


TITLE:	Telecom Connection Standards	
BUSINESS OWNER:	Access Network	
VERSION NO.	Version 1.0	




Specification for Connections of Houses and Buildings

اشتراطات توصيل البنية التحتية للمساكن و البنايات

BAHRAIN NETWORK (BNET) B.S.C ©

Version: Version 1.0

Effective Date:

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1. Definitions

The following are some of the key terms used throughout the document and their definitions:


Term	Description
BNET	Bahrain Network Company
NBN	National Broadband Network
LO	Licensed Operator
FTTB	Fibre to the Business
FTTH	Fibre to the Home
GPON	Gigabit Passive Optical Network
OLT	Optical Line Termination
HDF	High-density Distribution Frame
iFTB	Internal Fibre termination Box
eFTB	External Fibre Termination Box
TO	Telecom Outlet
ONT	Optical Network Terminal
CPE	Customer Premises Equipment
IBDN	Integrated Building Distribution Network
MTR	Main Telecom Room

2. Purpose

The purpose of this Specification is to define the standards for spaces, facilities and cabling in new residential houses and villas and business buildings for the purpose of providing telecommunications services and to promote adherence to and compliance with those standards.

3. Scope


This document covers standards for telecommunication spaces, facilities and cabling with regard to following categories of premises:

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- Individual houses and villas
- Small Residential Buildings
- Residential multi-storey buildings
- Commercial and Office buildings
- Private residential compounds
- Private Community Areas

It is intended to be a reference for use by those parties involved in the provisioning of telecommunication in-building facilities and telecommunications infrastructure, including:

- Property developers
- Building construction professionals (architects, engineers, builders, technicians)
- Technology suppliers (vendors, telecom contractors, electrical contractors, equipment suppliers)
- Licensed Operators

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4. Introduction

4.1 BNET Role


- a. The role of BNET as owner and operator of the fibre-based National Broadband Network (NBN) in the Kingdom, is to provide equivalent access to world leading services to all other licensees on equivalent terms and conditions; so enabling those licensees to meet the demands of consumers and businesses by providing world leading retail telecom services at fair and reasonable prices, and enabling other licensees to compete on an equal footing in retail markets.
- b. All houses and buildings shall have the telecom infrastructure built-in to support high-speed fibre networks and shall be capable of supporting current and future technology.

4.2 Importance of Standards

- a. These standards cover the key minimum requirements and outline the basic telecom network arrangements for house and building connectivity.
- b. The aim is to have a common, future-proof approach utilizing best practice for fibre infrastructure design.
- c. The standards in this specification will be reviewed on a regular basis, to ensure they serve the needs of the property developer and the consumer.

4.3 Role of the Property Developer/Owner

- a. BNET, as a core utility, builds and maintains the telecom infrastructure in the public footways and carriageways.
- b. Property developers are required to construct telecom infrastructure such as duct and joint boxes within private land and install cables and equipment inside buildings.
- c. Property Owners are required to install duct and conduit within the property boundary for BNET to connect to.

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5. GPON FTTH Topology

GPON = Gigabit Passive Optical Network

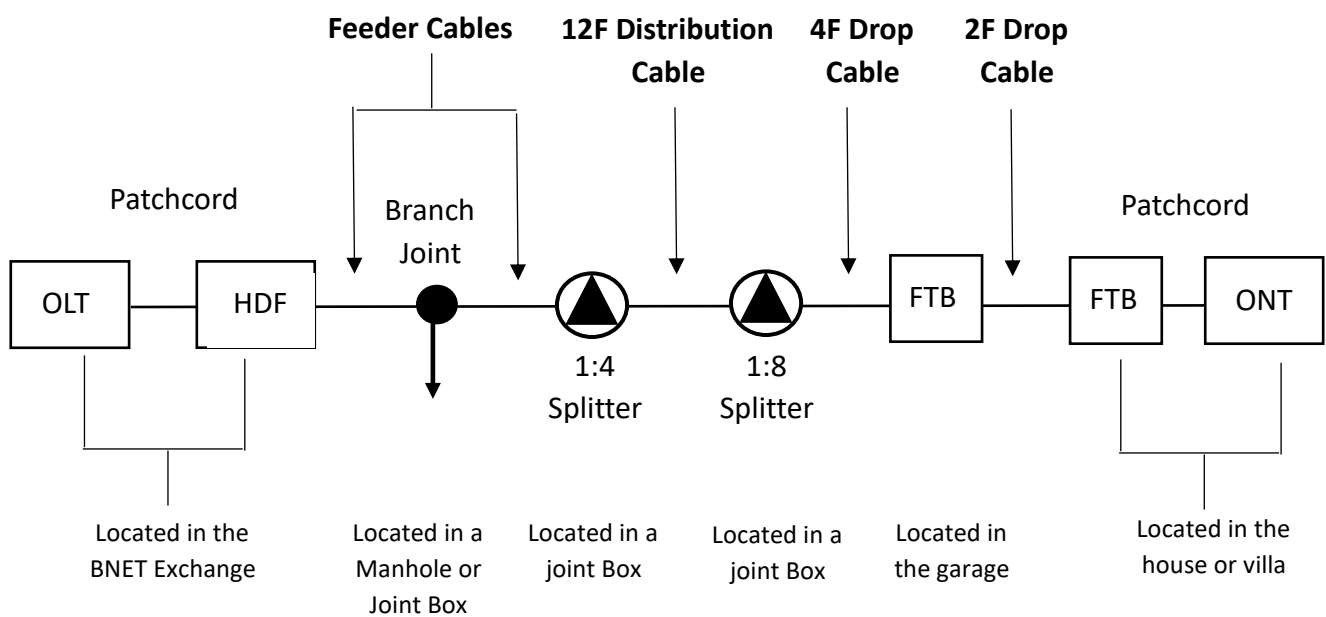
FTB = External Fibre Termination Box

OLT = Optical Line Terminal

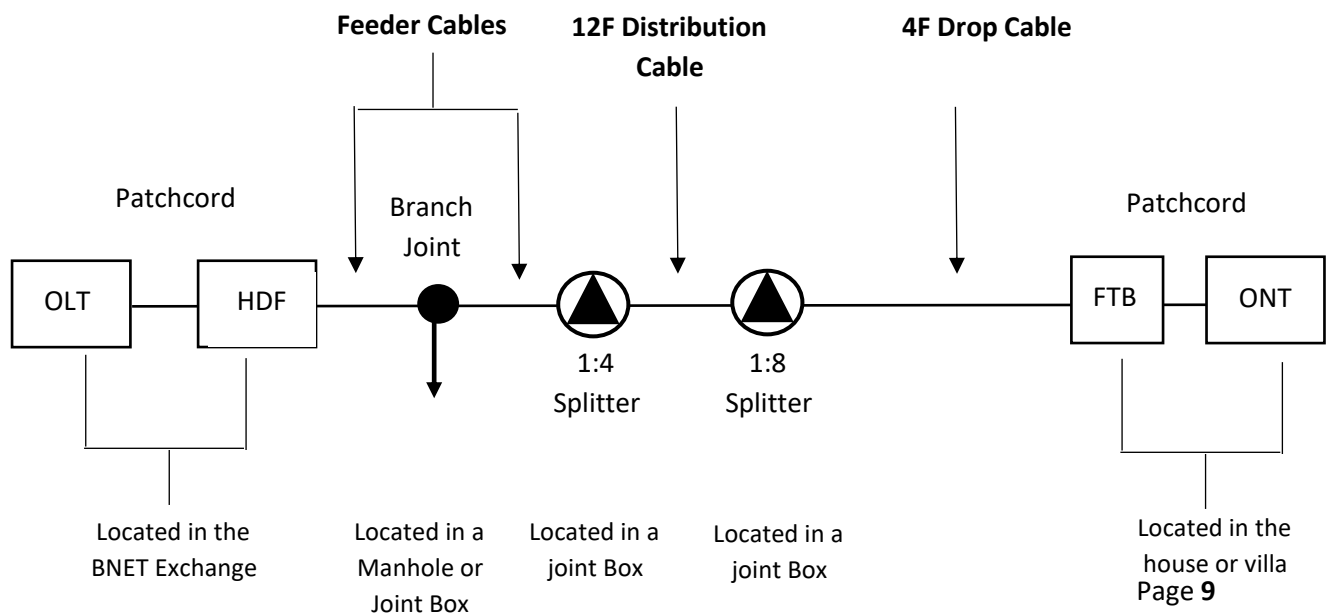
ONT = Optical Network Terminal


HDF = High Density (Fibre) Frame

5.1 Standard House or Villa Connection

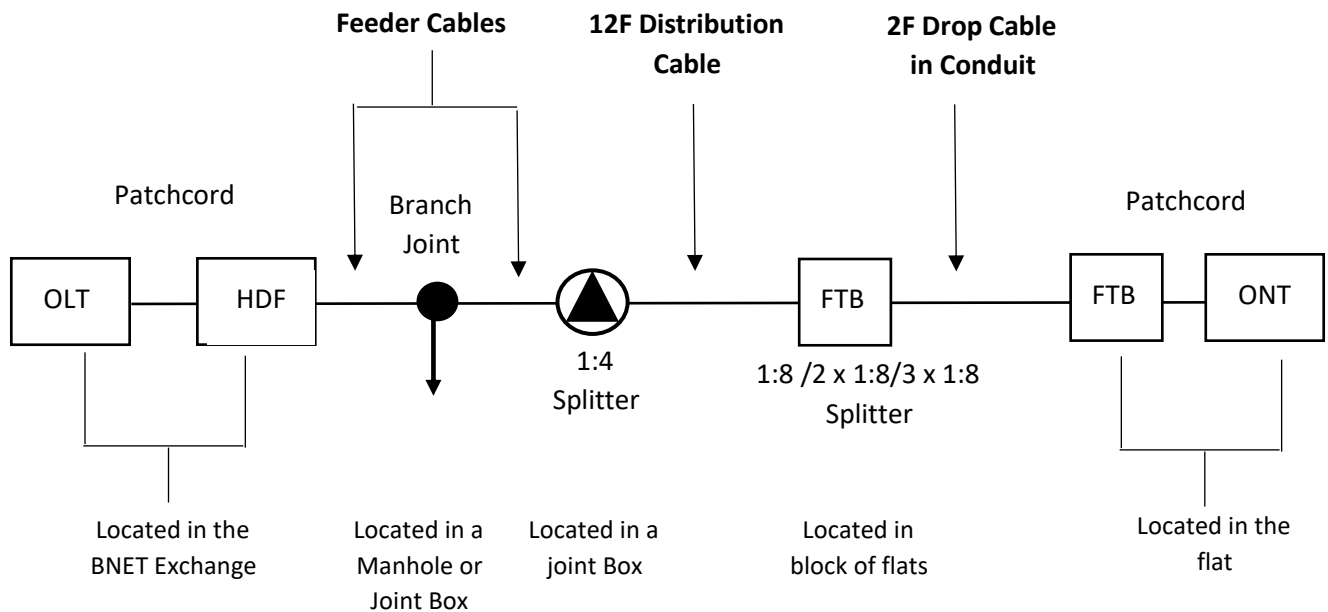


5.2 Alternative House or Villa Connection

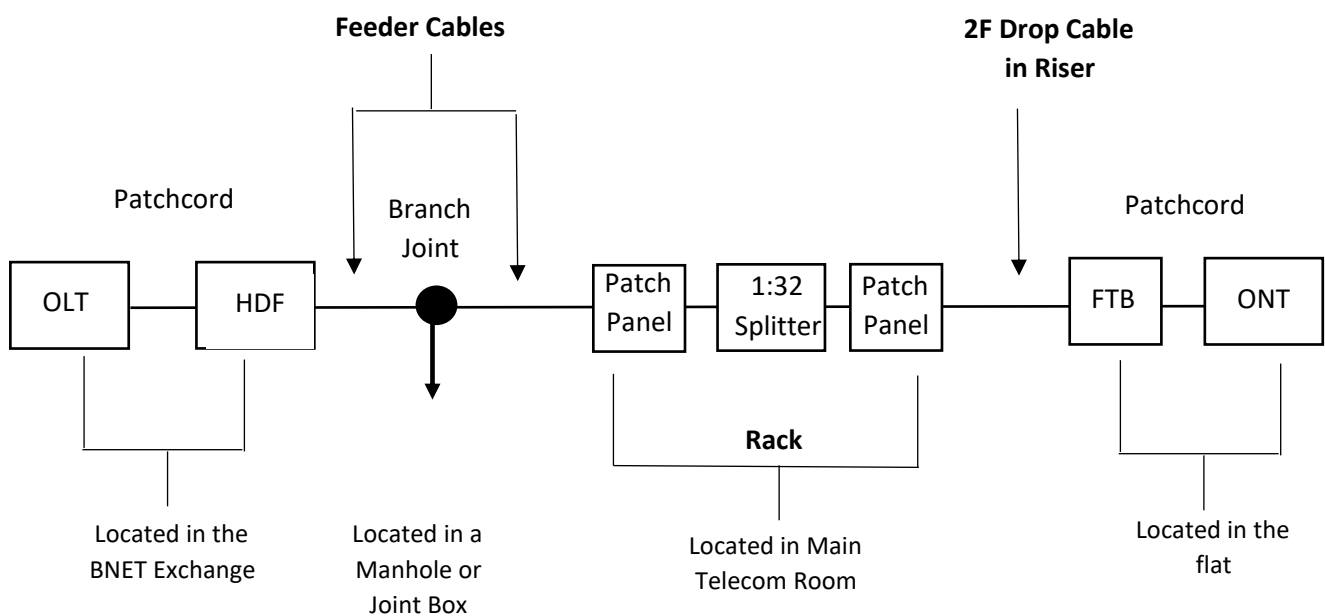



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5.3 Small Block of Flats



5.4 Multi-storey Residential Building

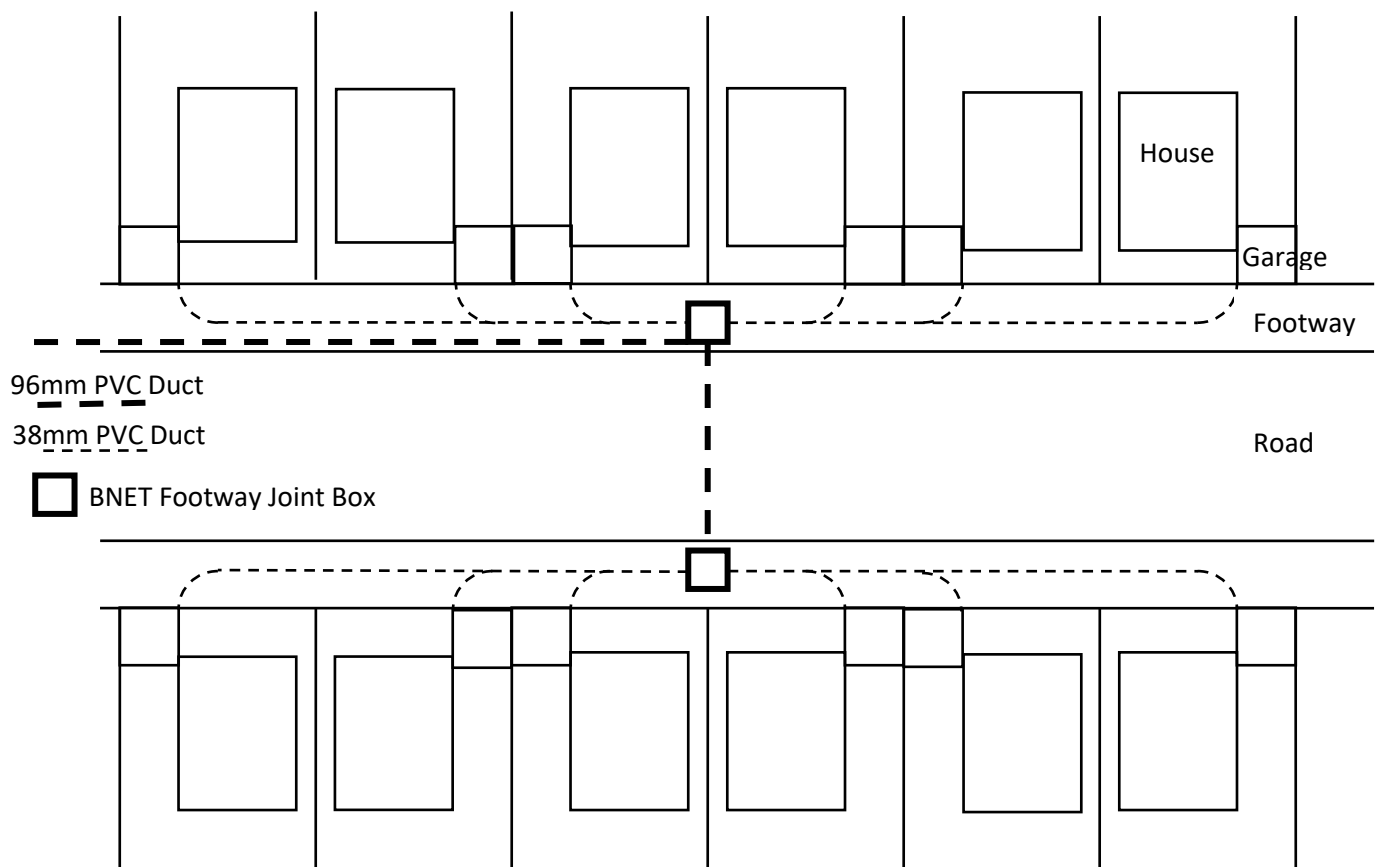



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6. House and Villa Connection

6.1 Overview

- BNET's policy is to connect all new houses and villas with a fibre underground connection.
- However, it may be necessary for BNET to provide an overhead connection in the absence of an underground duct lead-in to the premises.
- A typical residential network distribution includes main BNET 96mm duct/s with joint boxes, located in the footway, linking to 38mm duct lead-ins to houses.
- One joint box shall feed up to 6 houses.
- The standard entry position is through the garage and into the house.

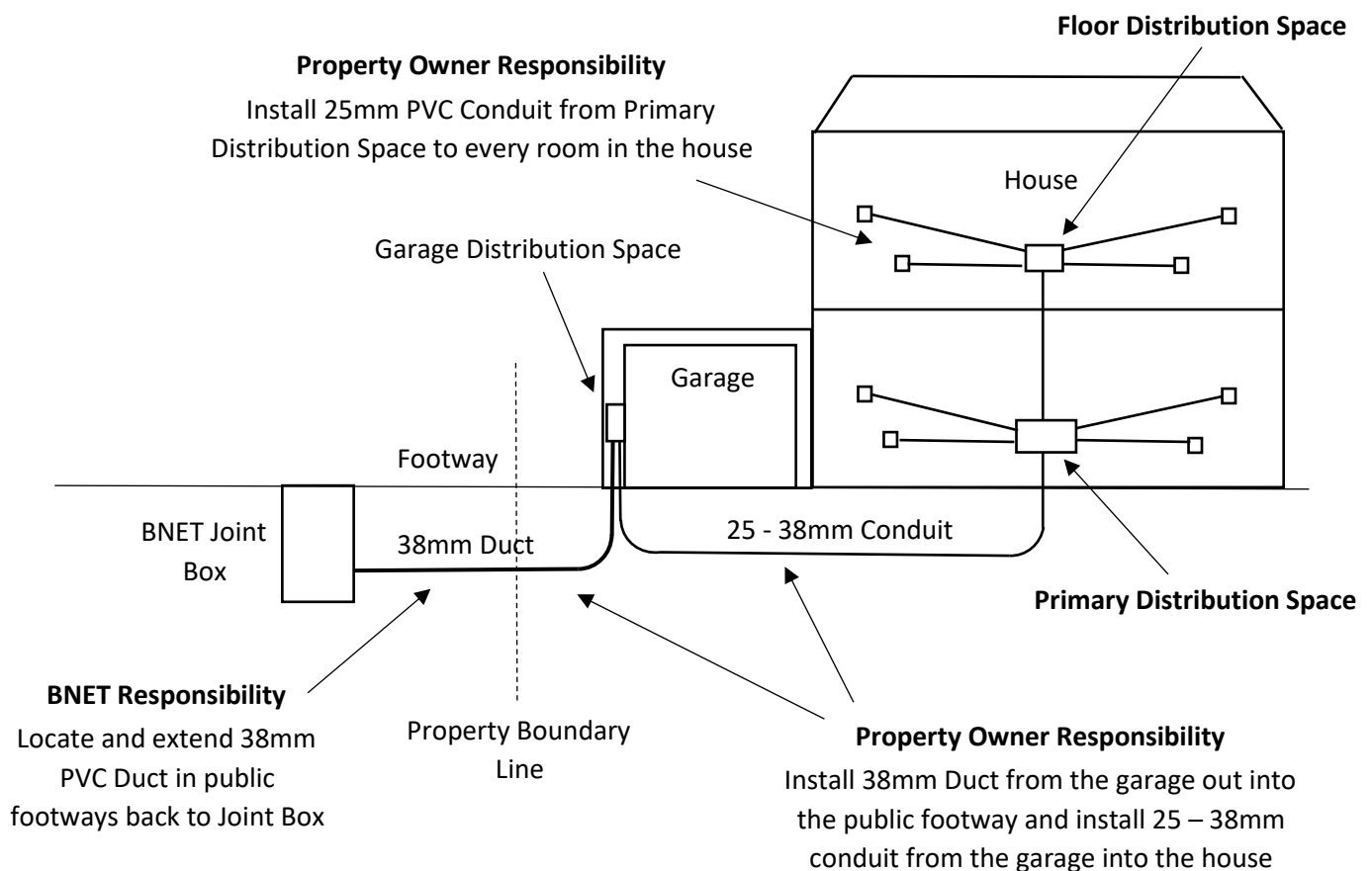



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6.2 Standard House and Villa Connection

- The standard entry location is through the garage.
- Connecting through the garage provides a testing point for fault diagnosis, without the need to access the home.
- The typical duct entry to a house or villa is illustrated in the following diagram.

Standard House and Villa Connection

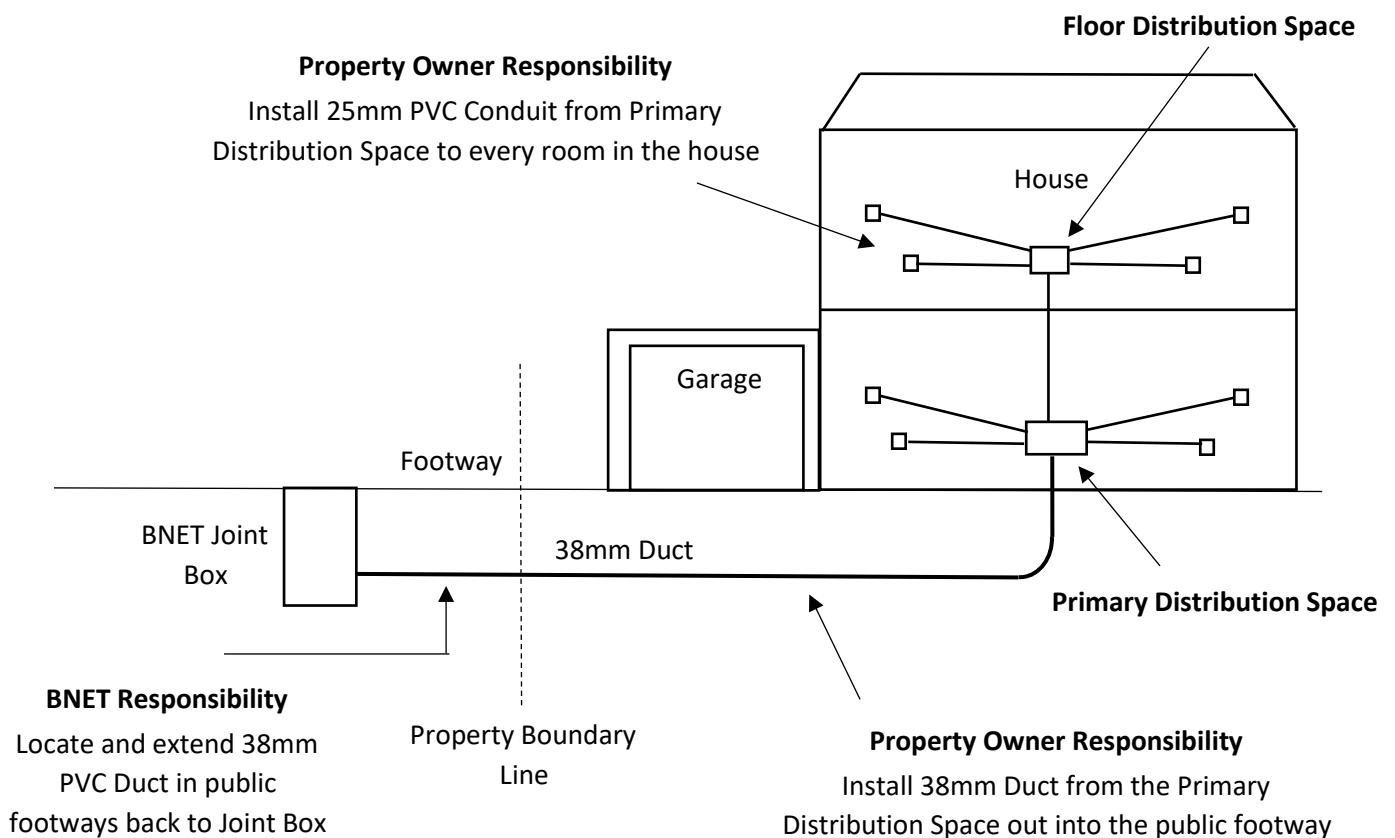



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6.3 Alternative House and Villa Connection

- It is possible to provide a 38mm duct directly from the Primary Distribution Space inside the house out to the footway, without going through the garage or boundary wall.
- In these cases, the route must be straight and only single 90° bend shall come up into the Primary Distribution Space.
- In these cases, the 38mm duct must be sealed in the Primary Distribution Space to prevent ingress of water or any other material.
- The 4F cable used to connect the house is designed for internal or external use, so can be extended to a central location in the house.
- The alternative duct entry to a house or villa is illustrated in the following diagram.

Alternative House Connection



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6.4 Property Owner's Responsibility


- a. The Property Owner is responsible for installing the duct and conduit with the property boundary and shall:
- b. Install a 38mm PVC duct from a Garage Distribution Space out into the footway.
- c. Install a 25 – 38mm conduit from the Garage Distribution Space to a central location in the house or villa.
- d. Install a minimum 25mm conduit to each main room in the house or villa.

6.5 BNET's Responsibility

- a. BNET is responsible for the connection in the public footway and to install the main feeding fibre cable and shall:
- b. Locate and connect to the 38mm duct installed by the Property Owner and extend to a nearby footway joint box.
- c. Install a 4 Fibre Drop Cable from the Joint Box into the Garage Distribution Space and connect to a 1:8 optical Splitter in the joint box.
- d. Install an External Fibre Termination Box in the Garage Distribution Space and terminate the 2 fibres in the 4 Fibre cable.

Once a Service Order (SO) has been received, BNET shall:


- a. Install a 2 Fibre Drop Cable from the Garage Distribution Space to the Primary Distribution Space inside the house or villa.
- b. Connect the 4F cable to the 2 Fibre Cable in the FTB in the garage.
- c. Install the FTB in the Primary Distribution Space and terminate the 2 Fibre Cable.
- d. Install and connect the ONT in the House or villa and make the connection in the Exchange.

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6.6 House and Villa Duct Lead-in

- a. The standard depth for BNET duct is 600mm from the top of the duct to the finished surface level.
- b. A 38mm duct 90° bend shall be installed to extend the duct into the Garage Distribution Space.
- c. The duct shall be laid with a slight slope away from the house or villa.
- d. The 38mm duct arranged by the property owner must be extended by a minimum of 300mm into the footway, ready for BNET to connect to.
- e. The socket end of the duct shall face towards the footway joint box.
- f. The unconnected ends of duct shall be sealed to prevent the entry of sand or other material.
- g. The end of the 38mm duct in the footway shall be clearly marked above ground for ease of location.
- h. A suitable 6mm nylon draw rope shall be installed through the length of the duct.
- i. The Property Owner shall be responsible for the maintenance and repair of lead-in ducts within the private property.
- j. The entry duct and bends shall be made from uPVC as per the following table:

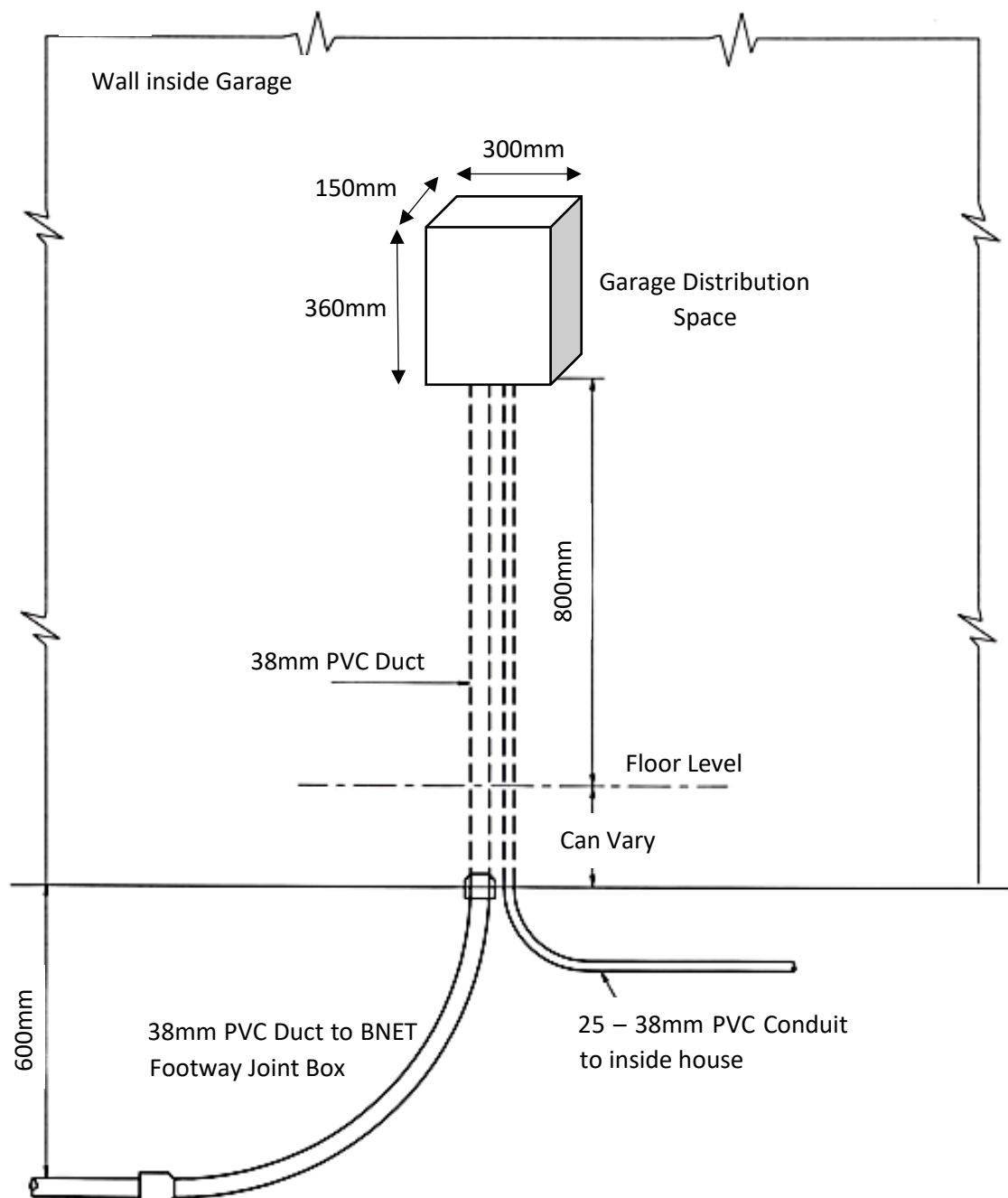
Duct	Outside Diameter	Inside Diameter	Thickness	Length
uPVC Duct	38.2mm	34mm	2.0mm	3m
uPVC Duct Bend 90°	38.2mm	34mm	2.0mm	-


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6.7 Garage Distribution Space

The arrangement of 38mm duct in the garage and the conduit going into the house, is illustrated in the following diagram.

The Garage Distribution Space can be enclosed as a cupboard or left open.



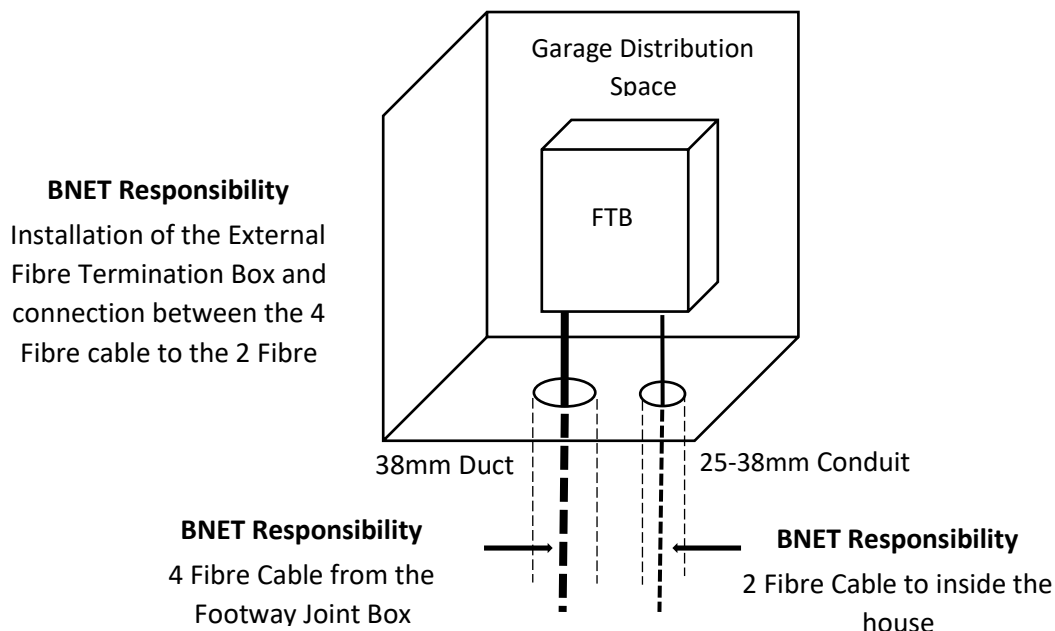
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6.8 External Fibre Distribution Box in the Garage

BNET shall install the Fibre Distribution Box in the Garage Distribution Space to terminate the 4 Fibre cable and connect to the 2 Fibre cable installed through the conduit to inside the house.


If the Garage Distribution Space is enclosed as a cupboard, a 4 Fibre Internal FTB shall be installed. If the space is left open, a 4 Fibre External FTB shall be installed.

External Fibre Distribution Box



6.9 Conduit from Garage to House

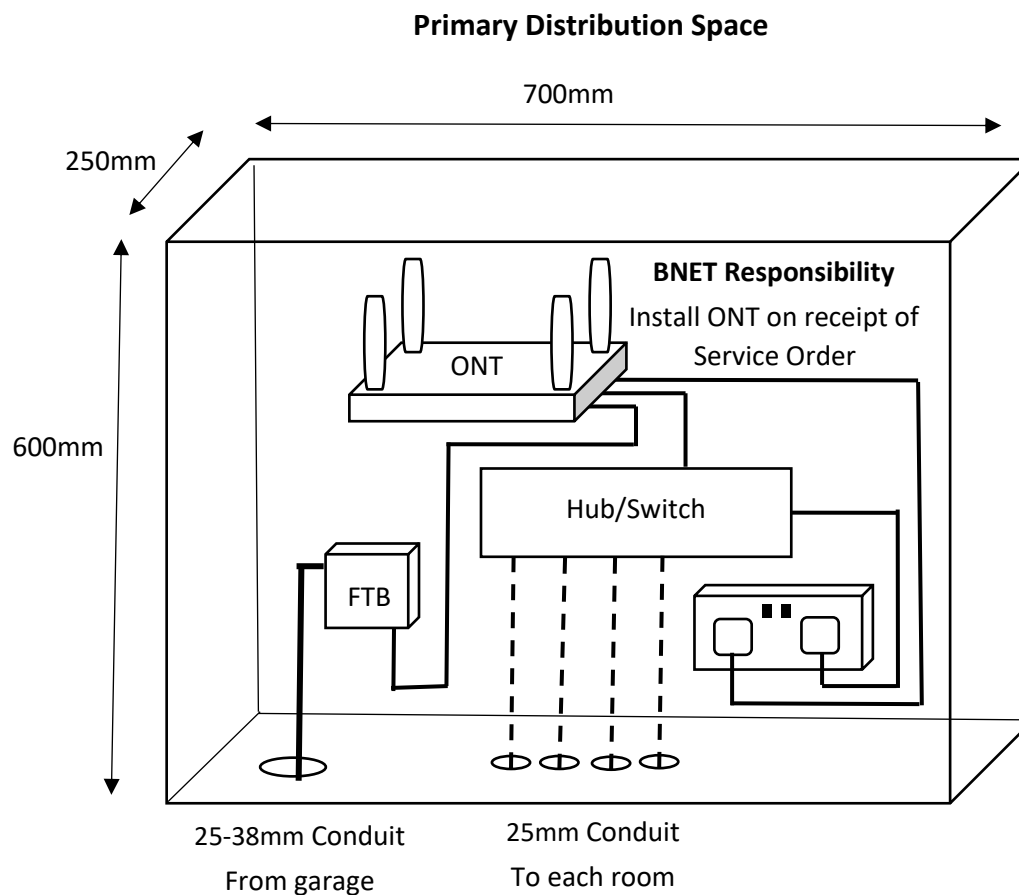
- The PVC conduit shall be between 25-38mm diameter.
- The conduit shall be installed from the garage to the Primary Distribution Space inside the house.
- The conduit shall be laid at a depth no less than 350mm or 450mm under soft surfaces.


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6.10 Primary Distribution Space

The Primary Distribution Space is the central point inside the house or villa at which all internal wiring terminates and branches out from. It shall be:

- Located in a suitable central location to provide a minimum distance of cable run to each Telecom Outlet (TO).
- Easily accessible for making changes or additions to the equipment within it.
- Constructed using suitable material with minimum dimensions and requirements as follows:




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The Primary Distribution Space will normally contain the following:

- Separate cables to each Telecom Outlet (TO) in the house.
- Termination modules and cross-connect facilities.
- Optical Network Termination (ONT) device (Note that if the ONT is installed in a closed space, additional Access Points will be required)
- Power supply

6.11 ONT Location

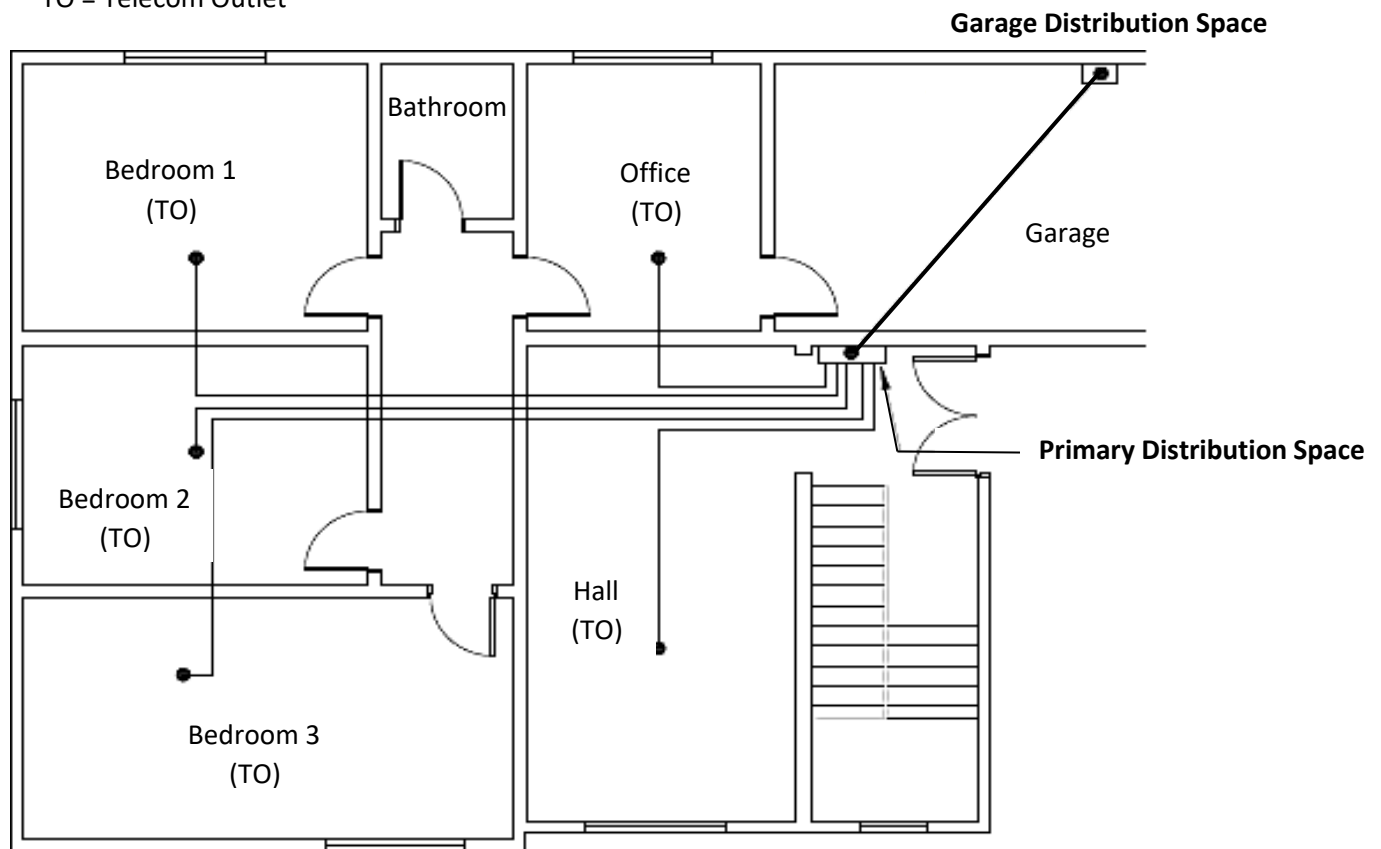
- a. The ONT shall be located in a central location, in or near the Primary Distribution Space.
- b. The WiFi service is dependent on the location of the ONT Device and locating it in a service cupboard or under the stairs will reduce the coverage and speed. Therefore, if the ONT shall be installed in a closed space, additional Access Points or Extenders will be required.
- c. The ONT shall not be located outdoors or in an outdoor cabinet.
- d. The ONT can be mounted onto a wall or placed on a desk but not fixed to a ceiling.
- e. 100mm clearance shall be provided on all sides to ensure adequate ventilation.
- f. It is recommended that the ONT be located far away from electric appliances that generate strong magnetic or electric fields, such as microwave ovens.


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6.12 House or Villa Telecom Wiring

The recommended architecture of a telecom wiring system within a house or villa is star-wired, as per the following diagram.

TO = Telecom Outlet




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6.13 Internal Conduit

- a. The Primary Distribution Space shall be connected to all telecommunications outlets (TO) using PVC conduit or other suitable pathway.
- b. The recommended minimum size of conduit is 25mm.
- c. Conduits shall be free from sharp edges, to prevent cable damage during and after pulling.
- d. Where required, a nylon draw rope or pull tape shall be installed in a conduit for pulling cables.
- e. For large houses and villas to reduce long conduit lengths, it is recommended that pull boxes shall be located such that they are readily accessible at all times and shall be spaced at a maximum of 15m apart to minimize cable stress during installation and to provide serviceability in the future.


6.14 Internal Cabling

- a. All cables, Telecom Outlets and hardware used in wiring residential premises shall be compliant with the relevant industry standards and carry a recognised international independent assessment body for quality and safety.
- b. Cables shall be extended using star architecture from the Primary Distribution Space to the Telecom Outlet, using a 4-pair Cat6 or Cat7 cable, plus an optional 2 Fibre Cable, according to requirements.
- c. All cable runs shall be continuous without joints and, in order to maintain performance, the entire cable run shall be replaced if it is damaged.
- d. It is the developer's responsibility to terminate cables on telecommunications outlets, cross-connects, distribution points and other telecommunications facilities within the premises.
- e. All cables shall be suitably labelled at the Primary Distribution Space and at Telecom Outlets.
- f. It is recommended that the developer hire competent personnel capable of executing works to the recognized standards.

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6.15 Telecom Outlets (TO)

- a. The Telecom Outlet (TO) connects the telecom devices within a cabling system.
- b. One or more RJ45 outlets shall be installed in any telecom outlet.
- c. The RJ45 assemblies used in telecom outlets should meet Cat6 or Cat7 requirements and be marked with the relevant category rating.
- d. All RJ45 outlets should be fitted with spring-loaded sliding shutters to prevent the entry of dirt and dust.
- e. Suitable TOs shall be installed for any internal fibre cabling.
- f. The total number of TOs that may be installed in any premises is not restricted and a minimum of one TO shall be installed in each main room. For larger rooms or halls, the provision of more TOs should be considered.
- g. All TOs shall be individually labelled with the same identification in the Primary Distribution Space and the TO for easy identification.

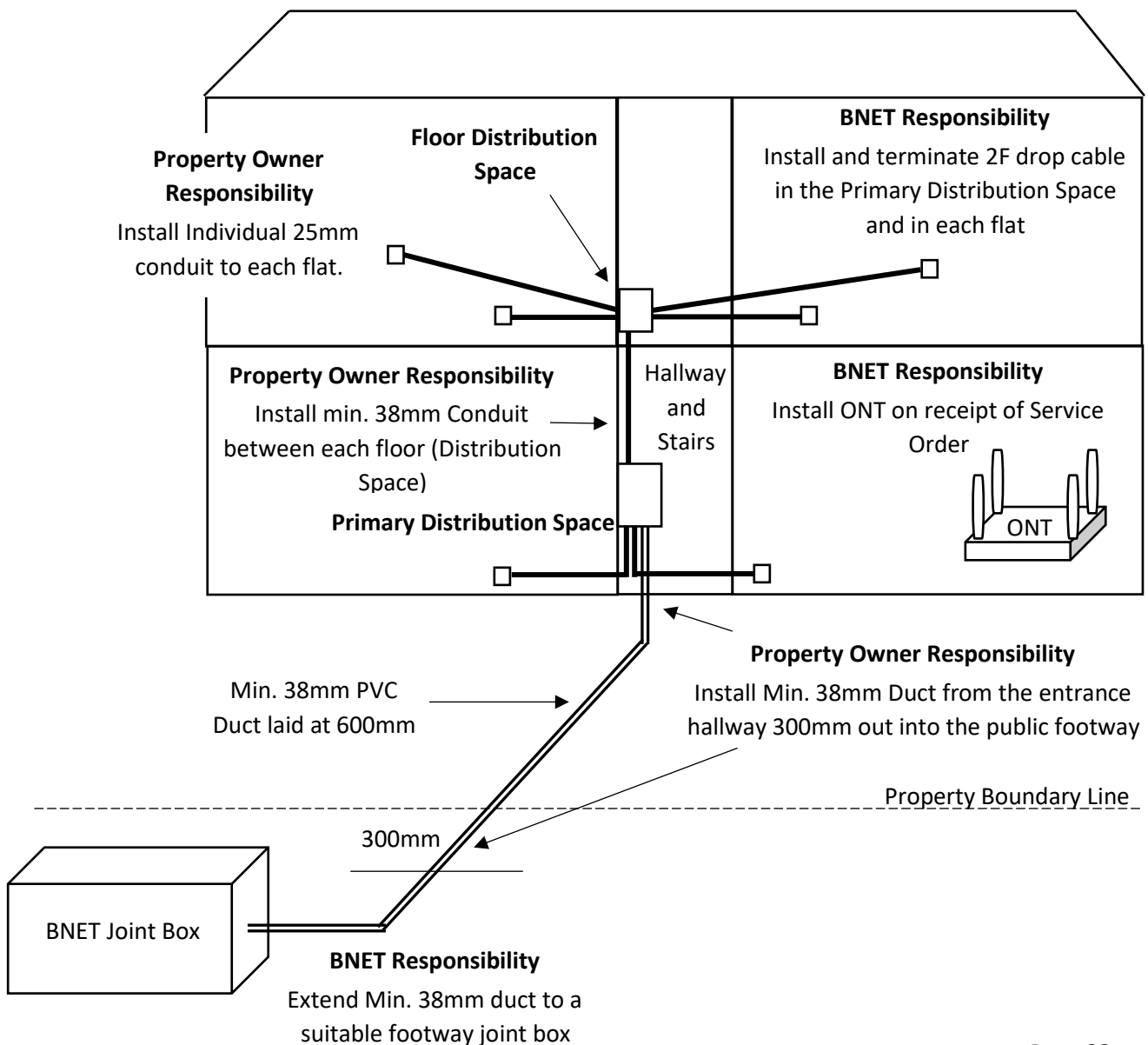
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7. Small Residential Buildings

7.1 Overview

- For small blocks of flats, individual conduits shall be run to each flat from a centrally located recessed wall space or cupboard on each floor with the Primary Distribution Space on the ground floor, as per the following diagram.
- This arrangement can be used for buildings up to a maximum of 3 storeys and up to 20 flats, subject to the building design.

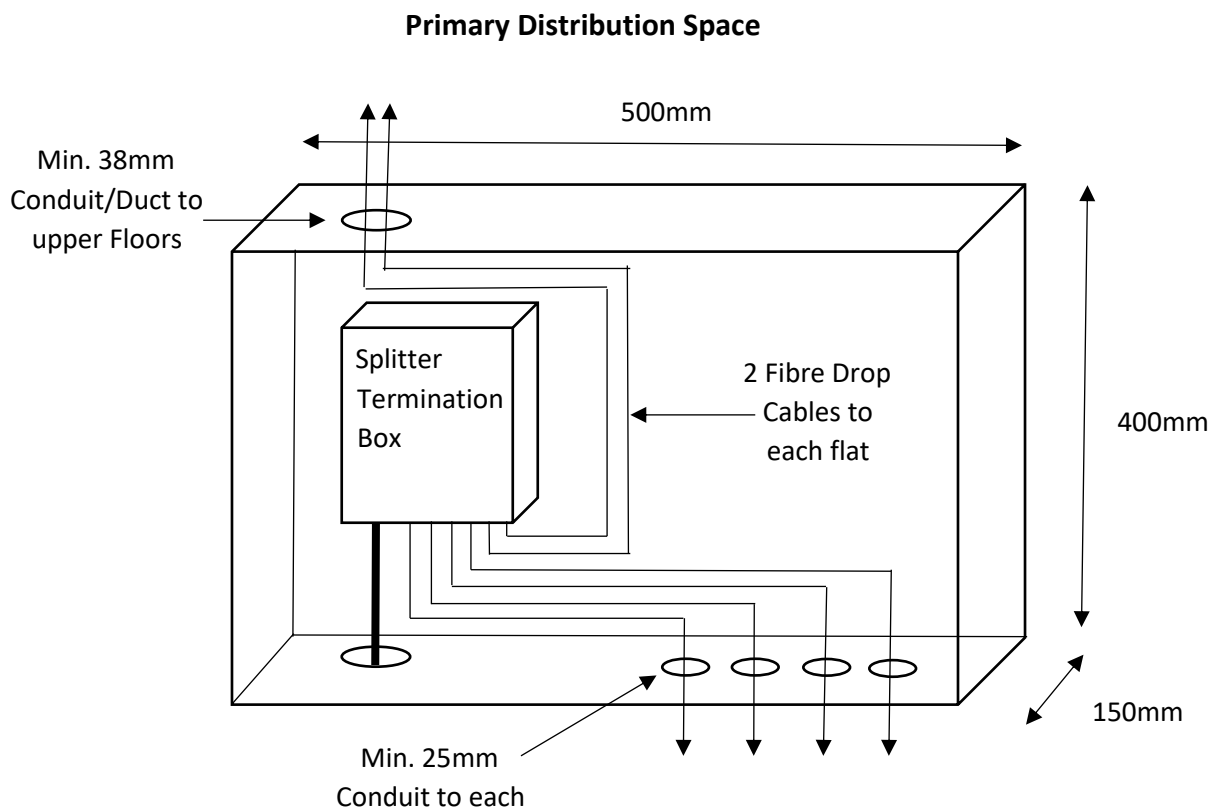
Small Residential Buildings



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7.2 Primary Distribution Space


- The Primary Distribution Space in a small residential block of flats shall be located in a common central area, near the main entrance door.
- It shall consist of a recessed wall space or cupboard with dimensions H 400mm x W 500mm x D 150mm.



7.3 Duct Lead-in

The standard duct lead for a small block of flats shall consist of a single 96mm duct from the Primary Distribution Space laid out to the public footway.

- The standard depth for BNET duct is 600mm from the top of the duct to the finished surface level.
- A 96mm duct 90° bend shall be installed to extend the duct into the Primary Distribution Space.


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- c. The duct shall be laid with a slight slope away from the building.
- d. The 96mm duct arranged by the property owner must be extended by a minimum of 300mm into the footway, ready for BNET to connect to.
- e. The socket end of the duct shall face towards the footway joint box.
- f. The unconnected ends of duct shall be sealed to prevent the entry of sand or other material.
- g. The end of the 96mm duct in the footway shall be clearly marked above ground for ease of location.
- h. A suitable 6mm nylon draw rope shall be installed through the length of the duct.
- i. The Property Owner shall be responsible for the maintenance and repair of lead-in ducts within the private property.
- j. The duct and bends shall be made from uPVC as per the following table:

96mm Duct	Outside Diameter	Inside Diameter	Thickness	Length
uPVC Duct	96.5mm	90mm	3.25mm	6m
uPVC Duct Bend 90°	96.5mm	90mm	3.25mm	-

7.4 Conduit

- a. Standard 25mm min. conduit shall be installed to each flat on the upper floor/s from a Floor Termination Space and to the Primary Distribution Space on the Ground Floor.
- b. A min. 38mm conduit/duct shall connect the upper floor/s to the Primary Distribution Space on the ground floor.
- c. All conduit shall be installed without sharp bends.

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7.5 Internal Cabling

- a. For each flat, a 2 Fibre Drop Cable shall be installed through the conduit, with 3m coils left at both ends for termination.
- b. The cable shall have a Low Smoke Zero Halogen sheath and the fibres shall be in compliance with ITU-T **G.657** optical fibre.
- c. The cables shall be labelled at both ends.

7.6 Splitter Termination Box

BNET shall:


- a. Install a Splitter Termination Box in the Primary Distribution Space.
- b. Terminate the 4 Fibre Drop Cable from the joint box and
- c. Splitter Termination Boxes will be installed as follows:

Number Flats	Splitter Termination Box
Up to 4 Flats	4F Drop Cable and FTB
Up to 8 Flats	1:8 Internal
Up to 16 Flats	2 x 1:8 (16 outputs) Internal
Up to 24 Flats	3 x 1:8 (24 outputs) Internal

On receipt of a Service Order (SO):

BNET shall:

- a. Install and terminate the 2 Fibre Drop Cable going to the flat in a suitable location.
- b. Install the ONT.

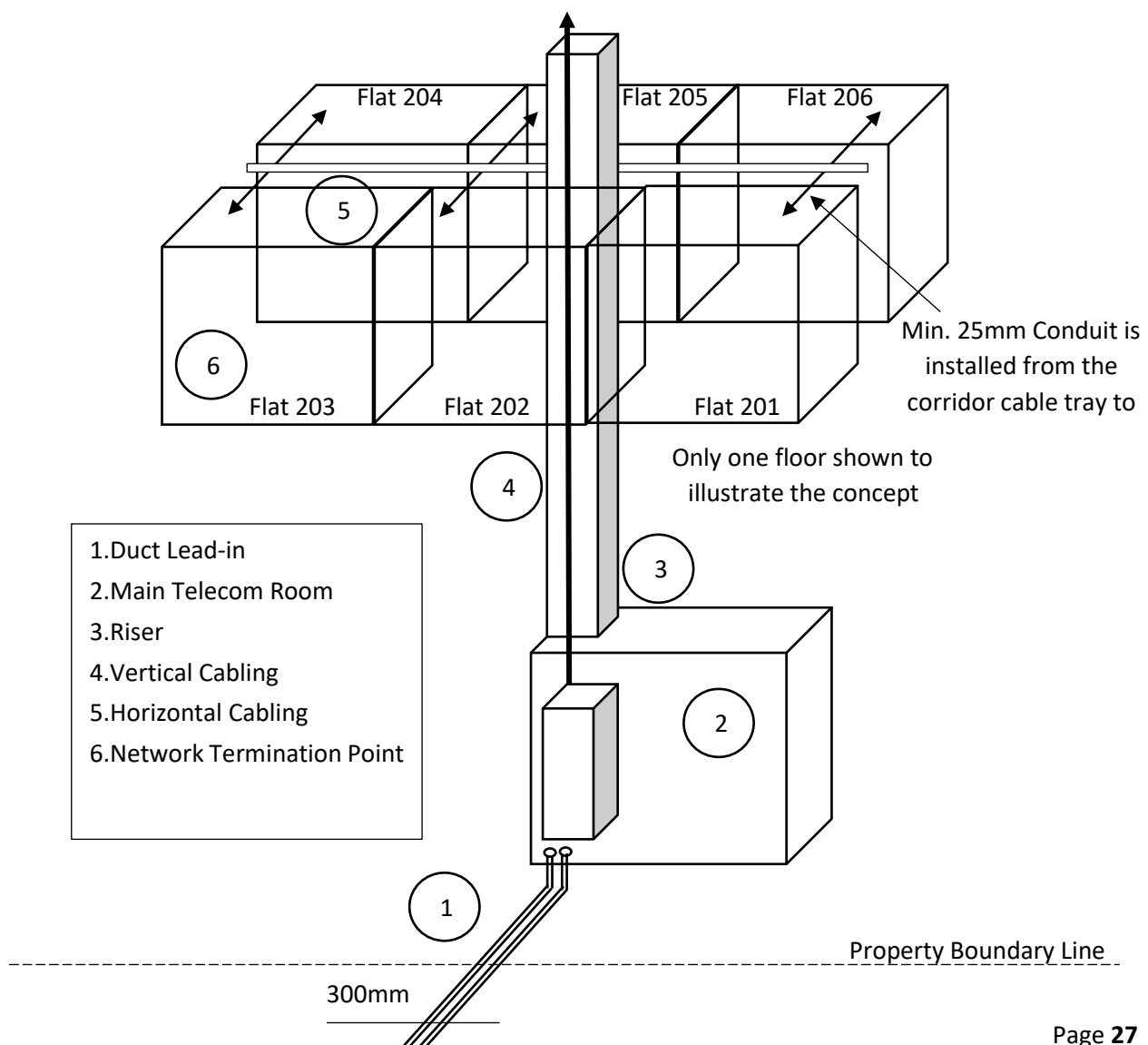
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8. Multi-storey Residential Buildings (IBDN)

8.1 Overview

For an Integrated Building Distribution Network (IBDN), the preferred method to distribute fibre cables in a multi-storey residential building is as follows:

- Install a special fibre vertical cable, where fibres can be accessed using breakout units in the riser on each floor. This avoids the need for any Telecom Rooms or Spaces on each floor.
- 2 Fibre Cables are extracted from the vertical cable and extended through tubes to each flat.




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8.2 Duct Lead-in

The standard duct lead for a multi-storey residential building consists of a minimum of 2 x 96mm ducts laid from the Main Telecom Room out to the public footway.

- a. The standard depth for BNET duct is 600mm from the top of the duct to the finished surface level.
- b. 96mm duct 90° bends shall be installed to extend the duct into the Primary Distribution Space.
- c. The ducts shall be protected by a concrete surround.
- d. The duct shall be laid with a slight slope away from the building.
- e. The 96mm duct arranged by the property owner must be extended by a minimum of 300mm into the footway, ready for BNET to connect to.
- f. The socket end of the duct shall face towards the footway joint box.
- g. The unconnected ends of duct shall be sealed to prevent the entry of sand or other material.
- h. The end of the 96mm duct in the footway shall be clearly marked above ground for ease of location.
- i. A suitable 6mm nylon draw rope shall be installed through the length of the duct.
- j. The Property Owner shall be responsible for the maintenance and repair of lead-in ducts within the private property.
- a. Underground telecom facilities must not be in the same vertical plane as other utilities, such as water or power that may share the same trench.
- b. Lead-in ducts shall be exclusively used for telecom services.
- k. The ducts and bends shall be made from uPVC as per the following table:

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96mm Duct	Outside Diameter	Inside Diameter	Thickness	Length
uPVC Duct	96.5mm	90mm	3.25mm	6m
uPVC Duct Bend 90°	96.5mm	90mm	3.25mm	-


Refer to Appendix B for standard lead-in entries to buildings

8.3 Main Telecom Room

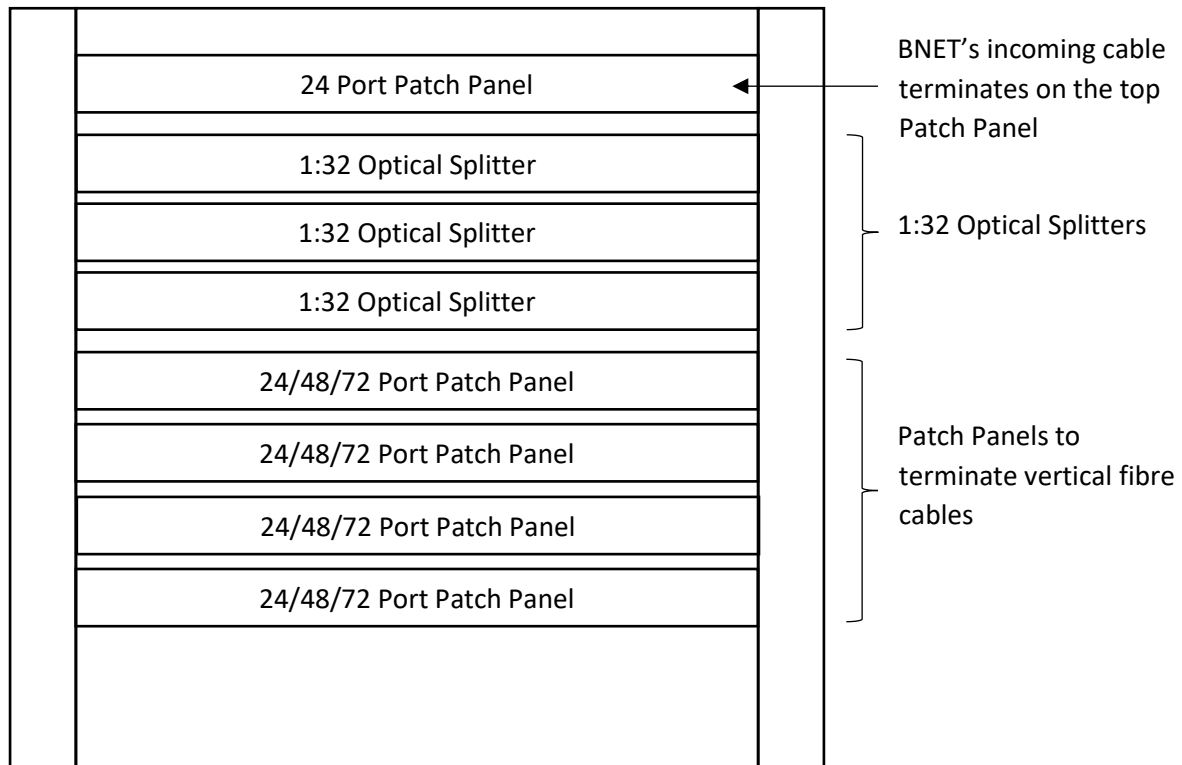
- The Main Telecom Room shall be located on the ground floor or in the Basement.
- The incoming fibre cable shall be installed by BNET into the Main Telecommunications Room.
- The size of the cable shall depend on the number of 1:32 splitters, as each splitter will require one fibre, but the minimum size of incoming fibre cable shall be a 4-fibre cable.
- The number of flats/units shall be divided by 30 to give the number of 1:32 splitters required, allowing 2 spare outputs for maintenance purposes.
- Depending on the fibre capacity required, the incoming fibre cable shall be connected in a wall-mounted splitter termination box or a rack-mounted patch panel.
- As a guide, the size of the MTR in a multi-storey residential building shall be as follows:

Number of Tenants	Minimum MTR Size	Type of Splitter
Up to 50 tenants	2m length x 2m width x 3m height	Wall-mounted 2 x 1:32
More than 50 tenants	3m x 3m x 3m	Rack-mounted 1:32 Splitters

- Where racks have been installed, the incoming fibre cable shall be terminated on a patch panel installed at the top of a 19" rack.
- Racks can be either wall-mounted or floor-mounted.
- On the rack underneath the patch panel, 1:32 splitters can be installed.
- Individual patch cords shall be used to connect the patch panel to the 1:32 splitter/s.

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Typical Rack Arrangement




Refer to Appendix D for Main Telecom Room Requirements.

8.4 Risers

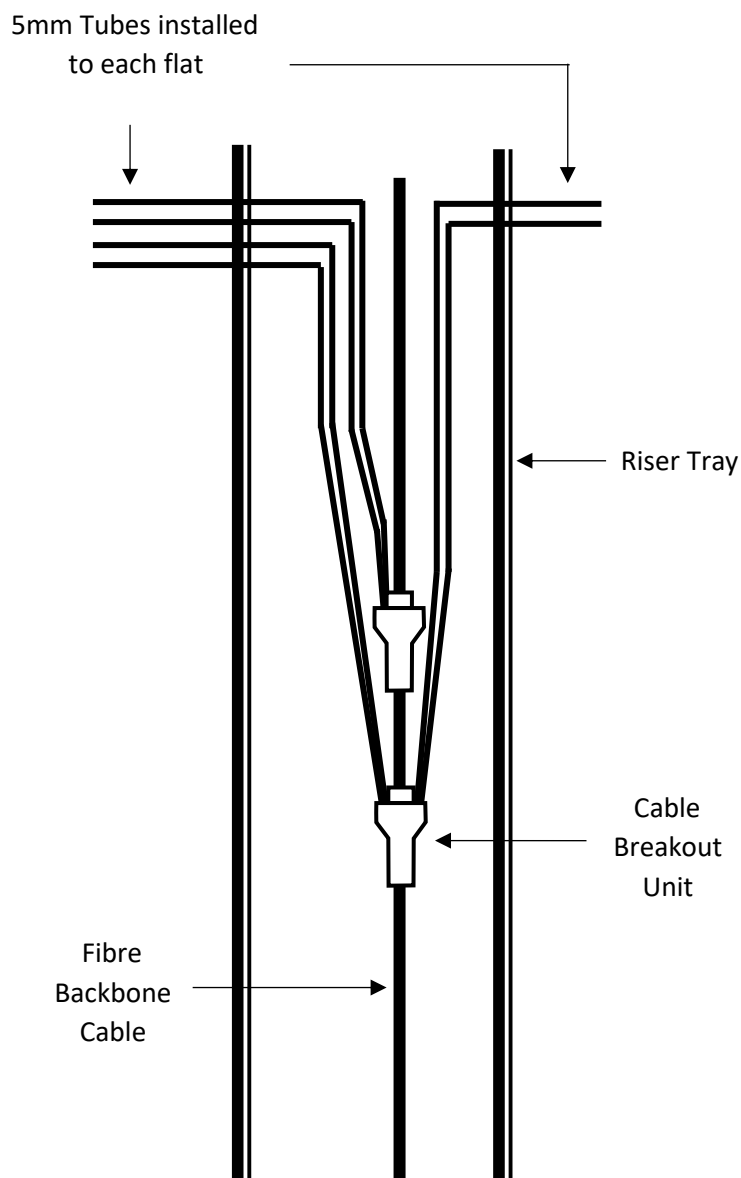
The risers are required in multi-storey buildings for the installation of telecom cables from the main telecom rooms to other floors and to provide a pathway and support for cables and minimize the stress that could cause damage to the cables.


- The risers to each floor shall be symmetrical and vertically in line from the Main Telecom Room.
- Galvanized slotted iron cable trays (heavy duty, return flange) shall be provided from the Main Telecom Room to each Floor Distributor and extend up to the Roof Telecom Room.
- The vertical tray size shall be 450mm wide x 50mm deep and be run continuously to all Floor Distributors.

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- d. In a campus environment where there is more than one building, all the above specified recommendations shall be considered irrespective of each building.
- e. The telecom cable trays should have adequate separation from electrical cable trays. Electrical cable trays should not cross the telecommunications cable trays.
- f. The cable riser can be accessed on each floor by authorized personnel only.
- g. Risers shall be accessible at all times.

Vertical Cabling in Riser Using Breakout Cable



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8.5 Vertical and Horizontal Cabling


- a. The vertical cable is installed in the Riser and on the top floor, a coil of surplus cable is secured.
- b. The cable is specially designed to allow the fibres to be accessed without cutting the whole cable.
- c. The length of the cable coil is sufficient to reach to the furthest corner of the floor.
- d. Cable Breakout Units are fitted over the cable where the fibres are extracted.
- e. 5mm Tubes are installed through the conduit to each flat.
- f. 2 fibre Drop cables are installed inside the tubes.
- g. The fibres used in the cables shall be in compliance with ITU standard G.657 and the cable sheath shall be Low Smoke Zero Halogen (LZOH).

8.6 Network Termination Point

- a. An Internal Fibre Termination Box shall be provided with 2 x SC/PC Connector to terminate the 2 fibres allocated for each apartment.
- b. The termination box shall be compact and fit within a standard size outlet.
- c. The area where the ONT will be installed needs to be air-conditioned and a 13 Amp socket shall be provided for a power supply.

8.7 Administration and Labelling

- a. Each component of the telecommunications infrastructure shall be labelled linking the component to its corresponding record.
- b. All cables shall be labelled with a unique identifier at both ends.

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- c. All labels shall be easily readable and resistant to environmental conditions and be printed by a mechanical device.

8.8 Alternative Solution

If the preferred IBDN solution cannot be implemented, Floor Telecom Spaces shall be required. In these cases, the minimum size of the spaces shall be as follows:

Number of Tenants	Minimum Floor Telecom Space
Up to 50 tenants	0.6m x 1m x 3m
More than 50 tenants	1m x 1m x 3m

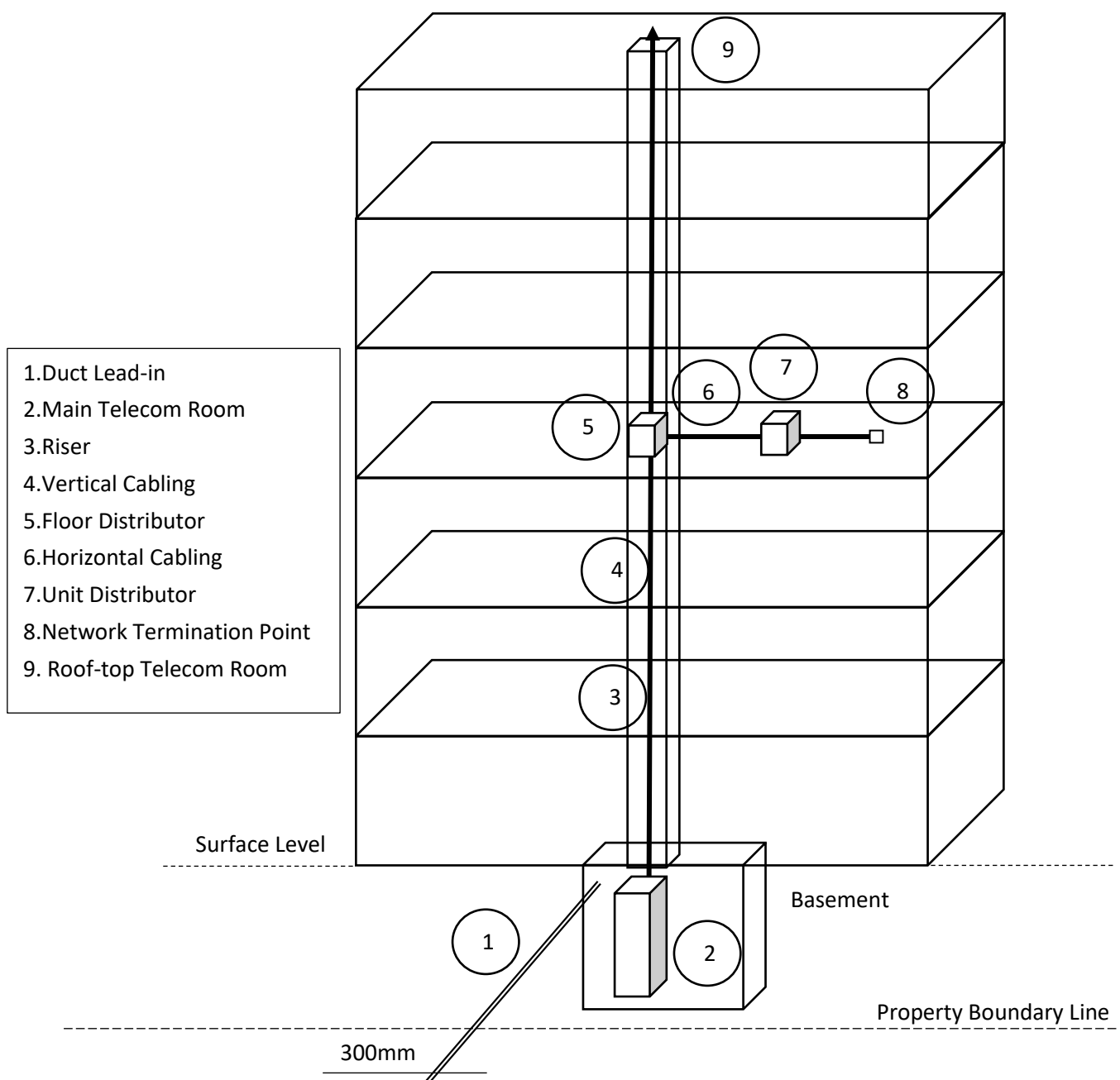
- a. A minimum of 2 Fibre cables shall be provided from the Main Telecommunications Room to each flat to meet current and future needs and allow for maintenance.
- b. The vertical/horizontal cabling shall be based on a cost-effective system that enables the extension of the fibres from the basement cable termination to each flat directly without splicing, or with minimal splicing to minimize losses and improve reliability.


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9. Commercial and Office Buildings

9.1 Overview

For commercial and office buildings, fibre will be used for the cable entry and backbone cables as a minimum, with CAT6 copper data cables for the horizontal distribution.




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9.2 Duct Lead-in Duct

The standard duct lead-in for a Commercial or Office building consists of a minimum of 2 x 96mm ducts laid from the Main Telecom Room out to the public footway.

- a. The duct lead-in can be laid to the ground floor or the basement.
- b. The standard depth for BNET duct is 600mm from the top of the duct to the finished surface level.
- c. 96mm duct 90° bends shall be installed to extend the duct into the Primary Distribution Space.
- d. The ducts shall be protected by a concrete surround.
- e. The duct shall be laid with a slight slope away from the building.
- f. The 96mm duct arranged by the property owner must be extended by a minimum of 300mm into the footway, ready for BNET to connect to.
- g. The socket end of the duct shall face towards the footway joint box.
- h. The unconnected ends of duct shall be sealed to prevent the entry of sand or other material.
- i. The duct lead-in to the building shall be sealed where it enters the Main Telecom Room, whether it is empty or has cables installed.
- j. The lead-in shall be straight with no right-angles or sharp bends, except the 90° pre-formed bend inside the Main Telecom Room.
- k. The end of the 96mm duct in the footway shall be clearly marked above ground for ease of location.
- l. A suitable 6mm nylon draw rope shall be installed through the length of the duct.

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- m. The Property Owner shall be responsible for the maintenance and repair of lead-in ducts within the private property.
- n. Underground telecom facilities must not be in the same vertical plane as other utilities, such as water or power that may share the same trench.
- o. Lead-in ducts shall be exclusively used for telecom services.
- p. The ducts and bends shall be made from uPVC as per the following table:

96mm Duct	Outside Diameter	Inside Diameter	Thickness	Length
uPVC Duct	96.5mm	90mm	3.25mm	6m
uPVC Duct Bend 90°	96.5mm	90mm	3.25mm	-

9.3 Secondary Building Lead-in Duct

For multi-storey commercial or office buildings, it is recommended to provide an alternative or 'back-up' duct lead-in for when any issue occurs to the main lead-in. It shall be located in such a way as to extend to an alternative road to enable cabling diversity.

Refer to Appendix B for standard duct lead-ins to buildings


9.4 Main Telecom Room

The Main Telecom Room is essentially a large telecom room in multi-storey building to house present and future telecom equipment such as racks and patch panels.

The room shall be:

- a. Provided either on the ground floor or in the basement.
- b. Dedicated for telecom use only.
- c. Secured from unauthorized entry.

It is recommended that the following considerations are taken into account when selecting the location for the Main Telecom Room:

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- a. accessibility for the delivery of large equipment.
- b. expansion of the equipment room should not be restricted by building components such as elevators, outside or other fixed walls, and so forth.
- c. the location of the equipment room should not be below the waterlevel, unless preventive measures against water infiltration are employed.
- d. the equipment room should be located away from electrical power supply transformers, motors and generators, X-ray equipment, radio and radar transmitters, and other sources of electromagnetic interference.
- e. The room must be easily accessible to telecom personnel 24/7, including weekends.
- f. The rooms must not be directly beneath or next to wet areas such as:
 - Showers.
 - Washrooms.
 - Swimming pools.
 - Garbage areas.
- g. The minimum size of the MTR depends on the building size and function and shall be sized to meet present and future requirements for cabling and equipment.
- h. The typical sizes are shown in the table below:

Building Type	Requirements (H x W x D)
For buildings with 50 or less tenants or up to 5 storeys or building area up to 3000m ²	3.0m x 2.6m x 0.6m
For buildings with 51 or more tenants or more than 5 storeys or building area more than 3000m ²	3.0m x 3.0m x 3.0m

Refer to Appendix D for Main Telecom Room Requirements.

9.5 Risers

The risers are required in multi-storey buildings for the installation of telecom cables from the main telecom rooms to other floors and to provide a pathway and support for cables and minimize the stress that could cause damage to the cables.

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- a. The risers to each floor shall be symmetrical and vertically in line from the Main Telecom Room.
- b. Galvanized slotted iron cable trays (heavy duty, return flange) shall be provided from the Main Telecom Room to each Floor Distributor and extend up to the Roof Telecom Room.
- c. The vertical tray size shall be 450mm wide x 50mm deep and be run continuously to all Floor Distributors.
- d. In a campus environment where there is more than one building, all the above specified recommendations shall be considered irrespective of each building.
- e. The telecom cable trays should have adequate separation from electrical cable trays. Electrical cable trays should not cross the telecommunications cable trays.
- f. Risers shall be accessible at all times.

9.6 Vertical Cabling

- a. Vertical Cables shall be Fibre Cables and their supporting hardware.
- b. They shall be used to link the Main Telecom Room to the Floor Distributors.
- c. The fibres used in the cables shall be in compliance with ITU standard G.657 and the cable sheath shall be Low Smoke Zero Halogen (LZOH).
- d. Vertical cabling requirements from the MTR shall be based on 16 fibres for every 100m² leasable floor space.

9.7 Floor Distributors

- a. It is recommended that Floor Distributor shall be used to connect the horizontal cabling with the vertical cabling and shall contain patching facilities.
- b. The design of the Floor Distributor shall ensure that the lengths of patch cords and equipment cords are minimized and administration should ensure that the design lengths are maintained during operation.

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- c. A minimum of one floor distributor shall be provided for every floor.
- d. For floor spaces exceeding 1000m², a minimum of one floor distributor shall be provided for every 1000m² of floor space reserved for offices.
- e. If a floor space is sparsely populated (for example a lobby), it is possible to serve this floor from the Floor Distributor located on an adjacent floor.

9.8 Horizontal Cabling


- a. Horizontal cabling consists mainly of cables from the Floor Distributor to the Unit Distributor on the same floor and from the Unit Distributor to the Network Termination Points.
- b. The selection of cable type will be determined by the class of applications to be supported.
- c. A unique identifier should be assigned to each horizontal cable and should be marked on each end.

9.9 Unit Distributors

Unit Distributors shall be provided for each customer premises space and the requirements are dependent on the customer premises area.

The Unit Distributor shall:

- a. Be located in an accessible location near the entrance to the unit with adequate working space around and away from heat or water sources.
- b. Connect each individual NT inside the unit with a ducting system.
- c. Have separate and sufficient space to install a copper cable patch panel and an optical distribution patch panel with the associated cable management.
- d. Have sufficient space for the incoming cables, maintaining minimum bending radius.
- e. Be not less than 90m from the farthest Network Termination Point.
- f. Have all cables and equipment labelled.

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9.10 Standard Requirements for Unit Distributors

- a. Minimum Internal Dimensions: 600mm x 600mm x 300mm.
- b. Installed at a height of 600mm – 1200mm from the finished floor level.
- c. The UD shall be concealed in the wall, with a lockable cabinet door flush with the wall.
- d. Each Unit shall have a minimum of a 4 Fibre cable connection from the Main Telecom Room.

9.11 Requirements for Unit Distributors in Business/Commercial Buildings


- a. One dedicated patch panel, fully equipped with pre-terminated adaptors (pigtailed).
- b. 16 connectors for every 100m² of leasable floor space.
- c. One dedicated Cat6/7 UTP patch panel based on 16 UTP connectors for every 100m² leasable floor space.

9.12 Network Termination Points

- a. A 2F cable shall feed the Network Termination Points.
- b. An electrical 240V/16A power outlet shall be provided at each optical network termination point.

9.13 Roof-top Telecom Rooms

- a. A Roof-top Telecommunications Room is a dedicated room to be provided on the roof top of high-rise buildings with ten stories and more, exclusively for telecommunications use and secured from unauthorized entry.
- b. The following recommendations should be considered during the design and construction of roof top telecommunications rooms:
- c. The floor loading of this area should be as large as possible, to support future installation of telecommunications equipment.


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- d. An opening of size 600mm x 400mm shall be provided on the wall of the room, 500mm below the room ceiling.
- e. The location of the room should be within the vertical structure or riser of the building, with due consideration for load safety provisions.
- f. Other requirements are the same as for the Main Telecom Room.
- g. The typical sizes are shown in the table below:

Building Floors	Requirements (H x W x D)
Up to 5 storeys	Not applicable
More than 5 storeys	3.0m x 3.0m x 3.0m

9.14 Conduits


- a. The use of conduits as a horizontal pathway system shall only be considered when the Network Termination Points are permanent and flexibility is not required.
- b. The minimum size of a conduit pipe used as a horizontal pathway shall be 38mm for commercial buildings.
- c. For the conduits, the inside bending radius should always be at least 10 times the internal diameter.
- d. A minimum of one nylon draw wire of at least 6mm must be installed in a conduit.
- e. Pull boxes should be located such that they are readily accessible at all times.
- f. Pull boxes shall be spaced at a maximum of 15m apart to minimize cable stress during installation and to provide serviceability in the future.
- g. Conduits shall be free from sharp edges, to prevent cable damage during and subsequent to pulling.
- h. Conduits protruding through a floor shall be terminated at a minimum of 50 mm from the floor to prevent water or other liquids from flowing into the conduits.

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9.15 Labelling and Identification

The labelling of network and maintaining network records is of critical importance.

- a. All network components such as cables, patch panels and network termination points shall be labelled.
- b. A typewritten, printed standard labelling system shall be used.
- c. All cables shall be labelled at both ends.
- d. Each network termination point shall be labelled with a unique identifier.
- e. Up-to-date drawings shall be kept in the building management office.
- f. The Property Developer shall maintain updated records of the following:
 - Layout plan of all telecommunications rooms showing the locations of the lead-in ducts, risers, power points, etc.
 - Layout plan showing the route of the vertical risers, the lead out point and the sizes
 - Floor layout plans showing the horizontal distribution and connection points to the vertical riser, the locations and sizes of Floor and Unit Distributors, etc.
 - Other cabling facilities.

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10. Private Residential Compounds

10.1 Overview

- The standard duct lead-in for buildings consists of 96mm diameter uPVC ducts extended from a footway joint box into the premises.
- The duct shall be used exclusively for telecommunication services.
- Road Crossings shall be perpendicular and kept to a minimum.

10.2 Duct Laying in a Private Compound

The standard connection of telecommunications network for a private development of villas involves the developer extending the 96mm duct to the footway for BNET to extend to a footway joint box.


The 96mm duct shall be:

- Laid in a straight line in the footway.
- In the correct BNET corridor for new road reservations.
- Maintain standard minimum separation from electricity or water services.
- Laid at a depth of cover of 600mm from the finished surface level.

10.3 Duct Bends

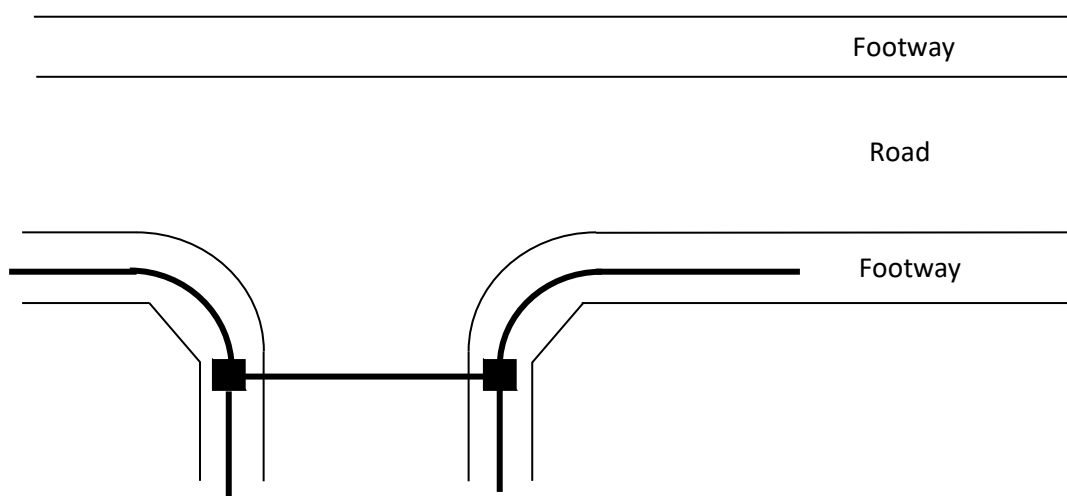
- 96mm duct 90° bends shall only be used for duct lead-in entry to a building.
- A 38mm duct lead-in to a house or villa shall require a 90° bend in the footway to turn to face the property and a second 90° bend to come up through the wall of the garage.

Refer to Appendix A for Standard Trench Cross-sections for duct laying.


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10.4 Joint Boxes

- a. The maximum distance of 96mm duct between joint boxes on a straight route is 230m.
- b. The maximum length of 38mm duct from the joint box to the garage shall not exceed 60m, with a maximum of two 90° bends.
- c. Joint boxes shall be precast wherever possible.
- d. Pre-cast joint boxes shall be installed on a 1000-gauge polythene sheeting.
- e. The finished level of the frame and cover shall be flush with the surface level of the footway.
- f. BNET shall install the internal brackets at the time of Splice Closure installation.
- g. Joint boxes shall be parallel to the road.
- h. Joint boxes shall not be constructed:
 - in the carriageway
 - in front of the entrance of house, steps, a garage entrance or a pedestrian crossing.
 - Above other utility services
- i. Joint boxes shall be set back into a minor road when laying across the road for a safer working area.



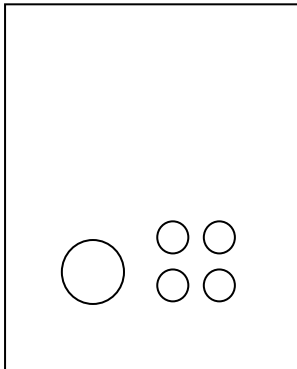
Refer to Appendix C for joint box construction drawings

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10.5 Duct Entry to Joint Boxes

A maximum of 4 x 38mm ducts can be extended from the end wall of a JRC4 but standard network design limits the number of houses to be connected to one box to 6 houses or villas.

End Wall of Joint Box

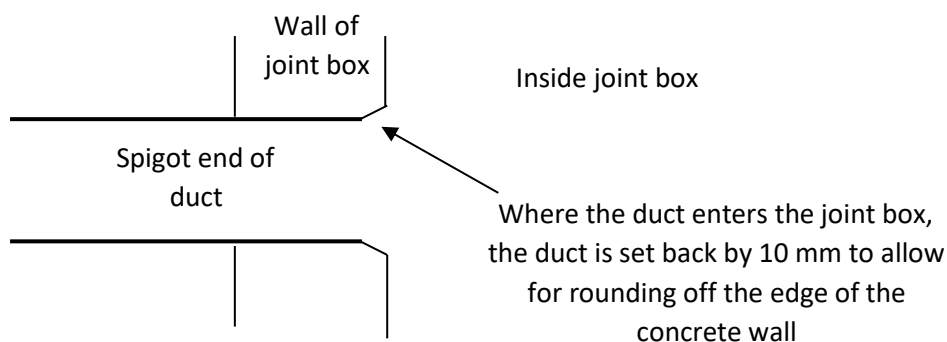



10.6 Excavation for a Joint Box

- The space required to construct joint boxes requires a minimum extra 500mm around the box to allow space for the shuttering etc.
- For a pre-cast joint box the minimum extra space shall be a minimum of 350mm allow for effective compaction.

10.7 Joint Box Finishing

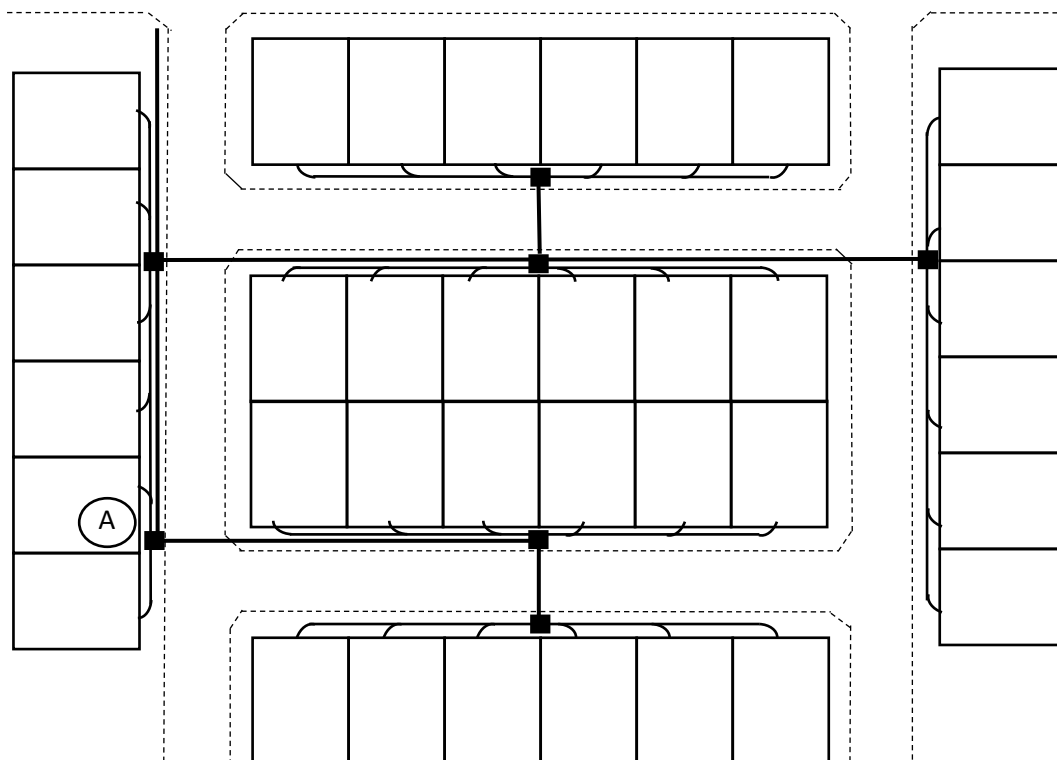
- The concrete around all ducts where they enter the jointing chambers shall be carefully flushed up and rendered in cement mortar.
- If the duct is cut flush with the inside wall of the joint box it must be filed smooth to avoid damage to cables.



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10.8 Standard Duct Design for Houses and Villas

- For the main distribution, the standard duct design involves the laying of 96mm duct within the telecom corridor and at a depth of 600mm from the top of the duct to the finished surface level.
- 38mm duct is laid to connect up to 6 houses to a common point.
- JRC4 Joint Boxes are to be constructed in the footway locations to connect the 38mm ducts to the 96mm duct.
- BNET will locate and extend the 96mm duct in the public footway to a new or existing Joint Box.




96mm PVC Duct

38mm PVC Duct

■ JRC4 Joint Box

(A)

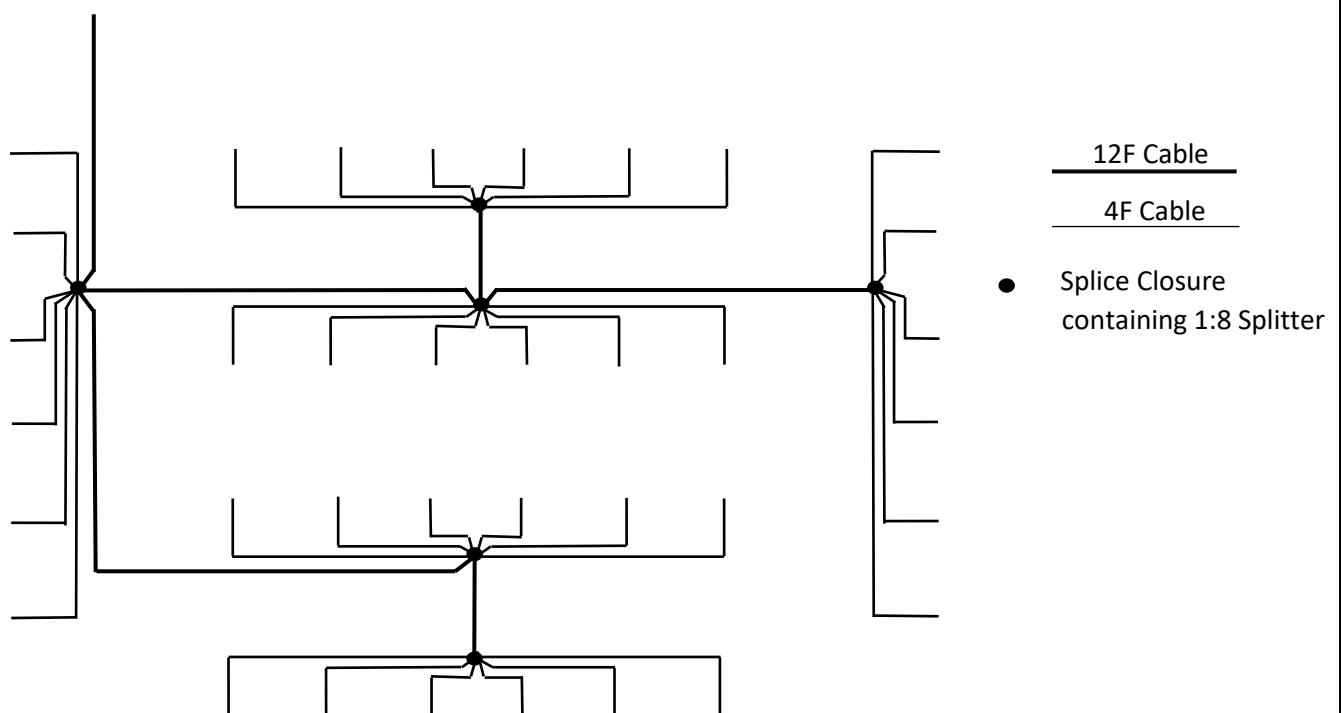
Note that the Joint Box at Location A is provided to allow the change in direction for the 96mm duct and not to house a Splice Closure. Therefore, the smaller JB2 can be installed instead of a JRC4.

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10.9 Cabling within a Private Compound

While the Property Developer shall install the duct and construct the Joint Boxes, BNET shall install the fibre cables within the duct and joint boxes and up to the Internal Fibre Termination Box (iFTB).


BNET will also complete all the associated installation of the splice closures and the splicing.



- Each house or villa is fed by a 4 Fibre Drop cable from the nearby splice closure.
- The 1:8 Splitter splice closure is located in a footway joint box.
- The main distribution cables are 12 Fibre.
- Inside the splice closure the 1:8 splitter uses one of the feeding fibres to produce 8 fibre outputs.
- The design involves connecting 6 houses to each 1:8 splitter, leaving 2 outputs spare for future requirements and maintenance.

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- f. The location of the 1:4 Splitters shall be co-located with one of the 1:8 Splitters, where appropriate, to avoid additional Splice Closures.
- g. However, for private compounds with up to 24 houses, the 1:4 Splitters shall be located in the public footway rather than on private land.

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11. Private Community Areas


Private Community areas are large developments with a mix of various residential houses/villas and Multi-story buildings in addition to commercial units and office space.

11.1 Demarcation Point Building (Optional)

- If BNET is required to supply fibre optic services to the Private Exchange Building, a Demarcation Point Building can be provided.
- If required, the Property Developer shall be responsible for constructing a small building near the entrance to the site to serve as a Demarcation Point.
- The size of this building shall be a minimum of 3.0m x 3.0m by 3.0m.
- A duct lead-in shall be provided with a minimum of 6 x 96mm uPVC ducts.
- Standard 19" racks shall be installed with patch panels.
- BNET shall install and terminate the required size of fibre cable.

11.2 Private Exchange Building

- A building shall be constructed to contain all the required cables and switching equipment for a range of telecom services.
- There shall be 2 x Duct lead-ins to the Exchange Building. One main and one for redundancy/diversity.
- The number of ducts shall depend of the area size and range of residential and business areas.
- A minimum of 12 x 96mm shall be installed for the main lead-in and shall be protected by a concrete surround.
- The second building lead-in shall have a minimum of 6 x 96mm ducts.

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11.3 Network Design withing the Community Area

The network design and arrangements shall be the same as for the other sections in this document:






- Individual houses and villas
- Small Residential Buildings
- Residential multi-storey buildings
- Commercial and Office buildings
- Private residential compounds
- Private Community Areas

11.4 Duct Requirements

- a. The number of ducts required shall depend on the area and the cables required to be installed.
- b. Duct and joint boxes shall be installed, based on requirements for the next 20 years.
- c. For most duct routes in residential areas, 1 x 96mm duct shall be sufficient, with JB2 or JUC4 Joint Boxes.
- d. For duct routes in major roads, additional ducts shall be laid with the respective size joint box.


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Joint Boxes based on Number of Ducts

Number of 96mm Ducts	Formation	Type of Joint Box
1 x 96mm		JUC4
2 x 96mm		JRC12
4 x 96mm		JRC14
6 x 96mm		JRC14 with 150mm extra depth
9 x 96mm		Manholes shall be required

11.5 Cabling Design

- Standard GPON topology shall be used for residential and small office or commercial buildings.
- For business buildings, fibre cable rings shall be designed and installed, with fibre cables to buildings fed from Primary Flexibility Splice Closures at points along the ring.
- The rings enable diversity with fibre feeding customers from both directions of the ring.


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12. Related Industry Standards

The related industry standard documents are listed below:

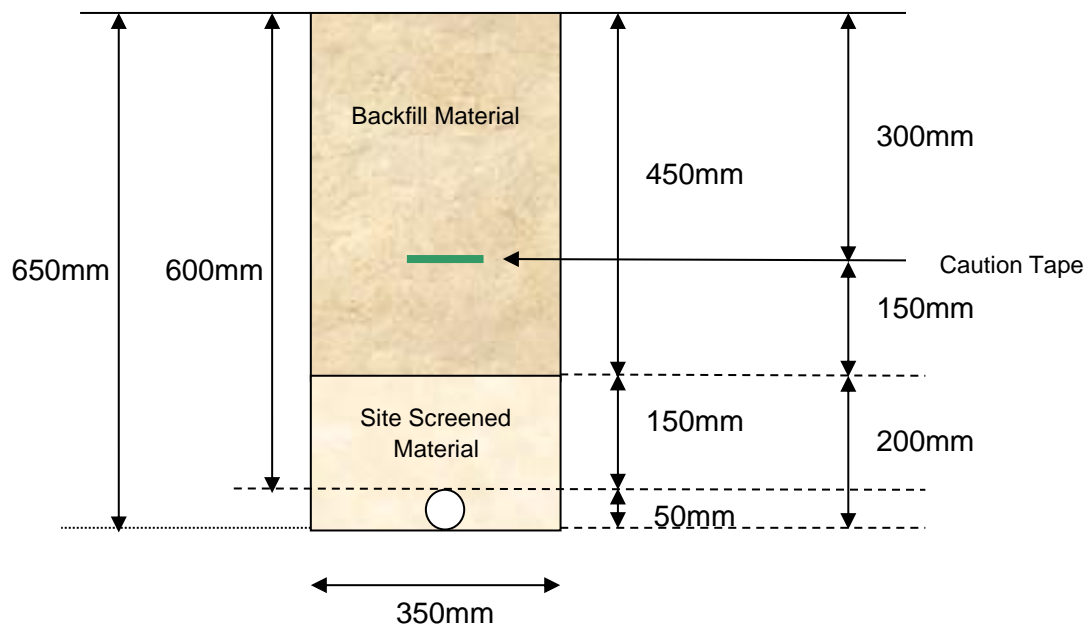
- ANSI/TIA/EIA 568.1-D: Commercial Building Telecommunications Cabling Standard.
- ANSI/TIA/EIA 569-A: Commercial Building Standard for Telecommunications Pathways and Spaces.
- ANSI/EIA/TIA-570, Residential and Light Commercial Telecommunications Wiring Standard.
- ANSI/TIA/EIA-758 Customer – owned outside plant telecommunications.
- AS/NZS ISO/IEC 15018:2005 Information technology – Generic cabling for homes.
- Building Industries Consulting Services, International (BICSI) Telecommunications Distribution Methods Manual (TDMM) – 13th Edition.
- ISO/IEC 11801: Generic Cabling for Customer Premises.
- BS EN50173: Information Technology, Generic Cabling Systems, General Requirements and Office Areas.

-End of Specification-

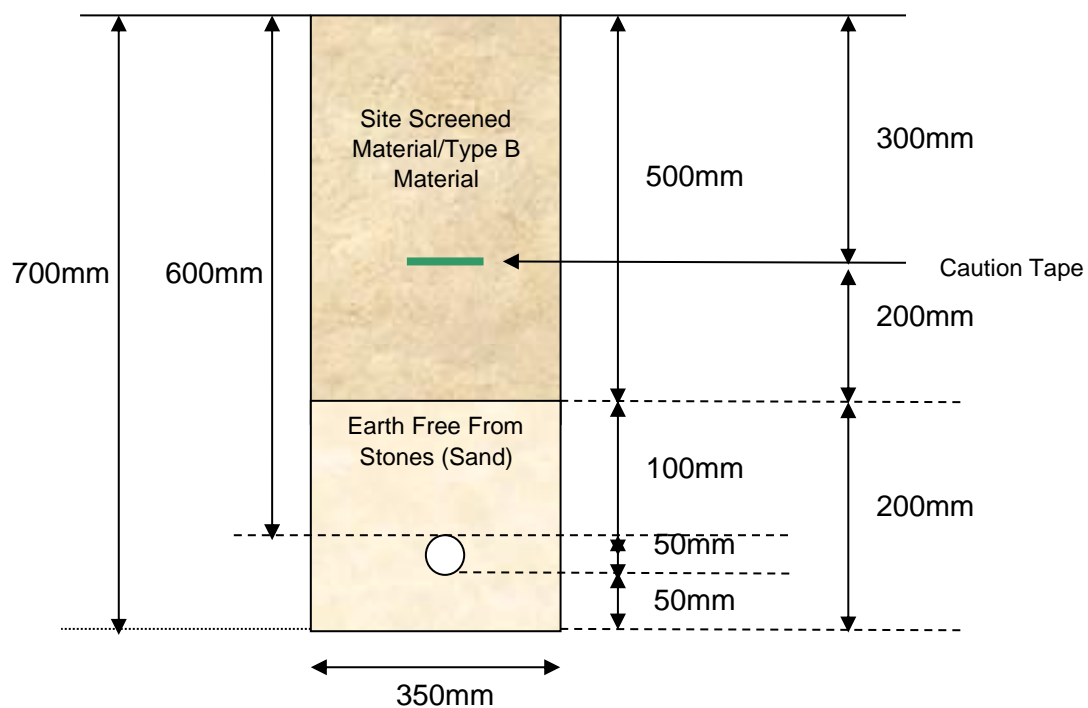
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13. Appendix A - Standard Trench Cross-Sections

1 x D38 Normal Ground – Unmade

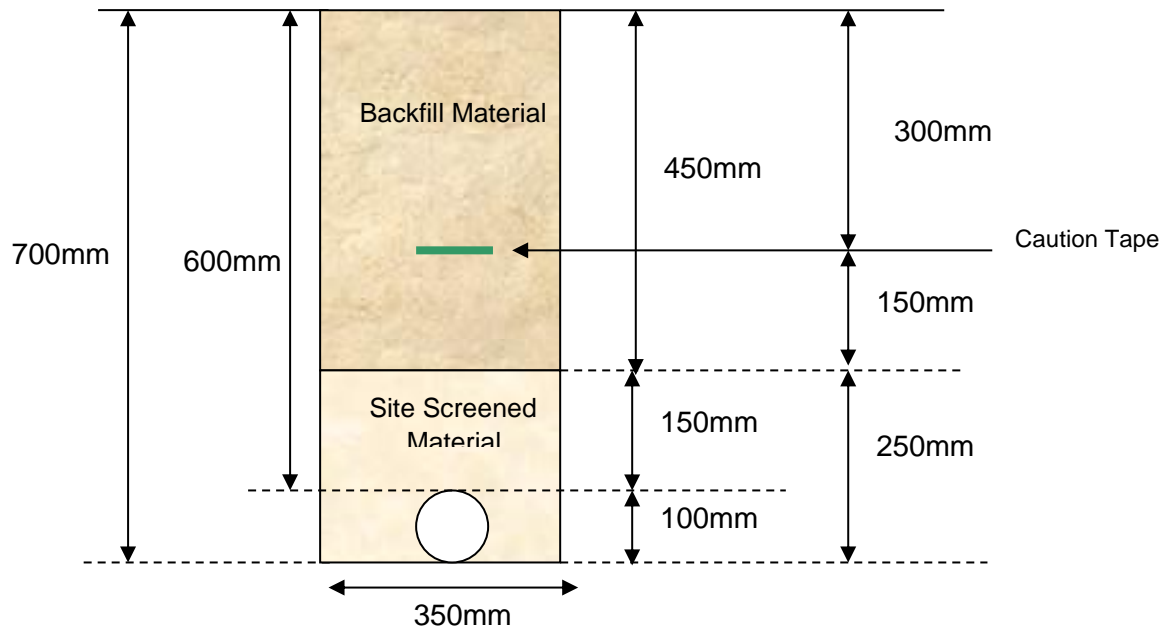


1 x D38 Rock - Unmade

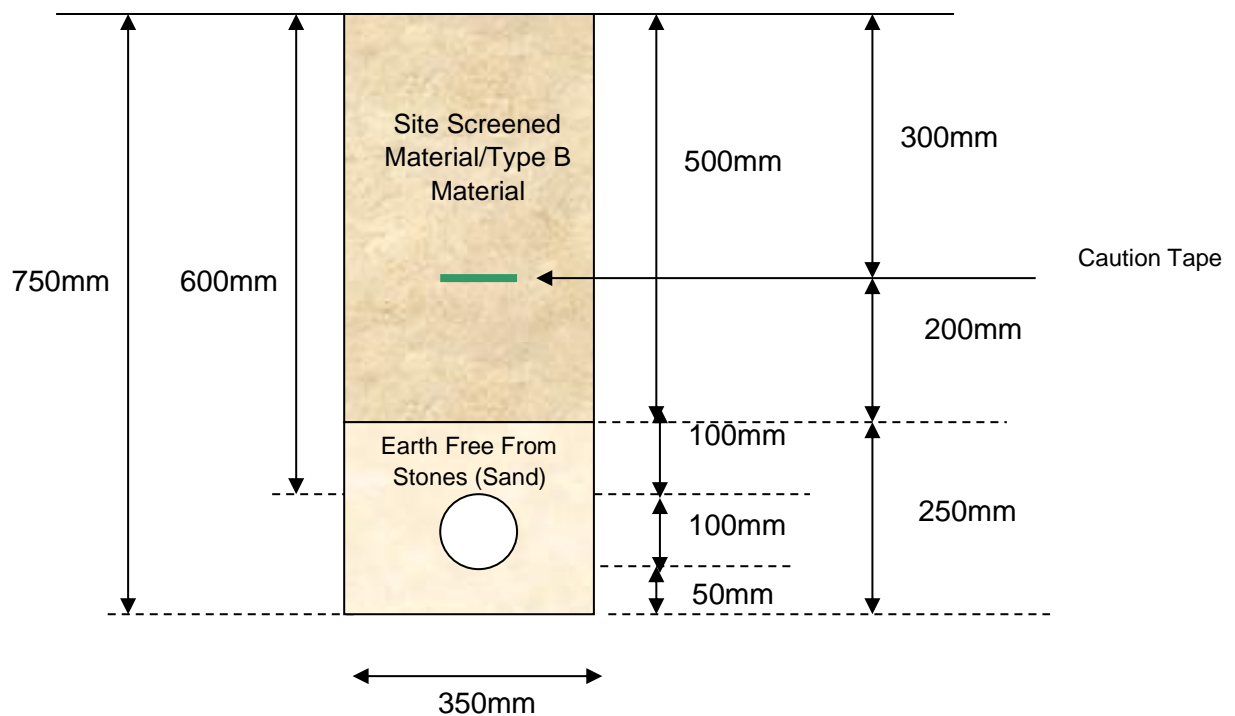



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1 x D96 Normal Ground – Unmade

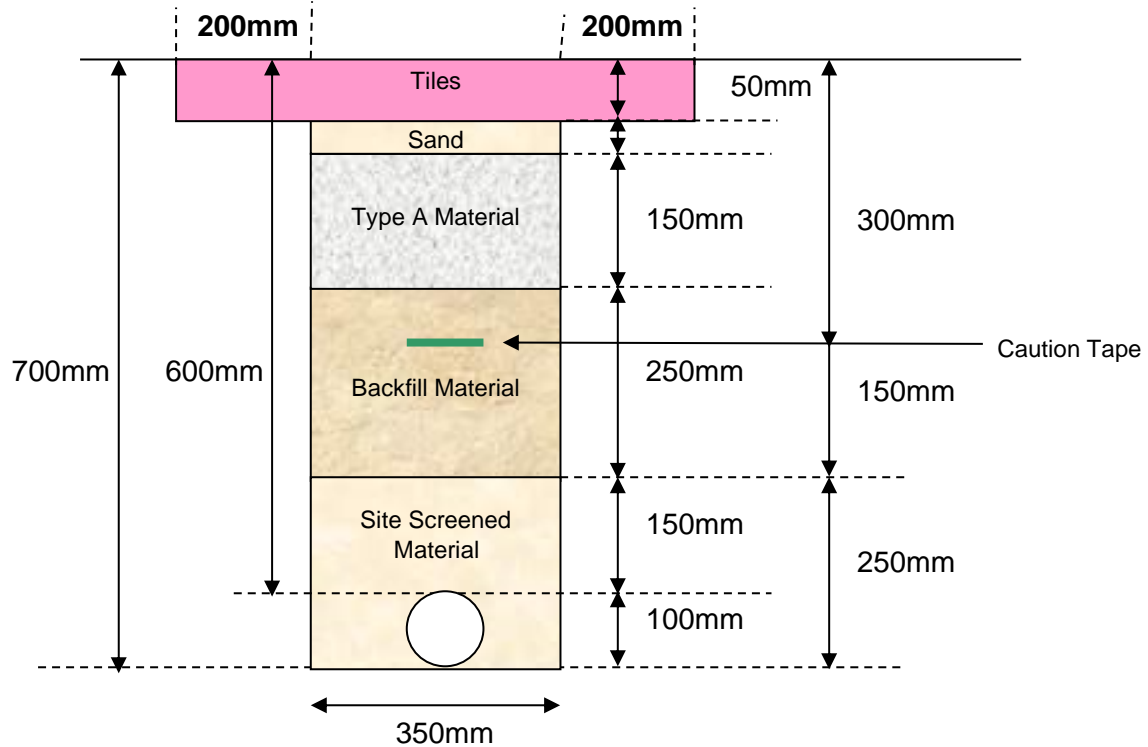


1 x D96 Rock - Unmade

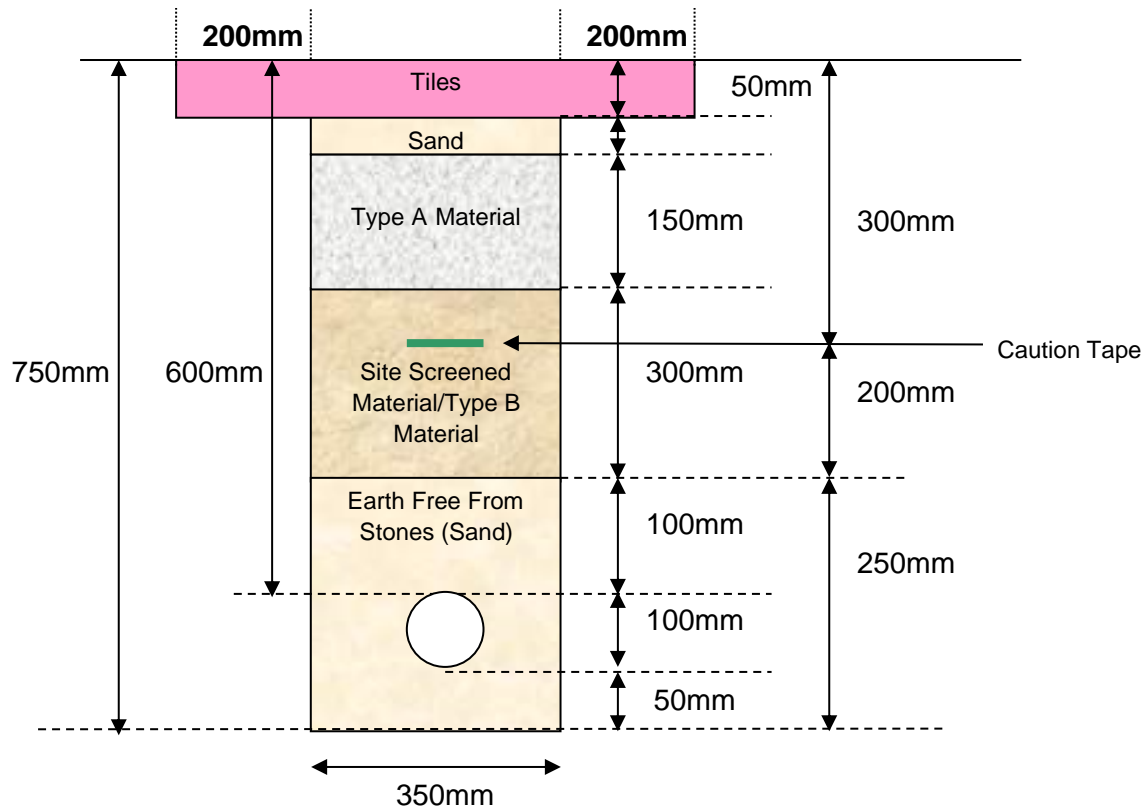



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1 x D96 Normal Ground – Footway Tiles

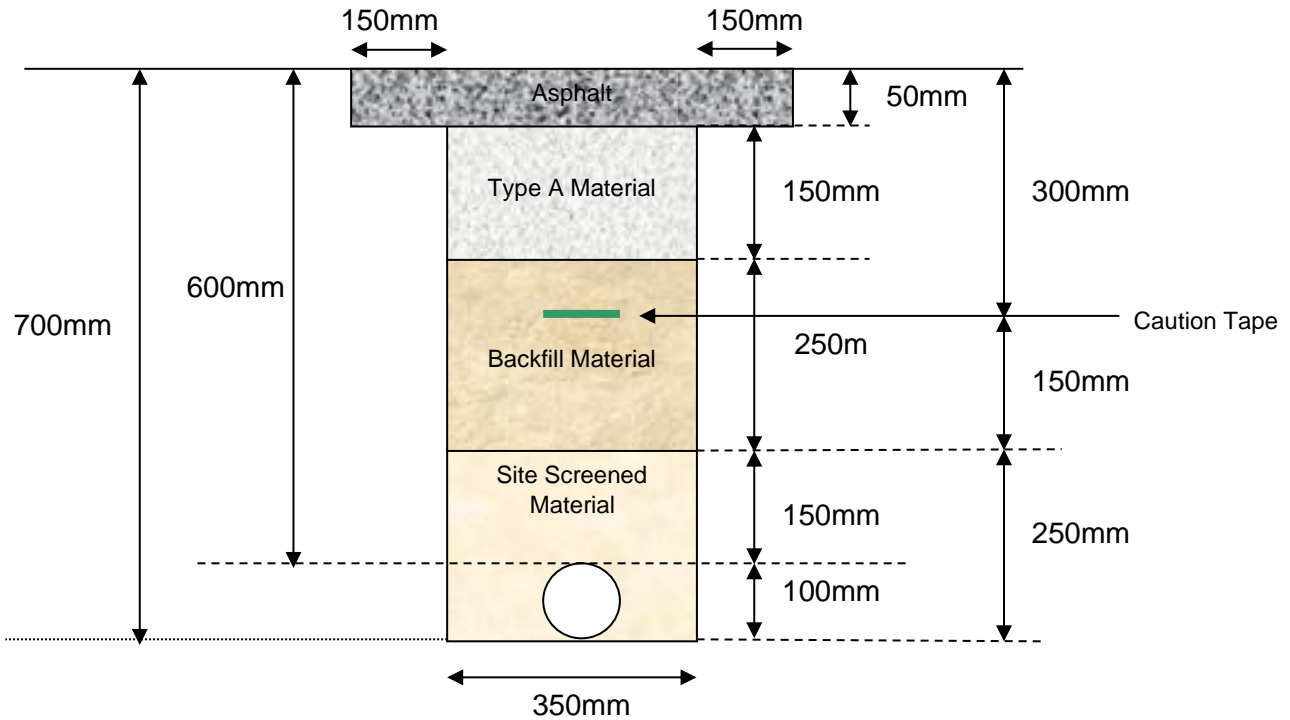


1 x D96 Rock – Footway Tiles

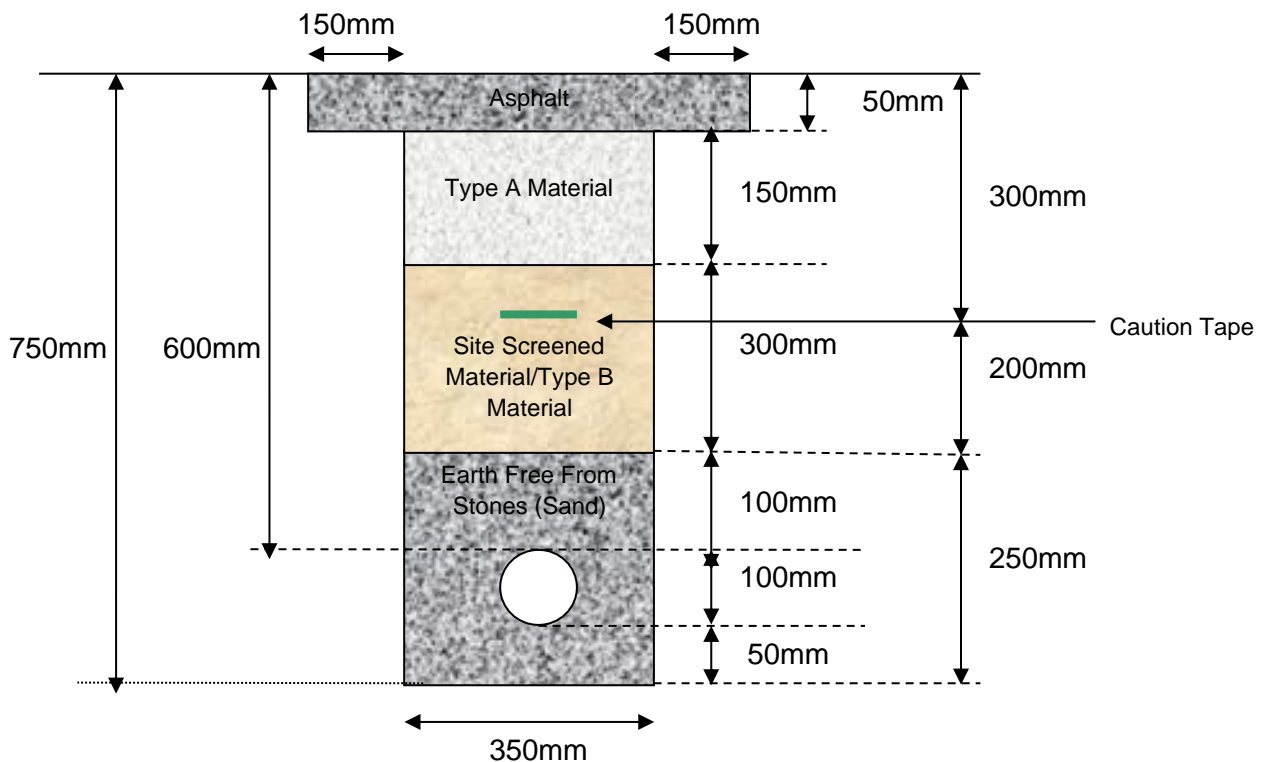



TITLE:	Telecom Connection Standards	
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1 x D96 Normal Ground – Footway Asphalt

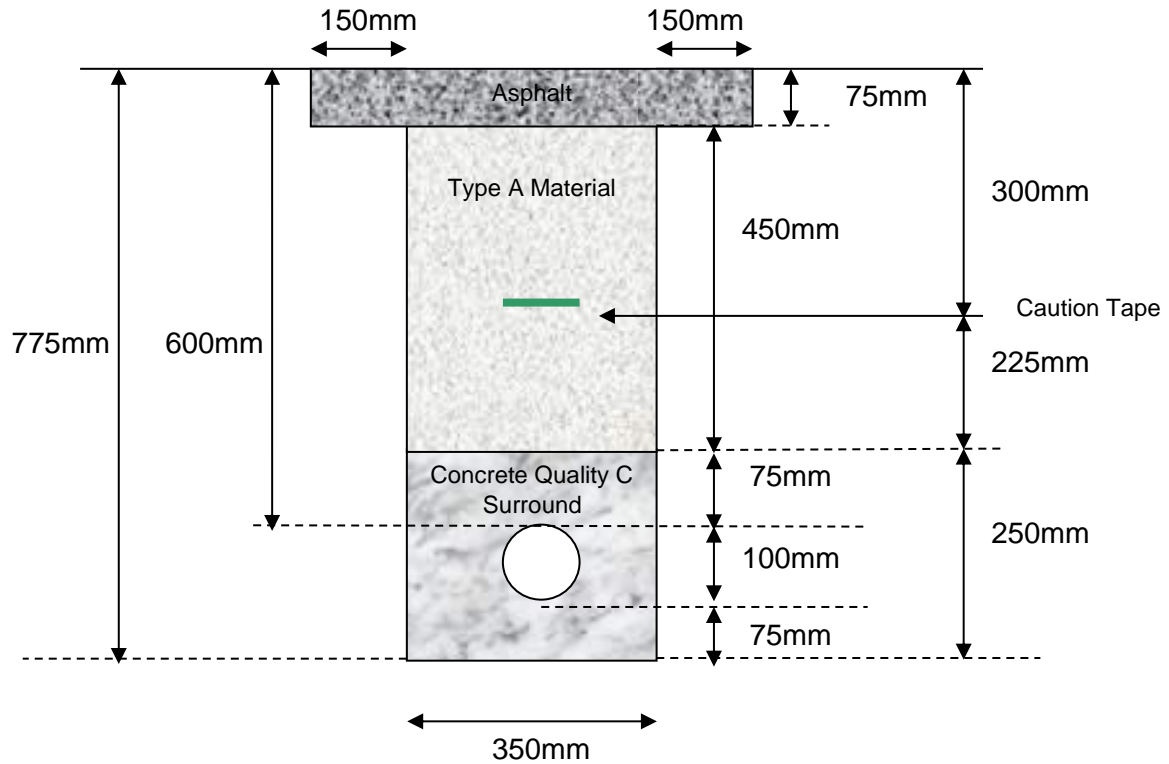



1 x D96 Rock – Footway Asphalt



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VERSION NO.	Version 1.0	

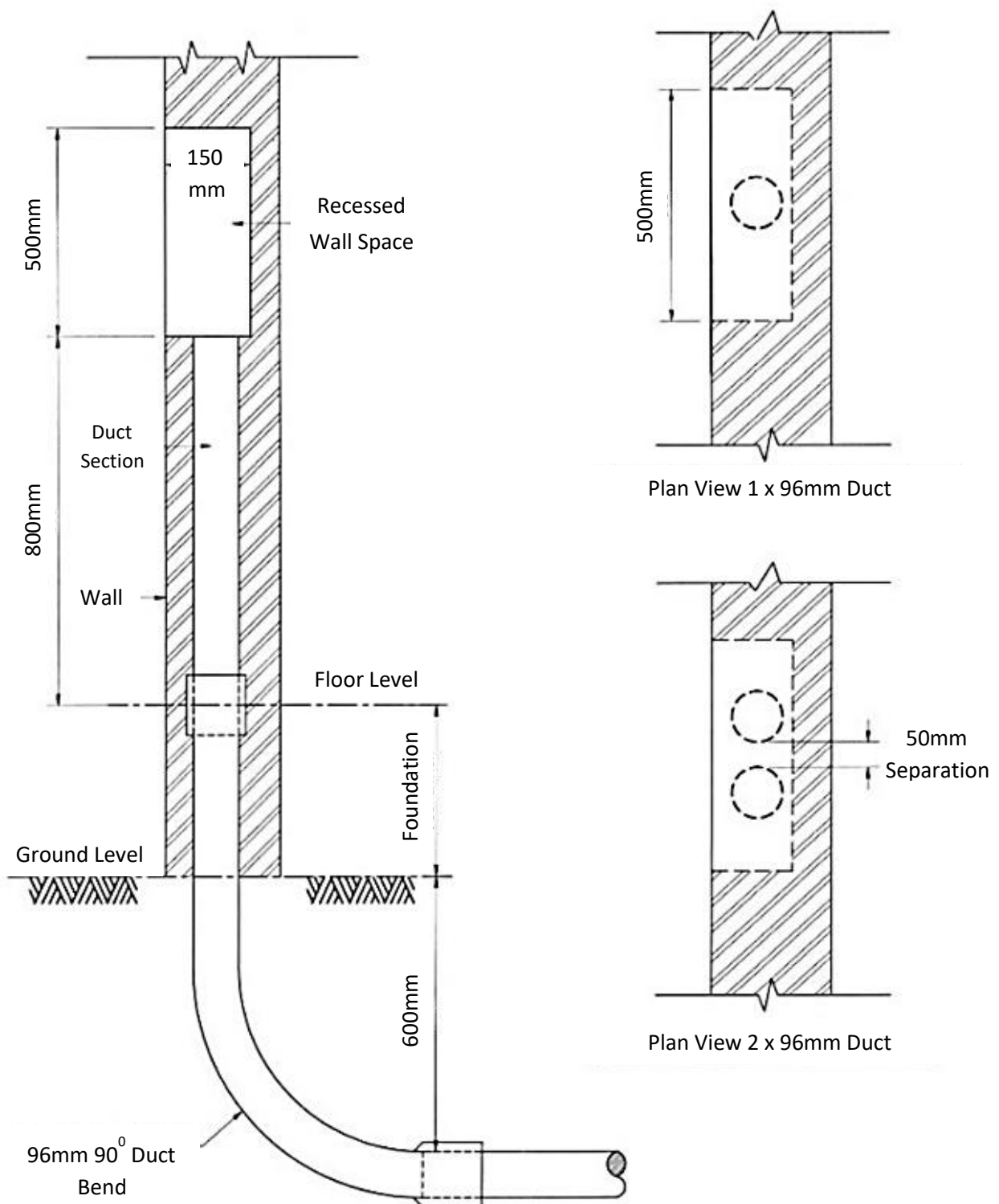
1 x D96 – Minor Road Crossing




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BUSINESS OWNER:	Access Network	
VERSION NO.	Version 1.0	

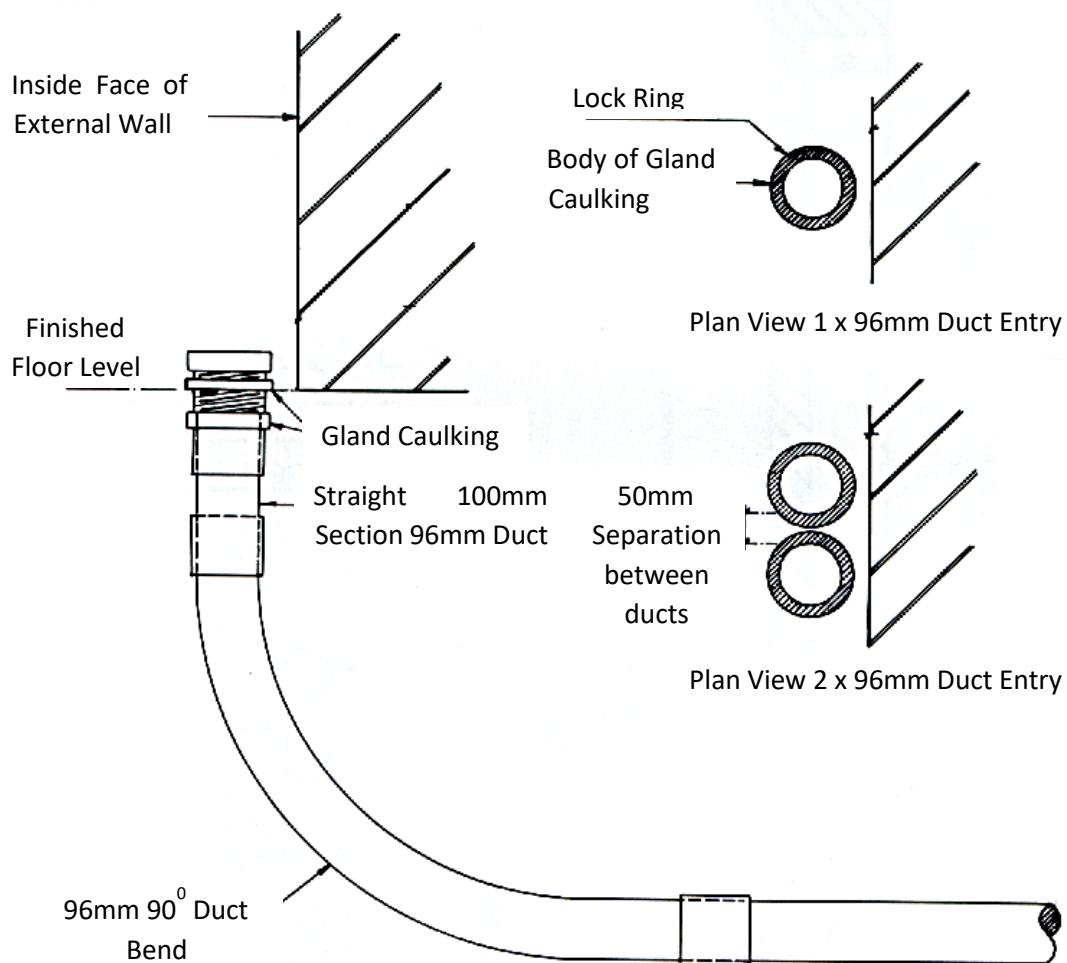
14. Appendix B – Standard Building Duct Lead-ins


Method 1 of Providing Duct to a Customer Premises – Inside Wall



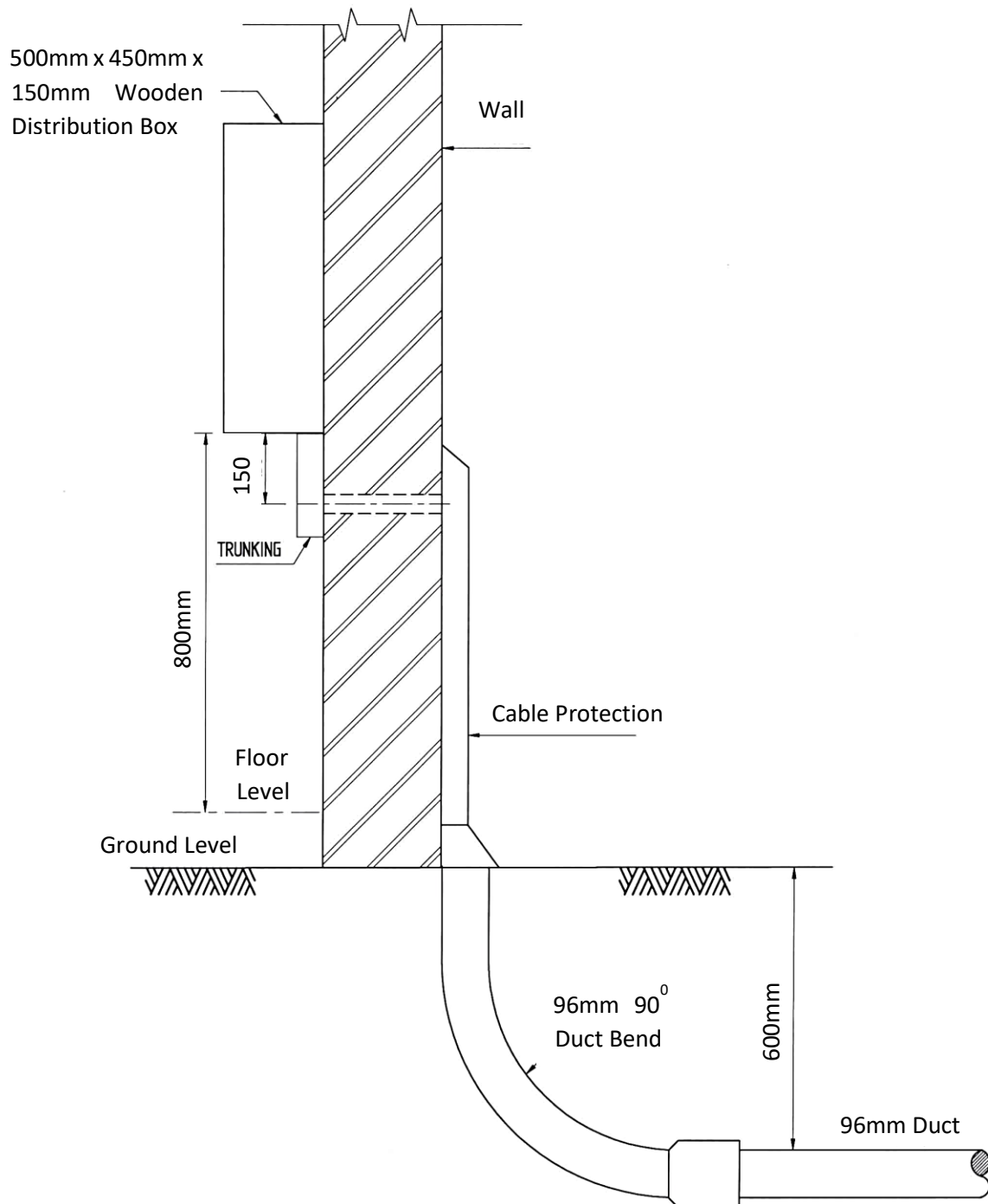
TITLE:	Telecom Connection Standards	
BUSINESS OWNER:	Access Network	
VERSION NO.	Version 1.0	


Method 2 of Providing Duct to a Customer Premises – Inside Room



TITLE:	Telecom Connection Standards	
BUSINESS OWNER:	Access Network	
VERSION NO.	Version 1.0	

Method 3 of Providing Duct to a Customer Premises – Retro-fit

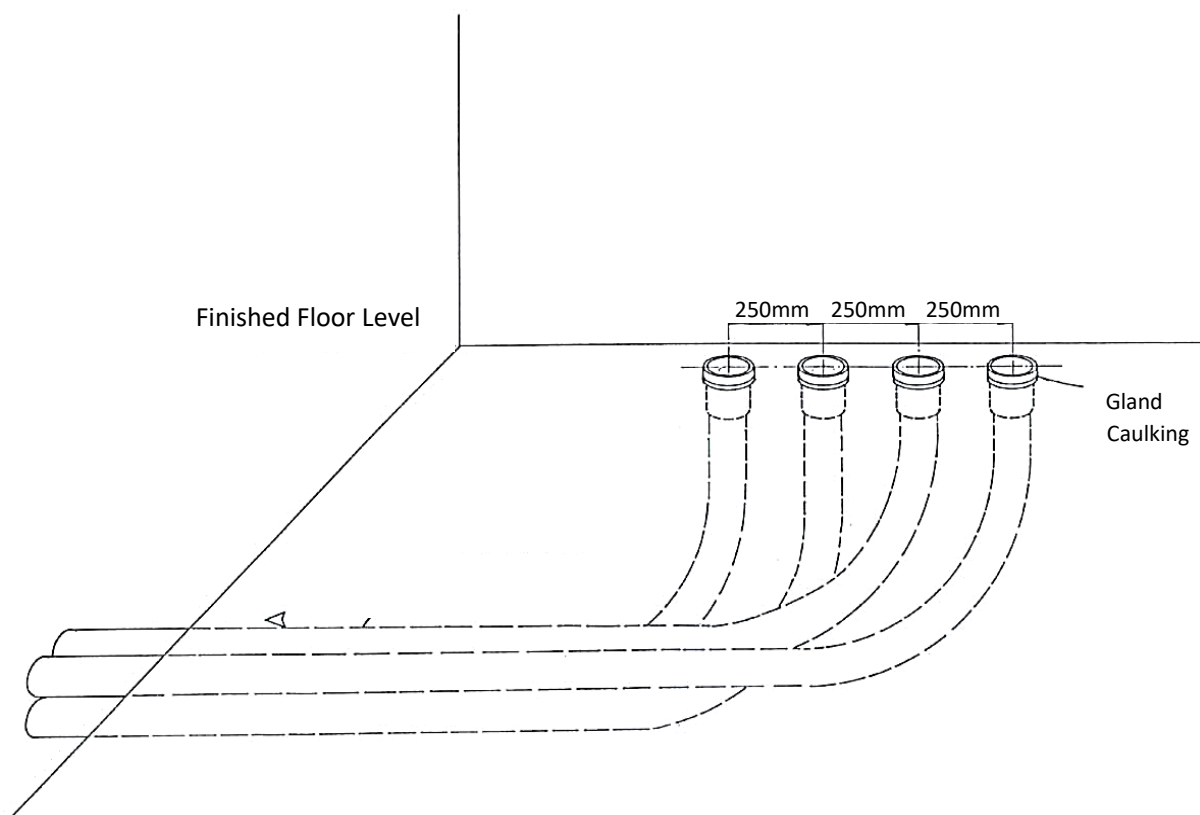



TITLE:	Telecom Connection Standards	
BUSINESS OWNER:	Access Network	
VERSION NO.	Version 1.0	

Building Duct Entry – 4 x D96

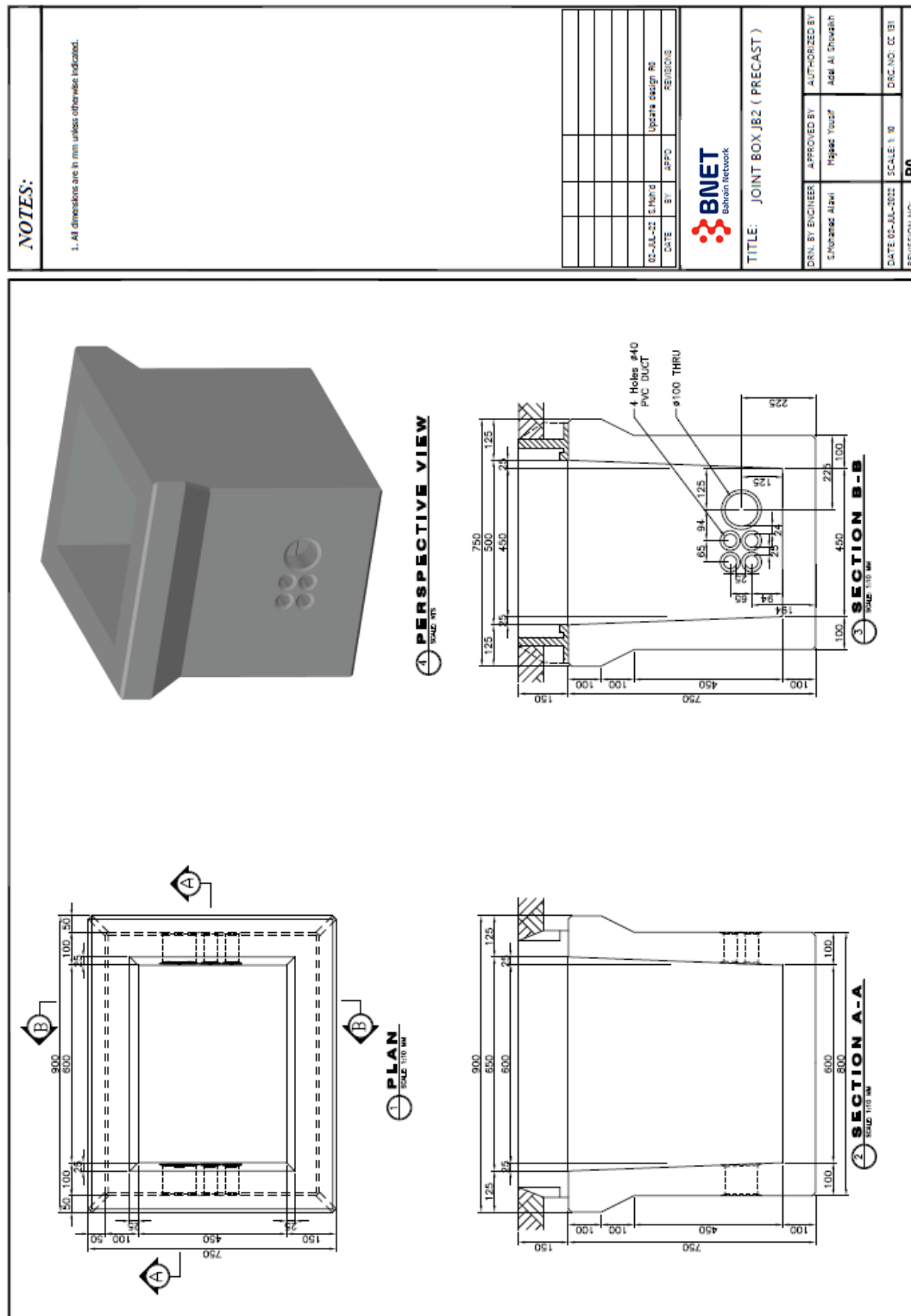
Where a 4 x D96 duct lead-in is required to a customer's premises, the standard arrangement is shown below.


Should more than 4 D96 be required, a Cable Chamber should be constructed at the construction stage.



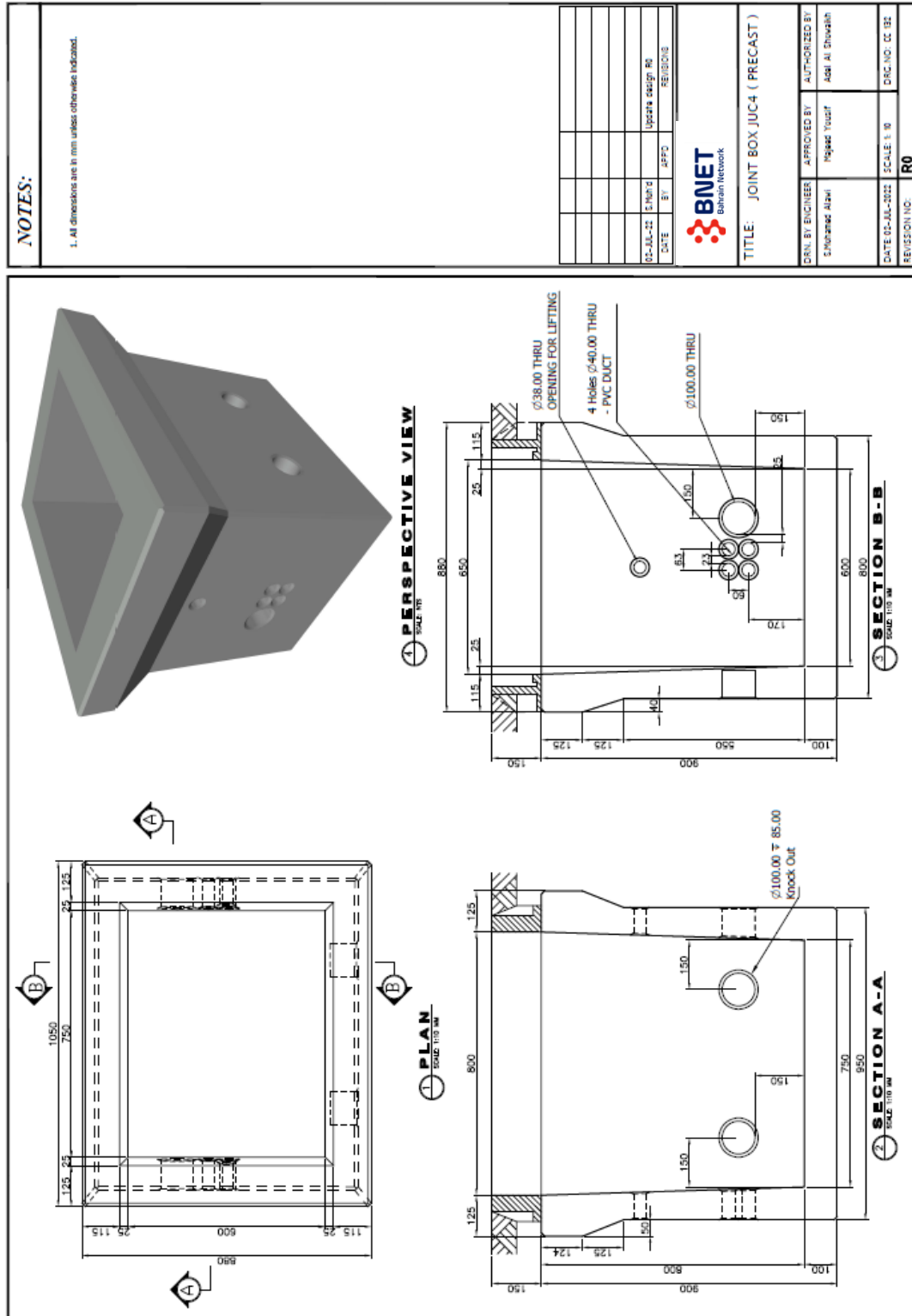
TITLE:	Telecom Connection Standards	
BUSINESS OWNER:	Access Network	
VERSION NO.	Version 1.0	


JB2 Pre-cast



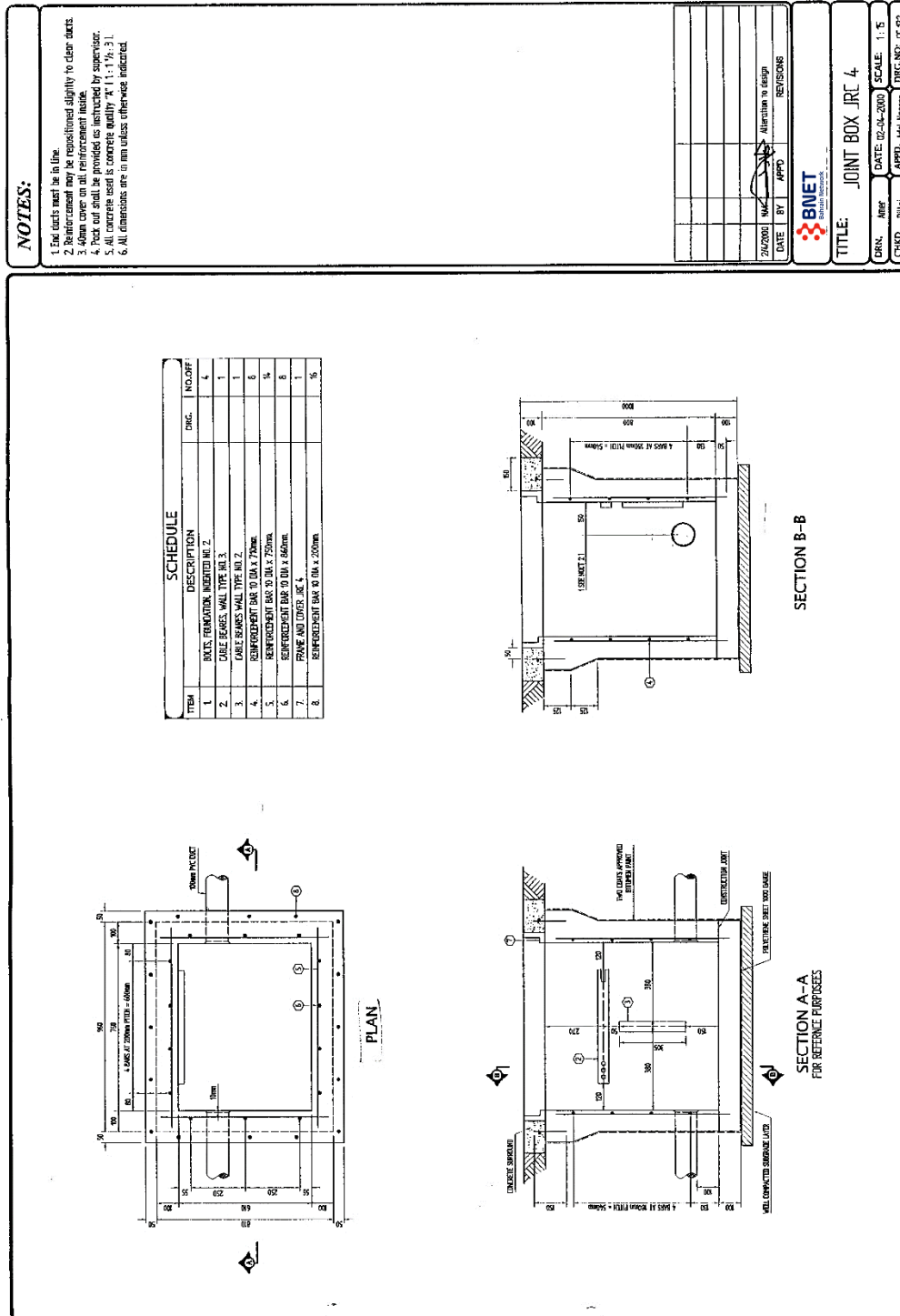
TITLE:	Telecom Connection Standards	
BUSINESS OWNER:	Access Network	
VERSION NO.	Version 1.0	


JUC4 – Precast



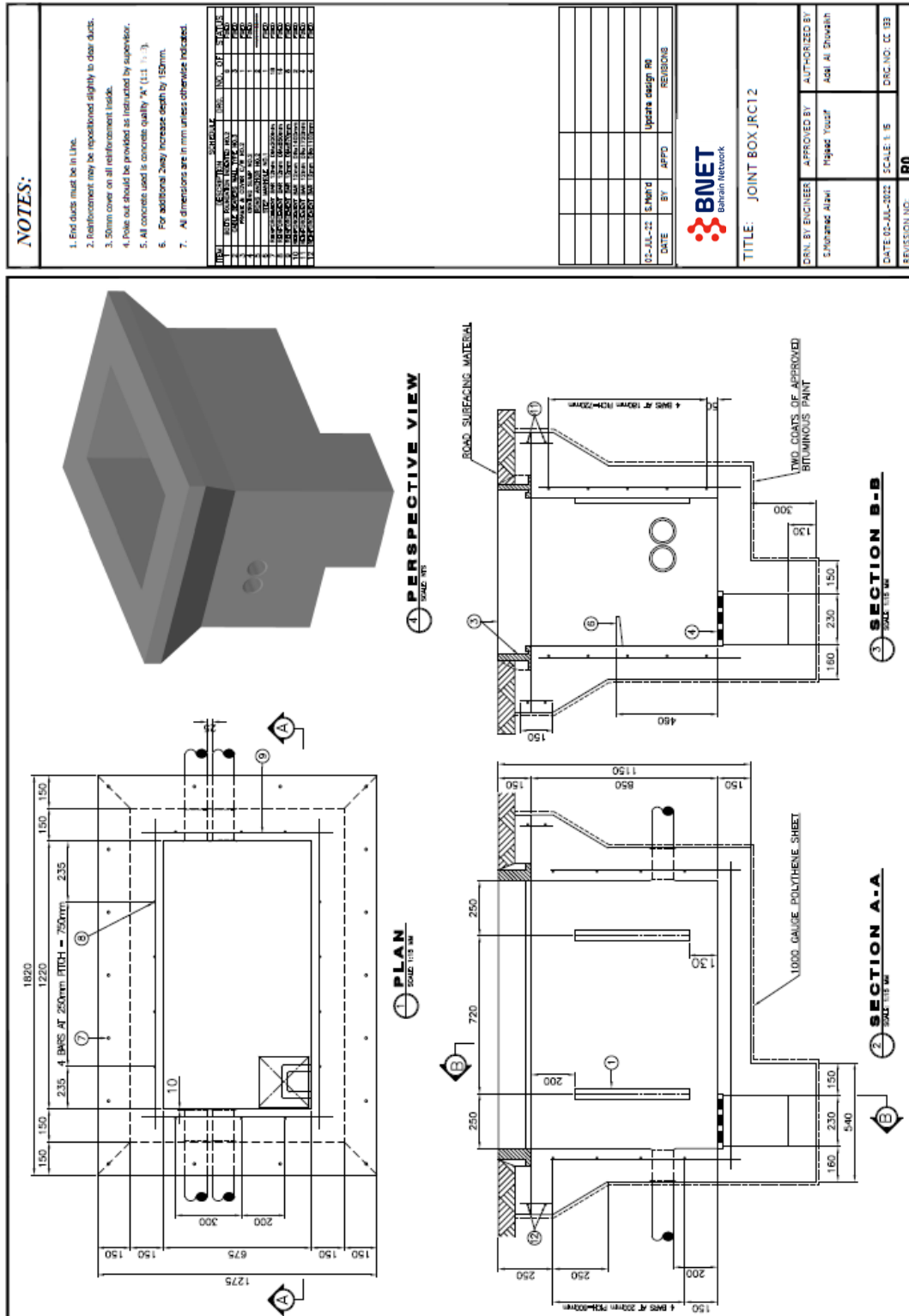
TITLE:	Telecom Connection Standards	
BUSINESS OWNER:	Access Network	
VERSION NO.	Version 1.0	


JRC4 – Construct in-situ



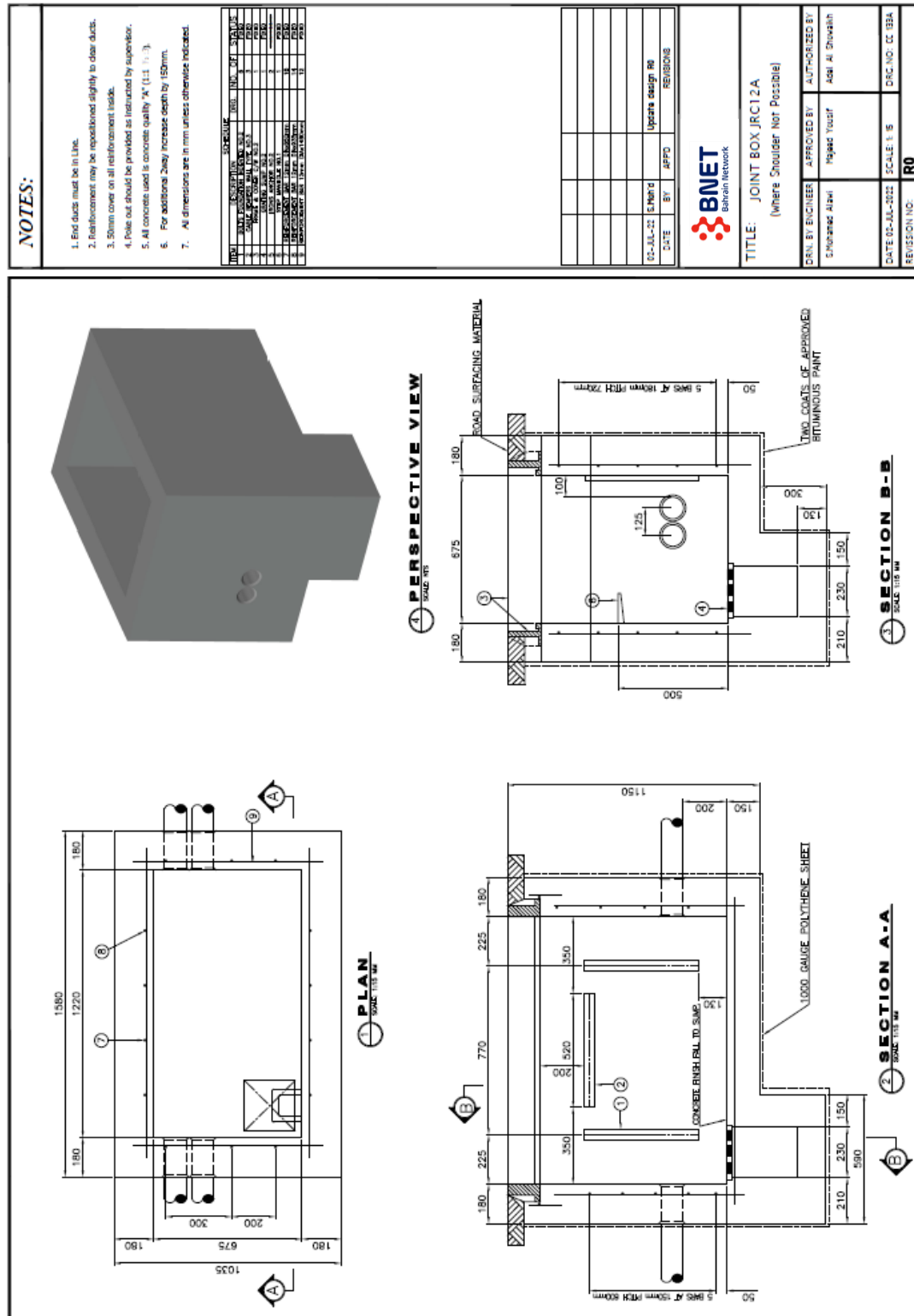
TITLE:	Telecom Connection Standards	
BUSINESS OWNER:	Access Network	
VERSION NO.	Version 1.0	


JRC12 – Construct in-situ



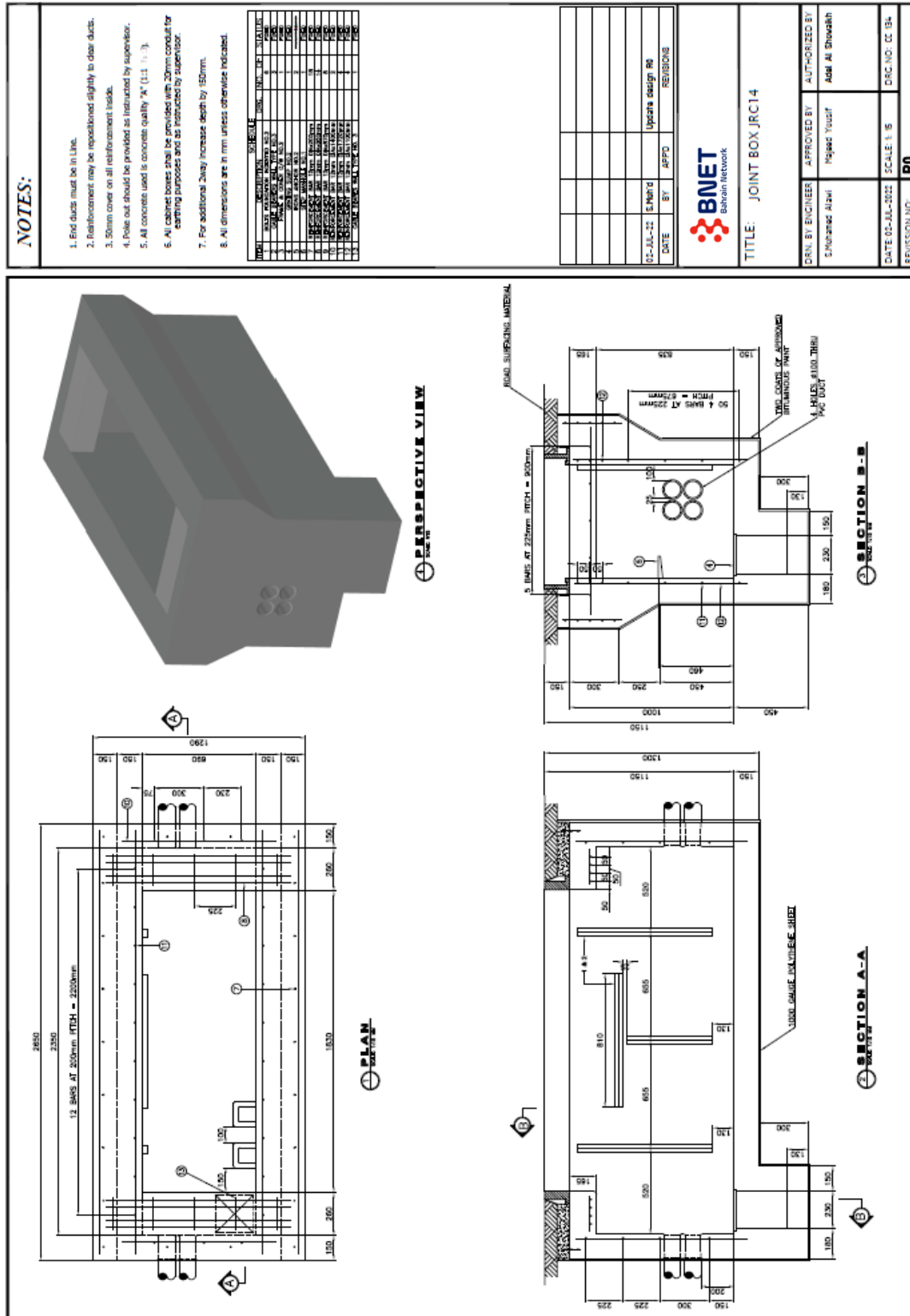
TITLE:	Telecom Connection Standards	
BUSINESS OWNER:	Access Network	
VERSION NO.	Version 1.0	


JRC12A – Construct in situ



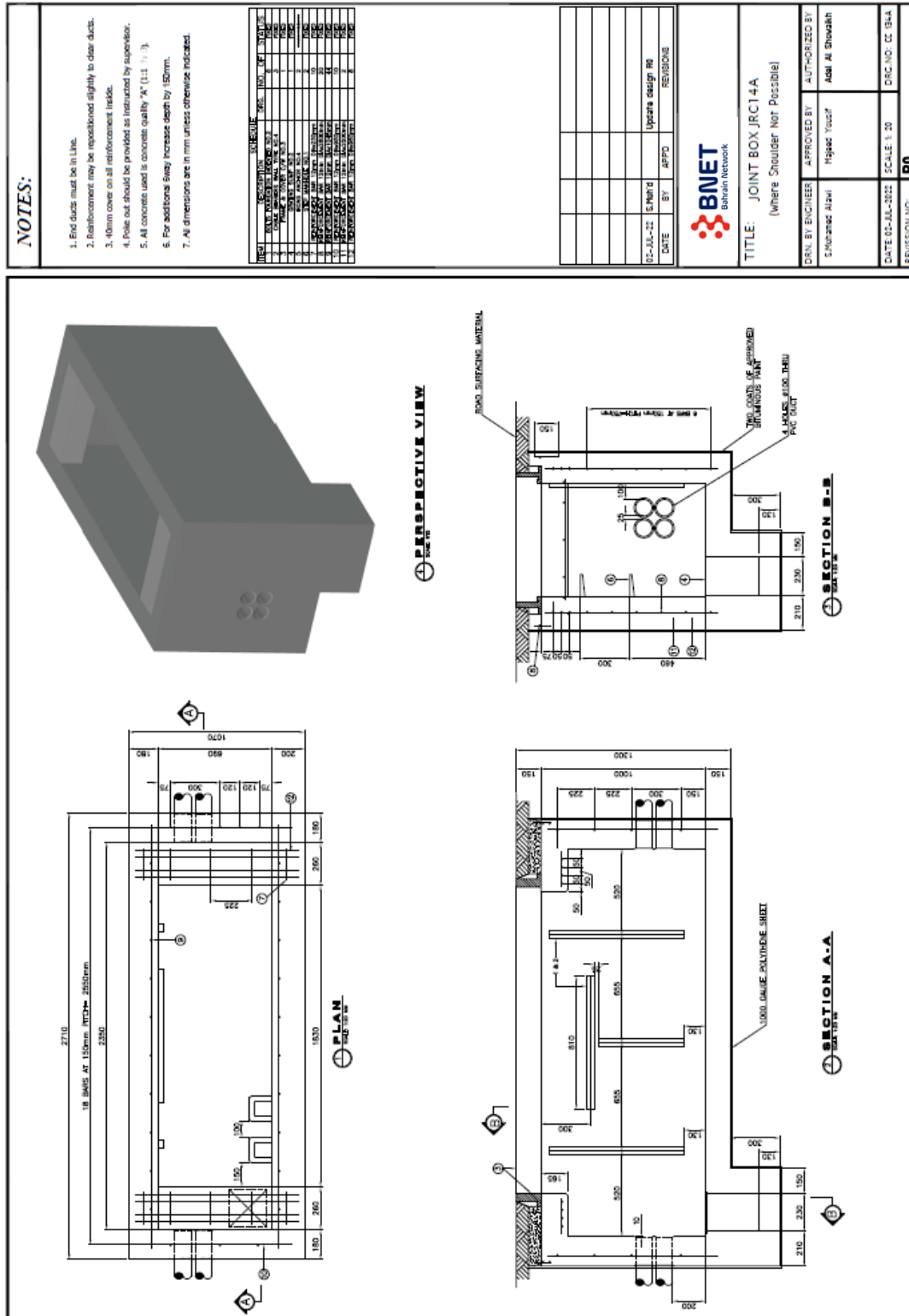
TITLE:	Telecom Connection Standards	
BUSINESS OWNER:	Access Network	
VERSION NO.	Version 1.0	


JRC14 – Construct in situ



TITLE:	Telecom Connection Standards	
BUSINESS OWNER:	Access Network	
VERSION NO.	Version 1.0	

JRC14A Construct in situ




TITLE:	Telecom Connection Standards	
BUSINESS OWNER:	Access Network	
VERSION NO.	Version 1.0	

16. Appendix D – Main Telecom Room Minimum Requirements

The minimum requirements as outlined in the below table should be considered in the design and construction of the Main Telecom Room:

Item	Requirements
Perimeters	No false ceiling; all surfaces treated to reduce dust; walls and ceiling painted white or pastel to improve visibility.
Access	All doors of telecom rooms to be of solid wood core or steel construction, fire retardant with a minimum rating of 2 hours. They shall be outward opening with an automatic door closer system fitted on the hinged edge. All doors of telecom rooms to be labelled.
Ceiling Height	The height between finished floor and lowest point shall be 3m to accommodate tall racks and overhead raceways. False ceilings shall not be installed.
HVAC	All year-round 18°C to 24°C, 30 to 55% humidity, positive pressure.
Lighting	Typically, minimum 200 lux at 1.0m above floor, with independent power from telecom equipment.
Electrical	Typically, a minimum of two dedicated 20 A, 230 V AC duplex outlets on separate circuits is required. Convenience duplex outlets should be placed at 2m intervals around the perimeter. Emergency power should be considered and supplied if available.
Bonding and Grounding	For telecommunications grounding, the recommendations set out in ANSI/TIA/EIA-607 (CSA T527) shall be followed.
Dust	Less than 100 micrograms/cubic meter/24 hour period.
Floor loading	Rooms should be located on floor areas designed with a minimum floor loading of 4.8 kPa. This will depend on heavy loads and if unusually heavy equipment is anticipated this will need to be increased.

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Fire Safety	Room shall be compliant with the fire and safety requirements like smoke detector, fire alarm, emergency light etc. 2 nos. handheld CO2 cylinder extinguishers to be provided inside the room. Water sprinklers shall be avoided. All containment openings of telecom rooms must be sealed with a regulation fire retardant material.
Walls	A minimum of two walls shall be covered with 20 mm plywood, 2.44 m high, rigidly fixed and capable of supporting attached equipment.
Other	No piping, ductwork, mechanical equipment or power cabling should be allowed to pass through the equipment room. The room must be free from contaminants and pollutants The room shall not be used as a store, for example cleaning the cleaning materials or stationery and office materials.
Note: The requirements as outlined in this table are indicative only. It is the responsibility of the designer / developer to ensure exact requirements for telecom spaces.	