INFO-COMMUNICATIONS DEVELOPMENT AUTHORITY OF SINGAPORE

TELECOMMUNICATIONS ACT

(CHAPTER 323)

GUIDELINES FOR INFO-COMMUNICATIONS FACILITIES IN BUILDINGS

DATE OF ISSUE: 15 September 2008

GUIDELINES FOR INFO-COMMUNICATIONS FACILITIES IN BUILDINGS

15 September 2008

The Info-communications Development Authority of Singapore ("IDA"), pursuant to Section 28 of the Telecommunications Act (Cap. 323) ("Act"), hereby issues these Guidelines For Info-Communications Facilities in Buildings ("Guidelines").

1. INTRODUCTION

1.1 Obligations of developers or owners

(a) These Guidelines lay down the detailed specifications of the space and facilities which developers or owners of buildings are to provide under the Code of Practice for Info-Communication Facilities in Buildings ("COPIF") in order to enhance the range and/or quality of info-communication services that may be provided to their buildings by telecommunication system licensees. This document is to be read together with the COPIF which sets out the mandatory requirements in respect of the space and facilities which developers or owners are required to provide. Nothing in these Guidelines shall exempt or excuse any developer or owner from complying with the provisions of the COPIF. In the event of any conflict between the COPIF and these Guidelines, the provisions of the COPIF will prevail.

(b) The specifications laid down in the Guidelines are based on existing policies and circumstances relating to the current and presently anticipated states of technological development, infrastructure deployment and service provision of the telecommunication system licensees. As such policies and circumstances may change in line with technological advancements and differing service demands, IDA reserves the right to revise, amend, modify and/or amplify any of the procedures, specifications and standards set out in these Guidelines from time to time.

1.2 Rules of Construction

Except where a term is specifically defined in these Guidelines, capitalised terms and words used in these Guidelines have the same meaning as in the COPIF.

1.3 Short Title

These Guidelines may be referred to as the "COPIF Guidelines".

2. GENERAL REQUIREMENTS FOR TELECOMMUNICATION FACILITIES

2.1 General

This chapter specifies the general requirements for telecommunication facilities including the segregation of telecommunication facilities from other utilities or services, diversity of lead-in and underground pipes, general and fire protections, joint inspection and acceptance of telecommunication facilities, and responsibilities of licensees and developers or owners.

2.2 Segregation requirements

(a) Non-electrical Plant

All manholes, underground pipes and cables for telecommunication services shall be kept clear of gas or water mains, service pipes and also isolated from manholes and joint boxes belonging to other services. The clearance shall be 150 mm, but in difficult situations, it may be reduced to 50 mm where the plants cross each other. Where gas and water mains are concerned, a clearance of at least 150 mm shall be maintained to permit the use of a pipe-threading machine. Underground plants, (including cables and pipes, crossing bridges constructed wholly or partly of steel) shall be insulated electrically from the steelwork throughout its entire length. Metal or PVC trunkings, tarmac and cement may be used but methods vary in individual cases.

(b) Electrical Plant

The minimum clearance to be provided between power and telecommunication cables are as follows:

(i) For high voltage single-core cables (exceeding 400 volts), the minimum clearance shall be 460 mm, no exception being permitted.

(ii) For high voltage multi-core cables (exceeding 400 volts), the standard minimum clearance shall be 300 mm. Where a clearance of 300 mm cannot be obtained, a smaller clearance may be allowed. However, for clearances less than 150 mm, a slab of concrete shall be inserted between the two sets of cables.

(iii) For low and medium voltage cables (less than 400 volts), the minimum clearance shall be 50 mm. If the clearance is less than 50 mm, insulation sheets of non-combustible material with a thickness of 40 mm shall be placed between the sets of cables.

(iv) For cables concealed in casings, conduits, trunkings or ducts, separate casings, conduits, trunkings, ducts, etc., shall be provided for the telephone and electrical cables. Where they intersect, a 'bridge' or suitable cross-over joint piece shall be provided.

(v) For multi-compartment trunking with telephone and electrical cables occupying different compartments, the trunking shall be so designed to ensure that the cables remain in their individual compartments when the cover of the

trunking is removed. The segregation between each compartment in the trunking shall be continuous.

(vi) All metal trunking and conduits shall be effectively earthed in accordance with the Singapore Standard CP16 (Code of Practice on Earthing).

(c) Different Communication Cables

It is necessary to segregate telecommunication cables from other service cables to prevent possible electrical interference and for safety and identification purposes.

2.3 Diversity

(a) An additional set of lead-in pipes shall be provided at a different location for the following buildings for diversity purposes:

(i) Hospital;
(ii) Airport;
(iii) Police station;
(iv) Fire station;
(v) Military installation;
(vi) Power generation or control installation;
(vii) Radio and TV station;
(viii) Computer centre;
(ix) Building with usable floor area above 60,000 sq. m; and
(x) Security agency.

(b) Where buildings are used for important telecommunication services such as high speed leased data circuits, it is prudent to provide a second set of lead-in pipes.

2.4 General protection

Accommodation provided for telecommunication cables and wires must be adequately protected from possible damage caused by mechanical means, exposure to weather, corrosive fumes, water or excessive dampness, accumulated dust, steam, oil, high temperature or any other circumstances to which they will be exposed.

2.5 Fire protection

(a) Water sprinkler systems must not be used in the main distribution frame room, telecommunication equipment room and telecommunication risers. To comply with Fire Safety & Shelter Department's ("FSSD") condition of waiver for such installation, the main distribution frame room and telecommunication equipment room must be accessible directly from the outside of the building.

(b) In addition, other forms of fire protection systems acceptable to the FSSD must be provided.

2.6 Facility record

For the purpose of maintenance and speedy restoration of services in the event of breakdown, it is essential that the exact location of the lead-in and underground pipes,

main distribution frame room, telecommunication risers, cable tray routes and details of any other facilities provided by developers or owners within the building compound such as location and dimension of manholes are properly documented on plans. A laminated set or copy should also be displayed prominently and permanently inside the main distribution frame room for easy reference during maintenance works.

2.7 Inspection procedure for completed space and facilities

(a) Except where the provision of main distribution frame rooms is not required for certain types of building developments under the COPIF, a written request shall be made to the Telecommunication Facility Co-ordination Committee ("TFCC") for a joint site inspection upon the completion of the construction works. The written request shall be copied to IDA. Please refer to Appendix 1 for the functions of the TFCC.

(b) The joint site inspection shall be confined to the following space and facilities as may be applicable –

(i) main distribution frame rooms;

(ii) telecommunication equipment rooms;

(iii) lead-in pipes and underground pipeline system;

(iv) telecommunication risers; and

(v) cable trays or metal trunking between the main distribution frame rooms, telecommunication equipment room and the telecommunication risers.

(c) Where any space or facility is found to be non-compliant with the Code of Practice for Info-communication Facilities in Buildings during the joint site inspection, such deficiency shall be recorded in the inspection checklist in form 2.1, signed by the relevant parties and submitted to IDA via the CORENET e-Submission system.

(d) Where no deficiencies are recorded in the inspection checklist, an arrangement may be made with the licensee whose services are required to install its installation, plant or system used for telecommunications in the space and facilities for the provision of services to the building.

(e) Where deficiencies are recorded in the inspection checklist, such deficiencies shall immediately be rectified. An arrangement may be made concurrently for licensees to install their installation, plant or system used for telecommunications within those space and facilities which are compliant with the COPIF but not otherwise. In the event a licensee is permitted to install its installation, plant or system used for telecommunications in any space and facilities which require rectification, IDA may require removal of such installation, plant or system used for telecommunications at the expense of the person responsible for the construction of the building for rectification works to be carried out.

(f) Once all deficiencies recorded in the inspection checklist are rectified, the declaration in form 2.2 shall be submitted to IDA via the CORENET e-Submission system.

(g) A flow chart depicting the inspection process is set out chart 2.3.

(h) Nothing in this section shall limit IDA's right to require the person responsible for the construction of the building to rectify any space and facilities that are not constructed in accordance with the COPIF at any time and regardless of whether or not such space and facilities have been inspected under the procedure set out in this section.

2.8 Acceptance of telecommunication facilities

(a) All facilities shall be completed at least 6 months before service is required. Joint site inspection shall be conducted to ensure that the facilities provided comply with the requirements as specified in the COPIF. The timeframe for handing over of facilities may be shortened for smaller developments and fast track projects subject to IDA's approval.

(b) The developer or owner shall rectify all defects detected during site inspection.

2.9 Responsibilities of the licensees

After handing over of the telecommunication facilities to the licensees for their deployment of telecommunication services, the licensees shall only be responsible for maintaining their telecommunication installation and plant and the general cleanliness in the main distribution frame room, telecommunication equipment room and telecommunication risers, whichever the case may be.

2.10 Responsibilities of developer or owner (updated on 6 September 2011)

(a) The developer or owner shall be responsible at its own expense for the provision and maintenance of all the facilities within the building, including but not limited to the facility records, cable trays, trunking, lead-in and underground pipes, manholes, main distribution frame room, telecommunication equipment room and telecommunication risers, and for ensuring that they are in good serviceable condition and accessible to the licensees' personnel at all times.

(b) The developer or owner shall assist the licensees at its own expense for drilling through concrete floors, ceilings or walls of buildings that form part of the facilities for telecommunication within the building.

(c) Where additional cables need to be installed inside the building to meet tenants' increased demand for telephone lines or other fixed-line telecommunication services, the developer or owner shall promptly assist the licensees at its own expense during the cable installation work, including but not limited to the removing and reinstating of fire stopping material sealing the floor opening inside the telecommunication risers or opening up of ceiling boards/panels.

(d) The developer or owner shall ensure at its own expense that adequate security measures are taken at the main distribution frame room, telecommunication equipment room and telecommunication risers to pre-empt trespassing by any unauthorised personnel. Under no circumstances should the main distribution frame room, telecommunication equipment room and telecommunication risers be used for any other purpose such as a store room. The developer or owner shall hand over the main distribution frame room, telecommunication equipment room and

telecommunication risers to the licensees through the Telecommunication Facility Co-ordination Committee upon acceptance of the facilities by the licensees, for their deployment of telecommunication services.

(e) For the avoidance of doubt, the developer or owner shall be responsible to carry out the foregoing at its own expense. In particular, the developer or owner shall not pass on any costs or expenses to the licensees for any installation or maintenance work related to the provisioning of fixed-line telecommunication services to the building, including but not limited to drilling and reinstatement costs, non-refundable deposits, premiums for purchase of additional insurance, blue prints or site maps and escort or security charges.

2.11 Broadband enabling cables (updated on 6 September 2011)

(a) The developer or owner may install and maintain broadband enabling optical fibre cables for its own use or for access by its tenants or lessees for broadband services.

(b) The developer or owner may engage wiring contractors, who are licensed by IDA, to install telecommunication cables in the buildings. They may also make commercial arrangement with a licensee to install the broadband enabling cabling in their buildings.

(c) However, in multi-tenanted buildings, tenants or lessees have the choice of getting any licensee to provide any telecommunication services. A tenant or lessee may lease the broadband enabling cables provided by the developer or owner based on commercial arrangements, or they may use the cables provided by a licensee. The developer or owner shall allow any licensee to provide telecommunication cables to the building to serve any tenant or lessee, should the latter require the use of such cables. Where the tenant or lessee subscribes to the telecommunication service of any licensee, the developer or owner shall promptly assist the licensee at its own expense during the cable installation works in accordance with the provisions under paragraph 2.10.

(d) The developer or owner is required to refer to and comply with the COPIF when planning or installing their own broadband enabling optical fibre cables. They should install their cables in a separate communication riser. However, in the absence of any communication riser in existing building, prior approval from IDA must be sought for using the telecommunication riser which is designated for the licensees' use. IDA may accede to the requests from the developer or owner to use the telecommunication riser where there is enough space for all users to share.

(e) In relation to paragraph 2.11 (d), the developer or owner or its tenant must remove its telecommunication cables from the telecommunication risers at its own expense, if there is insufficient space for the licensees' use.

(f) In addition, where the telecommunication risers are congested with cables, the developer or owner shall arrange at its own expense for their contractor to remove the unused cables which are left over by their former tenants so that there will be enough space for new cables to be laid. The developer or owner may, at its own expense and subject to the licensee's agreement, allow the licensee to use an alternative communication riser and provide the licensee with full access to such a communication riser in the same manner as the access to be provided for telecommunication risers as specified in paragraph 2.10.

2.12 Do's and Don'ts for Earthworks

The developer or owner shall refer to Appendix 9 (Do's and Don'ts for Earthworks) of these Guidelines for the precautions to be taken against damaging a telecommunication system licensees' plant.

FORM 2.1 (Updated on 6 September 2011)

Date: [*dd-mmm-yyyy*]

Infocomm Development Authority of Singapore
10 Pasir Panjang Road
#10-01 Mapletree Business City
Singapore 117438

Attn: Director
Interconnection & Access Division

Dear Sir,

CODE OF PRACTICE FOR INFO-COMMUNICATIONS FACILITIES IN BUILDINGS – NOTIFICATION OF COMPLETION OF INSPECTION OF SPACE AND FACILITIES

PROJECT REFERENCE NO:
PROJECT TITLE:
BUILDING ADDRESS/ SITE:
BUILDING NAME:
TFCC Reference No.:

I refer to the inspection conducted jointly between my representatives and representatives from Telecommunication Facility Co-ordination Committees ("TFCC") on [*dd-mmm-yyyy*].

In accordance with the requirement of the Building Facilities Code, the endorsed joint inspection checklist is enclosed for IDA's information.

Yours faithfully

[*Developer or owner's name*]

Encl

FORM 2.1 (CONT'D)

CODE OF PRACTICE FOR INFO-COMMUNICATIONS FACILITIES IN BUILDINGS - INSPECTION CHECKLIST FOR SPACE AND FACILITIES

PROJECT TITLE: _____
TFCC REFERENCE NO.: _____

1. The dimension and quantities of the space and facilities required to be provided are as follows:

(a) Main distribution frame room (MDF room)

MDF room	Length	Width	Height	Number of lead-in pipes
MDF room (1)				
MDF room (2)				

(b) Telecommunication Equipment Room (TER)

TER	Length	Width	Height	Number of lead-in pipes
TER (1)				
TER (2)				

(c) Telecommunication riser

Telecom riser	Length	Width	Height
Telecom riser (1)			
Telecom riser (2)			

2. The as-built dimensions and quantities of the space and facilities constructed are as follows:

(a) Main distribution frame (MDF room)

MDF room	Length	Width	Height	Number of lead-in pipes
MDF room (1)				
MDF room (2)				

CODE OF PRACTICE FOR INFO-COMMUNICATIONS FACILITIES IN BUILDINGS - INSPECTION CHECKLIST FOR SPACE AND FACILITIES

PROJECT TITLE: _____
TFCC REFERENCE NO.: _____

(b) Telecommunication equipment room (TER)

TER	Length	Width	Height	Number of lead-in pipes
TER (1)				
TER (2)				

(c) Telecommunication riser

Telecom riser	Length	Width	Height
Telecom riser (1)			
Telecom riser (2)			

(d) Underground pipes

Comment:

(e) Cable tray

Comment:

3. The joint inspection was conducted in the presence of:

(a) Developer or owner's Representative _____

Signature/Date _____

(b) TFCC Member (1) _____

Signature/Date _____

(c) TFCC Member (2) _____

Signature/Date _____

FORM 2.2 (Updated on 6 September 2011)

Date: [*dd-mmm-yyyy*]

Infocomm Development Authority of Singapore
10 Pasir Panjang Road
#10-01 Mapletree Business City
Singapore 117438

Attn: Director
Interconnection & Access Division

Dear Sir,

CODE OF PRACTICE FOR INFO-COMMUNICATIONS FACILITIES IN BUILDINGS – NOTIFICATION OF RECTIFICATION OF DEFECTS IN SPACE AND FACILITIES

PROJECT REFERENCE NO:
PROJECT TITLE:
BUILDING ADDRESS/ SITE:
BUILDING NAME:
TFCC Reference No.:

I refer to my letter titled "Building Facilities Code - Notification of Inspection of Space and Facilities" dated [*dd-mmm-yyyy*] and IDA's letter dated [*dd-mmm-yyyy*].

I hereby declare and confirm that I have rectified all defects identified during the joint inspection. The as-built dimension and quantity of the space and facilities provided are enclosed for IDA's information.

Yours faithfully

[*Developer or owner's name*]

Encl

FORM 2.2 (CONT'D)

CODE OF PRACTICE FOR INFO-COMMUNICATIONS FACILITIES IN BUILDINGS - INSPECTION CHECKLIST FOR RECTIFICATION OF DEFECTS IN SPACE AND FACILITIES

PROJECT TITLE: _____
TFCC REFERENCE NO.: _____

1. The dimension and quantities of the space and facilities required to be provided are as follows:

(a) Main Distribution Frame (MDF) room

MDF room	Length	Width	Height	Number of lead-in pipes
MDF room (1)				
MDF room (2)				

(b) Telecommunication equipment room (TER)

TER	Length	Width	Height	Number of lead-in pipes
TER (1)				
TER (2)				

(c) Telecommunication riser

Telecom riser	Length	Width	Height
Telecom riser (1)			
Telecom riser (2)			

2. The as-built dimensions and quantities of the space and facilities constructed and as rectified are as follows:

(a) Main distribution frame (MDF) room

MDF room	Length	Width	Height	Number of lead-in pipes
MDF room (1)				
MDF room (2)				

CODE OF PRACTICE FOR INFO-COMMUNICATIONS FACILITIES IN BUILDINGS - INSPECTION CHECKLIST FOR RECTIFICATION OF DEFECTS IN SPACE AND FACILITIES

PROJECT TITLE: _____
TFCC REFERENCE NO.: _____

(b) Telecommunication equipment room (TER)

TER	Length	Width	Height	Number of lead-in pipes
TER (1)				
TER (2)				

(c) Telecommunication riser

Telecom riser	Length	Width	Height
Telecom riser (1)			
Telecom riser (2)			

(d) Underground pipes

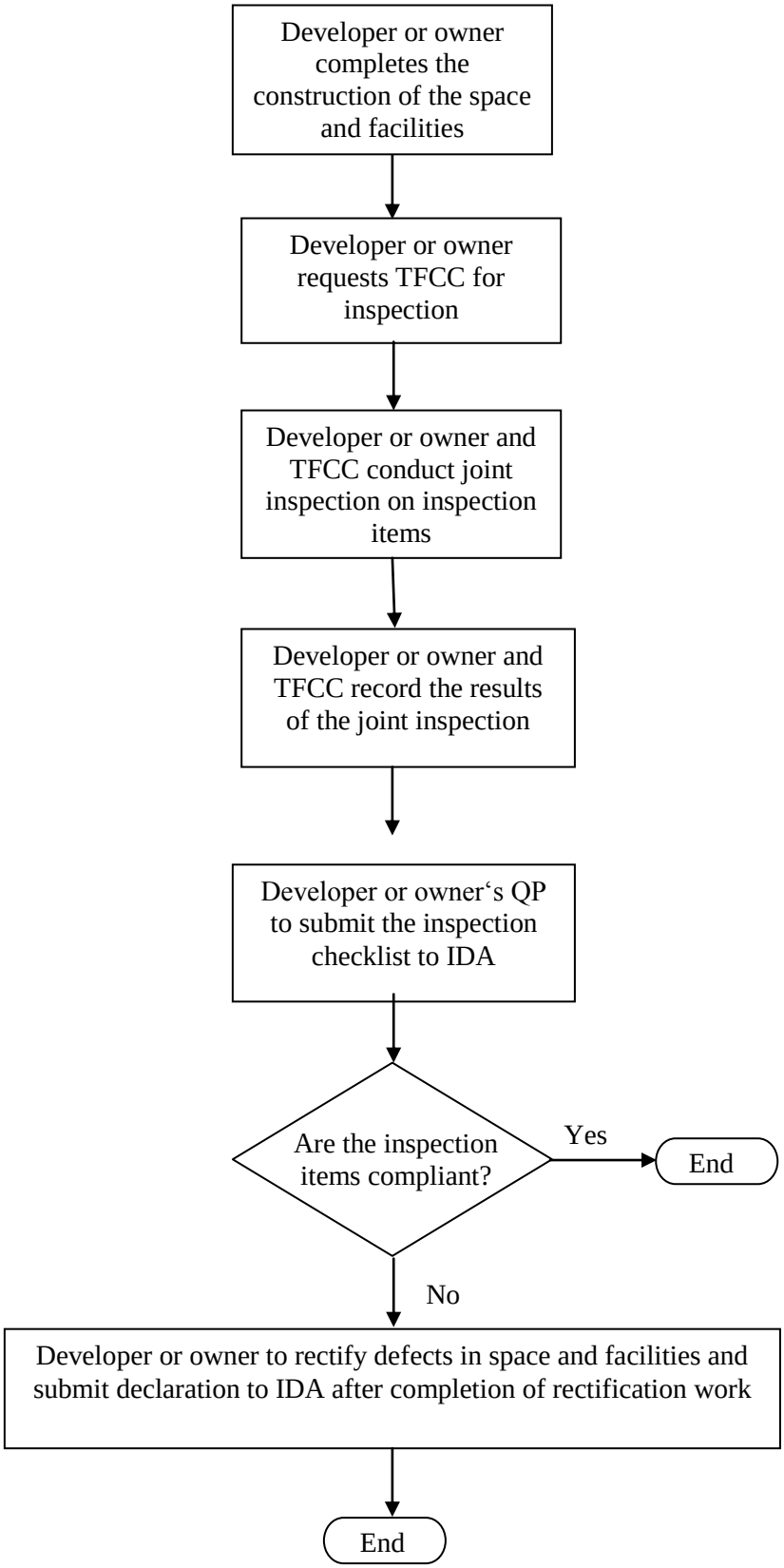
Comment:

(e) Cable tray

Comment:

CHART 2.3

INSPECTION PROCESS FLOWCHART



3. GENERAL REQUIREMENTS FOR PROVISION OF SPACE AND FACILITIES

3.1 Documentation

(a) A set of as-built installation drawings for a broadband coaxial cable system and a telecommunication (non-broadband coaxial cable) system shall be prepared by the developer or owner for each building type as specified in Chapters 4 to 9 of the COPIF. The drawings shall show the cable routes and distances, outlet identification, detailed drawings of distribution panels, operating parameters of amplifiers, splitters and couplers at each location, location of power source for the amplifiers, and other data that might be useful in carrying out maintenance and repair. For a broadband coaxial cable system, there should be a planned cable route from the broadband coaxial cable system's source port to the network input port.

(b) For a broadband coaxial cable system, the acceptance test data specified in Appendices 5 and 6 on test procedures should be recorded and preserved, including input frequencies and levels used for the tests.

(c) For a broadband coaxial cable system, the drawings and test data should be updated to show the effect of subsequent changes.

(d) The developer or owner of a building should maintain the records of the broadband coaxial cable system installed.

(e) All legends and symbols in the as-built drawings should be properly indicated. Upon request by the licensee, a copy of these drawings should be provided to them.

4. IN-BUILDING RADIO COVERAGE FOR PUBLIC MOBILE SERVICES

4.1 General

(a) Telecommunication system licensees operating public radio paging service networks, or 2G and/or 3G public cellular mobile telephone service networks face difficulty extending their network coverage into buildings and basements due to radio propagation characteristics. The difficulty faced by telecommunication system licensees in providing in-building coverage is particularly significant where building structures use materials unfavourable to radio signal penetration, e.g. metallic wall cladding, metalised window film, etc.

(b) This chapter serves to inform the developer or owner of the procedures and requirements so as to improve in-building coverage for public mobile services.

4.2 Responsibility of developer or owner

(a) These guidelines shall not exempt the developer or owner from obtaining:

(i) Licences from relevant authorities to install and operate radio equipment; and

(ii) Approvals from the relevant authorities for installation of physical structures and reinforcements to support antenna and other equipment, where necessary.

4.3 Official request to licensees

(a) The developer or owner may make an official request to any telecommunication system licensee who operates public mobile services for installation of radio equipment so as to improve in-building coverage.

(b) The developer or owner shall provide easy access to its premises at all times to licensees' staff to survey and conduct field tests to determine the suitability of in-building coverage.

(c) The licensees shall have the discretion to decide whether or not to improve the radio coverage of the building in the non-public area. At the discretion of the licensees, the cost of such improvement work may be charged to the developer or owner.

(d) In the event that the licensees undertake the in-building coverage improvement work, the developer or owner shall provide an equipment room and antenna support structure ready for installation of radio equipment. The key requirements are as follows:

(i) Antenna support structure at roof-top or on suitable external walls of a building. 3 mounting poles with minimum spacing of 2 m will be required for antenna mounting;

(ii) Straight-through cable riser of (200 x 100) mm from the basement of the building to the roof-top;

(iii) Cable tray of 200 mm width within the cable riser;

(iv) A PVC cable duct of 100 mm diameter across the ceiling above each floor including basement;

(v) A floor space of about 10 m^2 shall be provided preferably at the top floor, near the cable riser or with easy access to the riser through two 100mm cable ducts, for installation of radio equipment. The ceiling height should be at least 2500 mm. The 10 m^2 floor space should have a floor loading of at least 2.5kN/m^2;

(vi) Commercial electrical AC power supply of 230 V, 30 A isolator(s) terminated at a distribution board in the equipment room; and

(vii) Other space and facilities that the licensees require to be provided.

4.4 Enquiries

(a) Any enquiry on this chapter, including technical specifications, can be made to the respective licensees.

5. PUBLIC TELEPHONE BOOTHS

5.1 Procedures for requesting installation of public telephone booths

(a) The developer or owner is encouraged to cater and plan for sufficient public telephones within a public or commercial complex.

(b) Where public telephones are required, the developer or owner shall make arrangements with the respective telecommunication system licensees for the provision of such public telephones. The developer or owner shall submit building floor plans with the proposed installation of public telephone booths (See paragraph 5.2 of this chapter on the typical space and facilities requirement) to the licensees for consideration and agreement.

(c) In order to provide the building with the latest public telephone services and value-added features, the developer or owner shall furnish information related to the tenant structure and amenities available within the building or complex for licensee's early planning and discussion.

5.2 Typical space and facilities requirement for installation of public telephone booth

(a) Telephone cabling routes, if wall-mounted, shall preferably be concealed and outlets should be 1220 mm above finished floor level and 1600 mm apart for multiple installations. This is illustrated in Figure 5.1. For free-standing installation, spacing of floor outlets would be based on the dimensions of booths but generally shall be 915 mm apart.

(b) The developer or owner could also decide to have their own public telephone booth design. In which case, a full set of drawings of the proposed booth must be submitted to the telecommunication system licensees for consideration and study on its compatibility with the existing telephone instruments.

(c) The developer or owner shall make provision for a 230 V, 13 A power supply socket outlet near to the telephone outlet where the public telephones are proposed. Separate concealed power conduits should be laid and outlets shall be provided at each booth's position at 1220 mm above finished floor level, as shown in Figure 5.1.

5.3 Enquires

Any enquiries, including technical specifications, can be made to the respective licensees.

FIGURE 2-1 : TYPICAL CONDUIT FOR WALL MOUNTED PUBLIC TELEPHONE BOOTH

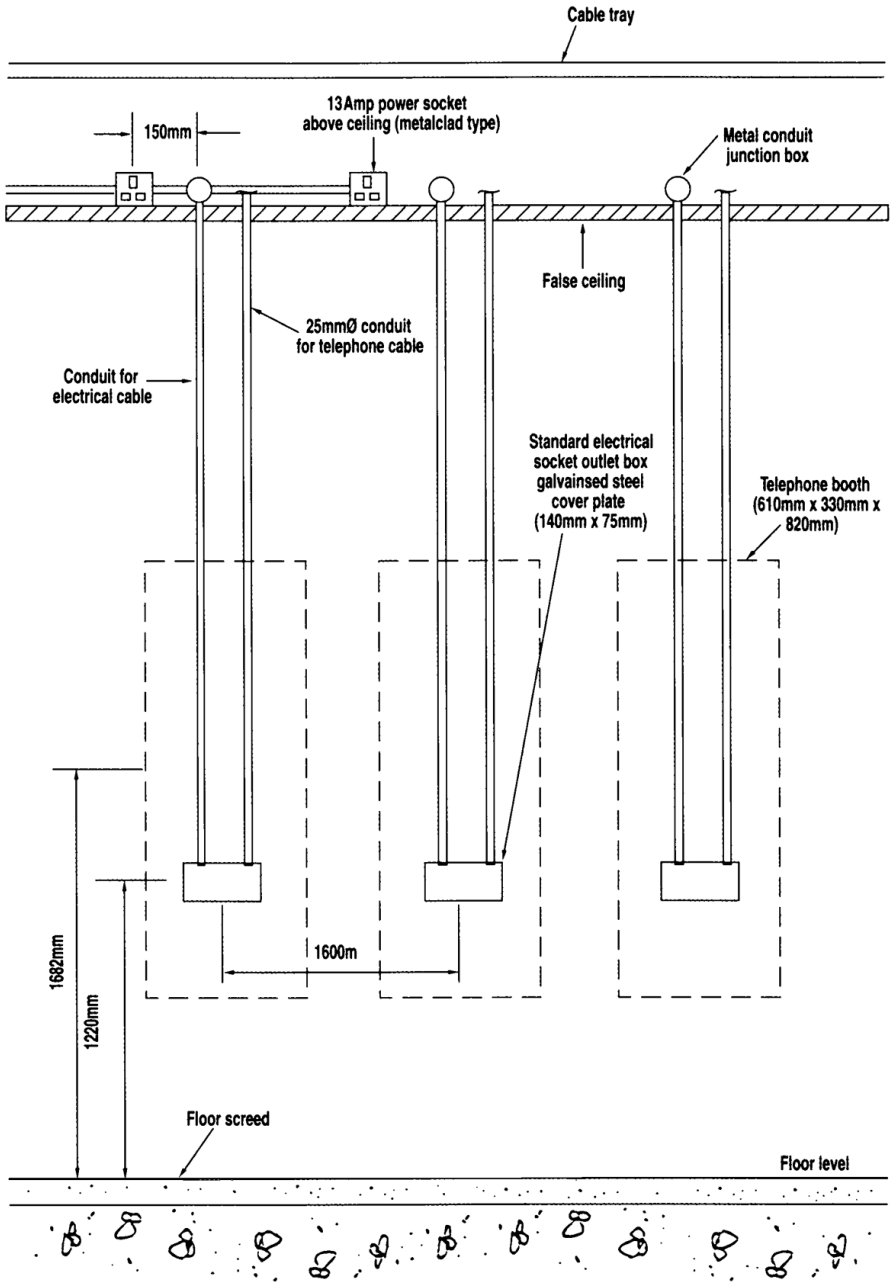


FIGURE 5.1: TYPICAL CONDUIT FOR WALL

6. ACCOMMODATION REQUIREMENTS FOR PABX/KTS/MLS

6.1 General

(a) Private Automatic Branch Exchange ("PABX") systems, Key Telephone Systems ("KTS") and Multi Line Systems ("MLS") are subscriber-owned telephone switching systems installed at subscribers' premises. Each system, depending on its size, represents a substantial capital investment by the subscriber and it would therefore be in the interest of the subscriber to ensure that the equipment is installed and accommodated at a secured location and in an environment conducive to the efficient operation of the system throughout its life-span.

(b) The accommodation requirements specified in this chapter are designed to provide the environmental conditions necessary to ensure continuous satisfactory performance of the equipment and expeditious maintenance service by the respective equipment suppliers.

(c) Generally, for a telephone switching system with an ultimate capacity exceeding 100 extensions, a separate room exclusively occupied by the equipment may be required (See paragraph 6.3 of this chapter).

(d) In the case of a MLS in which the equipment consists of more than two cabinets, a separate room for the equipment is preferred.

6.2 Accommodation requirements

(a) The accommodation provided by the developer or owner for a telephone switching system, in particular a PABX system, shall:

(i) be free of perceptible vibration, noise, steam, fumes, gases, dust, water seepage, sunshine and rain;

(ii) be air-conditioned with a recommended temperature of 20°± 2°C;

(iii) be maintained at relative humidity of 60% ± 10%;

(iv) be provided at all times a minimum clearance of 0.9 m in front of the equipment, its associated apparatus, distribution case and relevant accessories. This is measured from its most prominent points when opened to the fullest extent. The non-working aisles shall not be less than 0.6 m in width;

(v) be securely locked and not entered by any unauthorised person(s);

(vi) not be used for any other purposes other than the accommodation of the equipment and its associated accessories;

(vii) be away from water/sewerage pipes, sources of electrostatic energy, electric power cables, air-conditioning ducts or any other mechanical & electrical ("M&E") services;

(viii) have not have a water sprinkler in the room or rooms associated with the accessories;

(ix) be sufficiently lit to ensure that all accessible parts of the equipment are clearly visible to the equipment maintenance staff. The illumination level shall be at least 500 lux and fluorescent lighting is preferred;

(x) be provided with a power point within 2 m of the equipment for the use by the maintenance staff;

(xii) have its equipment located away from photocopy machines or any other equipment/ materials which may generate strong electrostatic field;

(xiii) if the equipment is required to be mounted or secured to a wall, the developer or owner shall be responsible for the design and construction of the wall to withstand the loading of the equipment during its life. For a fully wall-supported unit, the strength of the wall must be adequate to accept a total weight of at least one and a half times the weight of the equipment; and

(xiv) if the equipment is floor standing, the floor covering should not impede the movement of the equipment cabinet. The floor covering used should also be a type where it is prone to causing of electrostatic discharges.

6.3 Separate room

(a) The developer or owner may provide a large room to be partitioned into an equipment room, telephone switchboard operator's room, a standby battery room (if required) and an intermediate distribution frame room for systems with an ultimate capacity exceeding 250 extensions. A separate intermediate distribution frame room is not necessary for telephone switching systems with a capacity of less than 250 extensions.

(b) The floor area of the room will depend on the ultimate size and type of telephone switching system desired. It is prudent at this stage to provide a reasonable allowance for any anticipated future expansion of the system.

(c) A cabinet shall be provided for the storage of maintenance manuals, telephone extension records and spare parts, if applicable.

(d) If a standby battery is required, it shall be located close to but physically partitioned from the equipment so as to prevent the harmful effect of the battery's acid fumes on the equipment.

(e) It is recommended that an intermediate distribution frame be provided regardless of the number of extensions to be installed. However, a separate room to accommodate the intermediate distribution frame is not necessary in all cases.

(f) The intermediate distribution frame and battery room should be well ventilated with filtered air (for the standby battery room, the air change rate should be a minimum rate of 20 air changes per hour) to ensure this, the installation of a lourve ventilation and/or exhaust fan is necessary. The maximum temperature should not exceed 28°C.

6.4 Separate underground pipes and manholes

Every developer or owner who installs PABX systems, KTS or MLS within the subscribers' premises, shall provide separate underground pipes and manholes to cater for its own cables serving different buildings or locations.

6.5 Separate telecommunication risers

Every developer or owner who installs PABX systems, KTS or MLS within the subscribers' premises, shall provide separate telecommunication risers to house its own cables.

7. CABLE DISTRIBUTION SYSTEMS

7.1 General

(a) Cable distribution systems are the facilities provided to distribute telephone cables installed from the main distribution frame room or telecommunication equipment room to the telecommunication risers and from telecommunication risers to the telephone outlets.

(b) The design and capacity of the distribution system shall be flexible enough to accommodate any re-arrangement of premises layout or the growing telecommunication needs of the tenants of the building.

(c) A properly designed distribution system with adequate telephone outlets will ensure that cables can be installed or changed at anytime, with minimum inconvenience caused to tenants of the building and without affecting the structure or appearance of the building. Therefore, where it is possible to plan the position of the outlets, for example in residential buildings, it is advisable to plan for as many outlets as desired (Figure 7.1).

(d) The types of cable distribution system that can be used in a building generally depend on the types of buildings. Buildings can broadly be categorised into residential and non-residential buildings.

(e) The types of cable distribution systems suitable for use in a **non-residential building** can either be concealed or exposed.

(i) **Concealed distribution systems** comprise of the following:

(A) Under-floor duct distribution system;

(B) Raised floor system;

(C) Cellular floor distribution system;

(D) Ceiling distribution system;

(E) Perimeter raceway distribution system;

(F) Poke-through distribution system; and

(G) Conduit distribution system.

Note: Certain non-residential buildings may require a combination of two or more of the above mentioned systems for distributing telecommunication cables.

(ii) **Exposed distribution systems** comprise of the following:

(A) Cable tray;

(B) Exposed conduit; and

(C) Exposed trunking.

Note: Exposed distribution systems are normally used in places where concealed distribution systems are not practical or where aesthetics is not important.

(f) Due to the relatively low telephone density and generally stable telephone locations in **residential buildings**, suitable types of distribution systems are as follows:

(i) Under floor distribution system;

(ii) Perimeter raceway distribution system;

(iii) Ceiling distribution system; and

(iv) Multi-riser system.

Note: Certain residential buildings may have a combination of two or more of the above mentioned systems for distributing telecommunication cables.

(g) **Capacity of distribution system**

It is important to note that for all the systems mentioned, the practical capacity of a raceway, be it a duct, a conduit or a trunking is considerably less than the theoretical capacity. This is because the helix of the cable is normally retained even when the cables are unwound, thereby causing the cables to wrap round one another and occupy a larger area of the raceway than the theoretical value.

(h) **Identification of distribution system**

To identify and differentiate the telecommunication cable distribution system from cabling facilities for other utilities/services, all ducts, cable trays, trunkings, conduits, etc. for distributing telephone cables shall be painted white and labelled “Telecommunications”.

(i) **Surface cabling**

It is important to note that for concealed cables that become defective after installation and are not accessible, the telecommunication system licensees or wiring contractors shall replace the cables using the surface cabling method, unless additional facilities suitable for concealed cabling are provided.

(j) **Segregation of service**

It is important to segregate the cabling systems to accommodate different types of telecommunication services (e.g. telephone and broadband coaxial cable services) to minimise the possibility of any interference.

(k) **Earthing of metal parts**

All metal parts of the distribution system shall be effectively earthed complying with the following standards:

(i) Singapore Standard CP5: Code of Practice for Electrical Installations; and

(ii) Singapore Standard CP16: Code of Practice for Earthing.

7.2 Cable distribution systems for non-residential building

The requirements of the various types of distribution systems suitable for use in non-residential buildings are listed in the following paragraphs.

(a) **Under-floor duct distribution system for non-residential buildings**

(i) General:-

(A) A properly designed under-floor duct distribution system is a good method for distributing telephone cables (Figure 7.2).

(B) The under-floor duct distribution system suitable for use in non-residential buildings may be designed with total access or with junction box access.

(C) An under-floor duct distribution system designed with total access throughout its entire length to enable easy installation and maintenance of cables is known as the trench duct system (Figure 7.3).

(ii) Basic requirements:-

(A) The under-floor duct should extend into the telecommunication riser and link to the floor trench (Figures 7.4 & 7.5).

(B) The under-floor duct distribution system should be designed to enable access with little or no disruption to the tenants. Access to the system should be from the floor it is designed to serve, and not from the adjacent floor.

(C) The under-floor duct distribution system should be designed with the main junction boxes along the common corridor area or passageway (Figure 7.6).

(D) The under-floor duct distribution system should be free from internal roughness, sharp edges, moisture and dirt.

(E) The under-floor duct distribution system should be provided with floor outlets to lead the telecommunication cables out of the ducts (Figure 7.7).

(F) For an under-floor duct distribution system with junction box access, the thickness of the floor screed on top of the ducts should not exceed 40 mm for ease of carrying out cabling work.

(iii) Duct:-

(A) The size of the under-floor duct should be such that the cross-sectional area of all the cables accommodated within a duct does not exceed 30% of the cross-sectional area of the duct. Chapter 9 of these Guidelines lists the specification containing the dimensions of the different types of cable used.

(B) The under-floor duct should be made of either high impact rigid PVC or galvanised metal or steel of welded construction and of sufficient thickness.

(C) The under-floor duct should be of a minimum internal height of 25 mm.

(D) A nylon draw wire should be provided in the duct between every two adjacent junction boxes.

(iv) Junction boxes:-

(A) The under-floor duct distribution system should be provided with junction boxes at all junctions and bends to enable drawing of telecommunication cables. The distance between two junction boxes in a straight run should preferably not exceed 6 m (Figure 7.8).

(B) Where it is not practical to have a junction box at a bend, the bend should have a minimum radius of about six times the width of the duct.

(C) The size of the junction box should increase proportionately with that of the floor ducts.

(D) The cover of the junction box should preferably be square. Junction box cover should be secured to the junction box by means of screws or other acceptable means (Figure 7.9). The screws should remain intact on the junction box cover when the cover is removed.

(E) The junction box cover should be as close-fitting as possible and flushed with the floor surfaces. The cover should be sufficiently robust to resist damage by floor cleaning equipment.

(F) All junction boxes and telephone outlets should be readily accessible at all times. Walls or partitions should not be constructed on top of them (Figure 7.10).

(G) For carpeted floors, appropriate slits should be made on the carpet at all junction boxes and floor outlets to enable access to the floor ducts. Figure 7.11 illustrates one method of providing the access to the junction box for carpeted floors.

(H) Under special circumstances, the junction-box cover may be cut to accommodate the floor outlet except in common areas that are prone to washing or mopping (e.g., common corridors and lift lobby areas). Any cutting required on a junction-box cover should be done along the edges of the cover.

(v) Responsibility of developer or owner:-

The developer or owner should install and maintain the outlets and junction boxes.

(vi) The advantages of an under-floor duct distribution system are as follows:-

(A) Cables are well protected in the ducts, therefore interruption of service caused by physical damage to cables is minimised;

(B) Appearance of the premises is enhanced as the ducts are concealed under the floor screed; and

(C) Safe and easy working position.

(vii) The disadvantages of an under-floor duct system are as follows:-

(A) Difficult to access junction boxes or header ducts when floor is covered with carpet; and

(B) Water can seep through the junction boxes and damage the cables.

(b) **Raised floor distribution system for non-residential buildings**

(i) General:-

(A) A raised floor distribution system is a floor assembly superimposed upon an existing floor. Telecommunication cables are distributed in the space between the floor and raised floor assembly (Figure 7.12).

(B) A raised floor distribution system is usually used in computer rooms and offices with a high number of telecommunication lines.

(C) The floor assembly consists of a series of square modules of steel plates or panels or concrete slabs resting upon pedestals (Figure 7.13).

(ii) Basic requirements:-

(A) The raised floor panels should be supported on pedestals that are of a height sufficient to ensure a clear working space of at least 25mm below the floor panel.

(B) Trunking or cable trays should be provided to segregate telecommunication cables from electrical cables and cables of other services placed below the raised floor.

(iii) The responsibilities of the developer or owner are as follows:-

(A) The developer or owner should provide concealed floor fittings or suitable outlets for the telecommunication cables.

(B) The developer or owner should provide the trunkings or cable trays required to segregate telecommunication cables from electrical cables and cables of other services placed below the raised floor (Figure 7.14).

(C) The developer or owner should be responsible for removing and replacing floor panels.

(D) The developer or owner should possess the necessary fitting devices for removing or replacing the floor panels.

(iv) The advantages of a raised floor distribution system are as follows:-

(A) Cables are well protected below the raised floor, therefore interruption of service caused by physical damage to cables is minimised;

(B) Appearance of the premises is enhanced as the cables are concealed under the floor;

(C) Safe and easy working position;

(D) Any change in telecommunication requirements can be easily catered for; and

(E) Ability to accommodate a large number of cables.

(v) The disadvantages of a raised floor distribution system are as follows:-

(A) It is more costly to provide the system comparing with other distribution systems;

(B) The system may produce sound when walked upon; and

(C) Broadloom carpet cannot be used.

(c) **Cellular floor distribution system for non-residential buildings**

(i) General:-

(A) A cellular floor distribution system serves as a structural floor as well as a system for distributing telecommunication cables and cables of other services. Figure 7.15 shows the different compartments of a typical cellular floor system.

(B) The cellular floor distribution system comprises the distribution cells, which are mainly constructed of steel but concrete distribution cells can also be used, and header duct or trench header, which are used to link the distribution cells to the telecommunication riser.

(C) The cellular floor distribution system is basically a two-level system with the distribution cells on the lower level and header duct or trench header on the upper level.

(D) The layout of the distribution system and the design of the structural floor and its supporting members should be integrated.

(ii) Cellular floor system with header duct:-

(A) A header duct is installed on top of the distribution cell. It provides permanent and ready access to distribution cells which run at a right angle to it.

(B) Junction boxes are provided on the header duct.

(C) Since the header duct is the link between the distribution cells and the telecommunication riser, it is important that adequate capacity be provided.

(iii) Cellular floor system with trench header:-

(A) A trench header is a metallic trough that is flushed with the finished floor. It provides permanent and ready access to distribution cells that run at right angle to it.

(B) A trench header is equipped with removable steel cover plates for its entire length.

(C) If the trench header has two or more compartments to distribute cables of different services such as power and telecommunication, the segregation is maintained throughout the trench header.

(iv) Basic requirements:-

(A) The main trench header or header duct should be installed along the common corridor of the building and made accessible at all times.

(B) No partition should be constructed on top of the trench header or the duct junction box of the header duct.

(C) The number of preset insert units provided should meet the telecommunication needs of the building. Generally, it is recommended that every 1.8 m^2 of the floor space should have at least one preset insert unit.

(v) The responsibilities of the developer or owner are as follows:-

(A) The developer or owner should remove the covers of the trench header and any furniture resting on the covers, when installation or maintenance of telecommunication cables in the distribution system is being carried out.

(B) The developer or owner should possess the necessary equipment for removing trench header covers and detecting the preset insert units.

(C) The developer or owner should locate and make available the individual preset insert unit connected to the cell to enable installation of telephone cables.

(D) The developer or owner should undertake to drill the concrete floor and install after-set inserts at locations where telecommunication services are required and preset insert units are not available.

(vi) The advantages of a cellular floor system are as follows:-

(A) Cables are well protected in the cells, trench headers and header ducts, therefore interruption of service caused by physical damage to the cables is minimised;

(B) Appearance of the premises is enhanced as the trench or duct and the cells are concealed in the floor slab;

(C) Safe and easy working position; and

(D) The system can distribute a large number of cables.

(vii) The disadvantages of a cellular floor system are as follows:-

(A) More coordination is required. This is because the preset insert units need to be located prior to installation of telecommunication services; and

(B) Water can seep through the floor cells and damage the cable.

(d) **Ceiling distribution system for non-residential buildings**

(i) General:-

(A) The ceiling distribution system can be used when there is adequate ceiling space. The system comprises cable trays/trunkings, conduits and/or utility poles (Figure 7.16).

(B) In a ceiling distribution system, telephone cables are laid onto cable trunking or laid and tied with cable ties onto the cable trays within the ceiling space and routed to the telephone outlets by means of conduits or utility poles.

(ii) Basic requirements:-

(A) Where cable trays/trunkings/conduits are concealed in false ceilings of ceiling strips or boards that are not easily accessible, access panels should be provided for easy and unrestricted access to the cable trays (Figure 7.17).

(B) The dimension of the access panels should not be less than 600mm x 600mm, and they should preferably be provided at regular intervals of 6m as well as at positions where there is a change in the direction of the cable trays/trunkings/conduits.

(C) The passage between the ceiling trays/trunkings and the ceiling slabs should ideally be free from obstructions such as air-conditioning ducts, fire sprinklers, electrical trunkings, water pipes, etc. When obstructions are unavoidable, a minimum clearance as indicated in Figure 7.18 should be maintained.

(D) The cable trays and trunkings should be in accordance with the specifications described in paragraphs 7.2 (h) and 7.2 (j) respectively.

(E) 'L' brackets used for supporting cable trays should be installed in the same direction.

(iii) Responsibility of developer or owner

The developer or owner should be responsible for removing and replacing ceiling boards.

(iv) The advantages of a ceiling distribution system are as follows:-

It provides a flexible mean of distributing telephone cables to specific locations.

(v) The disadvantages of ceiling distribution system are as follows:-

(A) Ceiling boards must be made removable, and there is a high possibility of them being damaged or tainted due to frequent removal and replacement of these boards; and

(B) It may cause disruption to the tenants and environment when telephone wire installation or maintenance work is being carried out.

(e) **Perimeter raceways distribution system for non-residential buildings**

(i) General

(A) Perimeter raceways are ducts or trunkings installed along the perimeter of a room, shop or an office to distribute and conceal telecommunication cables.

(B) The perimeter raceway ducts or trunkings are either surface mounted or recessed into the base of the wall to form a skirting.

They can also be mounted at any height along the wall provided that these raceways will not be obstructed by signboards, etc., to be erected by potential tenants or shop-owners (Figures 7.19, 7.20 & 7.21).

(C) The ducts and trunkings can be constructed of metal, plastic or wood.

(D) Perimeter raceways come in various sizes and may be divided into two or more compartments to accommodate power, telecommunication and cables of other services (Figure 7.22).

(E) A sleeve through the wall can be used to connect telecommunication outlet points in adjacent rooms that are on the same floor.

(ii) Basic requirements

(A) The perimeter raceways should be provided with removable covers placed at a regular interval of 2m. The power and telecommunication sockets should preferably remain intact on the case of the raceway when the covers are removed.

(B) Multi-compartment perimeter raceways should be designed to ensure that electrical cables will remain in their compartments when the covers are removed.

(C) Fittings for mounting telephone sockets should be provided.

(D) If telecommunication cables cross the compartment for electrical cables, a "cross-over" or "bridge" must be provided to maintain segregation.

(iii) Responsibility of developer or owner:-

The developer or owner should be responsible for removing any object that may obstruct the removal of the covers from the raceways.

(iv) The advantages of a perimeter raceway system are as follows:-

(A) It can serve both as a skirting and a raceway for routing cables.

(B) Telecommunication outlets may be conveniently placed anywhere along the raceway.

(v) The disadvantages of a perimeter raceway system are as follows:-

(A) Extensive use of this system is made difficult by the columns and doors in the buildings; and

(B) It is only suitable for premises where the telephones are placed near the wall. In large offices where telephones are required in the centre of the offices, other types of distribution systems such as under-floor ducts need to be incorporated (Figure 7.23).

(f) **Poke-through distribution system for non-residential buildings**

(i) General

(A) In poke-through distribution systems, the telecommunication cables are concealed in conduits or laid on cable trays/trunkings placed within the ceiling space and are poked through the floor structure to the offices or shops above (Figure 7.24).

(B) This poke-through distribution system is vulnerable to the spreading of fire, gases, and smoke from floor to floor. Therefore, the use of this system must comply with Fire Safety and Shelter Department (FSSD)'s requirements.

(ii) The poke-through distribution system has many disadvantages and is therefore not recommended for use. When holes are drilled through the floor slab, the following may occur:

(A) Allow the passage of liquid and dirt to the floor below.

(B) Cause the spreading of fire, gases and smoke from floor to floor.

(C) Cause disturbance to tenants on the lower floor while workmen are providing and maintaining telecommunication services to tenants on the floor above.

(g) **Conduit distribution system for non-residential buildings**

(i) General

(A) Conduits can be used to distribute cables in those parts of a building where the telephone density is low and flexibility in changing the telephone location is not required. Examples of such areas of a building are guest rooms in a hotel and patient rooms in a hospital.

(B) The telephone positions in the hotel guest rooms and hospital patient rooms can be fixed and are unlikely to change in position. Conduits are used to distribute the cable to each room (Figure 7.25).

(C) Other types of distribution systems such as the under-floor duct system are used to serve the other areas of the building, e.g., administration office, where flexibility in changing telephone location is required.

(ii) Basic requirements

(A) The size of the conduit should be such that the cross-sectional area of all the cables placed in the conduit does not exceed 30% of the cross-sectional area of the conduit. The recommended capacities for conduits are as shown in Table 7.1.

Table 7.1 Recommended capacities for conduits

Conduit Size Mm	**Recommended numbers of cable**							
	4-way	6-way	8-way	5-pair	10-pair	20-pair	40-pair	80-pair
25	6	4	4	2	1	1	0	0
32	10	7	6	4	2	1	1	0
38	15	11	9	7	4	2	1	0
50	-	-	-	-	7	5	2	1

(B) Conduits should preferably be of at least of diameter of 25mm.

(C) Conduits provided should be as straight as possible and should be rigidly mounted.

(D) Conduits should be provided with junction boxes to enable drawing of cables. The distance between two junction boxes in a straight run should preferably not exceed 6m. A junction box should also be provided at all junctions and bends.

(E) Where it is not practical to have a junction box at a bend, the bend should have a minimum radius of about six times the internal diameter of the conduit. Not more than one such bend is allowed between two junction boxes and the distance between them should preferably be not more than 2m.

(F) A nylon draw wire should be provided in the conduit between every two junction boxes to enable the drawing of cables.

(G) Flexible conduits should not be used.

(H) Conduits should be free from internal roughness, sharp edges, moisture and dirt.

(h) **Cable trays**

(i) Basic requirements

(A) The material used for the cable tray should be perforated and galvanised;

(B) All cable trays should be truly aligned and securely mounted;

(C) Cable trays should not be routed through toilets, high-tension (HT) switch rooms, and other non-accessible areas;

(D) Cable trays should be straight run, and for any change in direction, the bend should have a minimum radius of 600 mm (Figure 7.26);

(E) No bolts, screws or sharp objects should protrude through the cable-bearing surface of the trays;

(F) The cable tray support must be L-shaped or inverted T-shaped;

(G) Where cable trays run alongside or across high-tension electrical cable, they should be separated for their entire length by a clearance as specified in Chapter 2, paragraph 2.2 of these Guidelines. The high-tension cable should be clearly indicated by signs or symbols;

(H) The maximum height of cable trays for horizontal cabling should not exceed 3.3 m from the floor level;

(I) The minimum clearance between ceiling/beam and cable tray should be 300 mm;

(J) For cable trays in a false ceiling, there may be instances that require cable trays to be replaced with pipes for easy installation of cable. For such cases, access must be provided in the false ceiling at appropriate locations;

(K) Slots provided in the wall for cable trays to go through should have a minimum height of 300 mm; and

(L) Where cable trays are concealed in false ceilings, the panels of the false ceiling should be fully and easily removable to allow unrestricted access.

(i) **Surface conduits**

(i) General:-

(A) The requirements for conduits, mounted and exposed along walls are similar to conduits that are concealed under-floor or in the ceiling. Please see paragraph 7.2 (g) for detailed requirements.

(B) For surface mounted conduits, the maximum height of the conduits for horizontal cabling should not exceed 3.3m from the floor level.

(j) **Exposed trunkings**

(i) Basic requirements:-

(A) The size of the trunking should be such that the cross-sectional area of all the cables placed in the trunking does not exceed 30% of the cross-sectional area of the trunking. Please refer to Table 7.1 for the amount of cables of various sizes that can be installed in conduits of various sizes.

(B) Trunking provided should be as straight as possible and should be rigidly mounted.

(C) The maximum height of the trunking for horizontal cabling should not exceed 3.3 m from the floor level.

(D) Trunking should be mounted so that access to the trunking is from the top. If access to the trunking is from the side, cable retainers must be provided at regular intervals inside the trunking to ensure that the cables are held in position when the covers are removed.

(E) The cover of the trunking should preferably be friction fit or secured by simple device (not screws) to permit easy access (Figure 7.27).

(F) Outlets should be provided along the side of the trunking.

(G) The trunking should be free from internal roughness, sharp edges, moisture and dirt.

(H) Segregation of telecommunication cables from electrical cables should be in accordance with Chapter 2, paragraph 2.2 of these Guidelines.

(k) **Concealed cabling in office furniture**

(i) General:-

Office furniture with built-in channels to conceal cables is becoming more frequently used. This furniture includes not only free-standing desks, but also flexible screens that are fitted adjacent to the desks and which can accommodate shelving, etc.

(ii) To ensure a safe and efficient system, this office furniture should meet the following basic requirements:

(A) The cable channel should be easily accessible for the installation of cables by the telecommunication system licensees' or the tenants' wiring contractors;

(B) Segregation of telecommunication cables and power cables should be maintained;

(C) If metal channels or ducts are used, they should be installed and earthed according to the Singapore Standards: CP5: 'Code of Practice for Electrical Installations' and CP16: 'Code of Practice for Earthing';

(D) When the cable channels are part of a flexible screen, the cable across the flexible junction between the screen panels should be protected and flexing of the panels should be prevented after the cables have been installed;

(E) The furniture should be positioned as close to the socket outlet points as possible; and

(F) Once the cables are installed, movement of the furniture should be minimised.

(l) **Suitable distribution systems for various types of premises**

The suitable distribution systems for various premises are as shown below in Table 7.2.

Table 7.2 Suitable distribution systems for various types of premises

Type of Distribution System							
Types of Premises	**Under-floor Duct**	**Raised Floor**	**Cellular Floor**	**Ceiling Distribution**	**Exposed Cable Tray**	**Exposed Conduit**	**Exposed Trunking**
Shop-houses Without Management Corporation				✓	✓	✓	✓
Shop-houses in HDB Residential Blocks				✓	✓	✓	✓
Shopping Centres	✓			✓	✓	✓	✓
Office Complexes	✓	✓	✓	✓	✓	✓	✓
Factories (Terrace & Flatted)	✓			✓	✓	✓	✓
Markets, Hawker/Food Centres				✓	✓	✓	✓

7.3 Cable distribution systems for residential buildings

The requirements of the various types of distribution systems suitable for use in residential buildings are listed in the following paragraphs.

(a) Under-floor distribution system for residential buildings

(i) General:-

(A) Under-floor distribution system suitable for use in residential buildings is constructed of either ducts, conduits, or a combination of both.

(B) At common corridor areas, the ducts or conduits are laid in the floor slab to distribute cables from the telecommunication riser. Junction boxes are provided at all junctions and bends (Figure 7.28).

(C) Within each residential unit, conduits are used to distribute the cables to various telephone outlets in each room within the unit (Figure 7.29).

(ii) Basic requirements:-

(A) The duct or conduit at common corridor areas should extend into the telecommunication riser (Figure 7.30).

(B) For joint-usage with electrical cables, a separate compartment should be provided for telecommunication cables. The

segregation requirements should be in accordance with chapter 2, paragraph 2.2 of these Guidelines.

(C) Under-floor ducts or conduits should be made of either galvanised metal or high impact rigid PVC.

(D) The duct or conduit should be free from internal roughness, sharp edges, moisture or dirt.

(E) The thickness of the floor screed on top of the ducts should not exceed 40 mm for ease in carrying out cabling work.

(iii) Common corridor area:-

(A) The system should be provided with junction boxes at all junctions and bends to enable drawing of telecommunication cables. The distance between two junction boxes in a straight run should preferably not exceed 6 m (Figure 7.8).

(B) Where it is not practical to have a junction box at a bend, the bend should have a minimum radius of about six times the internal diameter of the conduit or six times the width of the duct, whichever is applicable. Not more than one such bend is allowed between two junction boxes.

(C) The size of the junction box should increase proportionately with that of the floor ducts.

(D) The cover of the junction box should preferably be square. Junction box covers should be secured to the junction box by means of screws or other means acceptable to the telecommunication system licensee. The screw should remain intact on the junction box cover when the cover is removed.

(E) The junction box cover should be as close-fitting as possible and flushed with the floor surfaces. The cover should be sufficiently robust to resist damage by floor cleaning equipment.

(F) For carpeted floors, appropriate slits should be made on the carpet at all junction boxes to enable access to the floor ducts.

(G) All junction boxes should be readily accessible at all times.

(H) A nylon draw rope should be provided in the duct or conduit between every two adjacent junction boxes.

(iv) Within each residential unit:-

(A) Conduit laid inside the housing unit should have a maximum of two 'L' bends between two outlets. These bends must be smooth and gradual. Prefabricated gradual bends are preferred.

(B) Conduits should preferably be of at least 25 mm in diameter.

(C) The conduit should be free from internal roughness, sharp edges, moisture and dirt.

(D) The conduit should be as straight as possible and should be rigidly mounted.

(v) Responsibility of developer or owner:-

The developer or owner should be responsible for opening the junction box cover, when required by telecommunication system licensees to provide telephone service.

(vi) The advantages of an under-floor system are as follows:-

(A) Cables are well protected in the duct and conduits, therefore interruption of services caused by physical damage to cables is minimised;

(B) Appearance of the premises is enhanced as the ducts or conduits are concealed in the floor slab; and

(C) Safe and easy working position.

(vii) The disadvantages of an under-floor distribution system are as follows:-

(A) Junction boxes must be made accessible even when covered with carpet; and

(B) Water can seep through the junction box and damage the cable.

(b) **Perimeter raceway distribution system**

Perimeter raceways that are suitable for use in residential buildings to distribute cables are similar to those used in commercial buildings. For details on the system, please refer to paragraph 7.2 (e).

(c) **Ceiling distribution system**

(i) General:-

(A) Cable trays or conduits are used to distribute telecommunication cables along common corridors in residential building.

(B) From the cable tray or conduit along common corridors, the cables leading to an individual residential unit and within the unit can be routed using conduits installed above false ceiling and brought down to socket point through conduit in the wall.

(ii) Basic requirements:-

(A) Where cable trays/trunkings/conduits are concealed in false ceiling, access panels should be provided for easy and unrestricted access to cable trays/trunkings/conduits.

(B) The dimension of the access panels should not be less than 600 mm x 600 mm, and they should be provided at regular intervals of 6m as well as at positions where there is a change in the direction of the cable trays/trunkings/conduits.

(C) All cable trays should be truly aligned and securely mounted.

(D) Cable trays should not be routed through toilets, high-tension (HT) switch rooms, and other inaccessible areas.

(E) "L" brackets for supporting cable trays should be installed in the same direction.

(F) No bolts, screws or sharp objects should protrude through the cable bearing surface of the trays.

(G) Where cable trays run alongside or across electrical cable, segregation according to the specifications stipulated in chapter 2, paragraph 2.2 of these Guidelines should be compiled with.

(H) The maximum height of cable trays for horizontal cabling should not exceed 3.3m from the floor level.

(I) There should be a minimum clearance of 50mm between the cable tray and any obstruction above it. The space between the tray and false ceiling should be between 75mm and 150mm (Figure 7.18).

(iii) Where conduits are used within each residential unit to distribute telecommunication cables above a false ceiling, the following requirements should be met:

(A) Each conduit can have a maximum of two "L" bends. The bends should be smooth and gradual. Prefabricated gradual bends should be preferred. The distance between any two bends should preferably not exceed 2m;

(B) Where many bends are required, junction boxes should be provided at these bends to permit cabling works. An access

panel or removable ceiling board should be provided at every junction box location;

(C) Conduits should preferably be of at least of diameter of 25 mm.

(D) The conduit should be free of internal roughness, sharp edges, moisture and dirt;

(E) The conduit should be as straight as possible and should be rigidly mounted;

(F) Conduit within each residential unit should be used to lead the cable from false ceiling to each socket outlet on the wall (Figure 7.31);

(G) The socket outlet within each residential unit should be located at least 300 mm above floor level;

(iv) Responsibility of developer or owner:-

The developer or owner should be responsible for removing and replacing ceiling boards to enable the telecommunication system licensee's serviceman to have access to the cables above the false ceiling.

(v) The advantages of a ceiling distribution system are as follows:-

(A) It provides a flexible means of distributing telephone cables to specific locations.

(B) The possibility of physical damage to cables is minimised as the cables are protected if conduits are used.

(vi) The disadvantages of ceiling distribution system are as follows:-

(A) Telecommunication cables maybe damaged when other work is being done in the ceiling area;

(B) Ceiling boards should be made removable, and there is a high possibility of them being damaged or dirtied due to frequent removal and replacement; and

(C) Dirt and debris may be deposited on surrounding furniture when ceiling boards are removed and replaced.

(d) **Multi-riser system**

(i) General:-

(A) Instead of providing one telecommunication riser in a multi-storey residential building to serve all the units on the same

floor, a multi-riser system with one telecommunication riser serving one or more units per floor can be used (Figure 7.32).

(B) The telecommunication riser should have outlets at every housing unit. Wherever possible, the outlets should be located at the anticipated telephone locations to eliminate the cost of providing additional distribution systems from the outlet(s) to the telephone locations.

Figure 7.1: Location of telephone outlets & block terminal in a residential unit

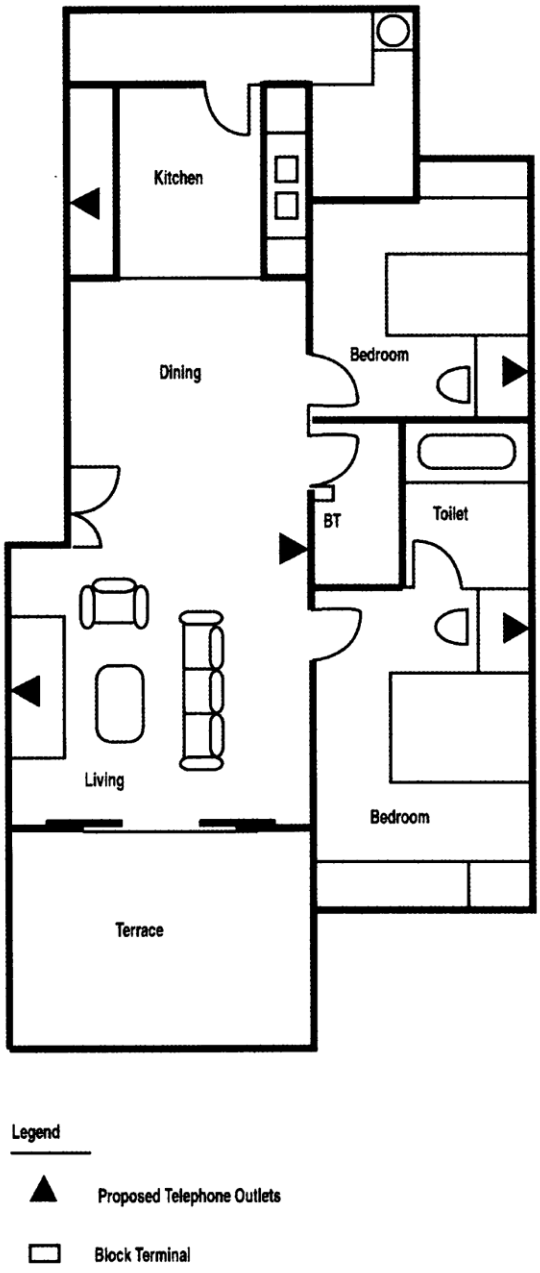


Figure 7.2: Under-floor duct distribution system

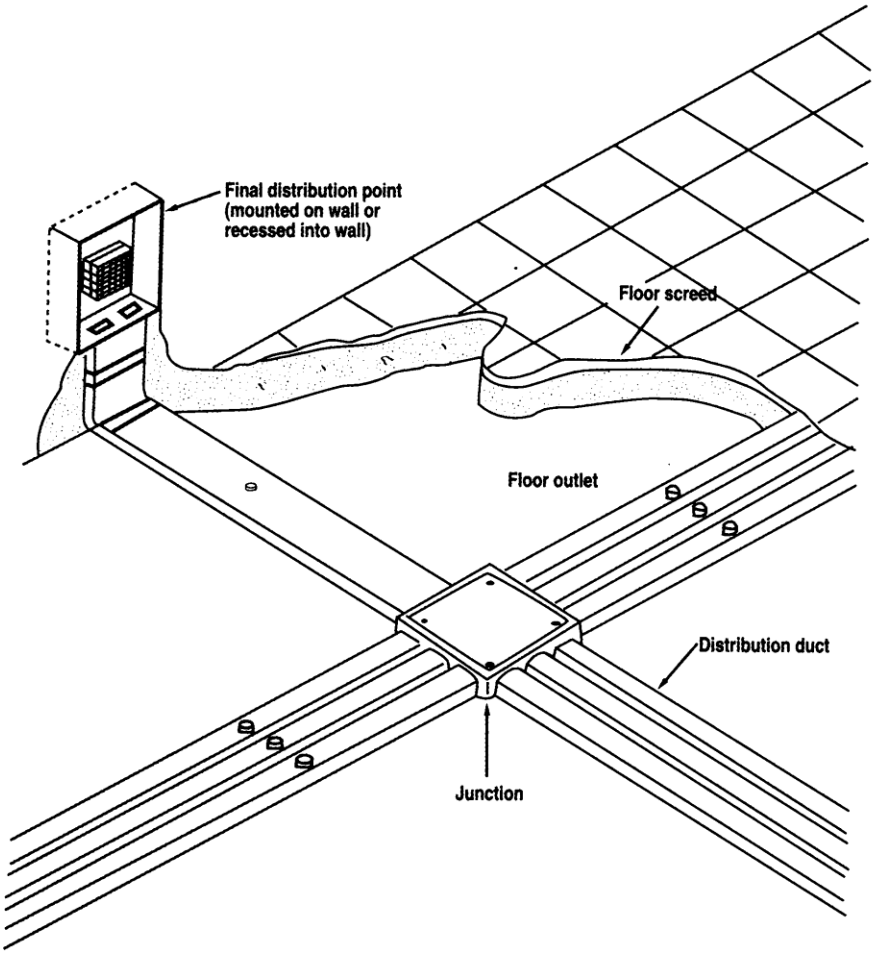


Figure 7.3: Trench duct system

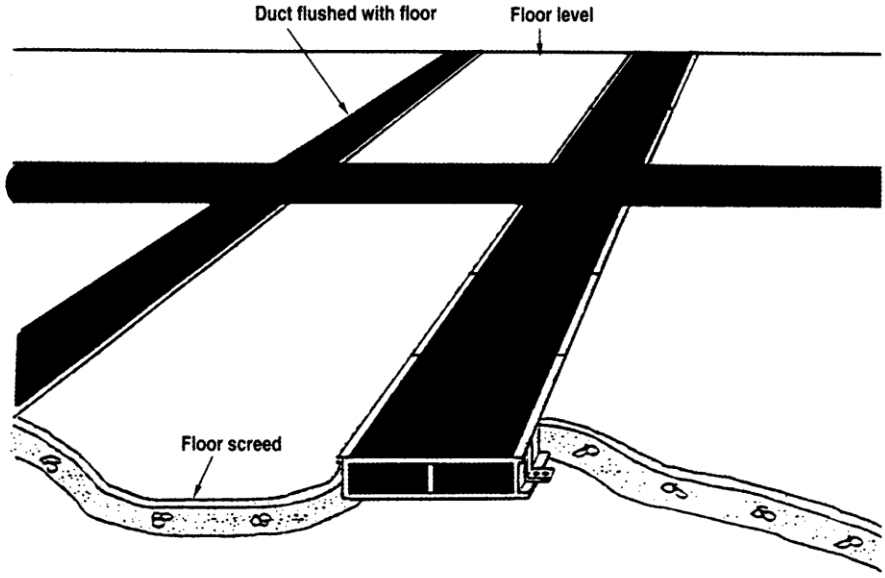


Figure 7.4: Under-floor duct extended to floor trench / flush trunking

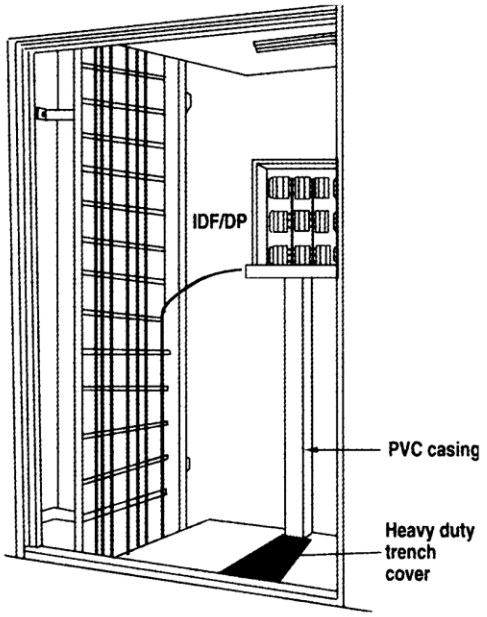
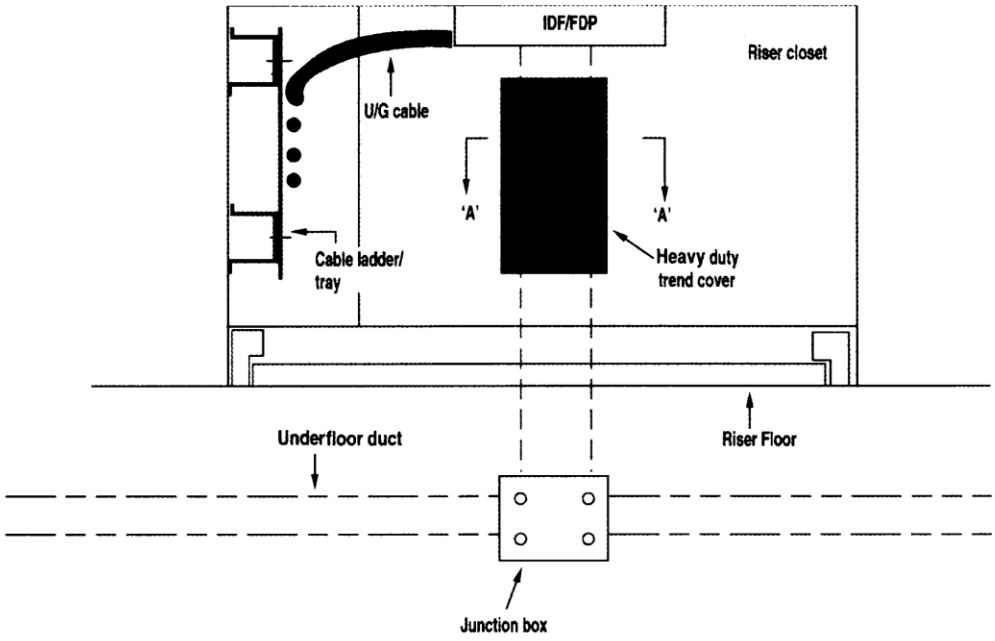
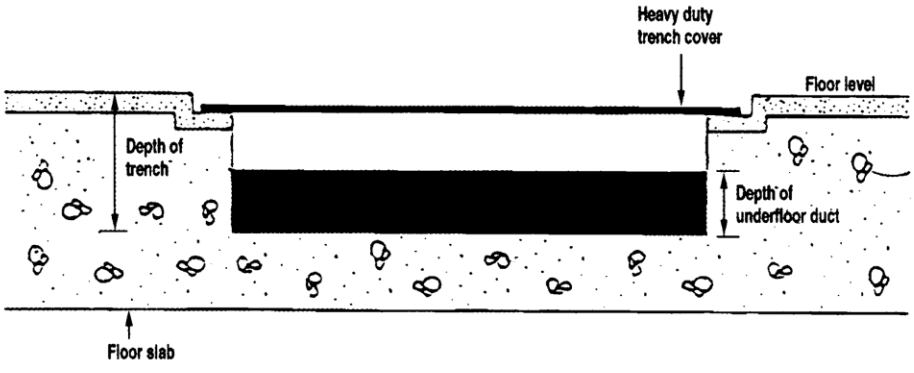


Figure 7.5: Floor trench in centre of riser



PLAN VIEW OF RISER



SECTION A-A

Figure 7.6: Main junction boxes along common corridor area or passageway

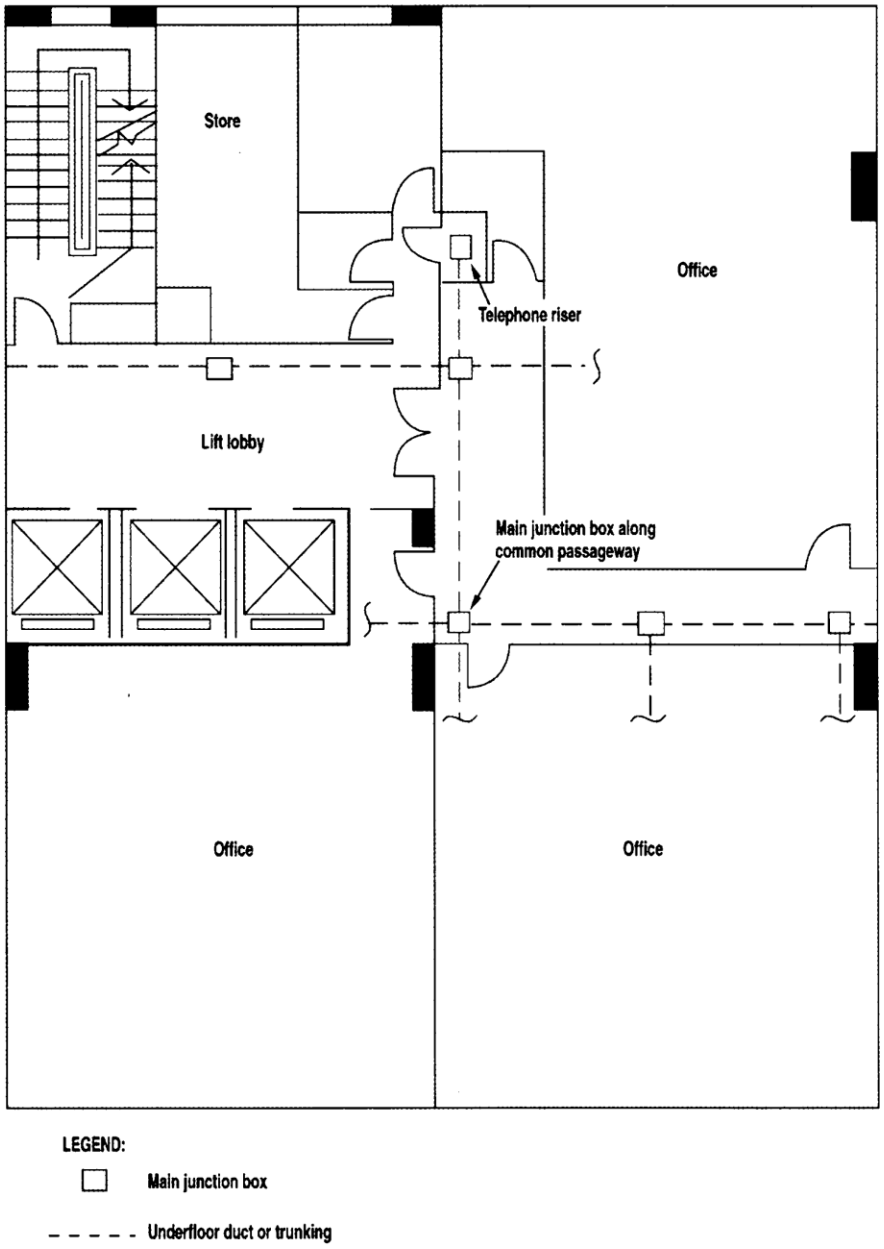


Figure 7.7: Types of distribution ducts & outlets

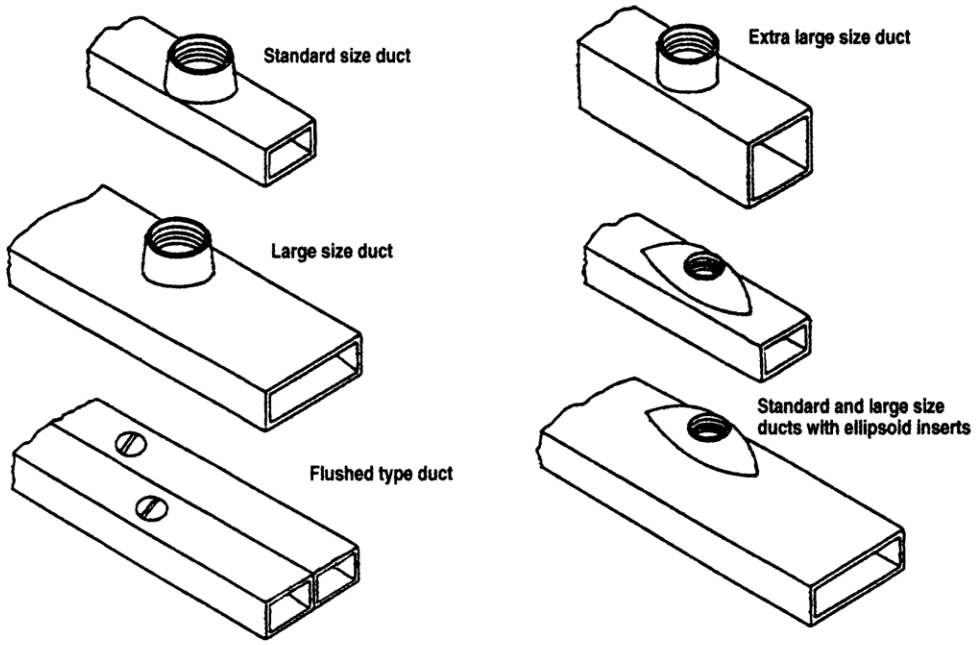


Figure 7.8: Junction boxes installed 6m apart

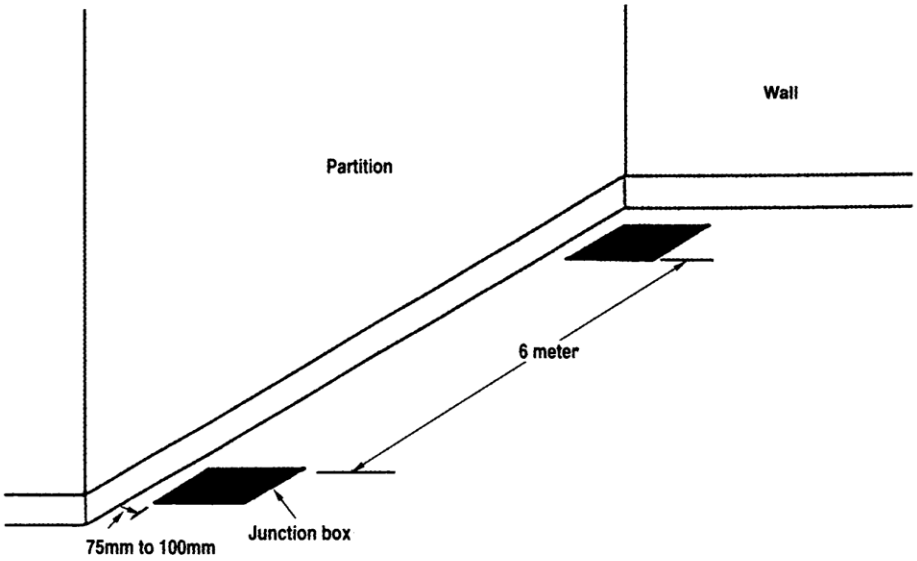


Figure 7.9: Exploded view of junction box

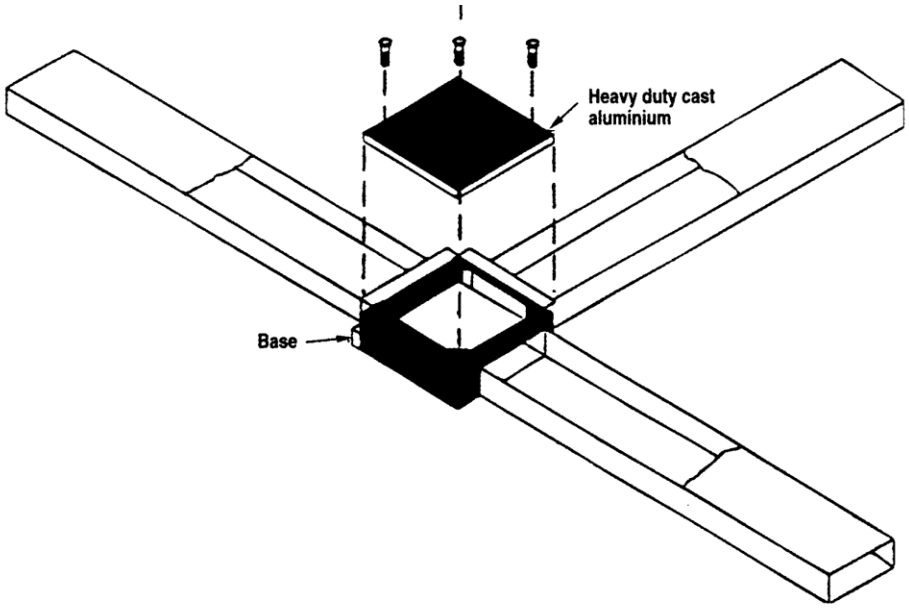


Figure 7.10: Partition sitting on junction box

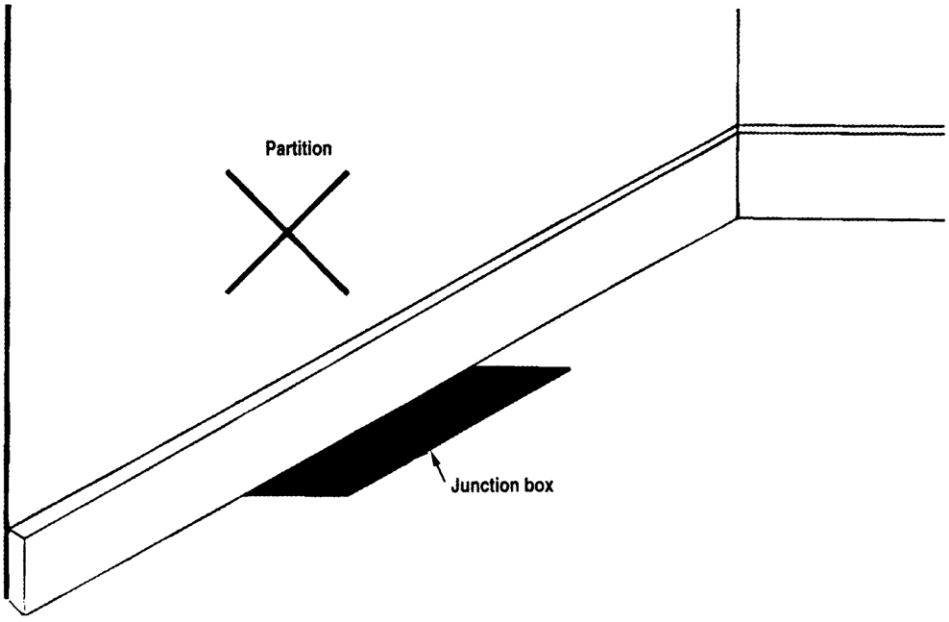


Figure 7.11: Access to junction box for carpetted floor

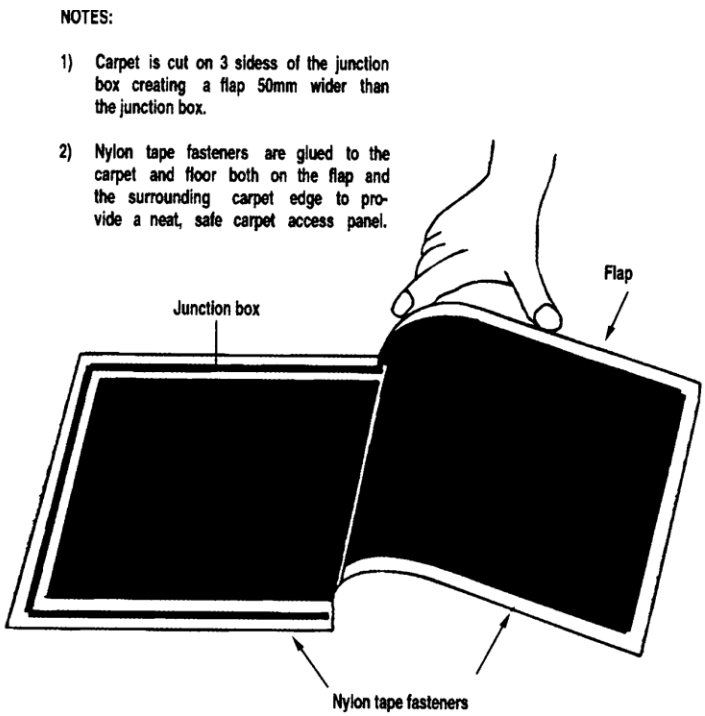


Figure 7.12: Raised floor system

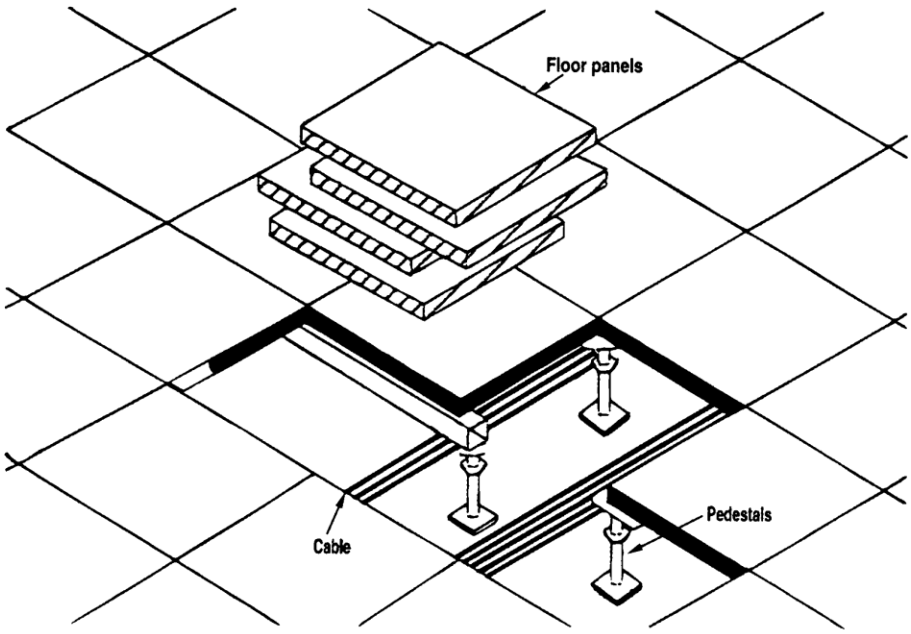


Figure 7.13: Pedestals

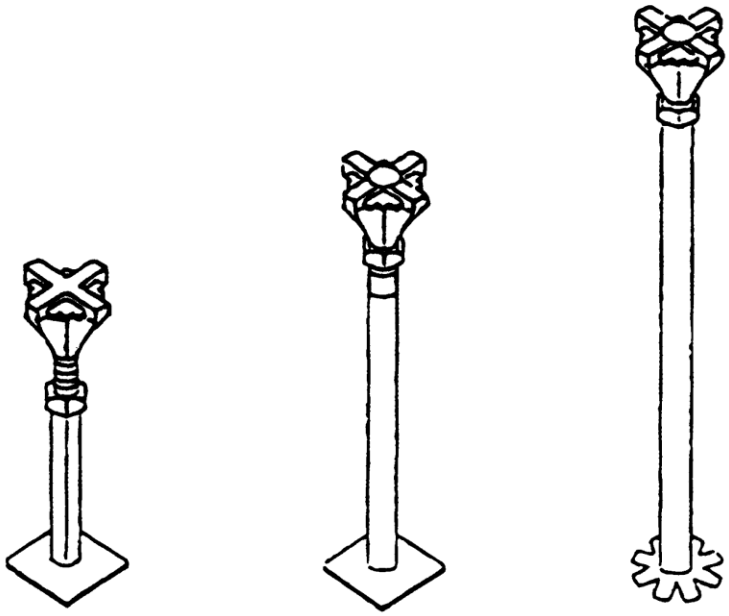


Figure 7.14: Typical section of raised floor system

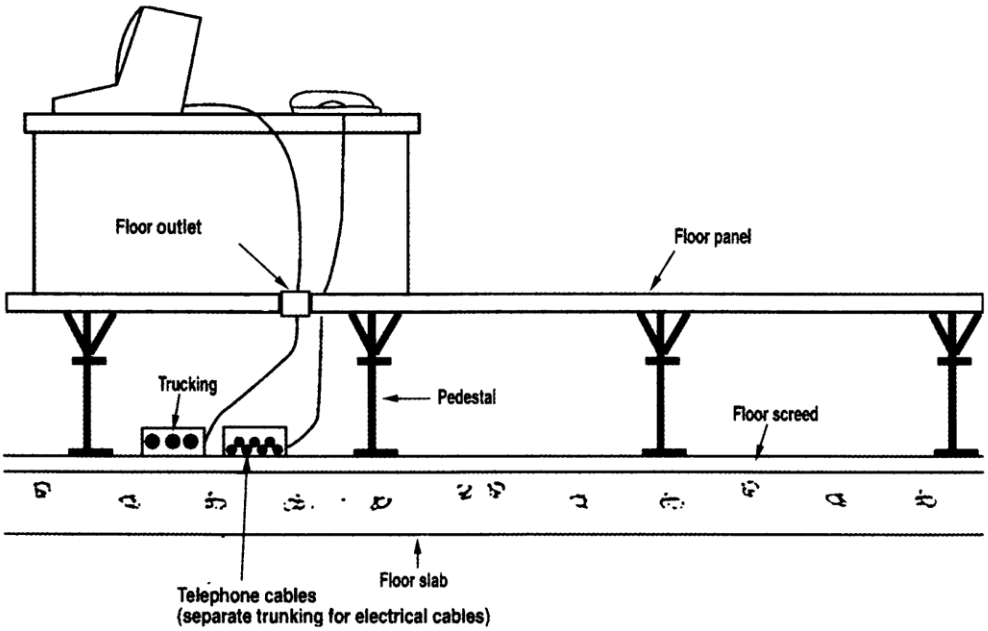


Figure 7.15: Sectional view of a cellular floor system

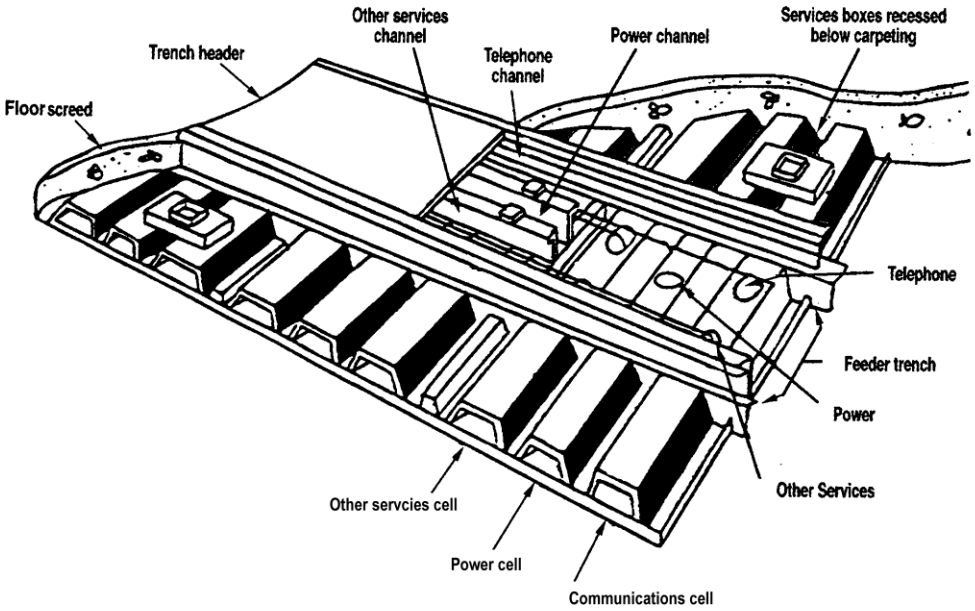


Figure 7.16: Ceiling distribution system using cable tray / trunking link with conduits & utility pole

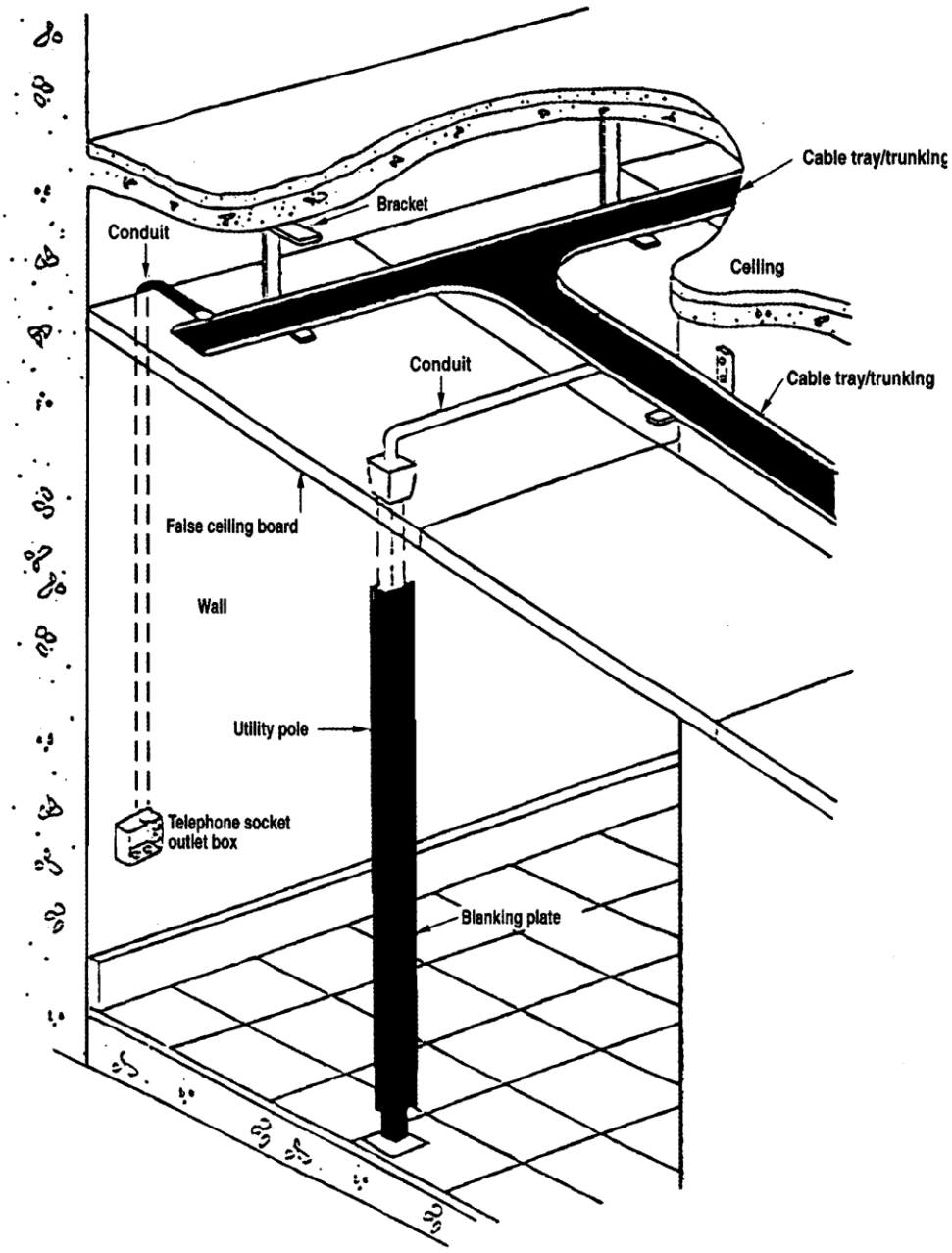


Figure 7.17: Ceiling distribution system – Typical detail of cable tray / trunking link with conduit in non-detachable false ceiling boards / strips that are not easily removable

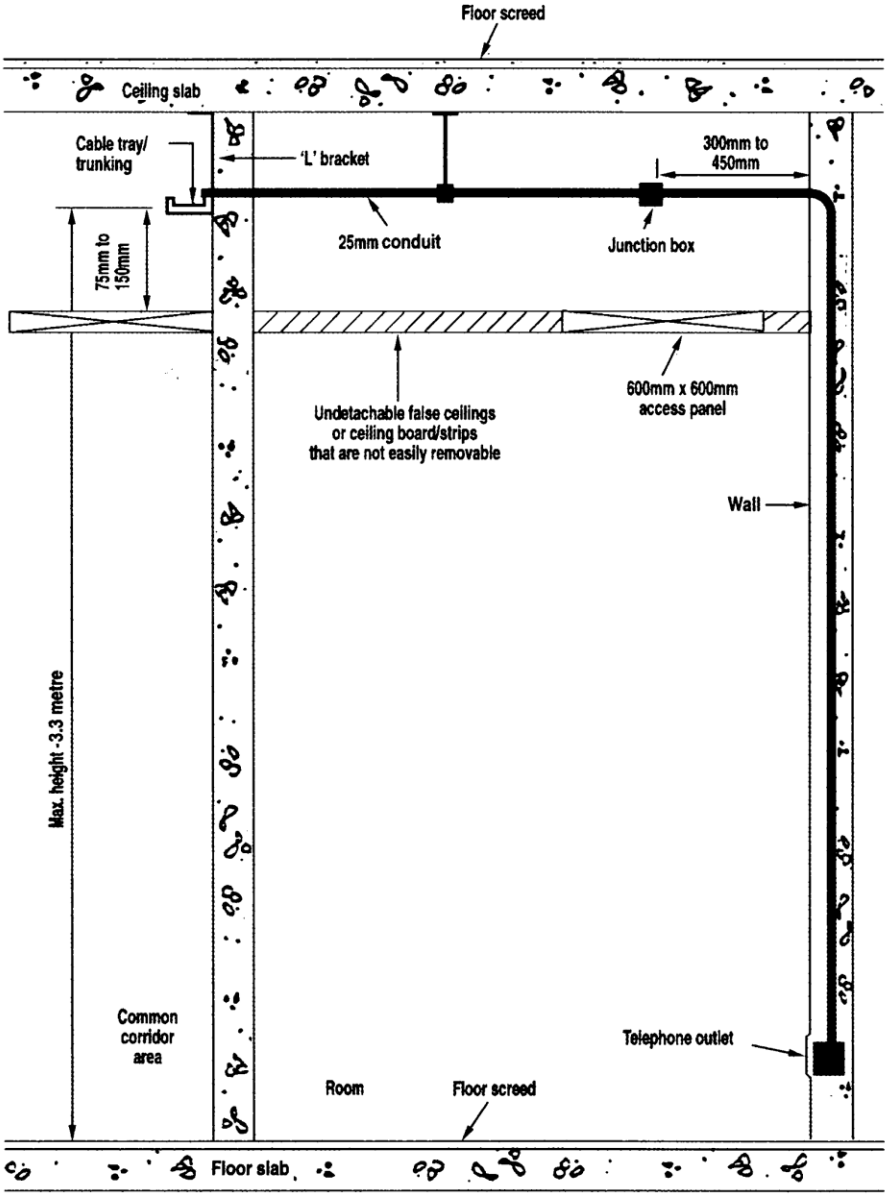
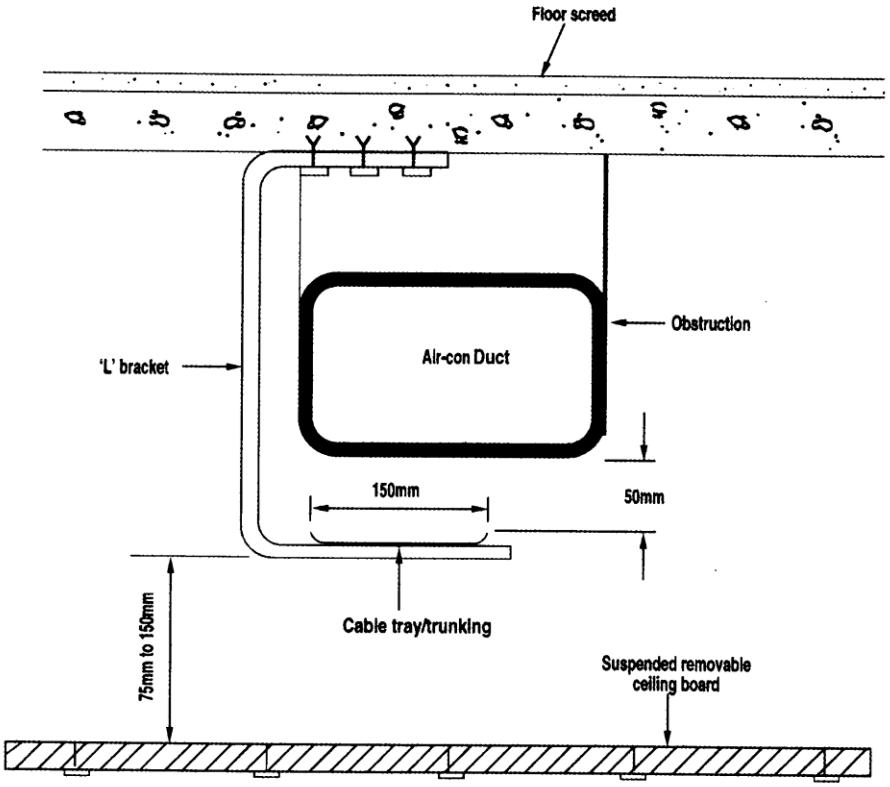


Figure 7.18: Clearance between cable tray / trunking & obstructions



Width of Cable tray/trunking	Minimum clearance between cable tray & obstruction
150mm	50mm
300mm	75mm
450mm	100mm
1000mm	150mm

Figure 7.19: Perimeter raceways mounted at table height level

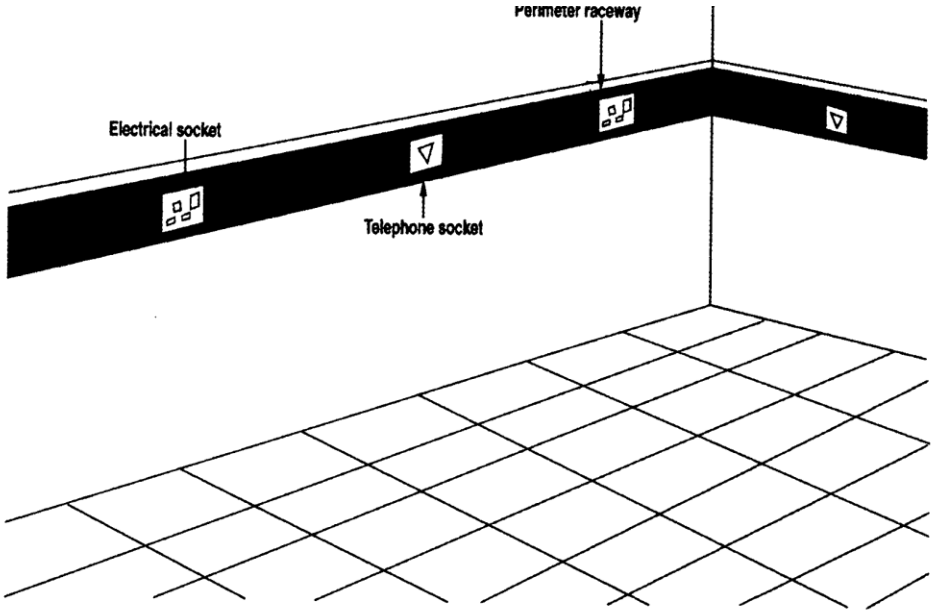


Figure 7.20: Perimeter raceways mounted at floor level

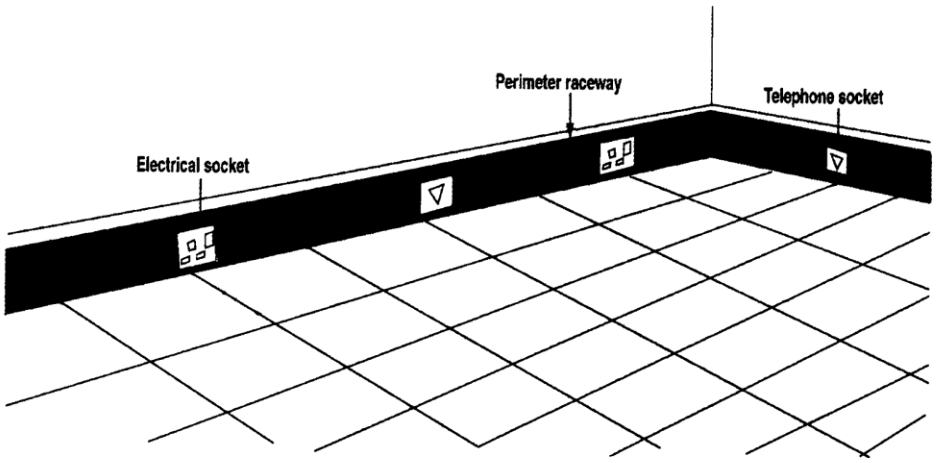


Figure 7.21: Perimeter raceways recessed into base of wall

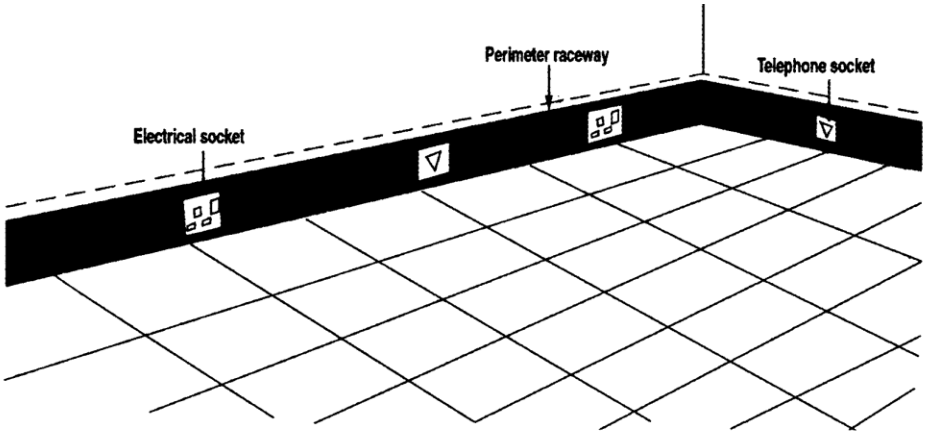


Figure 7.22: Section of a 3-compartment skirting trunking

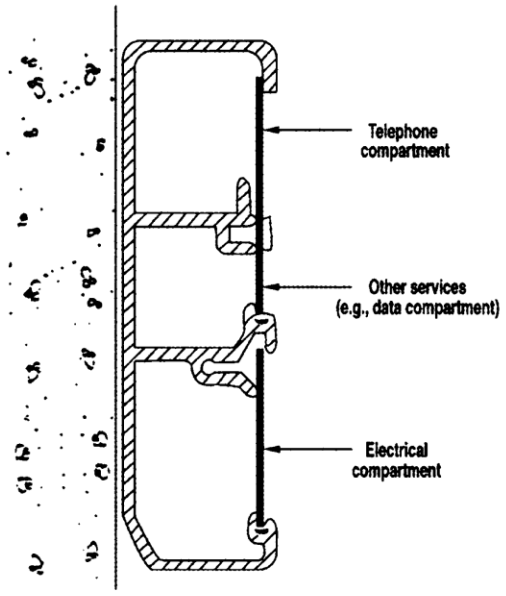


Figure 7.23: Perimeter raceways linked to under-floor duct distribution system

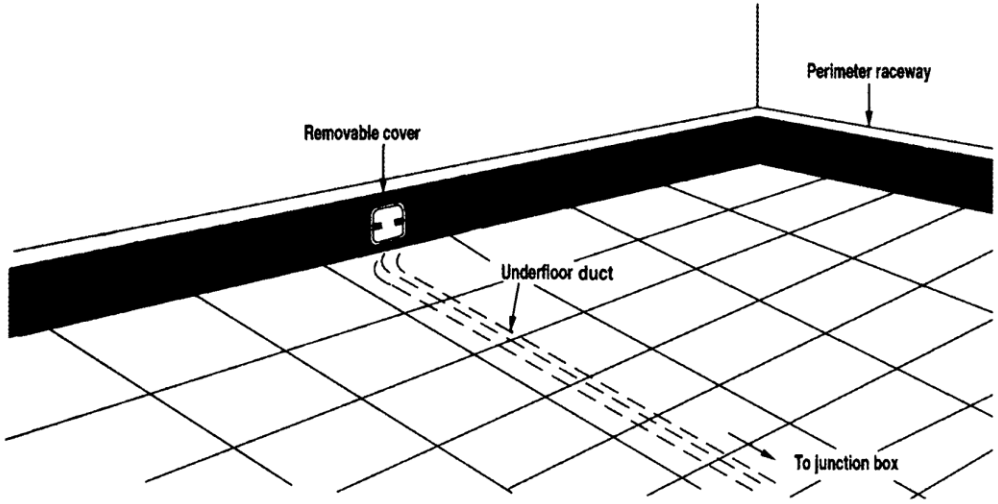


Figure 7.24: Poke-through system with conduit

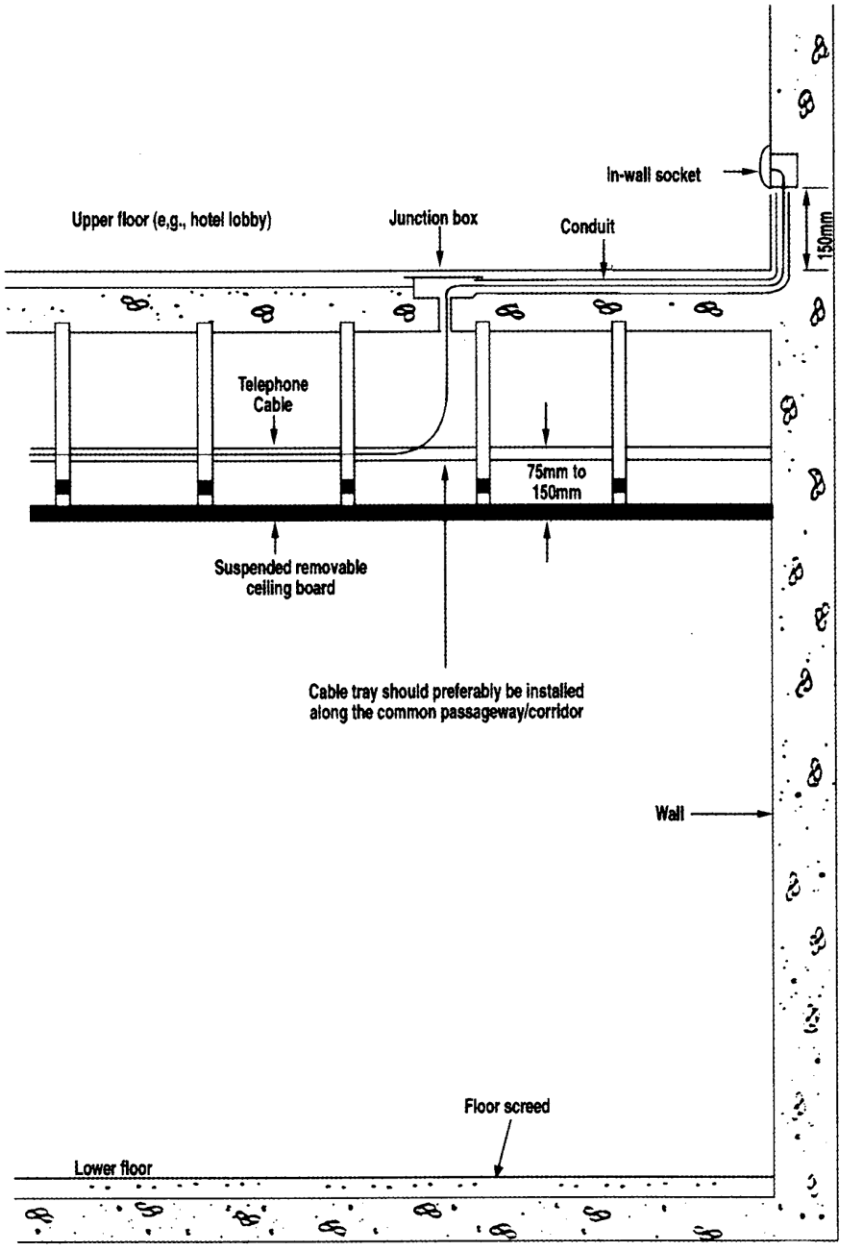


Figure 7.25: Conduit distribution system in certain areas of a hospital

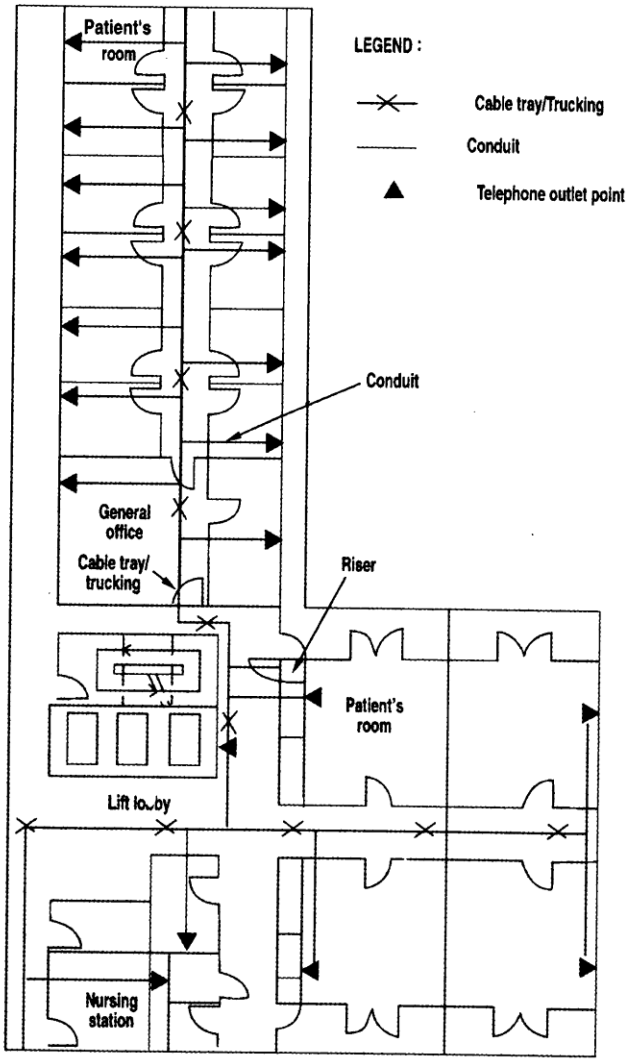


Figure 7.26: Cable tray bends & fitting with 600mm minimum radius

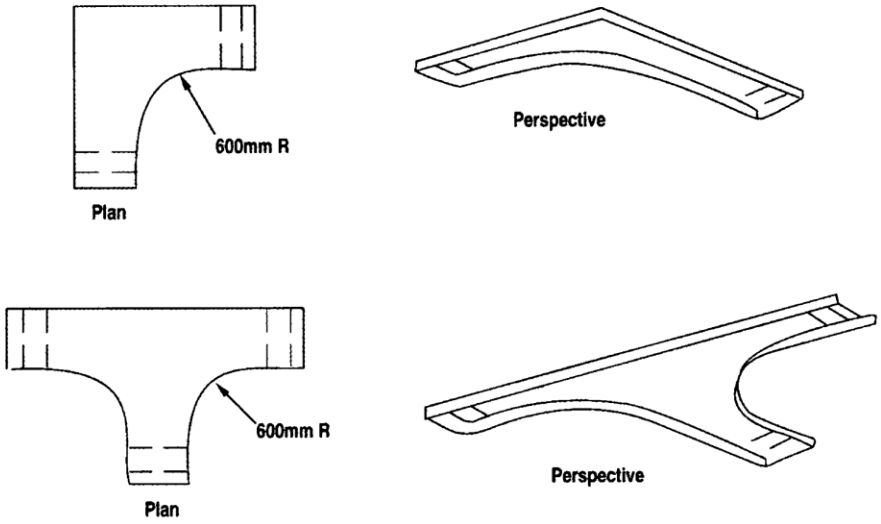


Figure 7.27: Typical example of a trunking system

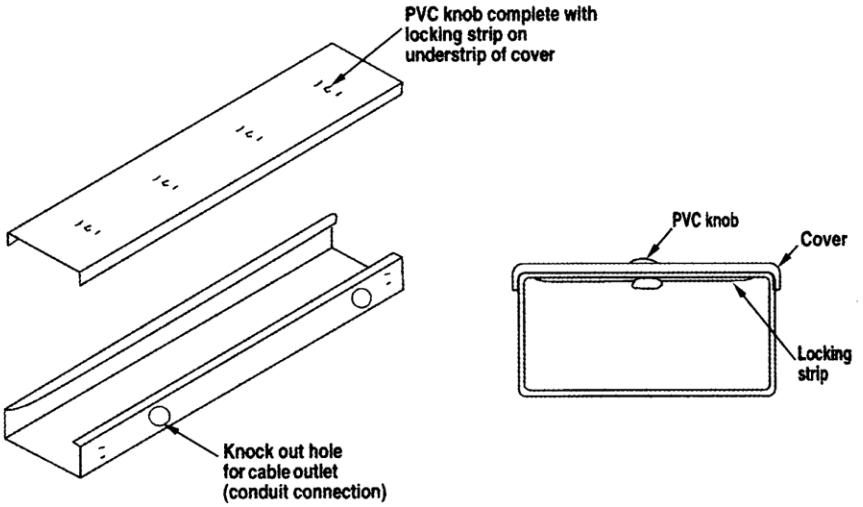


Figure 7.28: Combination of duct & conduit distribution system

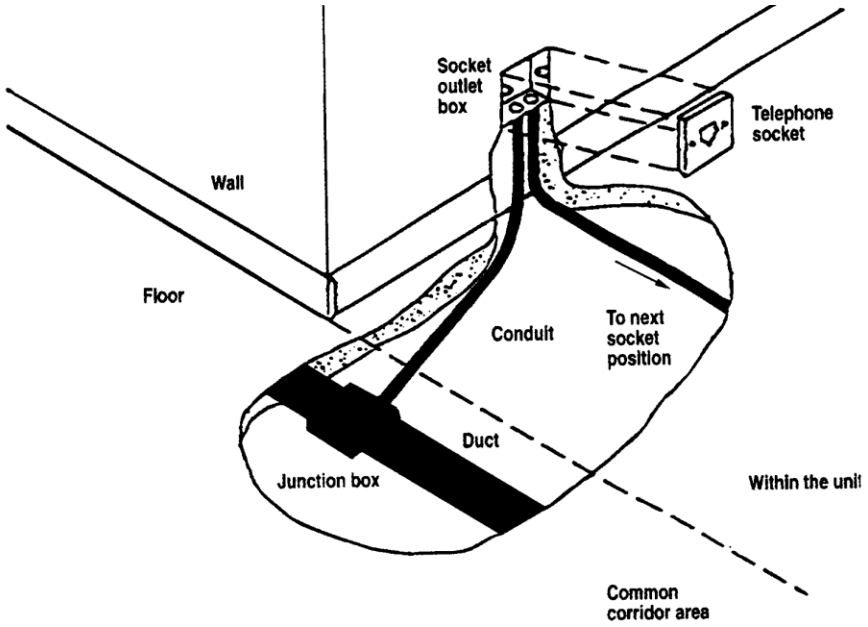


Figure 7.29: Using conduits to distribution cables

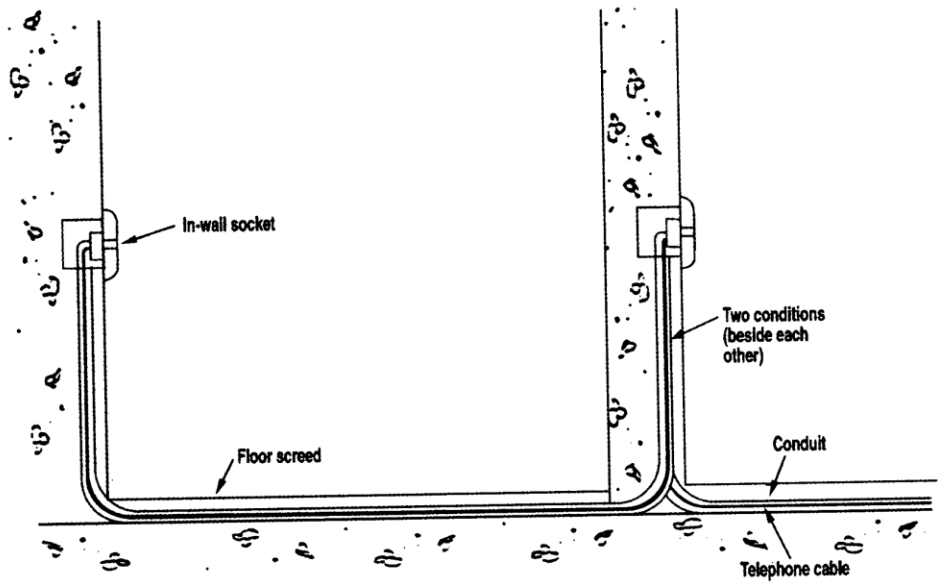


Figure 7.30: Floor duct extended into telecommunication riser

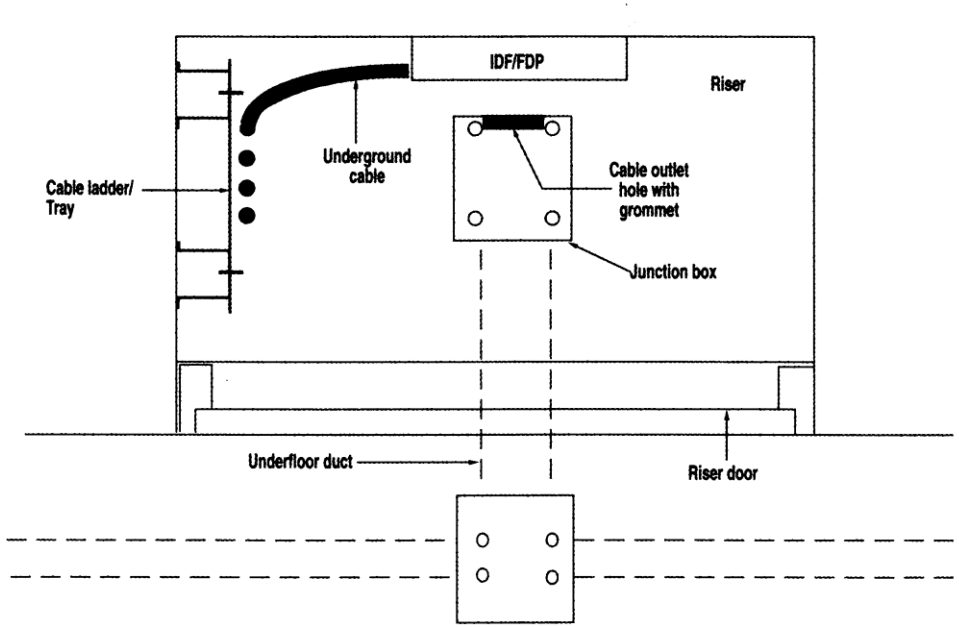


Figure 7.31: Conduit in false ceiling & wall to distribution cables

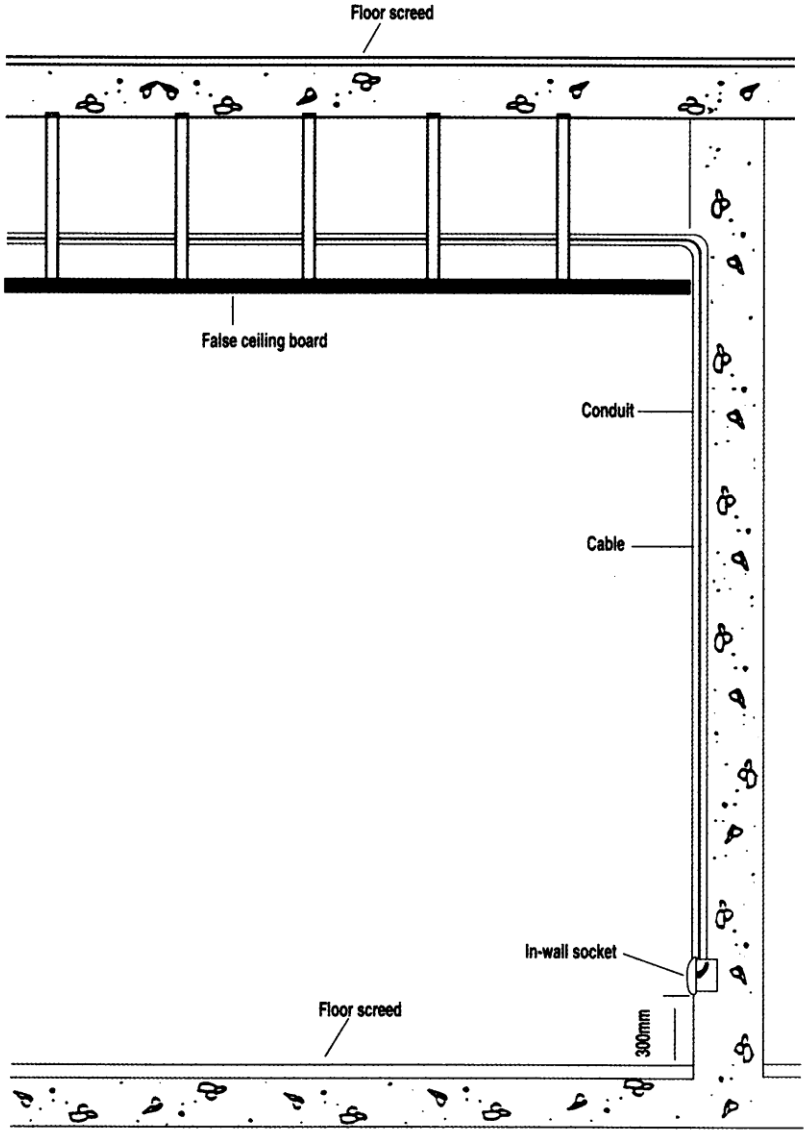
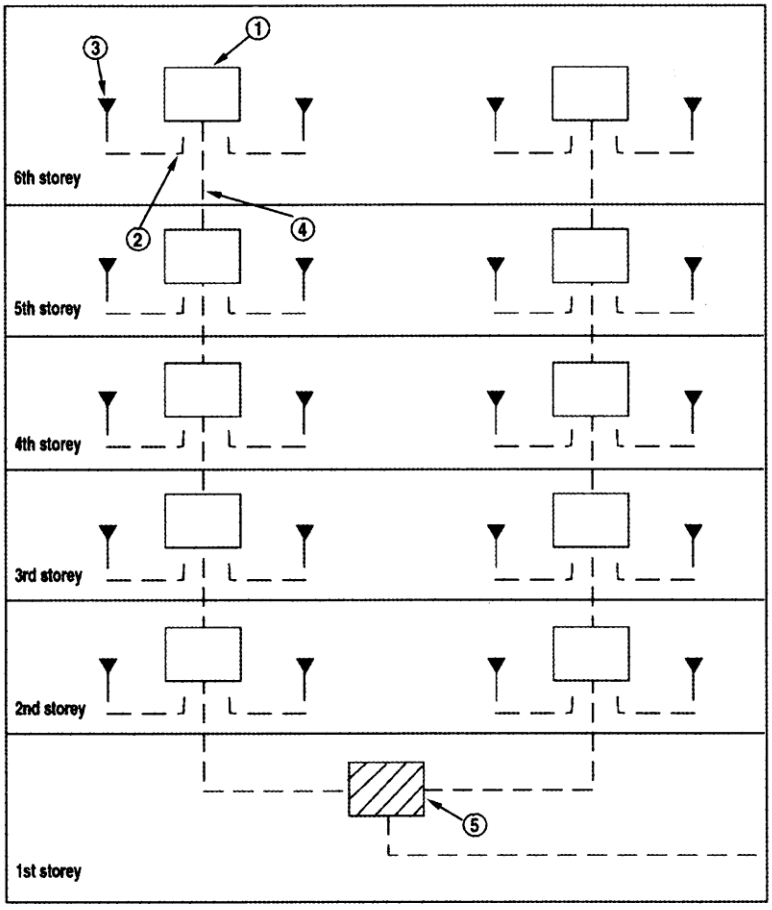


Figure 7.32: Multi-riser distribution in residential building



LEGEND:

① Distribution point

② Horiaontal cabling facilities (i.e., ducts, conduits or trunkings)

③ Telephone outlets

④ Cable riser (ducts and conduits)

⑤ MDF room

8. USER PREMISES CABLING AND INTERFACE POINT

8.1 Interface point for user premises cabling

(a) **Internal telecommunication (non-broadband coaxial cable) wiring**

(A) Internal telecommunication (non-broadband coaxial cable) wiring ("IW") means any telecommunication line, wire, cable, optical fibre, conduit or other physical medium connecting a user's telecommunication equipment and any interface point ("IP") but does not include the use of extension cords with built-in connectors and sockets. IW at the user's premises shall be supplied and installed by IDA licensed installers and contractors.

(B) Under the IDA Licensing Scheme for Telecommunication Wiring Contractors and Telecommunication Wiring Installers, all telecommunication wiring contractors and installers are required to comply with the Code of Practice for Internal Telecommunication Wiring.

Note: The Code of Practice for Internal Telecommunication Wiring is subject to revision from time to time to keep abreast of technical developments and technological advancement.

(b) **Interface point**

The IP means any point of interconnection between a user's telecommunication equipment and any telecommunication system of a public telecommunication licensee, and is where the public telecommunication network ends. Please refer to Figure 8.1 (IP at doorstep) and Figure 8.2 (IP at distribution point ("IP at DP")).

(c) **Location of IP**

The locations of IP are categorised as follows:-

(i) IP at doorstep

The types of premises under this category are shop-houses, business and residential premises served by overhead wiring (except for construction site offices) and public residential apartments (without telecommunication riser). The following guidelines should be adopted:

(A) The IP is at doorstep whereby a block terminal will be installed by the licensee for every unit.

(B) Users shall provide their own cabling between IP and their telecommunication equipment by engaging IDA's licensed contractors.

(ii) IP at distribution point ("DP")

The types of premises under this category are shopping centres, office complexes, factories (terrace/flatted), shopping complexes, markets, food/hawker centres, multiple buildings within a compound (campus layout), private houses (bungalow semi-detached terrace), private and public residential building provided with concealed wiring served directly from DP in the telecommunication riser. The following guidelines should be adopted:

(A) The interface points are at the distribution points.

(B) The developer or owner should provide internal telephone distribution facilities for concealing telephone cables.

(C) The developer or owner is encouraged to ensure the security of the IP and supervise the daily use of the internal telephone distribution facilities such as floor trunking, ceiling cable trays, conduits, telecommunication risers, etc.

8.2 Pre-cabling in non-residential building

(a) **Benefits derived from pre-cabling a building**

The developer or owner should pre-cable their buildings from the IP to the users' premises with multi-core cables. This will enhance the value of the building as it will speed up the provision of service and avoid frequent opening of ceiling boards, etc. to run wires or cables. The use of multi-core cables will greatly reduce the need to run a large number of telecommunication wires between telecommunication risers and office/shop units that can choke up the cable distribution system and mar the aesthetics of the building.

(b) Recommended cable size for various premises are as shown in Table 8.1.

Table 8.1 Recommended cable size

Types of premises	Recommended cable size
Markets, Food/ Hawker Centres	An 8-wire cable per stall.
Shopping Centres	At least one 10-pair cable per shop. However, if a shop unit is occupied by a tour agency or money changer, then more cable pairs may be needed.
Office, Complexes, Factories	The size of cables to use will depend on the projected need of the occupants. Normally, twice the projected requirement.

8.3 Pre-cabling in residential building

(a) General

(i) The developer or owner shall supply and install telecommunication cables, sockets, block terminal and all other materials (including the distribution

point box) for pre-cabling to all rooms in residential buildings. A minimum of two 8-wire cables shall be installed from the distribution point to block terminal for each residential unit.

(ii) A block terminal shall be used as a distributing point for connection to all rooms. It shall be located inside each residential unit (which may be located in the utility room or closet) (Figure 8.3).

(iii) The developer or owner shall install the cable from the block terminal in the residential unit (which may be located in the utility room or closet) to each socket using a star configuration (Figure 8.3).

(iv) The developer or owner shall label each cable pair at the distribution point end and block terminal and telephone socket ends, to enable identification of cable pairs. The developer or owner shall terminate the telecommunication cable onto the block terminal and telephone sockets according to the detailed connections in Figure 8.4. The licensees shall terminate their telecommunication cables onto their respective distribution points.

(v) The telecommunication cables, sockets and block terminals may be purchased from the licensees or its suppliers. Where structural cabling system is installed, the specifications of cables and sockets shall be unshielded twisted-pair (UTP) cable Category 6 or better, complying with the TIA/EIA-568-B cabling specifications (See Chapter 10 Next Generation National Broadband Network for details regarding the structural cabling system).

8.4 Termination of internal telecommunication wiring

(a) Termination at IP

Telecommunication wires or cables connecting from the user's premises, for non-residential buildings, should be terminated at block terminals, distribution cases or terminal blocks mounted on the intermediate distribution frame (IDF). The developer or owner should label each telecommunication wire or cable at the corresponding block terminals, distribution cases or terminal blocks.

(b) Termination of telecommunication wires or cables

Telecommunication wires or cables at each unit, for both residential and non-residential buildings, should be terminated at termination boxes or sockets. The developer or owner shall label each telecommunication wire or cable at the corresponding termination boxes or sockets. To facilitate installation and maintenance of cables, the termination boxes or sockets should be installed in a prominent location which is easily accessible.

8.5 Record of cable distribution system and documentation of pre-cabling or internal telecommunication wiring work

(a) The developer or owner shall keep an up-to-date set of the telecommunication cable distribution system drawings and a record of the pre-cabling or internal telecommunication wirings for reference purpose.

Figure 8.1: IP at doorstep

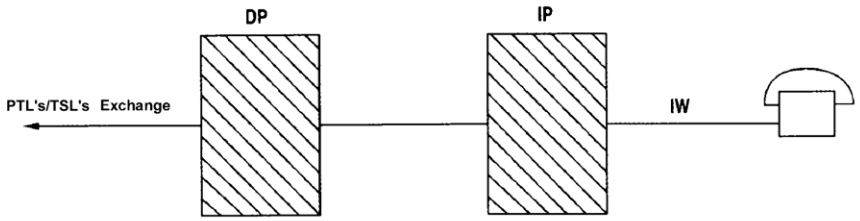


Figure 8.2: IP at DP

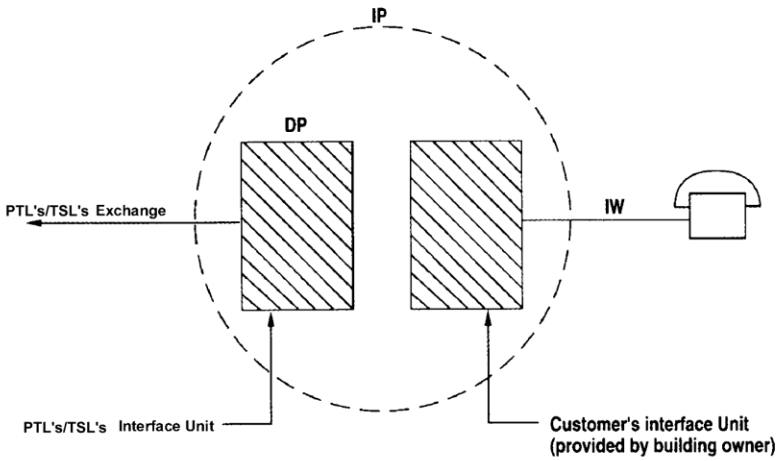
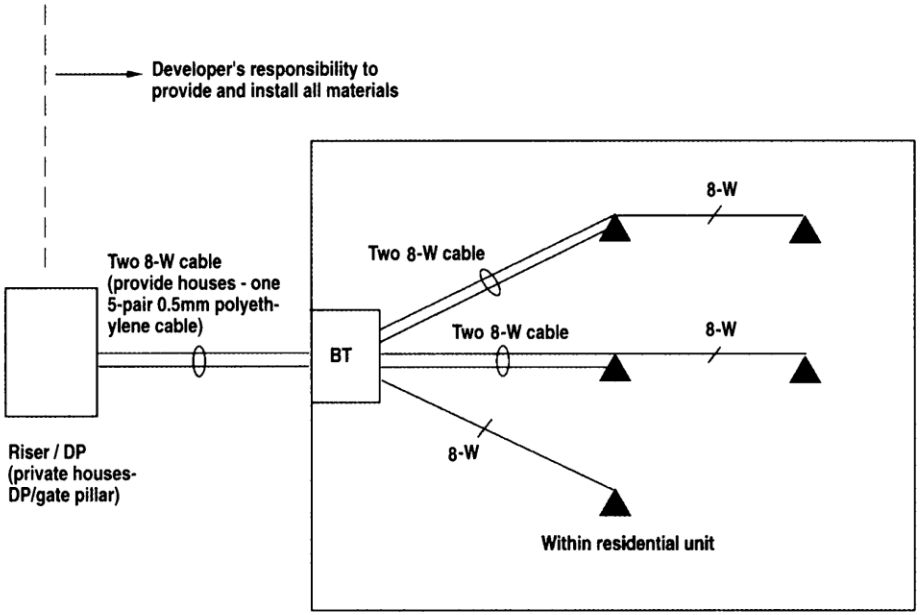


Figure 8.3: Telephone wiring configurations for residential buildings



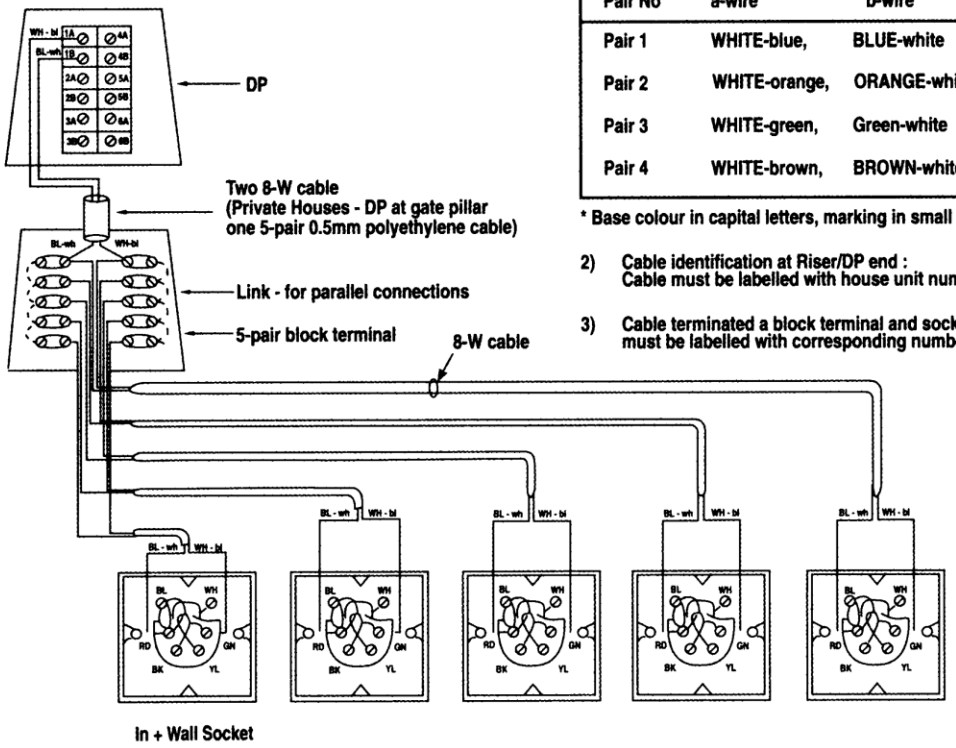
LEGEND

DP : Distribution point

BT : Block Terminal

▲ : Telephone socket

Figure 8.4: Telephone wiring configurations for residential building – Detailed connections



NOTE:

1) 8-W cable colour code and termination.

Pair No	*Colour of wire insulation a-wire	b-wire	Termination at socket
Pair 1	WHITE-blue,	BLUE-white	GN & RD terminate
Pair 2	WHITE-orange,	ORANGE-white	Spare (To coil round pair 1)
Pair 3	WHITE-green,	Green-white	
Pair 4	WHITE-brown,	BROWN-white	

* Base colour in capital letters, marking in small letters

2) Cable identification at Riser/DP end :
Cable must be labelled with house unit number

3) Cable terminated a block terminal and socket outlet must be labelled with corresponding number

9. SPECIFICATIONS OF CABLES AND SOCKETS

9.1 Telecommunication cables and ancillary accessories

All telecommunication cables and other wiring equipment to be used for telecommunication wiring work shall comply with the Code of Practice for Internal Telecommunication Wiring. The specifications related to telecommunication cables are shown below.

Table 9.1 Specifications related to telecommunication cables and block terminals

Specification reference	Title
IDA TS L1-1 : 2000	Specification for High Count PVC Cable (10-pair to 100-pair cables)
IDA TS L1-2 : 2000	Specification for Low Count PVC Cable (4-wire to 10-wire cables)
IDA TS L2-1 : 2000	Specification for 4-Way Modular On Wall Socket (equivalent to RJ-11)
IDA TS L3-1 : 2000	Specification for 2-Pair Block Terminal
IDA TS L3-2 : 2000	Specification for 4-Pair Block Terminal
IDA TS L3-3 : 2000	Specification for 5-Pair Block Terminal

Note: The above specifications are available for download from IDA website (http://www.ida.gov.sg).

9.2 Cable specifications

Types of cables	Outside Diameter of Cable (mm)	Cross Sectional Area of Cable (mm^2)	Specifications
4-wire	3.5	9.63	IDA TS L1-2 : 2000
6-wire	5.3	22.07	
8-wire	5.8	26.43	
10-wire	6.5	33.20	
10-pair	8.3	54.13	IDA TS L1-1 : 2000
20-pair	10.7	90.00	
40-pair	14.2	158.43	
80-pair	21.8	373.40	
100-pair	22.6	401.31	

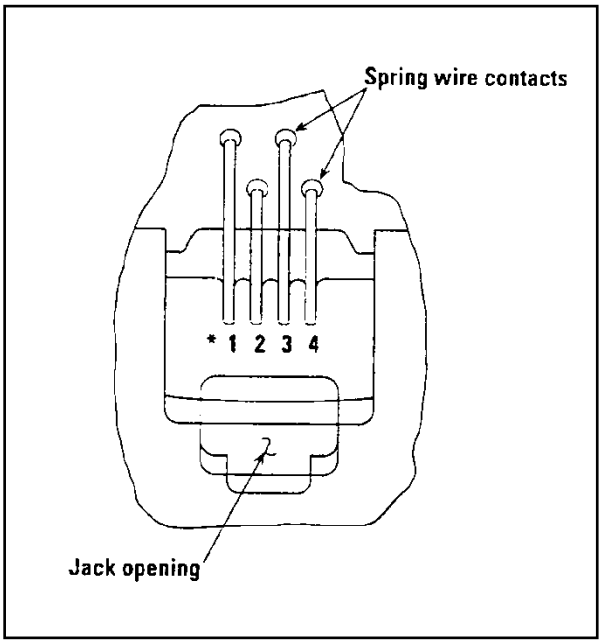
Wire Gauge = 24 AWG (or 0.5 mm diameter)
Conductor = Solid tinned copper
Wire insulation = PVC Compound Type 2 of BS6746
Cable Sheath = PVC Compound Type TM1 of BS6746

9.3 Specification of sockets

Type	Dimension	Specifications
On-Wall Socket	65 mm x 65 mm	IDA TS L2-1 :2000
In-Wall Socket	86 mm x 86 mm	IDA TS L2-1:2000

Modular jack of socket: RJ type in accordance with FCC (Federal Communication Commission) specifications Part 68 Sub-part F.

Colour Designation for Contacts and Terminals



* Contact No.	Colour	Designation
1	Black (BK)	Earth
2	Red (RD)	L2
3	Green (GN)	L1
4	Yellow (YL)	Spare

Colour Designation for Contacts & Terminals of Socket

10. NEXT GENERATION NATIONAL BROADBAND NETWORK

10.1 General

This chapter describes the space and facilities which shall be provided by the developer or owner for the installation of internal wiring for home networking to facilitate the provision of broadband services to residential buildings through the Next Generation National Broadband Network ("NGNBN").

10.2 Horizontal cable distribution

(a) In order to provide for horizontal cable distribution between a telecommunication riser and residential units, flats or tenants' premises of a multi-storey building, a separate empty 20 mm diameter uPVC conduit or PVC trunking compartment (for the case of surface cabling using multi-compartment trunking) shall be provided for NGNBN wire-lines, in addition to those facilities for telephony and broadband coaxial cable system services.

(b) The above-mentioned conduit should be installed in straight run from the telecommunication riser to each residential unit. The conduit may be concealed in walls and/ or floor slab and the bending radius of the central line of the conduit shall not be less than 100 mm to facilitate the installation of next-generation broadband cable(s). The conduit in the residential unit is to be terminated at an empty 2-gang box (which shall be provided by the developer or owner) with minimum internal dimensions of 160 mm (length), 80 mm (breadth) and 25 mm (depth) and a blank face plate (which may be located in the utility room or closet) A drawn-rope shall be provided in this empty conduit to facilitate the NGNBN cable to be pulled in.

(c) For distribution within a residential unit, flat or tenant's premise, a separate conduit or trunking compartment shall be provided for internal cabling for broadband services through the NGNBN, in additional to those cabling and outlets for telephony and broadband coaxial cable system services. It should meet the following requirements:

(i) A 20 mm diameter uPVC conduit should be installed to facilitate the laying of internal cabling between the RJ45 patch panel in the utility closet and each RJ45 outlet in the living room and bedrooms; and

(ii) The conduits connecting each RJ45 outlet to the utility closet should not exceed 2 bends.

10.3 Cabling distribution for landed dwelling-houses

(a) For a development consisting of one or more landed dwelling-houses, one empty 50 mm diameter uPVC continuous lead-in and underground pipe should be provided by the developer or owner for each landed house, which shall extend to the abutting road, to a point 1 m beyond the roadside drain located immediately outside the house and run into the house, and terminating at an empty 2-gang box (which shall be provided by the developer or owner) with

minimum internal dimensions of 160 mm (length), 80 mm (breadth) and 25 mm (depth) and a blank face plate (which may be located in the utility room or closet). The bending radius of this pipe shall not be less than 300 mm to facilitate the laying of the NGNBN cable into each landed property. A draw-rope will be provided in this empty underground pipe to facilitate the NGNBN cable to be pulled in. Where the above-mentioned uPVC pipe is provided directly into the property, the required number of lead-in pipes between the gate pillar and the road-side drain will be reduced from the existing requirement of 3 pipes to 2 pipes.

10.4 Cat 6 UTP cables for internal cabling

(a) For the NGNBN services to be provided to the home over Ethernet-based local area network technologies, unshielded twisted pair (UTP) cables of Category 6 or above[1] which conform to the TIA/EIA 568B specifications or equivalent should be used.

(b) Typically, the total cable runs should not exceed 100 m to each RJ45 wall outlet. The TIA/EIA 568B specification calls for 90 m maximum runs from the RJ45 patch panel of a home networking hub to a RJ45 wall outlet. An extra 10 m is allowed to connect to a RJ45 port of a terminal equipment (e.g. a personal computer) or a set-top box (provided by a NGNBN service provider) to the wall outlet and to connect from the patch panel to the home-networking equipment.

10.5 Electrical Power Supply

(a) An electrical 230 V 13 A switched socket outlet (i.e. power point) should be provided at the location where the empty 20 mm conduit as stated in paragraph 10.2 (b) (or the 50 mm pipe as stated in paragraph 10.3 (a)) is terminated. This outlet is for the purpose of providing electrical power supply to the NGNBN equipment.

[1] Cat 6 is introduced mainly to support Gigabit Ethernet, GE (1000BASE-Tx).

11. ANTENNAE AND INSTALLATION

11.1 General

This chapter relates to the installation of and specifications of antennae for the reception of TV broadcast programmes. Any queries under this section shall be directed to the Media Development Authority ("MDA").

11.2 Antennae

(a) Antennae installed for a broadband coaxial cable system shall be provided in accordance with the minimum requirements specified in Table 11.2.

Table 11.2 Minimum requirements of antennae

Designated Band	Gain (min)	Front-to-back ratio (min)	VSWR (max)
I	**4.0 dB**	**15 dB**	**)**
II	**4.0 dB**	**10 dB**	**) 2:1**
III/IV/V	**6.0 dB**	**20 dB**	**)**

(b) Antennae installed should be designed to withstand a wind velocity of 100 km/h.

(c) Antennae elements should be made of aluminium, with clamps of die-cast aluminium, zinc base alloy, anodised metal or ferrous material that is adequately protected against corrosion and has good electrical and mechanical properties. Clamp supports may also be made of ultra-violet stabilised plastic material.

(d) Bolts, nuts, washers and screws that are used for securing the elements to the antennae boom should also be adequately protected against atmospheric and electrolytic corrosion.

(e) The characteristic impedance of the antennae should be 75 Ω.

(f) Stainless steel antennae should be used where heavy-duty performance is required.

(g) Each part of the antenna and the mast should be adequately protected against the deterioration that may be caused by the worst weather conditions. Antennae should be installed on and cables should not pass through roofs with soft covering. Locations where atmosphere is explosive or flammable should be avoided.

11.3 Antennae mast and mounting bracket

(a) The mast should be constructed of galvanised steel (preferably hot-dip galvanised), stainless steel or other material of adequate mechanical strength to withstand the bending movements caused by the combined wind loading and the weight of the antennae.

(b) The top open end of the mast should be capped to prevent ingress of water.

(c) The mast should be supported by at least three sets of stay (or guy) wires that are evenly spaced.

(d) The mounting bracket of the mast should be galvanised, preferably by the hot-dip process and painted with zinc-enriched primer paint.

(e) Dynabolts, rawbolts, clamps, u-clips, turnbuckles and sleeve anchors that are used to secure the mounting bracket and for anchoring the stay (or guy) wires should be corrosion resistant.

(f) Stay (guy) wires should be of the electro-galvanised or stainless steel type.

(g) The gap between the antennae mast and the mast holder of the bracket should be sealed with silicon rubber or other waterproofing sealant.

(h) Protective coats that are damaged during installation must be painted with anti-rust paint of zinc-enriched primer paint if the galvanised part is affected.

11.4 Protection against lightning

(a) The elements and the boom of the antennae, the mast, the outer conductors of the antennae cables at inputs of the amplifiers and at the outputs of the amplifiers, should be bonded to the down conductors of the lightning protective system of the building.

(b) The inner conductor's of the antennae cables should be protected with surge diverters which are also bonded to the down conductors.

(c) Metallic distribution conduits on roof-top should also be earthed.

(d) Clamps and connectors used for securing the lightning conductors (or bonding cables) should be of electro-galvanised or stainless steel type.

Notes:

1. Where cable TV services are not yet available in a development due to technical or operational reasons, the developer or owner may install antennae to enable free-to-air TV signals to be distributed through the broadband coaxial cable system to all strata landed dwelling-houses and/or multi-storey residential building until cable TV services are available from the cable TV licensee.

2. Where antennae are installed on the broadband coaxial cable system, such antennae shall meet the requirements specified in this chapter.

APPENDIX 1 FUNCTIONS OF THE TELECOMMUNICATION FACILITY COORDINATION COMMITTEE ("TFCC") AND BUILDING PLAN CO-ORDINATION AND APPROVAL PROCESS

1.1 Functions of TFCC

The functions of TFCC are as follows:

(a) provide feedback to IDA on their proposals for IDA's consideration regarding changes to the COPIF;

(b) set-up pre-consultation meeting for building owners/ developers/ architects/ consultants on building facilities;

(c) process building plans and appoint Building Plan Project Co-ordinator for specific building projects;

(d) put up recommendations to IDA on waiver of COPIF requirements;

(e) ensure that both operators' requirements are incorporated into the building plan; and

(f) ensure the timely hand over of MDF room and in-building telecommunication facilities.

1.2 Building Plan Co-ordination & Approval Process

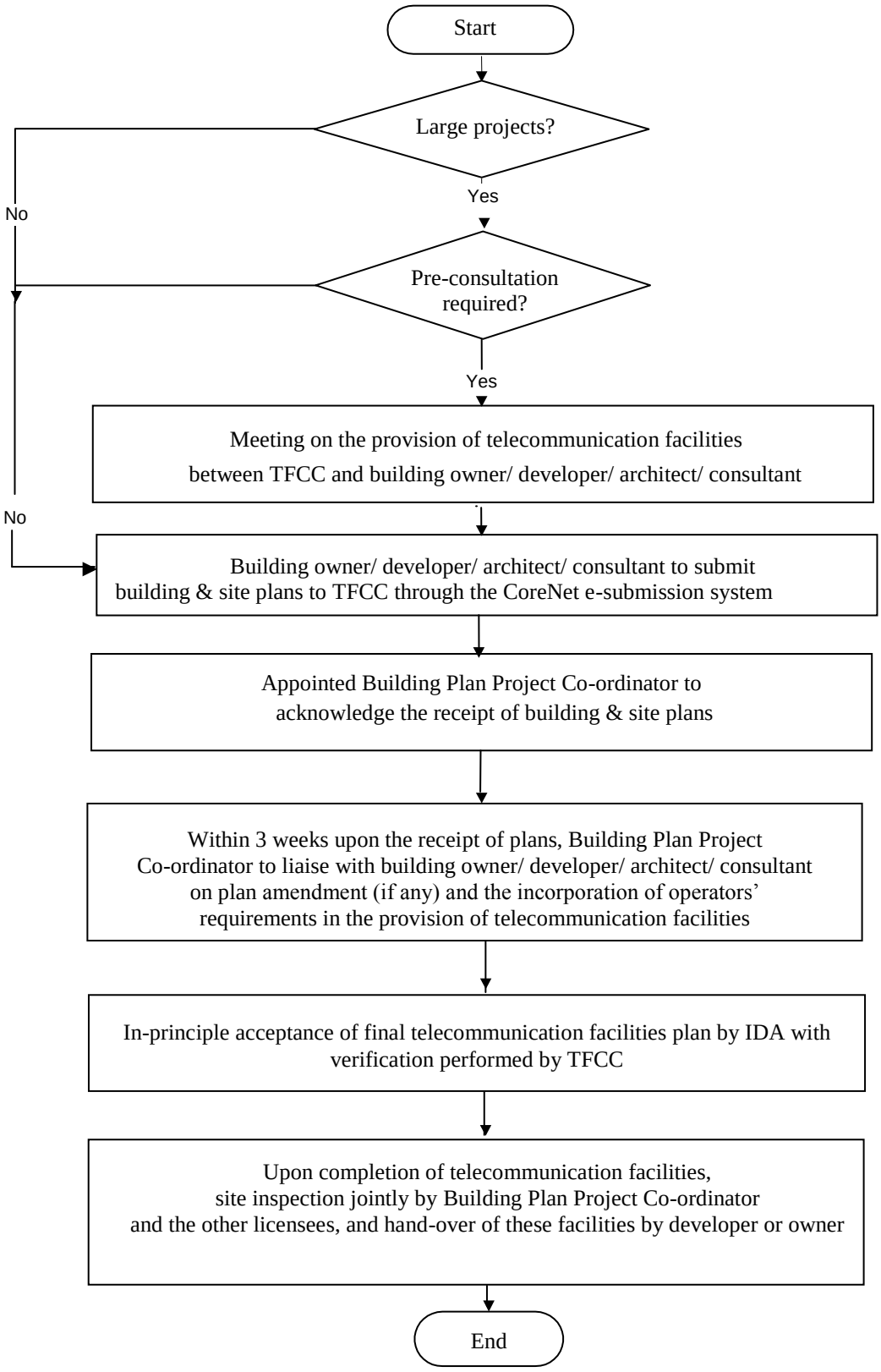
(a) For large developments, the owner or developer may require pre-consultation meeting with the TFCC on the provision of telecommunication facilities. They may contact and arrange an appointment with the Secretariat of the TFCC. The contact telephone and facsimile numbers for the Secretariat are 6848 4338 and 6825 6868 respectively.

(b) For small developments or projects in which pre-consultation is not required, the owner or developer shall submit the building plans and the site plan to the TFCC through the BCA's CoreNet e-submission system.

(c) The Building Plan Project Co-ordinator (appointed by the TFCC) will acknowledge the receipt of building plans. The co-ordinator will co-ordinate site meetings (with presence of representatives from licensees) to discuss in details on the provision of building telecommunication facilities. He/she will collate and forward final telecommunication service plan to building owners/ developers/ architects/ consultants and the other licensees. He/she will arrange for site inspection and MDF room hand-over when facilities are ready.

(d) The flow chart for building plan co-ordination and approval process is attached (Figure A1).

FIGURE A1 FLOW CHART FOR BUILDING PLAN CO-ORDINATION & APPROVAL PROCESS (AN OVERVIEW)



APPENDIX 2 DUCT SEALING SYSTEM FOR BUILDING WITH BASEMENT

2.1 Systems used

(a) MCT – Transit for round holes/pipes, type RGP-150, split type.

(b) SVT – Pyro-safe round fittings RDS-150, split type.

(c) ROX – Multi-diameter-modules with adaptable cores.

(d) BST – Multi cable transit, modular system.

Please refer to Figure A2 for typical view of duct sealing system.

2.2 Suppliers

(a) MCT System: Czeta Pte Ltd, 50 Kian Teck Road, Singapore 628788.

(b) ROX System: Finessco Industries Pte Ltd, 75A Joo Koon Circle, Singapore 629095.

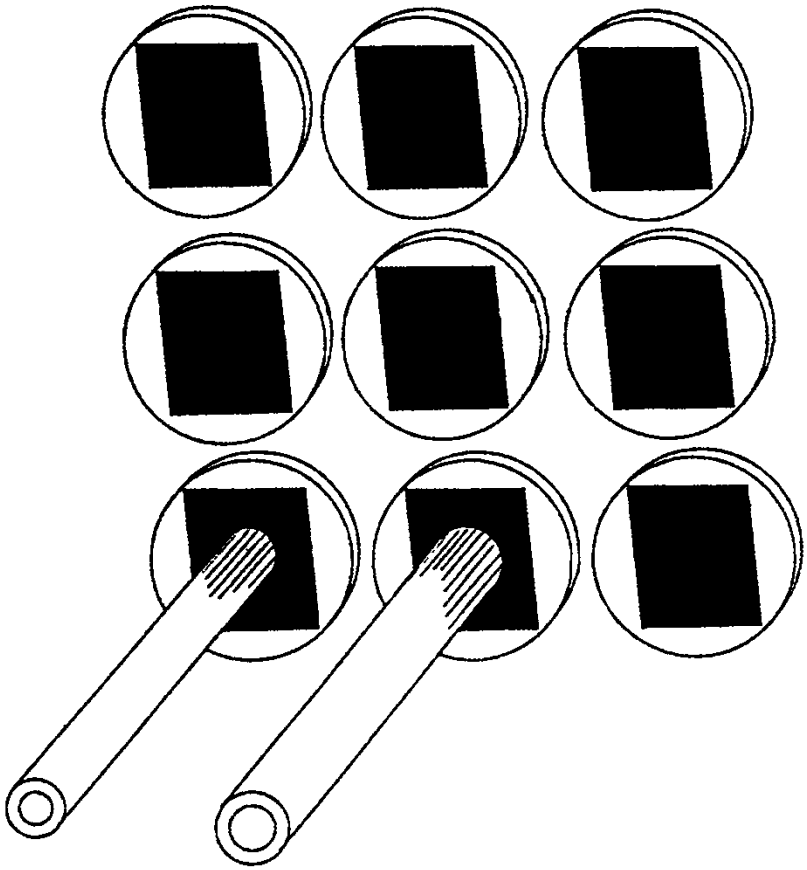
(c) BST System: Best Technology Pte Ltd, 37 Tannery Lane #03-06, Tannery House, Singapore 347790.

Note: The above list of companies dealing with duct sealing system is not exhaustive. IDA or the licensees do not endorse the qualifications or services of these companies. In addition, IDA or the licensees are not in any way associated with these companies.

2.3 Builder's responsibility

The developer or owner shall ensure that no water leaks on the duct seal throughout the lifespan of the building, including the maintenance of such duct sealing system.

FIGURE A2 PICTORAL VIEW OF CABLE DUCT SEALING SYSTEM



APPENDIX 5 PTL/TSL'S SPECIFICATIONS FOR 110 MM DIAMETER NOMINAL

SIZE UNPLASTICISED PVC PIPE IN ACCORDANCE TO SINGAPORE STANDARD, SS:272 1983

APPENDIX 3 TESTING AND ACCEPTANCE PROCEDURE FOR FACILITIES PROVIDED BY DEVELOPER OR OWNER

Upon completion of pipelaying works, the developer or owner shall make arrangements with the licensees through the TFCC to have the pipe tested in accordance with the following procedures for:

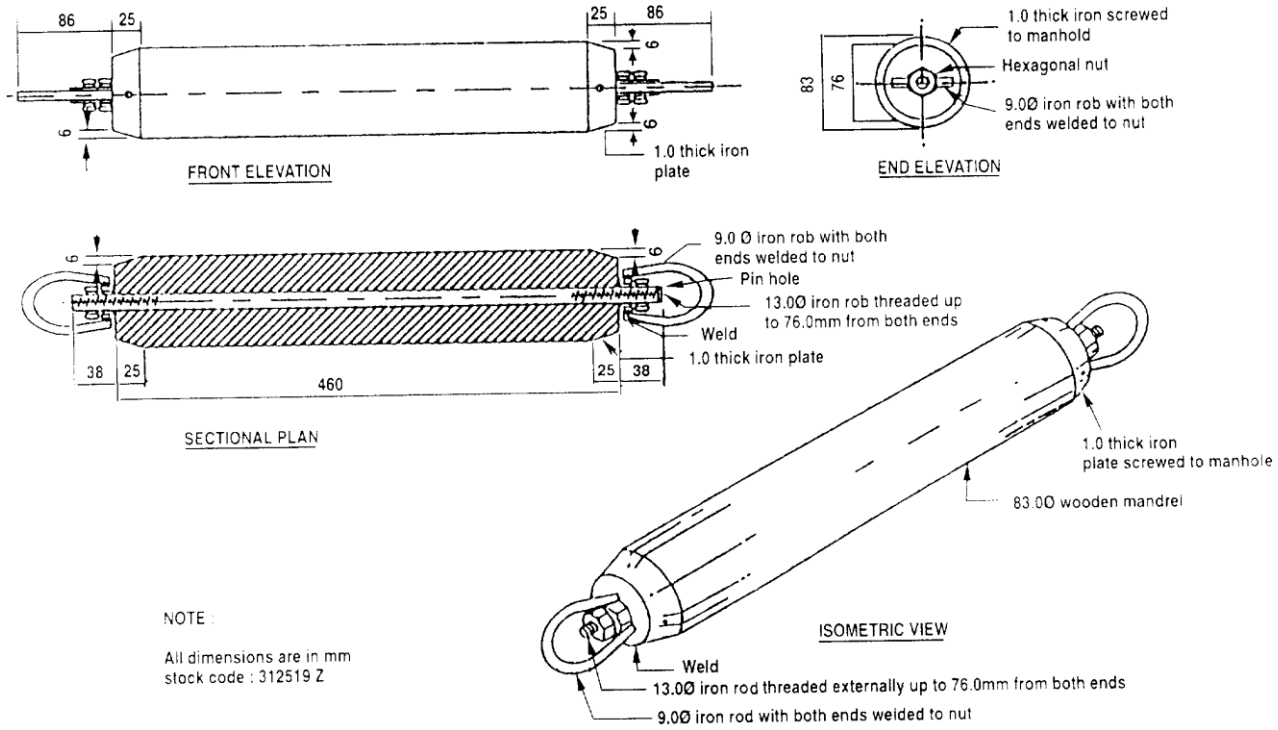
(a) 110 mm diameter nominal size uPVC Pipe:

A brush of appropriate size shall be drawn through each pipe to remove any dirt which may have entered. A standard wooden test mandrel as shown in Figure A3 shall then be drawn through each pipe from both ends of the pipe.

(b) 25 mm and 50 mm diameter nominal size uPVC Pipes:

A 2 m length of cable with diameter 15 mm smaller than the internal diameter of the pipe shall be drawn through each pipe from both ends.

FIGURE A3: WOODEN MANDREL



NOTE :

All dimensions are in mm
stock code : 312519 Z

APPENDIX 4 BROADBAND COAXIAL CABLE SYSTEM EQUIPMENT SPECIFICATIONS

The detailed performance specification of each component part to be installed in a broadband coaxial cable system (BCS) shall be selected to attain the overall system performance specification and requirements.

4.1 Minimum requirement of amplifiers

The amplifiers shall meet the minimum specifications set out hereunder:

a) The amplifier designs shall be based on parallel hybrid device ("PHD") integrated circuits.

b) The distribution amplifiers that will be cascaded, shall be operated with moderated trunk output levels in order to reduce the effects of accumulated distortions.

c) Carrier-to-composite triple beat at operating output levels of 50 dBmV and 39 dBmV output at 824 and 54 MHz respectively, 60-channel loading, shall be greater than 62 dB.

d) The carrier-to-composite (second order) at operating output levels of 50 dBmV and 39 dBmV at 824 and 54 MHz respectively, 60-channel loading, shall be greater than 60 dB.

e) The minimum performance characteristics of the high gain amplifier shall be as follows:

(i) Noise figure with equaliser: ≤ 10 dB
(ii) Flatness in unity gain configuration: ± 1 dB
(iii) Forward bandwidth (downstream): 54-824 MHz

(f) Amplifier housings shall be equipped with suitable means to prevent RF ingress and egress. When the cover is securely fastened, the housing shall have RF shielding effectiveness in excess of 80 dB when measured using the Dipole Antennae procedure, or in excess of 70 dB when measured using the Absorbing Clamp Method. The housing shall be of water tight construction, sealed with moisture blocking gaskets.

(g) Amplifiers shall provide for the use of appropriate equalisers (input and/or interstage), and shall contain diplex filters providing sufficient isolation to avoid interaction between forward and reverse transmission.

(h) Initial system configuration will accommodate broadband 54–824 MHz transmission for the MATV operations and 5 – 42 MHz upstream transmissions for BCS operations.

(i) Amplifiers shall not require automatic gain control ("AGC"), however, it is desirable to have the option of installing an AGC circuit on the initial

amplifier in any network leg. This would compensate for any level variation that may be introduced from the future BCS system.

4.2 Minimum requirements of passive devices: taps, splitters and system outlets

(a) Splitters and bi-directional couplers may be either separately installed or combined in convenient groups to form multi-taps for use as distribution panels.

(b) In order to minimise signal leakage (i.e. egress) from the installation, the screening effectiveness of splitters, bi-directional couplers and multi-tap combinations shall be either greater than 80 dB when measured using the Dipole Antennae Procedure, or greater than 70 dB when measured using the Absorbing Clamp Method.

(c) The frequency response of all passive devices, including taps/tees, splitters, couplers and power inserters will be minimally 5 – 824 MHz.

(d) To minimise signal reflections, devices that do not present a constant impedance match to the distribution cables should not be used. The return loss over the total frequency band shall be better than 12 dB.

(e) System outlets located at spare TV points or in areas shall have all ports terminated when not in use. This may be accomplished by use of self-terminating wall plates. These devices activate an internal termination when the receiver lead is removed. However, the use of self-terminating wall plates may not be necessary if the taps used in a terminated branch feeder have good tap-to-tap or tap-to-output protection and the performance of the network is not affected even if a TV wall outlet is not connected.

(f) Wall outlet boxes and plates shall be fabricated from non-corrosive material or from metallic material treated to resist corrosion.

4.3 Minimum requirements of connectors and splices

(a) Connectors for subscriber feeder cables shall be F-type, with long (12-19 mm) attached ferrule. The connectors will utilise a compression sealed plastic ferrule bushing within the ferrule and a neoprene rubber gasket within the rotational joint in order to keep out moisture. In addition, it is recommended to seal the front end of the F type connectors with neoprene rubber boots which fit over the female F port and are compressed by the front face of the F type connector. Other connectors with similar characteristics and in every respect not less effective than that of the F type connectors may also be used.

(b) Bulkhead fittings, cable connectors and splice barrels shall be compatible with each other and the coaxial cable used. This is particularly critical with respect to the diameter of the centre conductor and the clutch in the female fitting.

(c) Suitable connectors and splices for solid sheath cables shall be used. Connectors will utilise a fixed sleeve with two separate ferrules to seize the

other conductor and jacket of the cable independently. Connectors must be specifically designed for use with the coaxial cables types to be used.

(d) Main distribution cables require the use of pin type connectors. Feed-through types are unacceptable. Connector return loss specifications shall equal or exceed 30 dB from 47 – 824 MHz. F-type connectors are not allowed on the main distribution cables.

(e) Adapters between F connectors and housings or other devices shall be designed for use with each other and the coaxial cables used.

(f) All connectors shall be installed and protected with properly applied shrink tubing in order to minimise corrosion or oxidation of cables and connectors.

(g) All types of RF connectors, regardless of application, shall be mechanically, electrically and metallurgical suitable for use with the types of conductors used on various cables.

APPENDIX 5 COMMISSIONING OF TEST PROCEDURES FOR BROADBAND COAXIAL CABLE SYSTEM

5.1 Upon the completion of the installation work, an inspection shall be carried out to determine that all necessary equipment is in place, and properly installed. Each device, connector and cable of poor workmanship should be replaced as it would lead to signal ingress or egress if it is left unattended.

5.2 For a multi-storey building, a sample test shall be conducted for every storey and riser in the building. Tests shall be completed by making measurements on all vertical cable risers on all storeys. Signals shall be measured at the distribution panels. Test will be for continuity and proper levels. Not less than three visual carriers, spread across the band, should be tested. For a multi-storey building, a sample test shall be conducted for every storey in the building. This test shall involve outlets in at least two units in the same storey. Tests shall be completed by making measurements on all vertical cable risers on all storeys. Signals shall be measured at the distribution panels. On each storey, signal levels shall be measured at two system outlet locations, one representing the longest subscriber feeder and another representing the shortest subscriber feeder. Test will be for continuity and proper levels. Not less than four visual carriers, spread across the band, should be tested with CW signals at the input port at proper levels.

5.3 For a landed dwelling-house, a sample test shall be conducted by making measurements at the distribution panel in the pedestal box outside the house. Test will be for continuity and proper levels. Not less than three visual carriers, spread across the band, should be tested. Another physical inspection may be carried out after all the tests are completed. In order to minimise disturbance to residents, power levels may be measured at the distribution panel and interpolated for signal level within the house.

APPENDIX 6 METHODS OF MEASUREMENTS FOR BROADBAND COAXIAL CABLE SYSTEM

6.1 General

The basic methods of measurements shall be conducted in accordance with the recommendations both IEC 728-1 and National Cable Television Association ("NCTA"). Any equivalent method that ensures the same accuracy may be used for assessing performance.

The following measurements are considered:

(a) Measurement of mutual isolation between system outlets;

(b) Measurement of hum;

(c) Measurement of amplitude/frequency response within a channel;

(d) Measurement of visual, aural carrier centre frequency;

(e) Measurement of inter-modulation;

(f) Measurement of visual-carrier-to-noise ratio;

(g) Measurement of chrominance – luminance delay inequality;

(h) Measurement of differential gain and phase;

(g) Measurement of signal leakage.

6.2 Measurement of mutual isolation between system outlets

(a) References to system outlets shall also apply to the far ends of subscribers' feeders when no system outlets are used.

Isolation shall be measured between:

(i) System outlets connected to adjacent subscriber's taps;

(ii) System outlets connected to the same multiple subscriber's taps.

(b) Equipment required for the test set-up shall be provided and the measurement shall be conducted in accordance with the recommendations of IEC 728-1.

6.3 Measurement of hum

(a) Modulation distortion at power frequencies (i.e. hum) is the amplitude distortion of the desired signals caused by the modulation of these signals with components of the power source.

(b) Equipment required for the test set-up shall be provided and the measurement shall be conducted in accordance with the recommendations of FCC 76.605(a)(10) and NTCA Recommended Practices – Second Edition 1993.

6.4 Measurement of frequency response within a channel

(a) Frequency response is a measure of the overall gain variation of a cable system as a function of frequency. It is normally measured in dB peak to peak (sometimes called peak-to-valley) or as ± dB (half the peak-to-peak value).

(b) Equipment required for the test set-up shall be provided and the measurement shall be conducted in accordance with the recommendations of FCC 76.605(a)(6) and NTCA Recommended Practices – Second Edition 1993.

6.5 Measurement of visual, aural carrier centre frequency

(a) Vision carrier level in a cable television system is the rms voltage of a channel's visual (picture) carrier measured across a termination impedance which matches the internal impedance of the cable system. Aural carrier level in a cable television system is the r.m.s. voltage of a channel's aural (sound) carrier measured across a termination impedance which match the internal impedance of the cable system, generally expressed with reference to the channel's associated visual carrier level.

(b) Equipment required for the test set-up shall be provided and the measurement shall be conducted in accordance with the recommendations of FCC 76.605(a)(4) and NTCA Recommended Practices – Second Edition 1993.

6.6 Measurement of inter-modulation

(a) The method is applicable to measurements of single inter-modulation products, second-order inter-modulation products and third-order inter-modulation products.

(b) Equipment required for the test set-up shall be provided and the measurement shall be conducted in accordance with the recommendations of IEC 728-1 Clause 9 and NTCA Recommended Practices – Second Edition 1993.

6.7 Measurement of visual carrier-to-noise ratio

(a) Vision carrier to noise ratio is the power in a sinusoidal signal, whose peak is equal to the peak of a visual carrier during the transmission of synchronising pulse, divided by the associated system noise power in the 5 megahertz bandwidth. This ratio is expressed in dB.

(b) Equipment required for the test set-up shall be provided and the measurement shall be conducted in accordance with the recommendations of FCC 76.605(a)(7) and NTCA Recommended Practices – Second Edition 1993.

6.8 Measurement of chrominance – luminance delay inequality

(a) The chrominance – luminance delay inequality caused by a headend system or component is defined as the change in delay time of the chrominance component of the signal relative to the luminance component after passing through the system. The parameter is also called chroma delay.

(b) Equipment required for the test set-up shall be provided and the measurement shall be conducted in accordance with the recommendations of FCC 76.605(a)(11)(i) and NTCA Recommended Practices – Second Edition 1993.

6.9 Measurement of differential gain and phase

(a) The methods are applicable to the measurement of differential gain and differential phase for complete systems and items of equipment thereof.

(b) Equipment required for the test set-up shall be provided and the measurement shall be conducted in accordance with the recommendations of FCC 76.605(a)(11)(ii)(iii) and NTCA Recommended Practices – Second Edition 1993.

6.10 Measurement of signal leakage

(a) The term "leakage" refers to the undesired emanation of electromagnetic energy from the cable television system.

(b) Equipment required for the test set-up shall be provided and the measurement shall be conducted in accordance with the recommendations of FCC 76.605(a)(12) and NTCA Recommended Practices – Second Edition 1993.

APPENDIX 7 DESCRIPTION OF SOME STANDARDS DEVELOPMENT BY THE SCTE FOR BROADBAND COAXIAL CABLE SYSTEM

The Society of Cable Telecommunications Engineers Inc ("SCTE") is an accredited Standards Developing Organization of the American National Standards Institute ("ANSI") in the specialized area of broadband cable engineering. The following outline some of the standards available. For further details, please refer to the official publications from SCTE.

Interface Practices & In-Home Cabling Drop Specifications

IPS-SP-001 Flexible RF Coaxial Drop Cable–This specification is intended to apply to general purpose flexible RF coaxial drop cable and not specialty cables. There are numerous reasons to standardize drop cable, but the primary reason is for proper cable to "F" fitting interface.

IPS-SP-200 On Premises Bonding and Safety Specification–Electrical bonding refers to the methods and devices used to control or reduce voltages and currents imposed on the cable plant from foreign sources such as lightning and commercial AC power faults. The primary purpose of electrical bonding is to prevent damage to subscriber equipment and to prevent shock and injury to those involved in its construction, operation, and maintenance. The purpose of this practice is to stress the importance of providing a low resistance path to ground for both lightning and power protection.

IPS-SP-202 Drop Amplifiers – The purpose of this specification is to specify recommended mechanical and electrical standards for broadband radio frequency ("RF") devices whose primary purpose is to amplify signals presented to an input port and deliver the amplified signals to one or more output ports. The devices are also required to pass signals in a different range of frequencies in the reverse direction and, optionally, may provide amplifications of such reverse signals. The specification's scope is limited to 75 Ω devices whose ports are provided with "F" connectors. The most common use for such devices is on-premises RF signal distribution. Devices covered by this specification include products commonly known as the Drop Amplifiers. They may be mounted with NID housing on dwellings or independently within dwellings.

IPS-SP-206 Drop Passives: Splitters and Couplers – The purpose of this document is to specify recommended mechanical and electrical standards for broadband radio frequency ("RF") devices whose primary purpose is to split signals presented to an input port among two or more output ports with a splitting ratio that is nominally independent of frequency. Alternatively, such devices can be used to combine signals from several input ports into a common output port. Its scope is limited to 75 Ω devices whose ports are provided with "F" connectors. The most common use for such devices is on-premises RF signal distribution. Products covered by this specification include signal splitters (2, 3, 4 and 8-way) and directional couplers.

IPS-SP-207 Drop Passives: Antenna Selector Switches – The purpose of this document is to specify recommended mechanical and electrical standards for broadband radio frequency ("RF") devices whose primary purpose is to allow signals presented to an input port to be routed selectively to one of two or more output

ports. Alternatively, such devices can be used to select which among multiple input sources are routed to the common output port. Its scope is limited to 75Ω devices whose ports are provided with "F" connectors. The most common use for such devices is on-premises RF signal distribution. Products covered by this specification include switches commonly known as "A/B Switches" and "A/B/C Switches." These devices are regulated by the Federal Communications Commission as "Cable Input Selector Switches" under C.F.R. 47 ss 15 which are incorporated by reference into this standard.

IPS-SP-208 Drop Passives: Bonding Blocks (Without Surge Protection) – The purpose of this document is to specify recommended mechanical and electrical standards for broadband radio frequency ("RF") devices whose primary purpose is to provide a transition point between the network operator's service cable (the "drop") and the distribution wiring within premises. An important function of the device is to provide a connection point for a bonding conductor in accordance with requirement of the National Electrical Code or local building requirements. The scope of this specification is limited to 75 Ω devices whose ports are provided with female type "F" connectors.

IPS-SP-209 Drop Passives: Female F to Female F In-Line Adapters (F Splices) – The purpose of this document is to specify recommended mechanical and electrical standards for broadband radio frequency ("RF") devices whose purpose is to provide a transition between two type "F" Male connectors. The scope of this specification is limited to 75 Ω devices whose ports are provided with female type "F" connectors.

IPS-SP-210 Drop Passives: FM Splitters – The purpose of this document is to specify recommended mechanical and electrical standards for broadband radio frequency ("RF") devices whose primary purpose is to split signals presented to an input port such that signals in the FM broadband (88 MHz through 108 MHz) exit through one port and the remainder of the spectrum exits through other ports. Alternately, such devices can be used to combine signals in the FM band with signals in the remainder of the spectrum into a common output port. Its scope is limited to 75 Ω devices whose ports are provided with "F" connectors. The most common use for such devices is on-premises RF signal distribution. Two levels of compliance are specified. Those meeting electrical and mechanical but not environmental requirements may be designated as "indoor use" and the products must be marked as specified herein to guide users in their appropriate applications.

IPS-SP-211 Drop Passives: Matching Transformers 75 Ω to 300 Ω – The purpose of this test is to specify recommended mechanical and electrical standards for broadband radio frequency ("RF") devices whose primary purpose is to provide an impedance and connector match between 75 Ω coaxial type "F" and 300Ω twin-lead open screw connectorised devices. The most common use for such devices is matching coaxial cables from distribution system to screw antenna terminals on receivers. The alternative configuration provides a match between 300Ω twin lead (typically from off-air antennas) and type "F" receiver input ports.

IPS-SP-212 Drop Passives: Power Inserters – The purpose of this document is to specify recommended mechanical and electrical standards for broadband radio frequency ("RF") devices whose primary purpose is to multiplex AC power with RF signals carried over flexible drop cables. Alternatively, such devices can be used to extract power from cables which carry both RF and power voltages. The device also acts to block the power voltage from travelling both directions along the coaxial cable. The specification's scope is limited to 75 Ω devices whose ports are provided with "F" connectors for at least the RF ports. The most common application for such devices is on-premises RF signal distribution. Two levels of compliance are specified. Those meeting the electrical and mechanical but not environmental requirements may be designated with "indoor use" and the products must be marked as specified herein to guide users in their appropriate application.

IPS-SP-213 Drop Passives: In-Line Attenuators – The purpose of this document is to specify recommended mechanical and electrical standards for broadband radio frequency ("RF") devices whose primary purpose is to provide a fixed attenuation of RF signals by an amount that is nominally independent of frequency. Its scope is limited to 75 Ω devices whose ports are provided with "F" connectors. The most common use for such devices is on-premises RF signal distribution. Two levels of compliance are specified. Those meeting electrical and mechanical but not environmental requirements may be designated with "indoor use" and the products must be marked as specified herein to guide users in their appropriate application.

IPS-SP-214 MDU Amplifiers – The purpose of this specification is to specify recommended mechanical and electrical standards for broadband radio frequency ("RF") devices whose primary purpose is to amplify signals presented to an input port and deliver the amplified signals to one or more output ports. The devices are also required to pass signals in a different range of frequencies in the reverse direction and, optionally, may provide amplification of such reverse signals. The specification's scope is limited to 75Ω devices whose RF connectors may be "F" connectors or 5/8-24 mainline cable ports. The most common use of such devices is RF signal distribution in multi-dwelling units ("MDUs"). Devices covered by this specification include products commonly known as MDU Amplifiers.

IPS-SP-215 Drop Passives: F Male Terminators – The purpose of this document is to specify recommended mechanical and electrical standards for broadband radio frequency ("RF") devices whose primary purpose is to provide a low-reflection RF termination for 75Ω devices which are equipped with the "F" female ports which meet the requirements of SCTE IPS-SP-407.

<u>On Premises Specifications</u>

IPS-SP-002 On Premise Cable Installation and Performance – The purpose of this document is to improve and standardize new dwelling pre-wiring and existing dwelling cable installation. This document is intended primarily for the cable industry to use as a standard to supplement procedures already in use. This

document can be used by the local operator to distribute to home building industry crafts-people, home automation, electrical contractors and others that install coax cable for use with BCS signals. This will allow the local cable operator to provide BCS and future services to the home without having to rerun the coax in the house.

IPS-SP-203 Passive Network Interface Devices ("NID") Enclosure Specification – This specification is for NIDs intended to house internally, coax and telephony drop components. The primary purpose is to recommend a standard set of design requirements for mounting and enclosing drop components in outdoor applications.

IPS-SP-204 Coaxial Cable System Customer Premise Interface – The intent of this specification is to provide necessary information on minimum requirements that may be used by interested parties for the protection of coaxial cable interface circuits. This specification is written for surge protection at customer entrance interface/demarcation points.

IPS-SP-205 Active Network Interface Devices ("NID") – This specification is for Network Interface Devices ("NID") enclosures intended to house internally, broadband active drop components. The primary purpose is to recommend a standard set of design requirements for mounting and enclosing active drop components for outdoor applications. The functions of NID include physical connection point between drop loop and subscriber's wiring, bonding point, test point, and weather-able housing.

"F" Connector Specifications

IPS-SP-400 "F" Port (Female Outdoor) Physical Dimensions–Mechanical dimensions for the female "F" connector, outdoor. ANSI/SCTE.

IPS-SP-401 "F" Port (Male Outdoor) Physical Dimensions – Mechanical dimensions for the male "F" connector. This document does not cover the connector to cable interface.

IPS-SP-402 Recommended "F" Push-On (Feed Thru, Male) – Mechanical dimensions for the male push-on "F" connector. This document does not cover the connector to cable interface.

IPS-SP-404 Indoor F-Male Connector Installation & Performance – This document is the preliminary specification for the male and female connections used in In-Home cabling applications. The primary purpose is to recommend "F" connector practices pertaining to indoor usage. To this end, the document references existing practices and specifications from organisations such as NEC, SCTE, and UL. This specification is meant to recommend a connection system that is compatible with general purpose indoor flexible RF coaxial drop cable and with other components specified by SCTE Interface Practices/In-Home Cabling Subcommittee.

IPS-SP-405 Outdoor F-Male Connector Installation and Performance – The intent of this specification is to provide installation guidelines pertaining to the outdoor use

of "F" Connectors and their attachment to both female "F" ports and 75 Ω coaxial cables ranging from 59-Series standard braid through 11-Series quad braid. This specification is meant to recommend a connection system that is compatible with general purpose flexible RF coaxial drop cable and with other passive and active components used in the coaxial outdoor distribution network.

IPS-SP-406 "F" Port (Female, Indoor) Physical Dimensions – Mechanical dimensions for the female "F" connector, indoor. ANSI/SCTE.

IPS-SP-407 "F" Port Female Specifications – The purpose of this document is to specify torque, cantilever, axial strength and signal performance requirements for female "F" ports for both indoor and outdoor applications.

IPS-SP-408 Male F Ports – The purpose of this document is to specify requirements for male "F" equipment ports for both indoor and outdoor applications. This specification does not cover connectors intended for installation on cables, whether of the "pin" type or the "feed-through" type.

IPS-SP-600 Trap "F" Male Connector – Mechanical dimensions for the male "F" Connector portion of in-line traps.

Mainline Specifications

IPS-SP-100 Specification for Trunk, Feeder and Distribution Coaxial Cable – This specification is intended to apply to general purpose semi-rigid RF coaxial cable, not specialty cables.

IPS-SP-500 Recommended 5/8 – 24 Port (Female) – Mechanical dimensions for the female 5/8 – 24 entry port.

IPS-SP-501 Recommended 5/8 – 24 Port (Male) – Mechanical dimensions for the male 5/8 – 24 port plug.

IPS-SP-502 Recommended Mainline Plug (Male) to Cable Interface – The primary purpose of this specification is to ensure acceptable electrical and mechanical performance integrity between cable and connector interfaces. The scope of this standard will be directed to the key performance of impedance, low galvanic action, low loop resistance, maximum cable retention, minimum inter-modulation distortion and AC hum, signal response, RF shielding, and water tight seals.

Test Procedure Documents

IPS-TP-001 Cold Bend – The purpose of this procedure is to provide instructions to measure the cold bend properties of flexible RF coaxial drop cable.

IPS-TP-002 Flexible Coaxial Cable Impact Test – This test is to establish that specified flexible RF coaxial drop cables are capable of withstanding an impact at low temperatures.

IPS-TP-003 Polyethylene Jacket Longitudinal Shrinkage – The purpose of this test is to determine the amount of shrinkage of the jacketing material used on flexible RF coaxial drop cables.

IPS-TP-004 Insertion Force – This test procedure is designed to measure the amount of linear force required to install a drop ("F") connector onto a drop cable of the proper size.

IPS-TP-005 Centre Conductor Bond to Dielectric Bond – This test is to determine the amount of bond between the centre conductor and dielectric for specified flexible RF coaxial drop cables. Adopted.

IPS-TP-006 Coaxial Cable Impedance – The purpose of this procedure is to provide a test procedure for measuring the impedance of BCS coaxial cable using the Hewlett-Packard HP 8444A Tracking Generator, HP 8568B Spectrum Analyser, Wide Band Engineering ("WBE") A56 Return Loss Bridge, and WBE A65 low loss impedance transformers.

IPS-TP-007 Coaxial Cable Structural Return Loss – The purpose of this procedure is to provide instructions to measure the Structural Return Loss ("SRL") characteristics of flexible RF coaxial drop cable from 5 MHz to 1,000 MHz. SRL is a ratio between the reflected and the reference signals or the reflection coefficient (Þ). ANSI/SCTE.

IPS-TP-008 DC Loop Resistance – This method is intended for use in determining the DC Loop Resistance of coaxial cables using the Wheatstone Bridge Method.

IPS-TP-009 Coaxial Cable Attenuation – Measurement technique for determining attenuation of coaxial cable at various frequencies.

IPS-TP-010 Ampacity – This method is intended for use in determining the current carrying capacity (i.e. ampere capacity) of coaxial drop cables.

IPS-TP-011 Transfer Impedance – This procedure is for the measurement of transfer impedance of coaxial drop cables from 5 MHz to 1,000 MHz.

IPS-TP-012 Dielectric Withstand – This test procedure describes a method to determine if the dielectric used in flexible RF coaxial drop cables will withstand an alternating voltage for a preset time limit.

IPS-TP-013 Interface Moisture Migration – This test method can be used for comparing the various methods used in sealing the interface by an artificial environment which cannot be correlated to field service, and for detecting moisture leakage of the "F" connector Interface. Liquid penetrate examination can be used to indicate the presence, location, and to an extent, the nature and magnitude of the detected moisture paths. This test method is intended primarily for localised areas of examination utilising minimal equipment. This method can also be used to determine the liquid tightness of integral or external seals, encapsulations or other environmental protection devices of the interface.

IPS-TP-014 Aerial Cable Corrosion Protection Flow – This test is to determine that moisture blocking materials used in cables intended for indoor and aerial applications do not flow or drip out of the cable.

IPS-TP-015 Diameter of Drop Cable – The purpose of this procedure is to determine one or more of the following characteristics relating to flexible coaxial drop cables. · Cable jacket outside diameter. Average core diameter over foil. · Centre conductor diameter. · Percentage of braid coverage. This method is intended to make use of relatively inexpensive equipment. For a more precise method using laser micrometers and the like see IPS-TP-018.

IPS-TP-016 Jacket Web Separation – The purpose of this procedure is to provide the best methodology for separating messenger from messenger cable, with intent to ensure the validity of the measured data and that the data falls within specified requirements as dictated by this procedure.

IPS-TP-017 Moisture Inhibitor Corrosion Resistance – This is to test the corrosion resistance of flooded drop cable.

IPS-TP-018 Measuring Diameter Over Core – To document sample preparation, sample testing, and test procedure for off-line measurement of diameter over tape and ovality over tape of messenger cables.

IPS-TP-102 Centre Conductor Bond to Dielectric for Trunk, Feeder and Distr. Coaxial Cables – This test is to determine the bond strength between the centre conductor and dielectric for specified semi-flexible cables.

IPS-TP-103 Air Leakage Test Method for Trunk, Feeder, and Distribution Coaxial Cable – The purpose of this test is to detect voids in the dielectric (if applicable) and voids between the centre conductor and dielectric.

IPS-TP-108 Static Minimum Bending Radius for Coaxial Trunk, Feeder and Distribution Cables – This test procedure is to be used for initially establishing or alternatively verifying the minimum static bend radius for coaxial distribution cable products. This procedure establishes the methodology to be used in the determination of a minimum bend radius as well as establishing a acceptance criteria by which products can be tested or compared.

IPS-TP-110 Test Method for "Mainline" Pin (Plug) Connector Return Loss – The purpose of this procedure is to provide instruction to measure the return loss characteristics of a single Mainline Pin (Plug) Connector to cable interface, at the end of the cable, from 5MHz to 1 GHz. This test method applies to SCTE specifications IPS-SP-501 and IPS-SP-502. It implements the time domain gating feature of the network analyser which removes the near end interface, and termination from the far end connector (Device Under Test).

IPS-TP-111 Test Method for "Mainline" Splice Connector Return Loss – The purpose of this procedure is to provide instruction to measure the return loss characteristics of a single Mainline Splice Connector interface between 2 mainline cables, from 5 MHz to 1 GHz. This test method applies to SCTE specifications IPS-SP-501 and IPS-SP-502. It implements the time domain

gating feature of the network analysers which removes the near end interface, and far end termination from Splice connector (“DUT”).

IPS-TP-201 Insertion Gain/Loss, Frequency Response and Bandwidth – The purpose of this test is to determine the insertion gain or loss (as appropriate) as a function of frequency of a properly terminated device, as measured across the frequency range of interest. Depending on use of the data minimum and maximum gain or loss, response variation and/or bandwidth can be derived. Components exhibiting high loss characteristics (isolation) may be more accurately measured using IPS-TP-203.

IPS-TP-202 Return Loss – The purpose of this test is to determine the precision of the impedance match provided at a given port of the component being evaluated, as measured across the frequency range of interest.

IPS-TP-203 Isolation – The purpose of this test is to determine the degree of signal isolation provided by the component being evaluated, as measured across the frequency range of interest.

IPS-TP-204 Hum Modulation – The purpose of this test is to determine the degree of amplitude modulation at power-line-related frequencies added to a transmitted signal by the component being evaluated. The numeric result of the test is consistent with the definition used by the FCC [C.F.R. 47, §76.605(a)(11)] in its performance standards as applied to cable television systems, i.e. The peak-to-peak variation in signal level caused by modulation expressed as a percentage of the un-modulated carrier signal level (the level measured during the synchronising pulse for NTSC television signals). This numerical value is double the conventional definition of amplitude modulation in which 100% modulation results in the minimum carrier level just reaching zero.

IPS-TP-205 Test Method for Noise Figure – The purpose of this test is to determine the noise figure of a properly terminated amplifier device, as measured across the frequency range of interest. This specification is applicable to testing of 75 Ω components which are equipped with type "F" connectors.

IPS-TP-206 Composite Triple Beat Distortion – The purpose of this test is to determine the degree of composite third order (triple beat) distortion caused by passing a spectrum of carriers through the component being evaluated, as measured on the most-affected carrier.

IPS-TP-207 Composite Second Order Distortion – The purpose of this test is to determine the degree of composite second order (“CSO”) distortion caused by passing a spectrum of carriers through the component being evaluated, as measured on the most-affected carrier.

IPS-TP-208 Cross Modulation Distortion – The purpose of this test is to determine the degree of cross modulation (X-mod) distortion caused by passing a spectrum of carriers through the component being evaluated, as measured on the most-affected carrier.

IPS-TP-209 Test Method for Power Consumption – The purpose of this test is to determine rate of consumption of 60 Hz energy by AC line powered devices.

IPS-TP-210 Coaxial Cable System Customer Premise Protection – This document covers the test procedures for the evaluation for the surge protectors used for coaxial cable systems at the customer premise. This document is to be used in conjunction with the SCTE specification IPS-SP-204.

IPS-TP-211 Test Method for Group Delay – The purpose of this test is to determine the group delay of a properly terminated device, as measured across the frequency range of interest. This specification is applicable to testing of 75 Ω components which are equipped with the type "F" connectors.

IPS-TP-215 Test Method for Torque Requirements for Ground Wire Penetration of Bonding Set Screw – This test procedure is to determine the mechanical force needed to penetrate ground wire to the appropriate depth. Ground wire penetration should be less than 25% of wire outer diameter.

IPS-TP-400 Withstand Tightening Torque – To determine the strength required per IPS-SP-401 (through torque) that will cause one or more of the following conditions to occur to the male interface. · Stripping of the internal threads. · Breakage of the male interface. · Failure of the nut hex-flats. Adopted.

IPS-TP-401 Axial Pull Connector/Cable – To determine the tensile pull required to cause one or more of the following conditions in a cable/connector test system: · Catastrophic cable structural failure. · Connector structural failure. · Separation due to slip at the cable/connector interface.

IPS-TP-402 Push-On Insertion Force – This document describes the test method for determining the axial installation force to install the indoor push-on connector onto the "F" female plug (port). This method is intended to allow for manufacturer's freedom of design yet control the effort to install the connector. Every push-on connector has a different method for installing based on individuality of design. This document intends to encompass a wide variety of such designs, being flexible in some sections and standard in others.

IPS-TP-403 Shielding Effectiveness (GTEM Method for RF Signal) – This test procedure measures the shielding effectiveness ("SE"), in dB, of cables, connectors, and small devices such as splitters and traps commonly used in the BCS environment, using the technology known as the GTEM (Giga Hertz Transverse Electromagnetic Mode) cell.

IPS-TP-404 Axial Load Temperature Cycling – This test procedure is intended to evaluate the connection between the connector and the coaxial cable when it is subjected to a continuously varying environmental cycle. The installed connectors have an axial load of 15 pounds applied to them during the environmental cycling.

IPS-TP-405 DC Contact Resistance – This test procedure is intended to evaluated the DC contact resistance between the connector and the coaxial cable following exposure to a salt spray test per MIL-STD-202F, method 101D.

IPS-TP-406 Salt Spray – This test procedure is intended to evaluate the plating of connectors and the coaxial cable following exposure to a salt spray test per ASTM B 368.

IPS-TP-407 "F" Connector Return Loss – The purpose of this procedure is to provide instructions to measure the return loss characteristics of a single type "F" connector-to-cable interface, at the beginning of a cable, from 5 MHz to 1,000 MHz. This test method applies to SCTE specifications IPS-SP-402, IPS-SP-403, and IPS-SP-404. This test method makes use of the time domain gating feature of the network analyser to remove the far end connector effects from the near end connector under test. ANSI/SCTE.

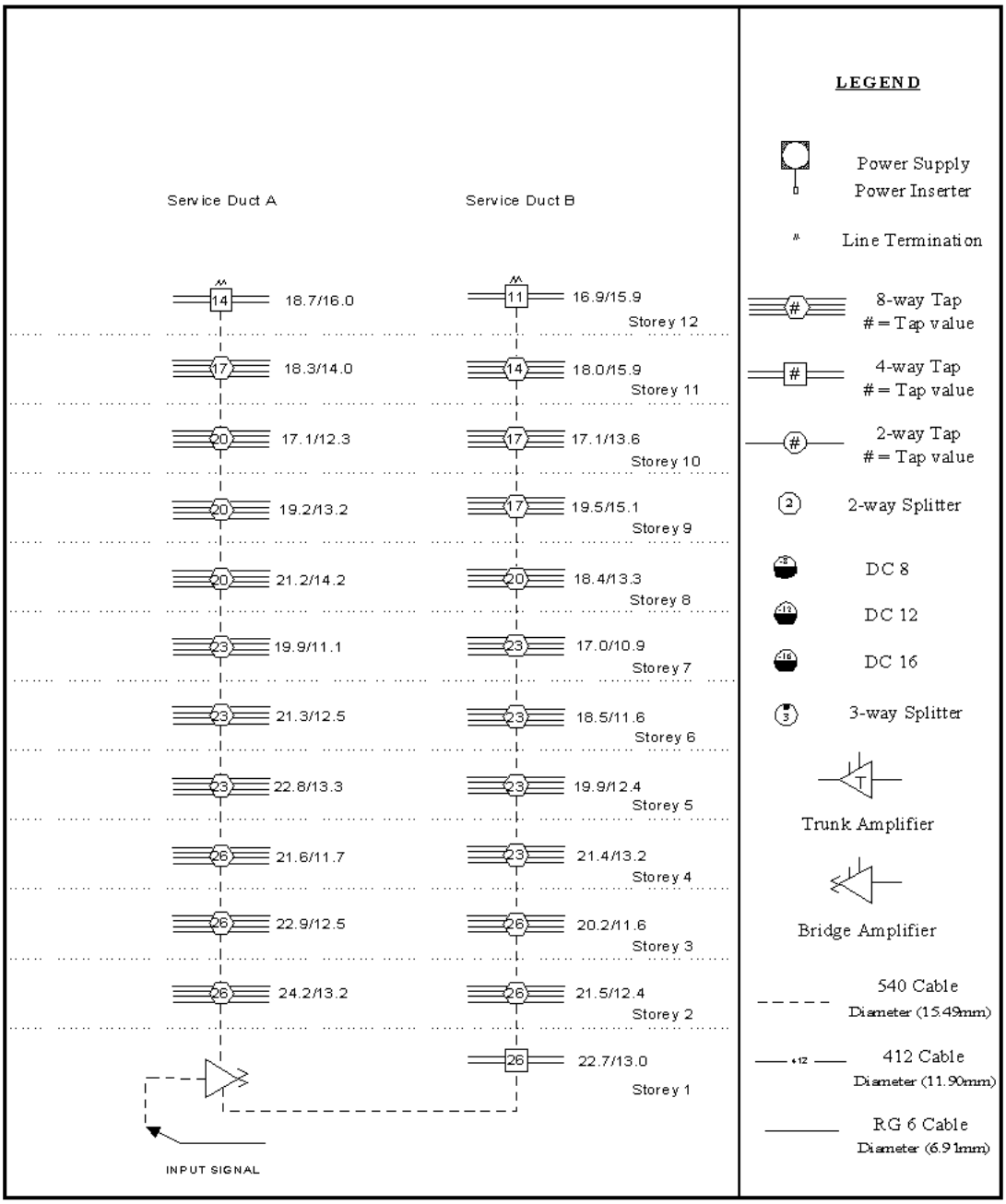
IPS-TP-408 "F" Connector Return Loss In-line Pair – The purpose of this procedure is to provide instructions to measure the return loss characteristics of a pair of type "F" connectors and the cable interface, inserted in the middle of a cable, from 5 MHz to 1,000 MHz. This test method applies to SCTE specifications IPS-SP-402, IPS-SP-403, and IPS-SP-404. This test method makes use of the time domain gating feature of the network analyzer to remove the near end and far end test set connector effects from type "F pair" in the middle of the cable, joined by a type F(f) - type F(f) adapter.

IPS-TP-409 Common Path and Inter-modulation Distortion – The intent of this test procedure specification is to provide a means of measuring the coaxial interface that becomes non-linear to the path of radio frequencies.

IPS-TP-500 Core Depth Verification – The purpose of this test method is to determine the cored depth of semi-flex aluminium sheath cable. The core depth is the internal measured distance between the dielectric foam and the square-cut end of the outer aluminium sheath. This test method will define the suggested method for core depth measurement.

IPS-TP-700 Hex Crimp Tool Verification/Calibration – This test method is used to determine and verify the actual crimp dimension of hex crimp tools. It also provides a measurement technique for determining the final hex size that may affect pull-off performance of the cable-to-connector interface. A calibration technique for adjusting hex crimp tools is also specified.

APPENDIX 8 TYPICAL BROADBAND COAXIAL CABLE SYSTEM SCHEMATIC FOR STRATA LANDED DWELLING-HOUSES AND MULTI-STOREY RESIDENTIAL BUILDINGS


Service Duct A
Service Duct B
14
18.7/16.0
11
16.9/15.9
Storey 12
17
18.3/14.0
14
18.0/15.9
Storey 11
20
17.1/12.3
17
17.1/13.6
Storey 10
20
19.2/13.2
17
19.5/15.1
Storey 9
20
21.2/14.2
20
18.4/13.3
Storey 8
23
19.9/11.1
23
17.0/10.9
Storey 7
23
21.3/12.5
23
18.5/11.6
Storey 6
23
22.8/13.3
23
19.9/12.4
Storey 5
26
21.6/11.7
23
21.4/13.2
Storey 4
26
22.9/12.5
26
20.2/11.6
Storey 3
26
24.2/13.2
26
21.5/12.4
Storey 2
26
22.7/13.0
Storey 1
INPUT SIGNAL
LEGEND
Power Supply
Power Inserter
Line Termination
8-way Tap
= Tap value
4-way Tap
= Tap value
2-way Tap
= Tap value
2-way Splitter
DC 8
DC 12
DC 16
3-way Splitter
Trunk Amplifier
Bridge Amplifier
540 Cable
Diameter (15.49mm)
412
412 Cable
Diameter (11.90mm)
RG 6 Cable
Diameter (6.91mm)

APPENDIX 9 DO'S & DON'TS FOR EARTHWORKS

9.1 DO'S

(a) Do contact telecommunication system licensees during planning stage and before commencement of work for the development project to:

(i) Obtain service layout plans and subsequent updates after a lapse of 6 months;

(ii) Arrange site meeting for briefing by telecommunication system licensees; and

(iii) Discuss with telecommunication system licensees on whether to divert or support those telecommunication system licensees' plants that are affected by the development.

(b) Do carry out the following procedures prior to commencing excavation, piling, soil investigation or earthworks:

(i) Refer to telecommunication system licensees' service layout plans;

(ii) Engage an IDA licensed cable detection worker to carry out cable detection and notify telecommunication system licensee(s) 7 days before the commencement of earthworks which are within the vicinity of any telecommunication cables in accordance with section 29(1) of the Telecommunications Act (Chapter 323);

(iii) Wait for telecommunication system licensees' replies within 7 days of notification before commencement of earthworks;

(iv) Carry out trial holes by manual digging to expose telecommunication system licensees' plants at sites; and seek assistance from telecommunication system licensees to ascertain the location of telecommunication system licensees' plants if plants cannot be located;

(v) Provide and maintain visible markings (such as poles, tapes, painting and etc.) indicating the actual position of telecommunication system licensees' plants within the construction site and inform telecommunication system licensees for site inspection; and

(vi) Update telecommunication system licensees' plant location information on the developer's construction plans.

(c) Do sever tree roots before grubbing the tree stump.

(d) Do inform telecommunication system licensees on the backfilling procedure over telecommunication system licensees' plants.

(e) Do disseminate information regarding telecommunication system licensees' service layout to all relevant parties involved in earthworks such as main contractor, subcontractors, machine operators, licensed cable detection worker, etc. as it has been

found that poor or lack of communication is one of the main causes of damage to telecommunication system licensees' plants.

(f) Do note that the depth of telecommunication system licensees' plants varies due to the site conditions.

(g) Do report immediately on any damage done to the respective telecommunication system licensees. The list of telecommunication system licensees can be obtained from IDA's website.

(h) Do note the legal liability for failure to notify telecommunication system licensees of earthworks (see Note (a)), for failure to ascertain location of telecommunication cable belonging to or under the management or control of any telecommunication system licensee (see Note (b)), and for damaging telecommunication system licensees' plants (see Note (c)).

(i) For further enquiry, please contact:

Info-communications Development Authority of Singapore
8 Temasek Boulevard
#14-00 Suntec Tower Three
Singapore 038988
Email: info@ida.gov.sg

Notes: (a) Under Section 29 of the Telecommunications Act (Chapter 323) ("TA"), any person who fails to give a 7-day notification to telecommunication system licensees prior to commencement of earthworks is liable on conviction to a fine not exceeding $100,000 or to imprisonment for a term not exceeding 3 years or to both.

(b) Under Section 32 of the TA, any person who digs, bores, trenches, grades, excavates or breaks any ground with any mechanical equipment or explosive or allows his employee or agent to do so without first ascertaining the location of any telecommunication cable belonging to or under the management or control of any telecommunication system licensee that may be interfered with is liable on conviction to a fine not exceeding $100,000 or to imprisonment for a term not exceeding 3 years or to both.

(c) Under Section 49 of the TA, any person, who in the course of carrying out earthworks, damages any cable of a telecommunication system licensee is liable on conviction to a fine not exceeding $1 million or to imprisonment for a term not exceeding 5 years or to both.

9.2 DON'Ts

(a) Don't dig trial holes with JCB or excavator.

(b) Don't carry out any excavation, soil investigation, piling or earthworks in the vicinity of telecommunication system licensees' cables without confirming the actual positions of telecommunication system licensees' plants.

(c) Don’t open any telecommunication system licensee's manhole and equipment box without prior approval by the licensee.

(d) Do not cover up any telecommunication system licensee's manhole and equipment box with earth or building materials.

(e) Don't grub up tree stumps without first severing the roots.

(f) Don't take for granted that telecommunication system licensee's lines are in a straight run.

(g) Don't cover up damages but report them immediately.

(h) Don’t remove any concrete encasement around a telecommunication system licensee’ pipelines after exposing it unless approval from the telecommunication system licensee is given.

Note: Under section 29(3) of the TA, it shall be the duty of the person who carries out any earthworks to comply with all reasonable requirements of the telecommunication system licensee for the prevention of damage to the telecommunication cable, to ensure that reasonable precautions are taken when carrying out such earthworks, and to allow the telecommunication system licensee reasonable access to the work site.