide system shall support (host), based on the various channel sizes:

Fibre optic cabling channel guides (FOCG)			
FOCG Sizes	3mm OD jacket	2mm OD jacket	1.7mm OD jacket
50mm wide x 50mm high	180	360	480
100mm wide x 50mm high	320	720	960
150mm wide x 50mm high	480	1080	1440
300mm wide x 50mm high	960	2160	2880

Table 3 Fibre Optic Channel Guide (FOCG) – Sizing schedule

e) The fibre cabling within a solid channel raceway shall not exceed 150mm in depth.

7.8.12. Cable pathways inside framed walls

When installing cabling (horizontal or backbone) within timber or steel framed wall cavities, cabling shall be installed vertically where practicable and vertically in line with the outlet or point at which the cabling exits the wall cavity.

When installing horizontal cabling within framed walls, the maximum number of cables shall not exceed:

	GCS	Security	BMS	AV (HDMI)
Per 20mm Hole	2	3	2	0
Per 25mm Hole	3	4	3	1
Per 32mm Hole	4	5	4	2

Table 4 Holes in timber frame walls – sizing schedule

Any slots created or holes drilled through structural timber members shall comply with AS/NZS 3604 (Timber-Framed Buildings).

7.8.13. Surface mounted trunking

Surface mounted trunking shall be installed where alternative methods for concealment of cables are not possible. Twin compartment trunking shall be used to segregate power and ELV cabling. No exposed conduit or duct is to be used within buildings without prior written approval from the University IT Infrastructure Head.

Surface mounted trunking and ducting shall follow the natural vertical and horizontal lines of the room structure. It is preferable to install vertical trunking where possible in a corner if it is close to the outlet location or in a location to make it look as aesthetically pleasing as possible while maintaining expandability and flexibility.

The fixing of surface mount trunking directly to the ceiling or other horizontal surface (lid facing down) should be avoided. Where this is necessary, Velcro™ ties shall be screwed within the trunking at maximum of 2 metre spacing to ensure that cables are retained when lids are removed. Alternatively, solid cross sections placed to hold the cable in place may be used.

7.8.13.1. Trunking fixings

Trunking shall be screw-fixed to walls using suitable fixings (for example cavity fasteners for cavity walls and masonry anchors for concrete walls) at approximately 1m intervals when run vertically and approximately 600mm intervals when run horizontally. Fixings shall not cause undue distortion to the ducting when tightened.

7.8.14. Under floor cabling

Backbone and distribution cabling may be installed under floors when access permits.

For all under floor cabling the following requirements are to be adhered to:

a) Cables shall be suitable for the environment in which they are installed.

b) Exposed standard distribution cables may be used when the under-floor space is dry and not subject to spray or splashes. Cables shall be installed clear of access and vent points.

c) External grade cables (gel-filled or water-block) and rodent resistant cables shall be installed when the cables are at risk. Alternatively, sealed conduits may be used to protect cables from possible damage by water or rodents.

d) A minimum separation of 500mm shall be observed between fibre optic cabling and ground level. Where this cannot be achieved cabling shall be installed within plastic conduit of 50mm diameter.

e) Where practical all internally rated copper cable shall maintain a minimum distance of 500mm from finished ground level, externally rated cabling may be used for cabling positioned between 200mm and 500mm from ground level

f) Any cabling installed within 200mm of ground level shall be provided with additional mechanical protection, that is, installed within 50mm plastic conduit maintaining the minimum bend radius and expansion requirements.

g) In all cases the manufacturer shall be consulted to ensure the installation meets the specifications and requirements for warranty.

Contractor note:

It is preferred that cabling be concealed by installation in ceiling, floor or wall cavities. However, it may be necessary to surface mount cabling within ducting where no cavity exists or where concealment would prove to be inordinately expensive, disruptive or impracticable. Two-compartment trunking shall be used to segregate power and ELV services cabling.

All trunking shall be run in an inconspicuous manner. Excess cabling shall not be stored in the ducting.

Where cable is run in a false (suspended) ceiling it shall be suspended from fixed non-movable structural features, purpose installed flat cable trays, or from catenary wires. Fixed, non-movable features exclude *water pipes, sprinkler systems and trunked electrical power.*

Cables shall not be laid on ceilings or ceiling tiles or attached to any suspended ceiling support structures.

Plastic capping shall not be used in new installations and low-profile trunking (mini trunking) should be considered where cable numbers are low. Mini trunking may:

a) Be used at 2m above finished floor height
b) Be used for no more than two cables: and
c) Be retained if 2m above finished floor height and no change is required.

All capping shall be UV rated.

8. DOCUMENTATION

The designer and contractor shall refer to the UoO BTSS CHAPTER 1: INTRODUCTION for all general conditions required by the University when installing pathways to support other services covered by the standards suite of documents.