GUIDELINES RELATING TO INFO-COMMUNICATIONS FACILITIES IN BUILDINGS

INFOCOMM DEVELOPMENT AUTHORITY OF SINGAPORE

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INTRODUCTION

This set of Guidelines Relating to Info-communications Facilities in Building (hereinafter referred to as "the Guidelines") lays down the detailed specifications of the optional space and facilities which developers or owners of buildings are recommended to provide 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 Code of Practice for Info-communications Facilities in Buildings ("COPIF:2005") 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:2005.

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 specifications set out in the Guidelines from time to time.

Director-General (Telecom)
Info-communications Development Authority of Singapore
[*date*]

PART 1 IN-BUILDING RADIO COVERAGE FOR PUBLIC MOBILE SERVICES

1.1 GENERAL

1.1.1 While the telecommunication system licensees operating paging services networks and/or 2G communication services networks and/or 3G mobile communication services networks endeavour to provide island-wide coverage for public mobile services, it is constrained by radio propagation characteristics from extending the coverage into buildings and their basements.

1.1.2 These guidelines are provided for developers or owners to inform them the procedures and requirements for improvement of in-building coverage for public mobile services.

1.2 RESPONSIBILITY OF DEVELOPERS OR OWNERS

These guidelines shall not exempt the developers or owners and/or their contractors from obtaining:

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

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

1.3 OFFICIAL REQUEST TO TELECOMMUNICATION SYSTEM LICENSEES

1.3.1 The developer or owner may make an official request to these telecommunication system licensees for consideration to install radio equipment to improve in-building coverage.

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

1.3.3 These telecommunication system 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 telecommunication system licensees, the cost of such improvement work may be charged to the developer or owner.

1.3.4 In the event that the telecommunication system 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:

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

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

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

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

(e) A floor space of about $10m^2$ 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 2500mm. The $10m^2$ floor space should have a floor loading of at least $2.5kN/m^2$;

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

(g) Telecommunication system licensees may require other space and facilities to be provided.

1.4 ENQUIRIES

Any enquiry on this part, including technical specifications, can be made to the respective telecommunication system licensees.

PART 2 PUBLIC TELEPHONE BOOTHS

2.1 PROCEDURES FOR REQUESTING INSTALLATION OF PUBLIC TELEPHONE BOOTHS

2.1.1 Developers or owners are encouraged to cater and plan for sufficient public telephones within a public or commercial complex.

2.1.2 In the case where public telephones are required, developers or owners should make arrangement with the respective telecommunication system licensees for the provision. Developers or owners should submit two sets of complete building floor plans with the proposed installation of public telephone booths (See Part 2 paragraph 2.2 on the typical space and facilities requirement of this set of guidelines) to the telecommunication system licensees for consideration and agreement.

2.1.3 Furthermore, to enable the building to be provided and equipped with the latest public telephone services and value-added features, developers or owners should furnish information related to the tenant structure, amenities available within the building/complexes for telecommunication system licensees' early planning and discussion.

2.2 TYPICAL SPACE AND FACILITIES REQUIREMENT FOR INSTALLATION OF PUBLIC TELEPHONE BOOTH

2.2.1 Telephone cabling routes, if wall-mounted, should preferably be concealed and outlets should be 1220mm above finished floor level and approximately 1600mm apart for multiple installations. This is illustrated in Figure 2-1. For free-standing installation, spacing of floor outlets would be based on the dimensions of booths but generally could be 915mm apart.

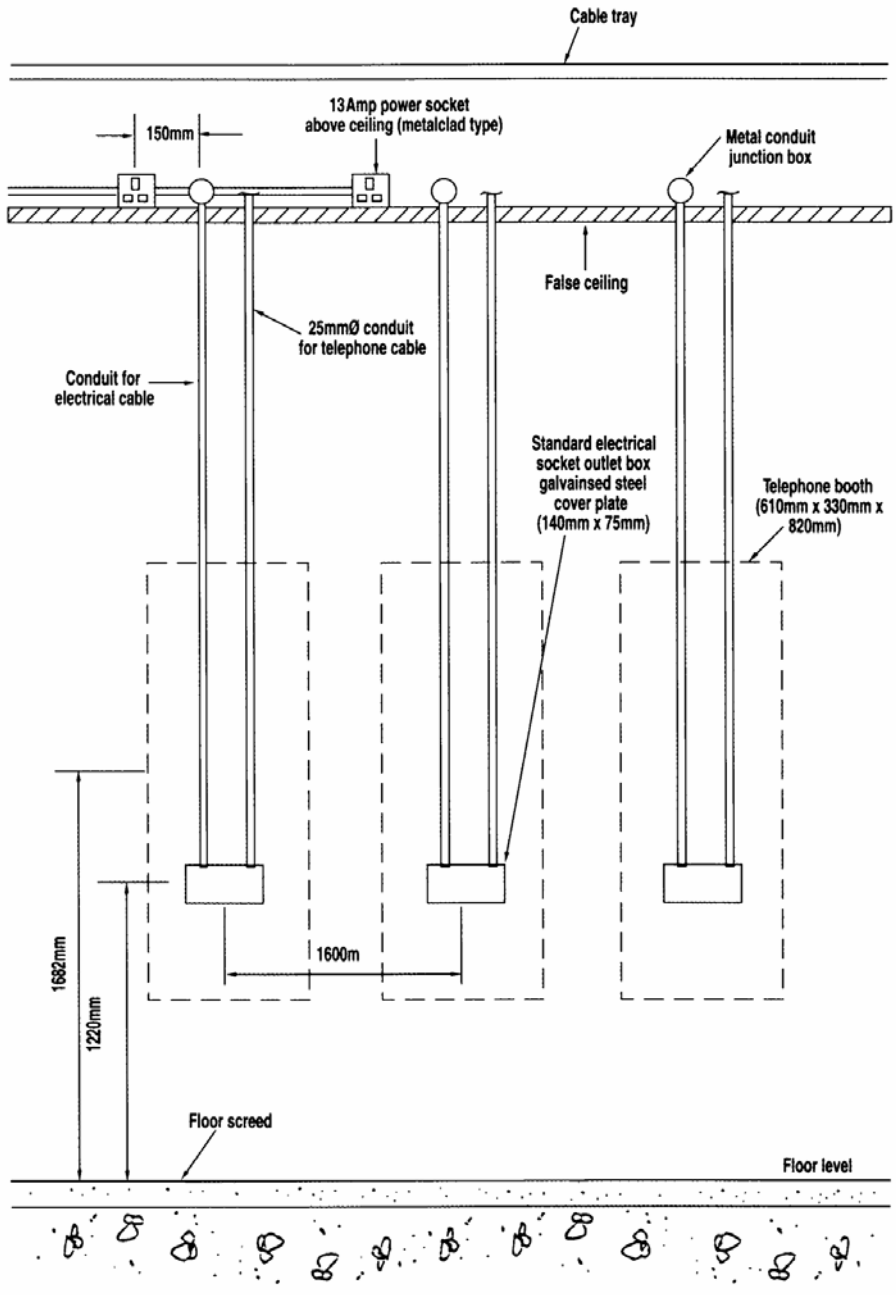
2.2.2 Developers or owners could also decide to have their own public telephone booth design. In which case, a full set of drawings of the proposed booth must be submitted to the telecommunication system licensees for consideration and study on its compatibility with the existing telephone instruments.

2.2.3 Developers or owners should make provision for a 230V, 13A power supply socket outlet near to the telephone outlet where the public telephones are proposed. Separate concealed power conduits should be laid and outlets should be provided at each booth's position at 1220mm above finished floor level, as shown in Figure 2-1.

2.3 ENQUIRIES

2.3.1 Any enquiry on this part, including technical specifications, can be made to the respective telecommunication system licensees.

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



PART 3 ACCOMMODATION REQUIREMENTS FOR PABX/KTS/MLS

3.1 GENERAL

3.1.1 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 in a secured location and in an environment conducive to the efficient operation of the system throughout its life-span.

3.1.2 The accommodation requirements specified here 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.

3.1.3 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 Part 3 paragraph 3.3 of this set of guidelines).

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

3.2 ACCOMMODATION REQUIREMENTS

3.2.1 The accommodation for the customer's telephone switching system, in particular PABX system, should:

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

(b) Be air-conditioned with a recommended temperature of 20°± 2°C.

(c) Be maintained at relative humidity of 60% ± 10%;

(d) Provide at all times a minimum clearance of 0.9m 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 0.6m in width;

(e) Be securely locked and not entered by any unauthorised person(s);

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

(g) Be away from water/sewerage pipes, sources of electrostatic energy, electric power cables, air-conditioning ducts or any other Mechanical & Electrical ("M&E") services;

(h) No water sprinkler in the room and rooms associated with the accessories;

(i) 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;

(j) Provide a power point within 2m of the equipment for the use by the maintenance staff;

(k) The equipment should be away from photo-copier machines or any other equipment/ materials which may generate strong electrostatic field;

(l) 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

(m) 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.

3.3 SEPARATE ROOM

3.3.1 The most satisfactory arrangement is to provide a large room which should be partitioned into an equipment room, telephone operator's room, a standby battery room (if required) and an IDF room for systems with an ultimate capacity exceeding 250 extensions. A separate IDF room is not necessary for telephone switching systems with a capacity of less than 250 extensions.

3.3.2 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.

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

3.3.4 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.

3.3.5 It is recommended that an IDF be provided regardless of the number of extensions to be installed. However, a separate room to accommodate the IDF is not necessary in all cases.

3.3.6 The MDF/IDF 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.

PART 4 CABLE DISTRIBUTION SYSTEMS

4.1 GENERAL

4.1.1 Cable distribution systems are the facilities provided to distribute telephone cables installed from the Main Distribution Frame ("MDF") room/ Telecommunication Equipment Room ("TER") to the telecommunication riser and from telecommunication riser to the telephone outlets.

4.1.2 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.

4.1.3 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 4-1).

4.1.4 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 non-residential and residential buildings.

4.1.4.1 Non-residential buildings comprise the following:

(a) Multi-storey office, shopping cum residential complex;

(b) Multi-storey office building;

(c) Hotel;

(d) Factory/warehouse; and

(e) Other types of buildings including, but not limited to, food centres, markets, hospitals, cinemas, club-houses, religious buildings and shop-houses.

4.1.4.2 Residential buildings comprise the following:

(a) Multi-storey residential buildings (e.g. apartments, condominiums or public housings); and

(b) Landed/strata landed housing (e.g. bungalows, semi-detached and terrace houses).

4.1.5 Cable distribution systems for non-residential buildings

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

4.1.5.1 Concealed distribution systems comprise 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.

4.1.5.2 Exposed distribution systems comprise 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.

4.1.6 Cable distribution systems for residential buildings

Due to the relatively low telephone density and generally stable telephone locations in residential buildings, suitable types of distribution systems are:

(a) Under floor distribution system;

(b) Perimeter raceway distribution system;

(c) Ceiling distribution system; and

(d) Multi-riser system.

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

4.1.7 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.

4.1.8 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”.

4.1.9 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.

4.1.10 Segregation of service

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

4.1.11 Earthing of metal parts

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

(a) CP5: Code of Practice for Electrical Installations; and

(b) CP16: Code of Practice for Earthing.

4.2 CABLE DISTRIBUTION SYSTEMS FOR NON-RESIDENTIAL BUILDINGS

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

4.2.1 Under-floor duct distribution system for non-residential buildings

(a) General

(i) Under-floor duct distribution system, when properly designed is a good method for distributing telephone cables (Figure 4-2).

(ii) The system suitable for use in non-residential buildings may be designed with total access or with junction box access.

(iii) A 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 4-3).

(b) Basic requirements

(i) The duct should extend into the telecommunication riser and link to the floor trench (Figures 4-4 & 4-5).

(ii) The 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.

(iii) The system should be designed with the main junction boxes along the common corridor area or passageway (Figure 4-6).

(iv) The distribution system should be free from internal roughness, sharp edges, moisture and dirt.

(v) The system should be provided with floor outlets to lead the telecommunication cables out of the ducts (Figure 4-7).

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

(c) Duct

(i) 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. Part 6 of the Guidelines lists the specification containing the dimensions of the different types of cable used.

(ii) 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.

(iii) The duct should be of a minimum internal height of 25mm.

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

(d) Junction boxes

(i) 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 6m (Figure 4-8).

(ii) 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.

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

(iv) 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 4-9). The screws should remain intact on the junction box cover when the cover is removed.

(v) 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.

(vi) 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 4-10).

(vii) 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 4-11 illustrates one method of providing the access to the junction box for carpeted floors.

(viii) 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.

(e) Responsibility of developer or owner

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

(f) Advantages of under-floor duct system

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

(ii) Appearance of the premises is enhanced as the ducts are concealed under the floor screed.

(iii) Safe and easy working position.

(g) Disadvantages of under-floor duct system

(i) Difficult to access junction boxes or header ducts when floor is covered with carpet.

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

4.2.2 Raised floor distribution system for non-residential buildings

(a) General

(i) 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 4-12).

(ii) Raised floor system is usually used in computer rooms and offices with a high number of telecommunication lines.

(iii) The floor assembly consists of a series of square modules of steel plates or panels or concrete slabs resting upon pedestals (Figure 4-13).

(b) Basic requirements

(i) 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.

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

(c) Responsibilities of developer or owner

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

(ii) The developer or owner should provide the trunking or cable tray required to segregate telecommunication cables from electrical cables and cables of other services placed below the raised floor (Figure 4-14).

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

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

(d) Advantages of raised floor distribution system

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

(ii) Appearance of the premises is enhanced as the cables are concealed under the floor.

(iii) Safe and easy working position.

(iv) Any change in telecommunication requirements can be easily catered for.

(v) Can accommodate a large number of cables.

(e) Disadvantages of raised floor distribution system

(i) It is more costly to provide the system comparing with other distribution systems.

(ii) The system may produce sound when walked upon.

(iii) Broadloom carpet cannot be used.

4.2.3 Cellular floor distribution system for non-residential buildings

(a) General

(i) 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 4-15 shows the different compartments of a typical cellular floor system.

(ii) 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.

(iii) The 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.

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

(b) Cellular floor system with header duct

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

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

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

(c) Cellular floor system with trench header

(i) 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.

(ii) It is equipped with removable steel cover plates for its entire length.

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

(d) Basic requirements

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

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

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

(e) Responsibilities of developer or owner

(i) 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.

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

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

(iv) 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.

(f) Advantages of cellular floor system

(i) 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.

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

(iii) Safe and easy working position.

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

(g) Disadvantages of cellular floor system

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

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

4.2.4 Ceiling distribution system for non-residential buildings

(a) General

(i) 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 4-16).

(ii) 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.

(b) Basic requirements

(i) 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 4-17).

(ii) 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.

(iii) 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 4-18 should be maintained.

(iv) The cable trays and trunkings should be in accordance with the specifications described in Part 4 paragraphs 4.2.8 and 4.2.10 respectively.

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

(c) Responsibility of developer or owner

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

(e) Advantages of ceiling distribution system

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

(f) Disadvantages of ceiling distribution system

(i) 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.

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

4.2.5 Perimeter raceways distribution system for non-residential buildings

(a) General

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

(ii) The 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 4-19, 4-20 & 4-21).

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

(iv) 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 4-22).

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

(b) Basic requirements

(i) 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.

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

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

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

(c) 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.

(d) Advantages of perimeter raceway system

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

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

(e) Disadvantages of perimeter raceway system

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

(ii) 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.

4.2.6 Poke-through distribution system for non-residential buildings

(a) General

(i) In poke-through 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 4-24).

(ii) This 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.

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

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

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

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

4.2.7 Conduit distribution system for non-residential buildings

(a) General

(i) 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.

(ii) 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 4-25).

(iii) 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.

(b) Basic requirements

(i) 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 4-1.

Table 4-1 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

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

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

(iv) 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.

(v) 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.

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

(vii) Flexible conduits should not be used.

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

4.2.8 Cable trays

(a) Basic requirements

(i) The material used for the cable tray should be perforated and galvanised.

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

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

(iv) Cable trays should be straight run, and for any change in direction, the bend should have a minimum radius of 600mm (Figure 4-26).

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

(vi) The cable tray support must be L-shaped or inverted T-shaped.

(vii) 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 sub-section 4.4.2 of Code of Practice for Info-communications Facilities in Buildings ("COPIF"). The high-tension cable should be clearly indicated by signs or symbols.

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

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

(x) 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.

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

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

4.2.9 Surface conduits

(a) General

(i) The requirements for conduits, mounted and exposed along walls are similar to conduits that are concealed under-floor or in the ceiling. Please see Part 4 paragraph 4.2.7 for detailed requirements.

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

4.2.10 Exposed trunkings

(a) Basic requirements

(i) 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 4-1 for the amount of cables of various sizes that can be installed in conduits of various sizes.

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

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

(iv) 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.

(v) The cover of the trunking should preferably be friction fit or secured by simple device (not screws) to permit easy access (Figure 4-27).

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

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

(viii) Segregation of telecommunication cables from electrical cables should be in accordance with sub-section 4.4.2 of COPIF.

4.2.11 Concealed cabling in office furniture

(a) 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.

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

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

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

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

(iv) 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;

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

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

4.2.12 Suitable distribution systems for various types of premises

The suitable distribution systems for various premises are as shown below in Table 4-2.

Table 4-2 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				✓	✓	✓	✓

4.3 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.

4.3.1 Under-floor distribution system for residential buildings

(a) General

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

(ii) 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 4-28).

(iii) Within each residential unit, conduits are used to distribute the cables to various telephone outlets in each room within the unit (Figure 4-29).

(b) Basic requirements

(i) The duct or conduit at common corridor areas should extend into the telecommunication riser (Figure 4-30).

(ii) For joint-usage with electrical cables, a separate compartment should be provided for telecommunication cables. The segregation requirements should be in accordance with sub-section 4.4.2 of COPIF.

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

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

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

(c) Common corridor area

(i) 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 6m (Figure 4-8).

(ii) 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.

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

(iv) 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.

(v) 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.

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

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

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

(d) Within each residential unit

(i) 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.

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

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

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

(e) 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.

(f) Advantages of under-floor system

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

(ii) Appearance of the premises is enhanced as the ducts or conduits are concealed in the floor slab.

(iii) Safe and easy working position.

(g) Disadvantages of under-floor distribution system

(i) Junction boxes must be made accessible even when covered with carpet.

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

4.3.2 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 Part 4 paragraph 4.2.5.

4.3.3 Ceiling distribution system

(a) General

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

(ii) 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.

(b) Basic requirements

(i) 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.

(ii) The dimension of the access panels should not be less than 600mm x 600mm, 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.

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

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

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

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

(vii) Where cable trays run alongside or across electrical cable, segregation according to the specifications stipulated in sub-section 4.4.2 of COPIF should be compiled with.

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

(ix) 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 4-18).

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

(i) 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.

(ii) 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.

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

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

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

(vi) Conduit within each residential unit should be used to lead the cable from false ceiling to each socket outlet on the wall (Figure 4-31).

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

(f) 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.

(g) Advantages of ceiling distribution system

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

(ii) The cables are protected in the conduit, hence possible interruption of service caused by physical damage to cable is minimised.

(h) Disadvantages of ceiling distribution system

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

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

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

4.3.4 Multi-riser system

(a) General

(i) Instead of providing one telecommunication riser in a high-rise apartment 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 4-32).

(ii) 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 4-1 : LOCATION OF TELEPHONE OUTLETS & BLOCK TERMINAL IN A RESIDENTIAL UNIT

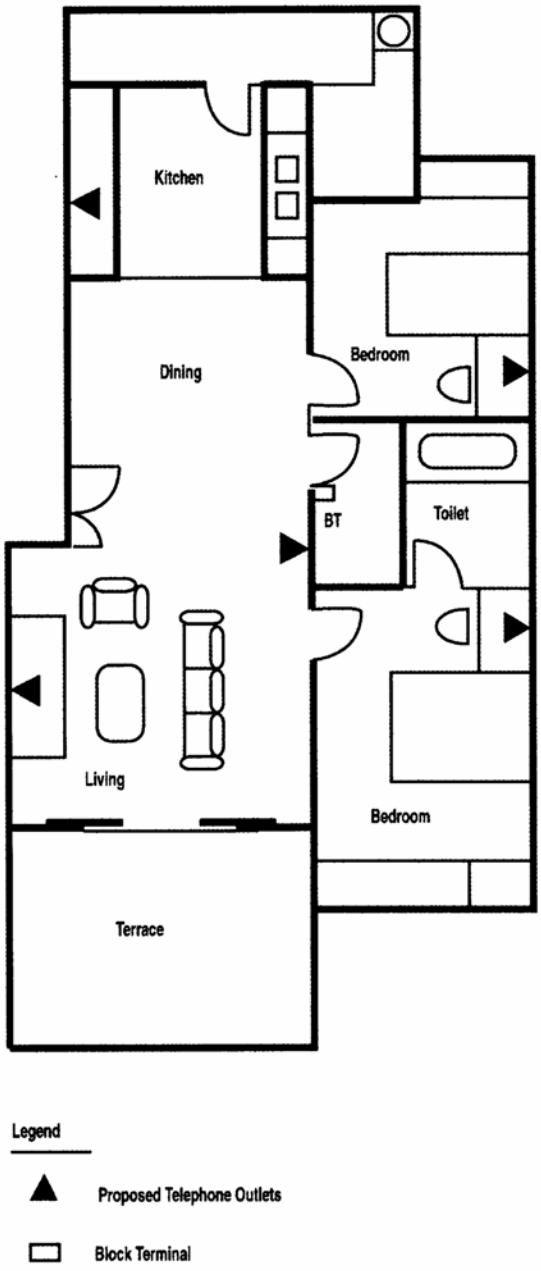


FIGURE 4-2 : UNDERFLOOR DUCT DISTRIBUTION SYSTEM

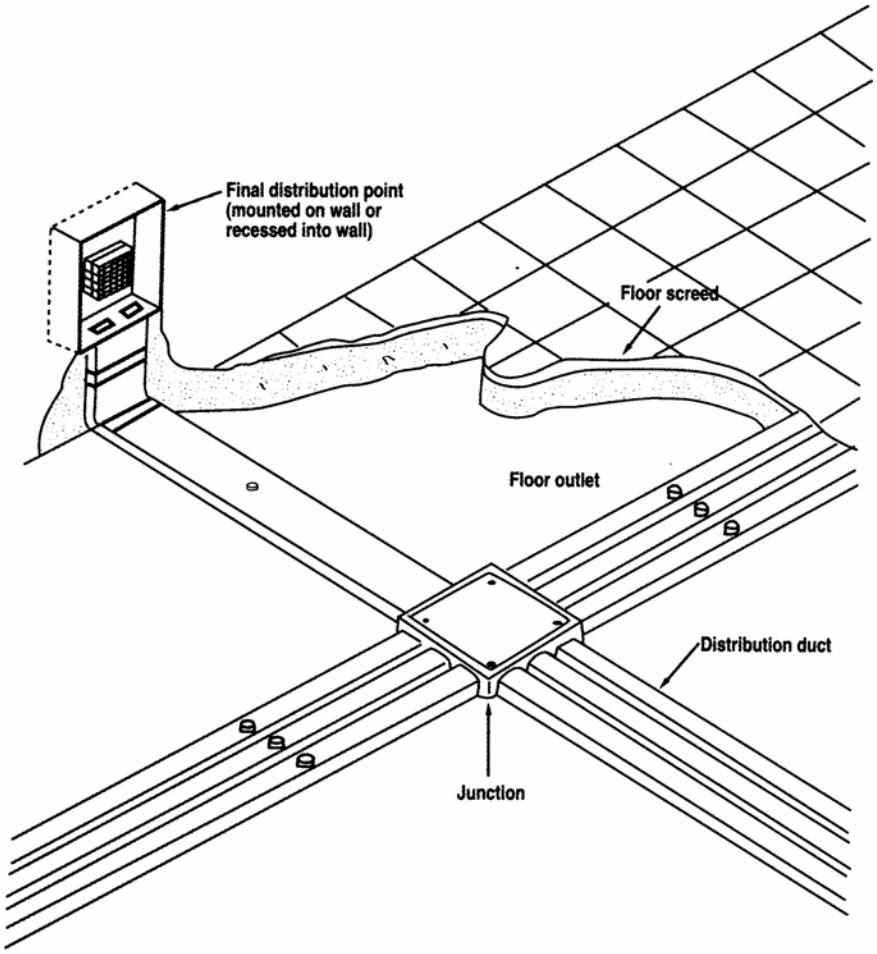


FIGURE 4-3 : TRENCH DUCT SYSTEM

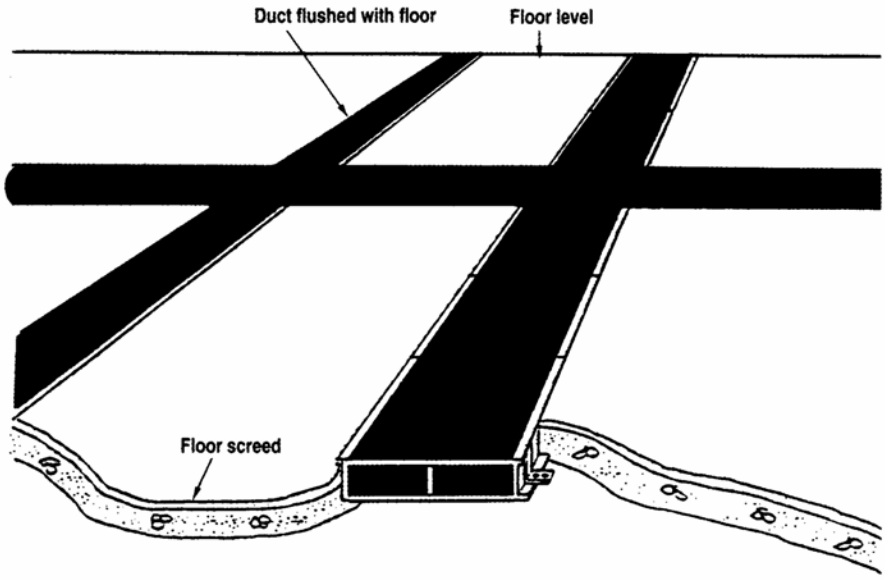


FIGURE 4-4 : UNDERFLOOR DUCT EXTENDED TO FLOOR TRENCH / FLUSH TRUNKING

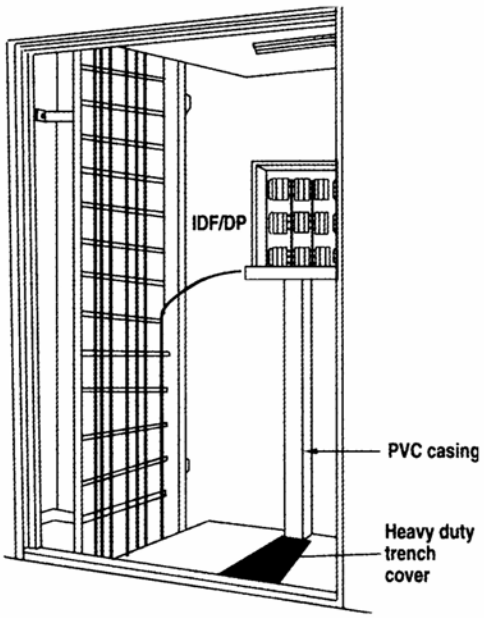
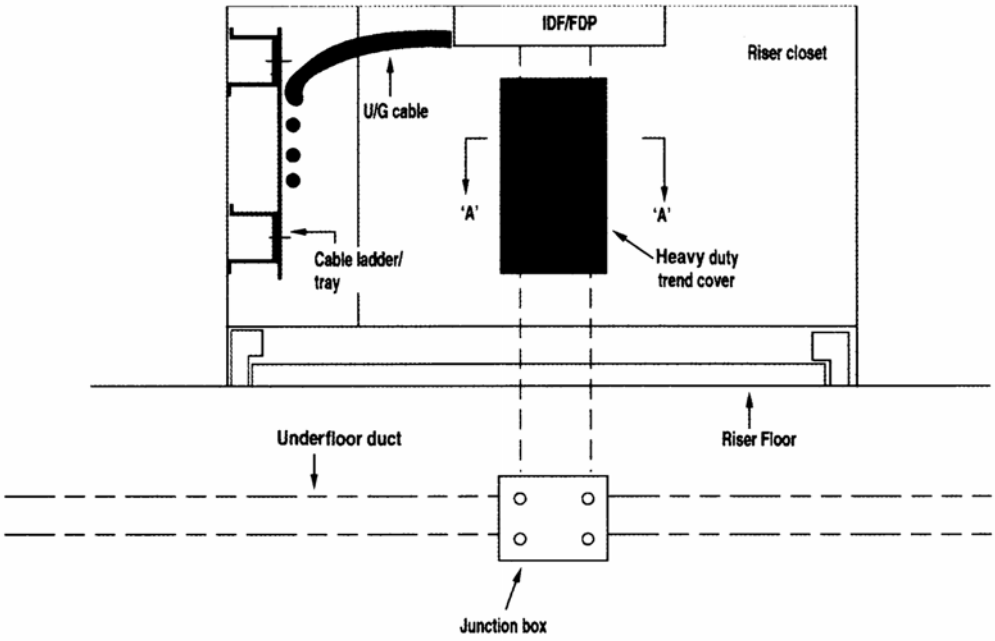
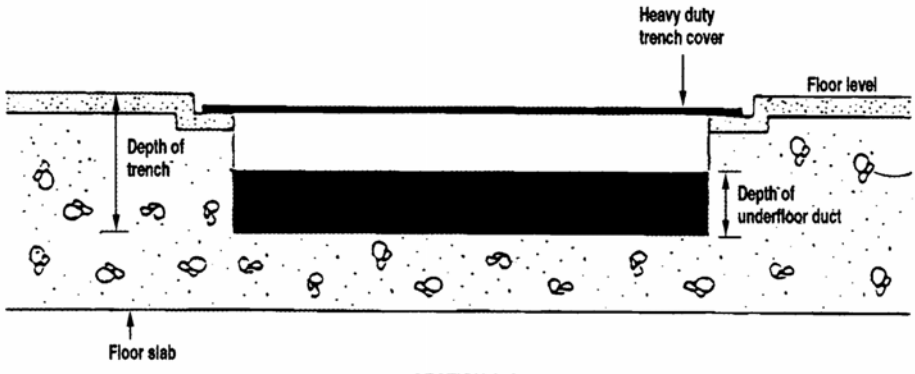


FIGURE 4-5 : FLOOR TRENCH IN CENTRE OR RISER



PLAN VIEW OF RISER



SECTION A-A

FIGURE 4-6 : MAIN JUNCTION BOXES ALONG COMMON CORRIDOR AREA OR PASSAGEWAY

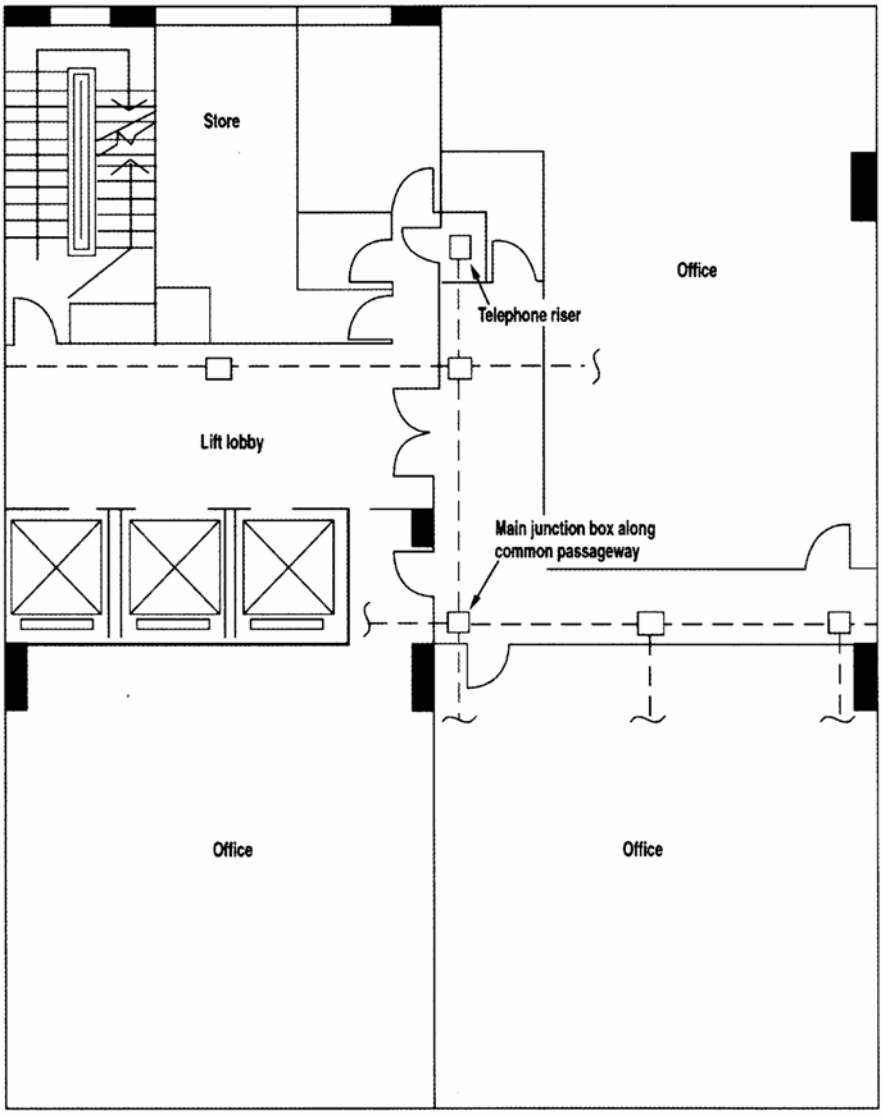


FIGURE 4-7 : TYPES OF DISTRIBUTION DUCTS AND OUTLETS

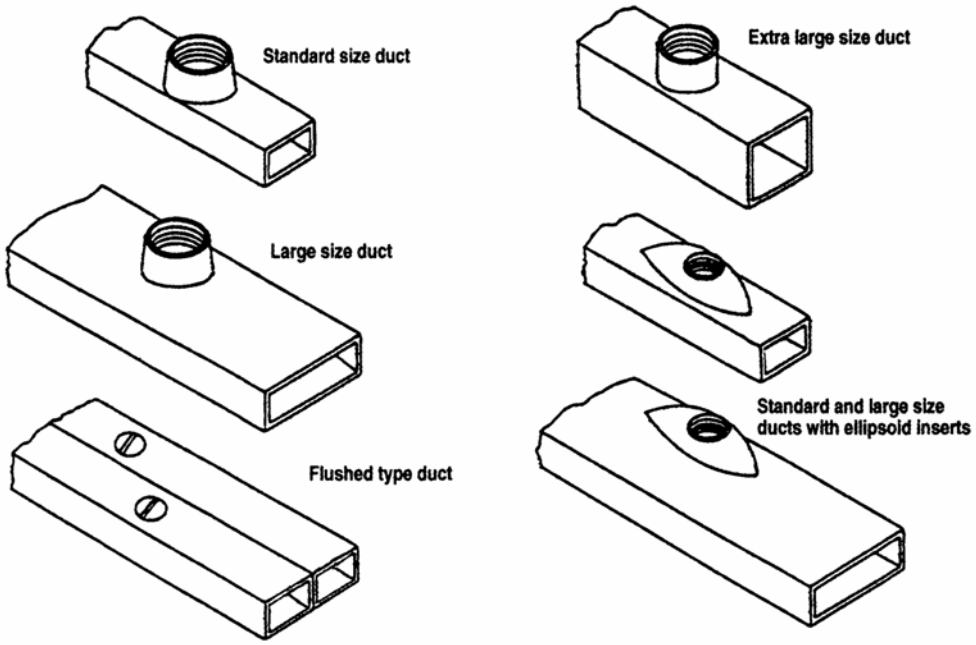


FIGURE 4-8 : JUNCTION BOXES INSTALLED 6 METRES APART

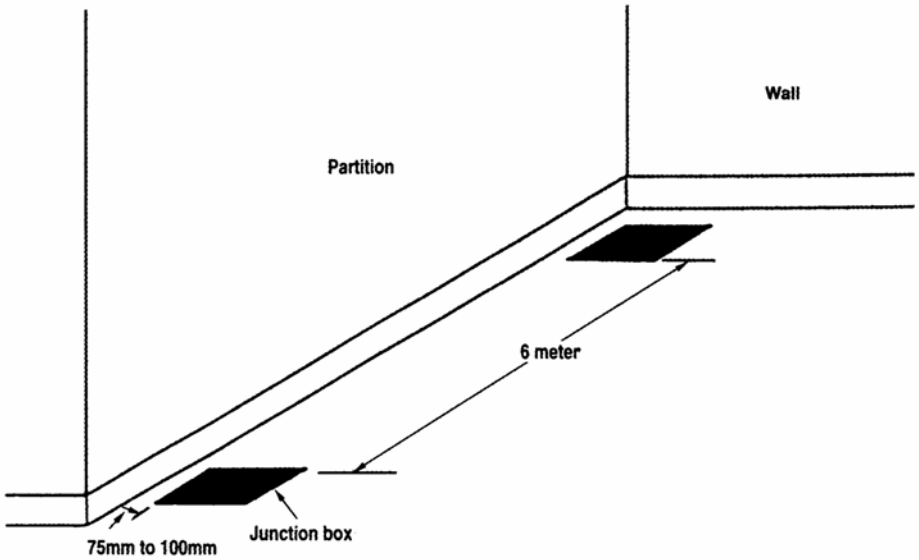


FIGURE 4-9 : EXPLODED VIEW OF JUNCTION BOX

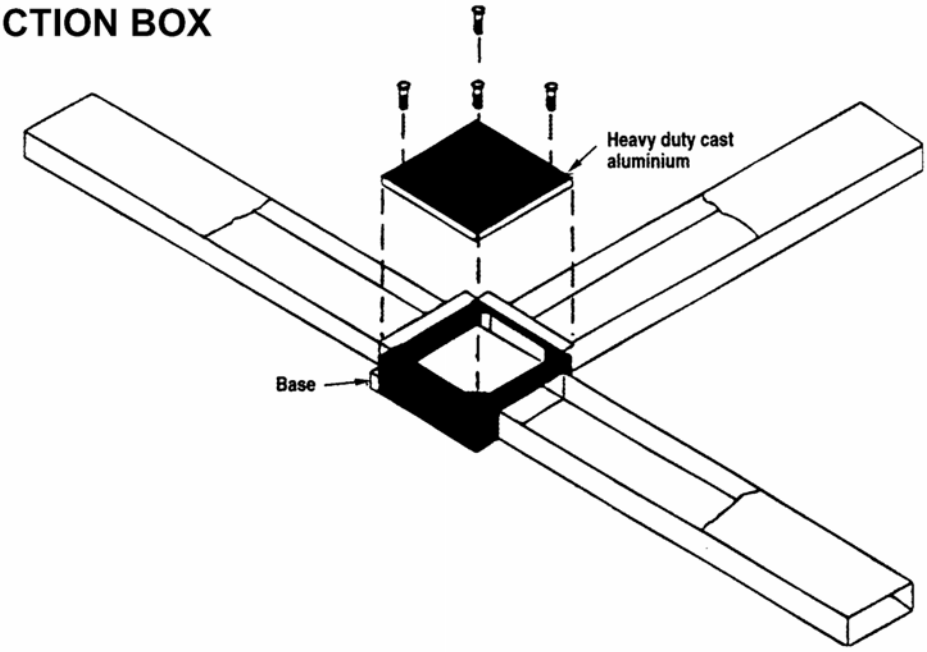


FIGURE 4-10 : PARTITION SITTING ON JUNCTION BOX

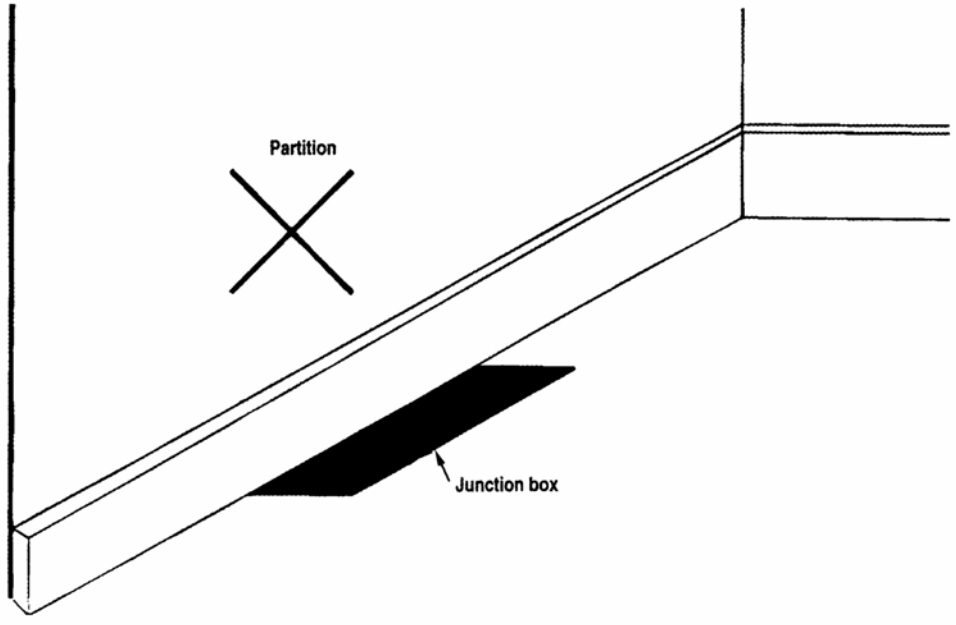


FIGURE 4-11 : ACCESS TO JUNCTION BOX FOR CARPETTED FLOOR

NOTES:

1) Carpet is cut on 3 sidess of the junction box creating a flap 50mm wider than the junction box.

2) Nylon tape fasteners are glued to the carpet and floor both on the flap and the surrounding carpet edge to provide a neat, safe carpet access panel.

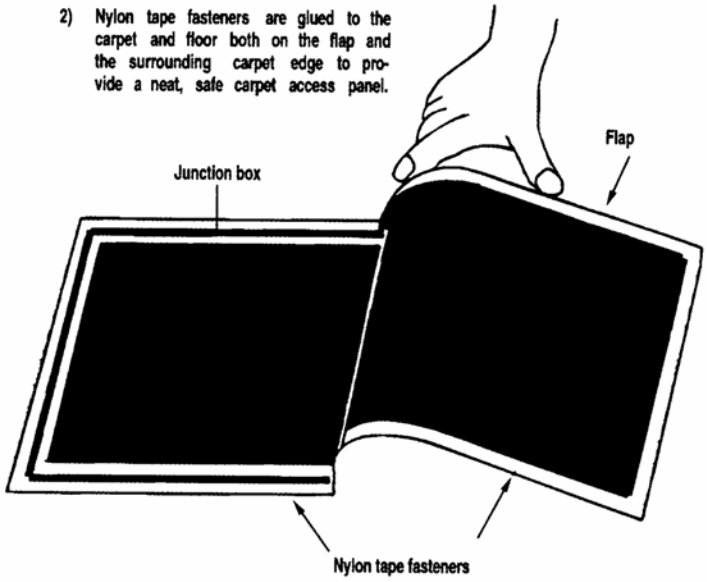


FIGURE 4-12 : RAISED FLOOR SYSTEM

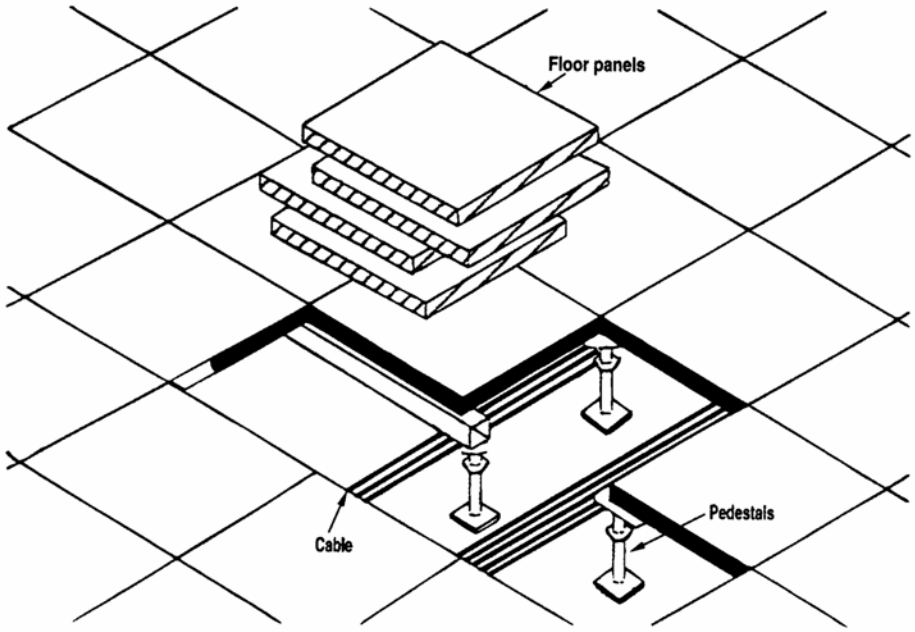


FIGURE 4-13 : PEDESTALS

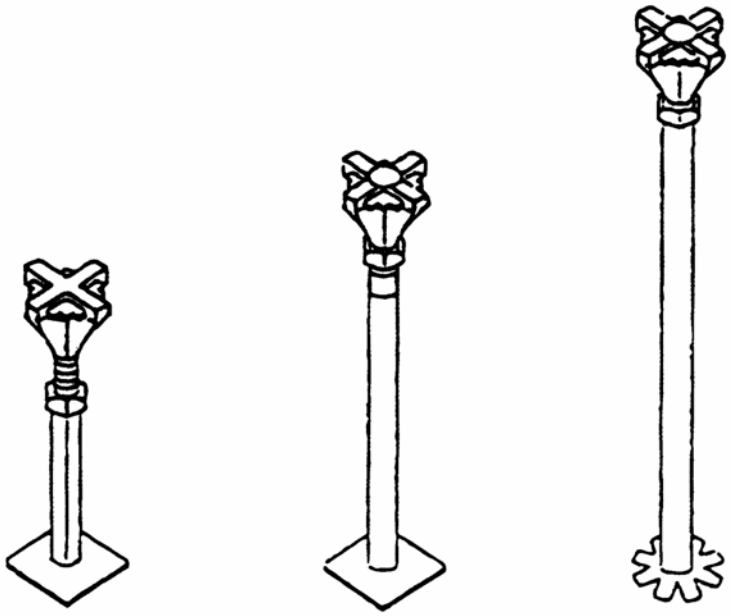


FIGURE 4-14 : TYPICAL SECTION OF RAISED FLOOR SYSTEM

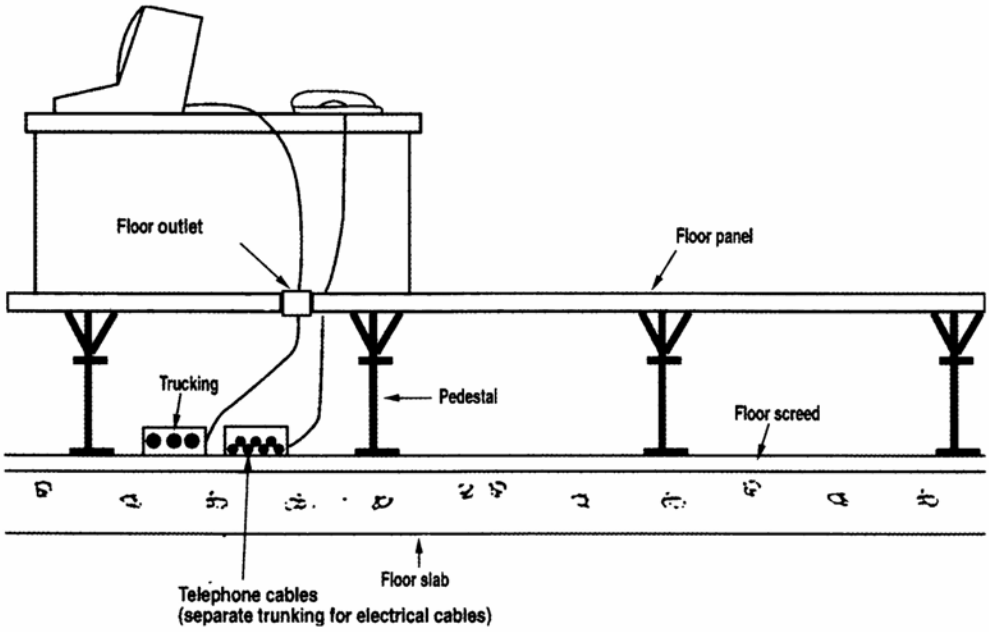


FIGURE 4-15 : SECTIONAL VIEW OF A CELLULAR FLOOR SYSTEM

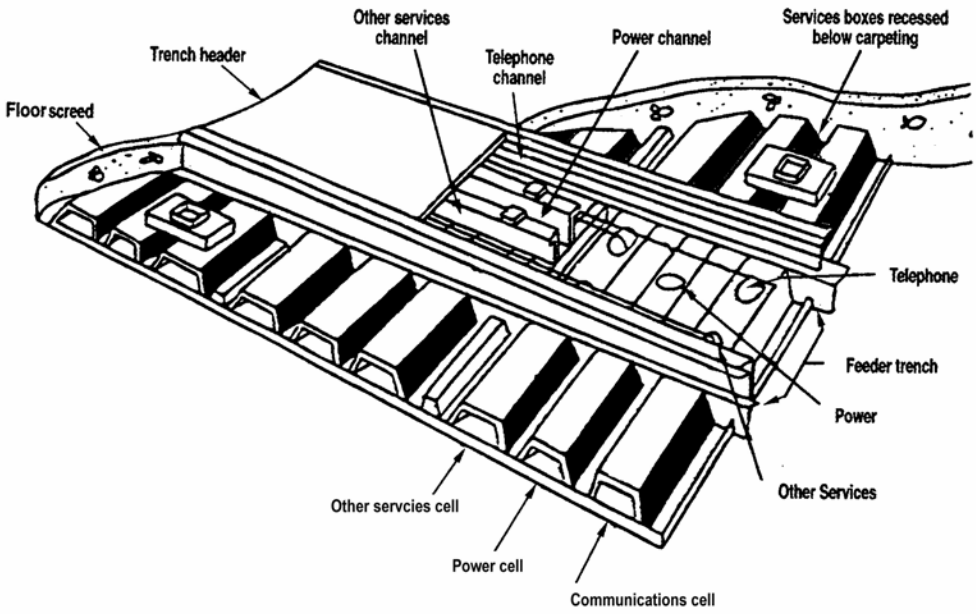


FIGURE 4-16: CEILING DISTRIBUTION SYSTEM USING CABLE TRAY/ TRUNKING LINK WITH CONDUITS & UTILITY POLE

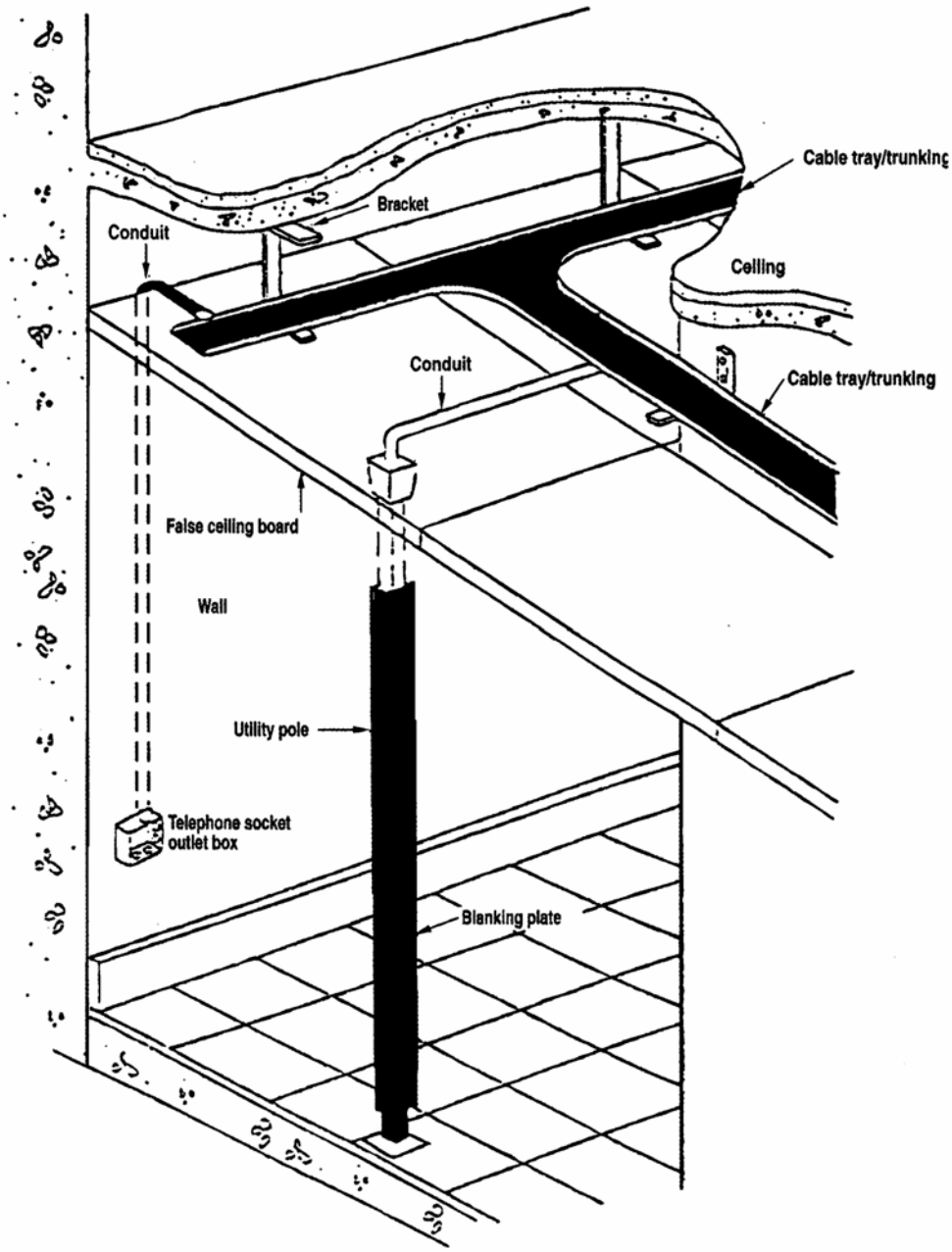


FIGURE 4-17 : CEILING DISTRIBUTION SYSTEM - TYPICAL DETAIL OF CABLE TRAY/TRUNKING LINK WITH CONDUIT IN UNDETACHABLE FALSE CEILING BOARDS/ STRIPS THAT ARE NOT EASILY REMOVABLE

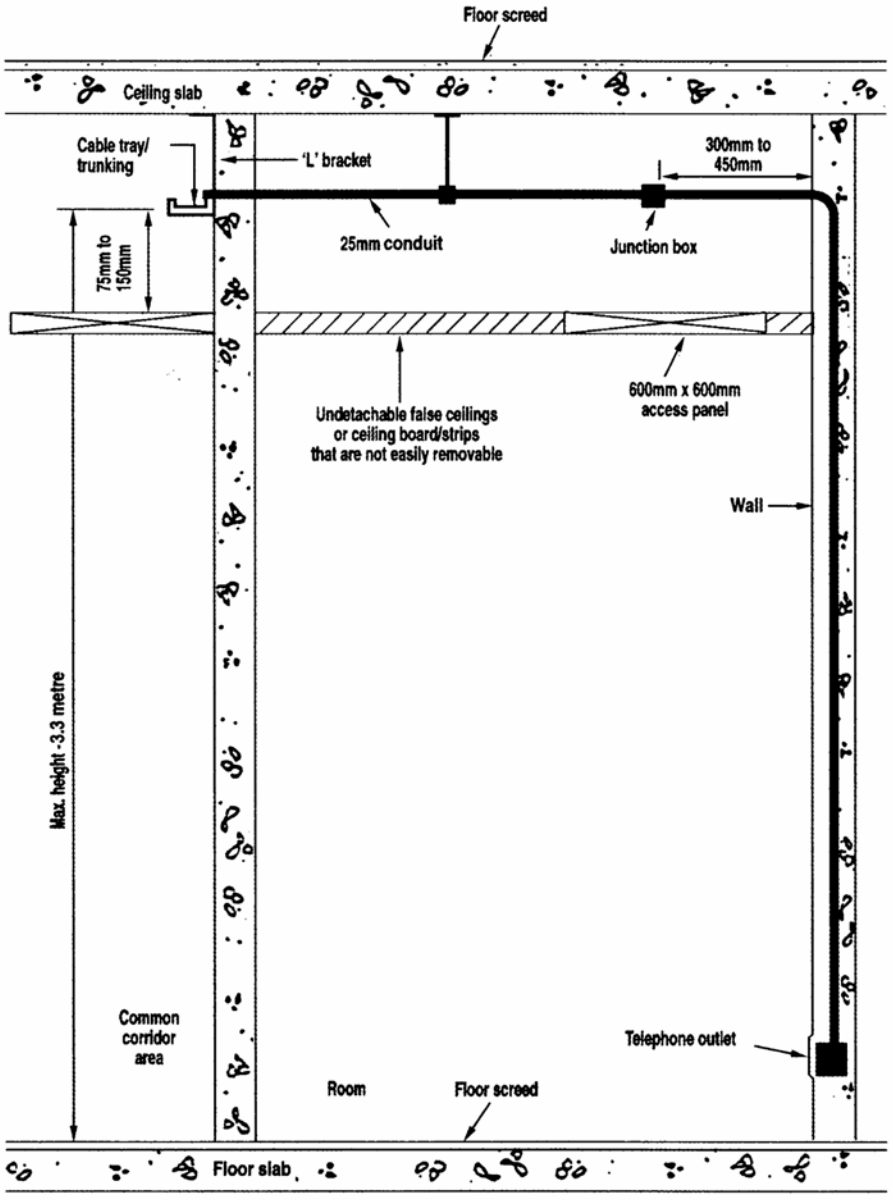
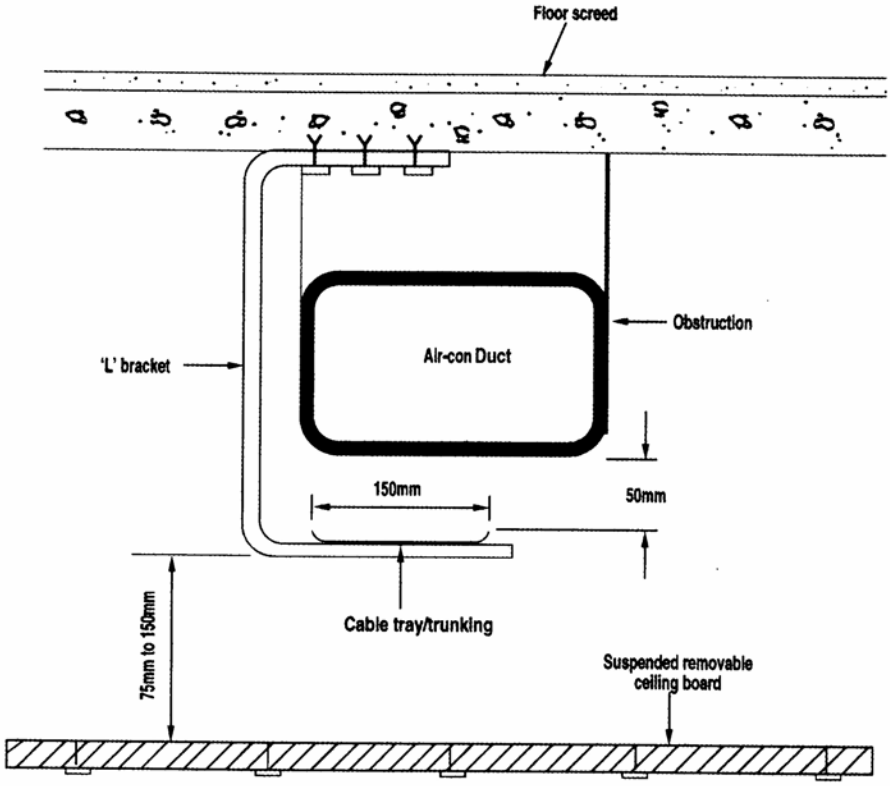


FIGURE 4-18 : CLEAREANCE BETWEEN CABLE TRAY / TRUNKING AND OBSTRUCTIONS



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

FIGURE 4-19 : PERIMETER RACEWAYS MOUNTED AT TABLE HEIGHT LEVEL

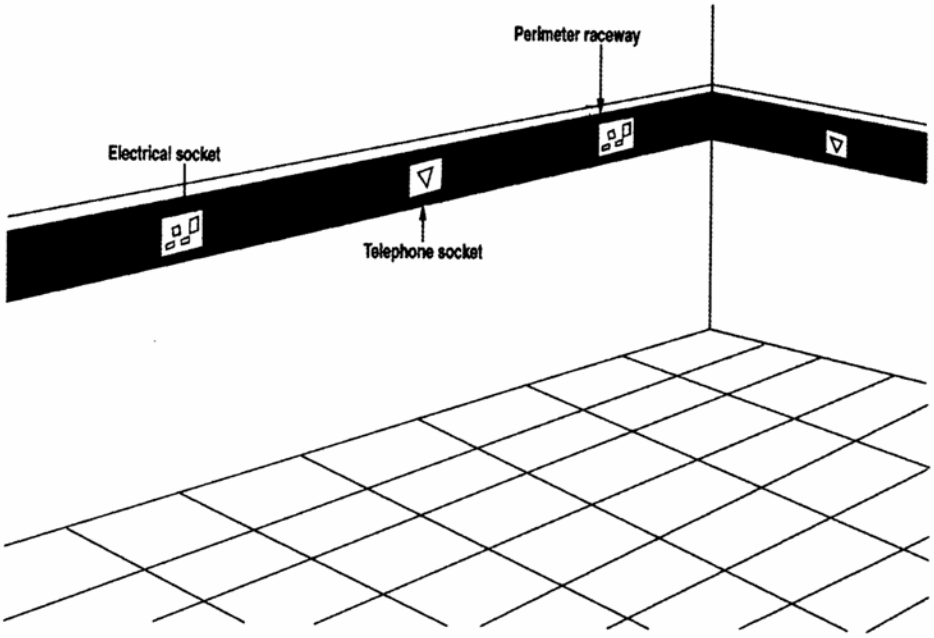


FIGURE 4-20 : PERIMETER RACEWAYS MOUNTED AT FLOOR LEVEL

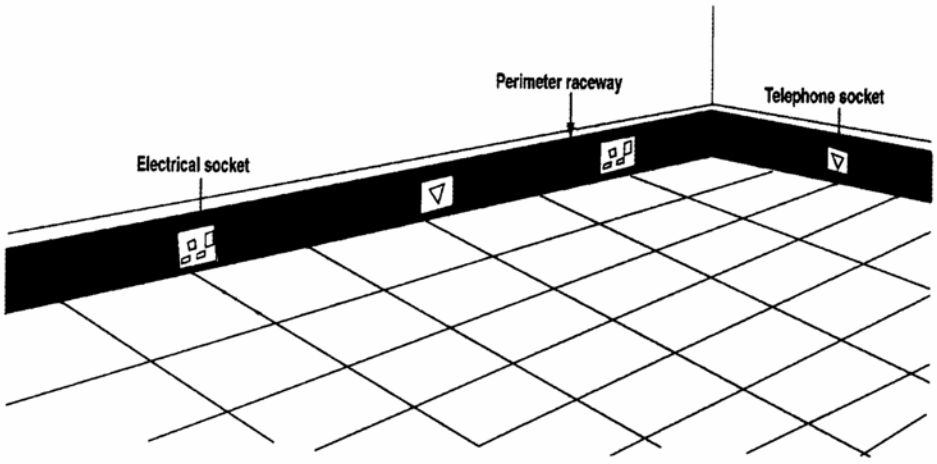


FIGURE 4-21 : PERIMETER RACEWAYS RECESSED INTO BASE OF WALL

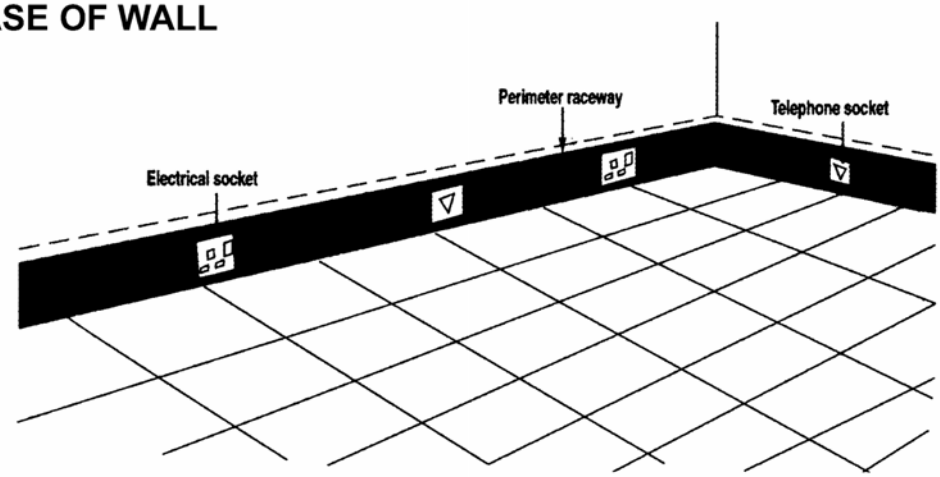


FIGURE 4-22 : SECTION OF A THREE - COMPARTMENT SKIRTING TRUNKING

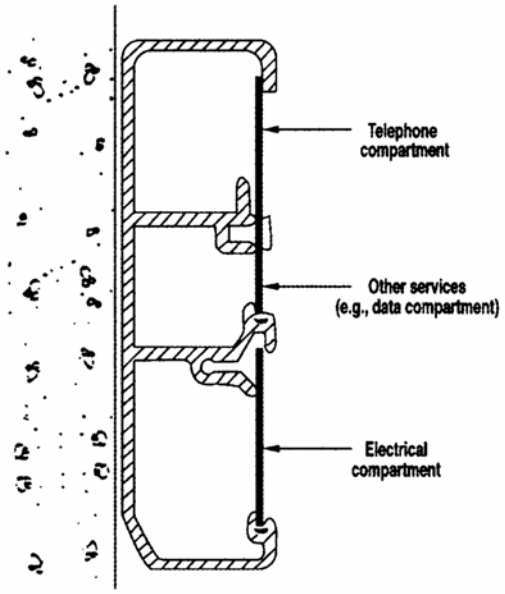


FIGURE 4-23 : PERIMETER RACEWAYS LINKED TO UNDERFLOOR DUCT DISTRIBUTION SYSTEM

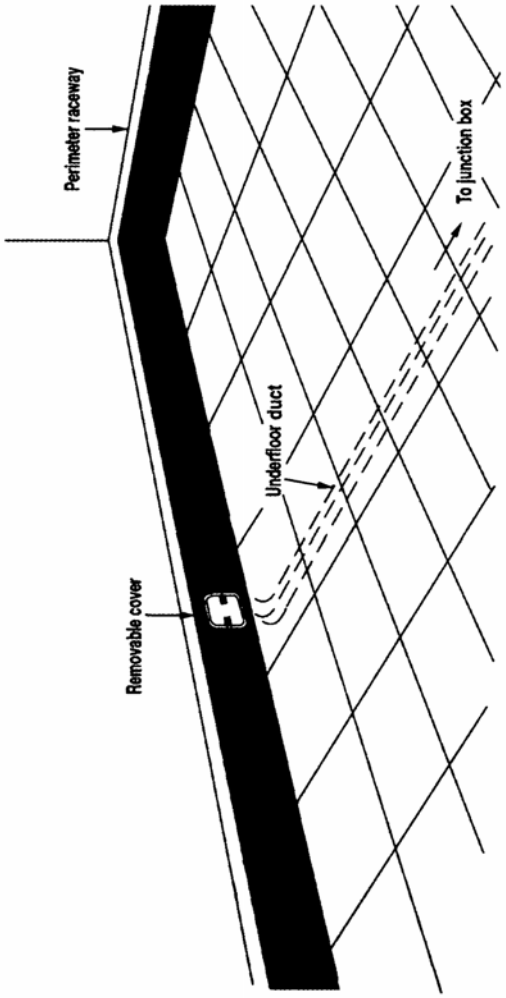


FIGURE 4-24 : POKE - THROUGH SYSTEM WITH CONDUIT

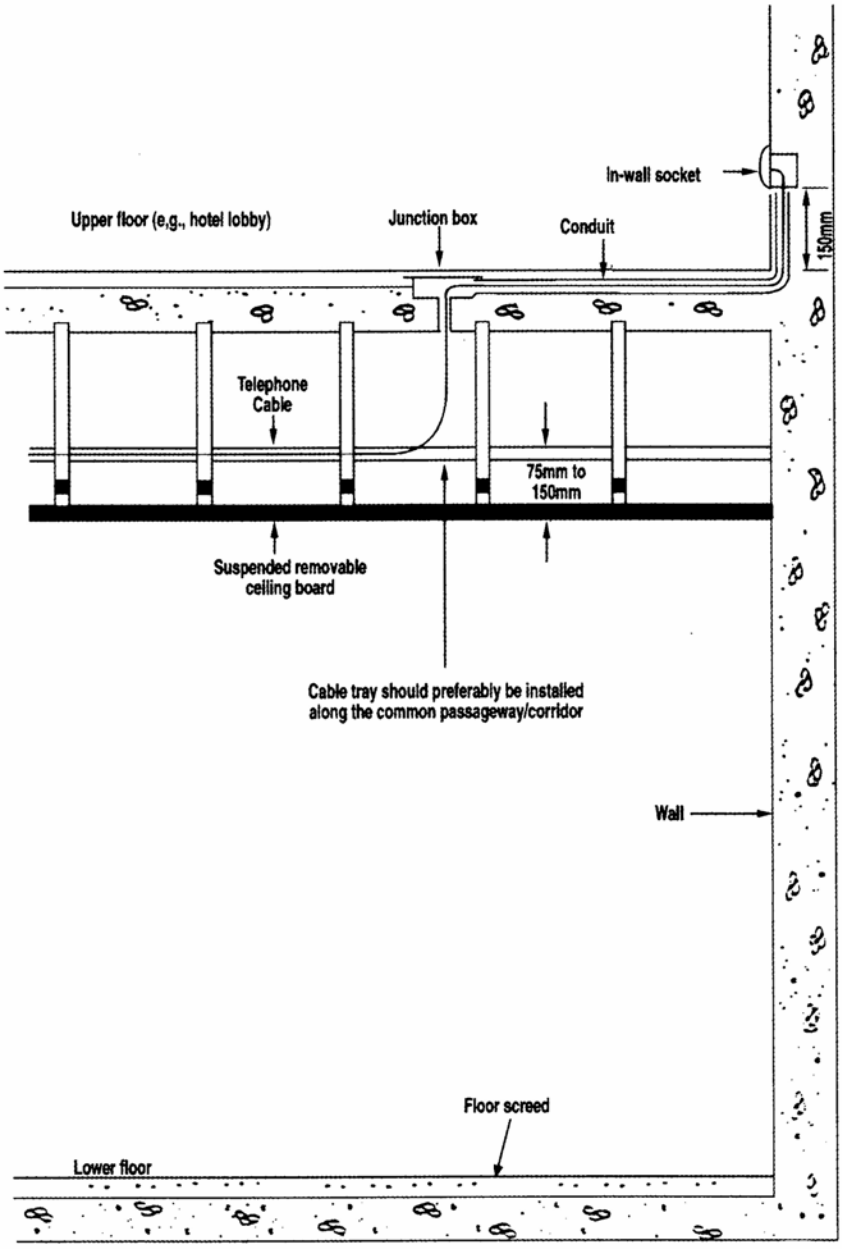


FIGURE 4-25 : CONDUIT DISTRIBUTION SYSTEM IN CERTAIN AREAS OF A HOSPITAL

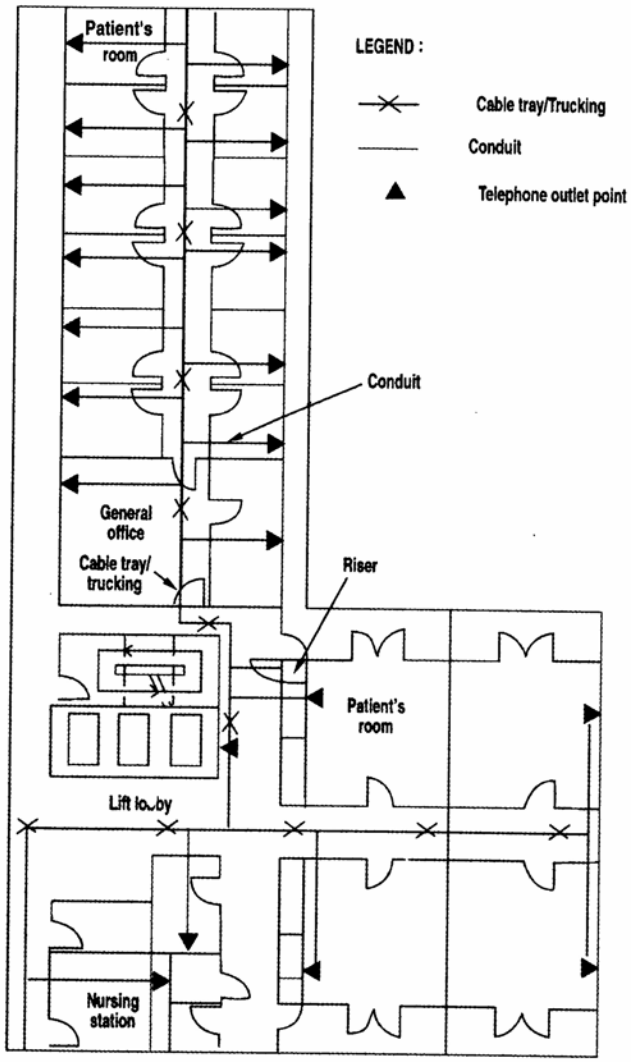


FIGURE 4-26 : CABLE TRAY BENDS & FITTING WITH 600MM MINIMUM RADIUS

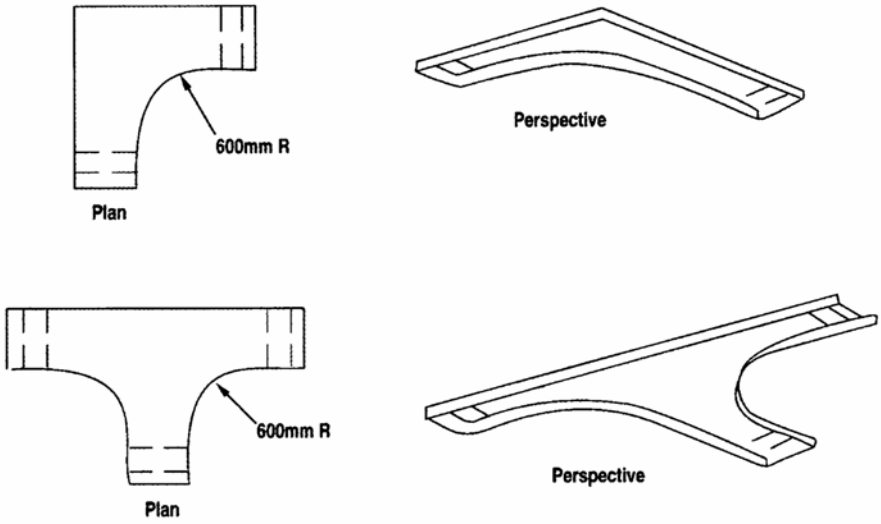


FIGURE 4-27 : TYPICAL EXAMPLE OF A TRUNKING SYSTEM

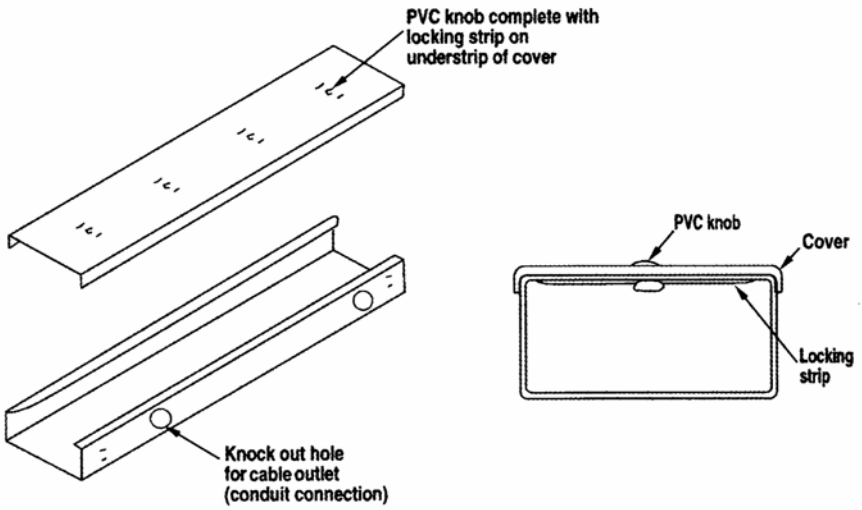


FIGURE 4-28 : COMBINATON OF DUCT & CONDUIT DISTRIBUTION SYSTEM

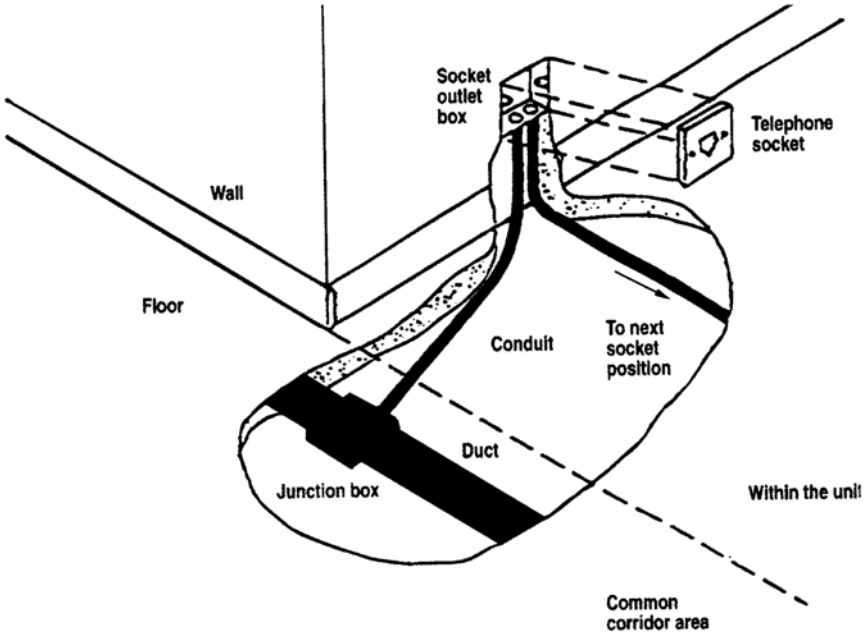


FIGURE 4-29 : USING CONDUITS TO DISTRIBUTION CABLES

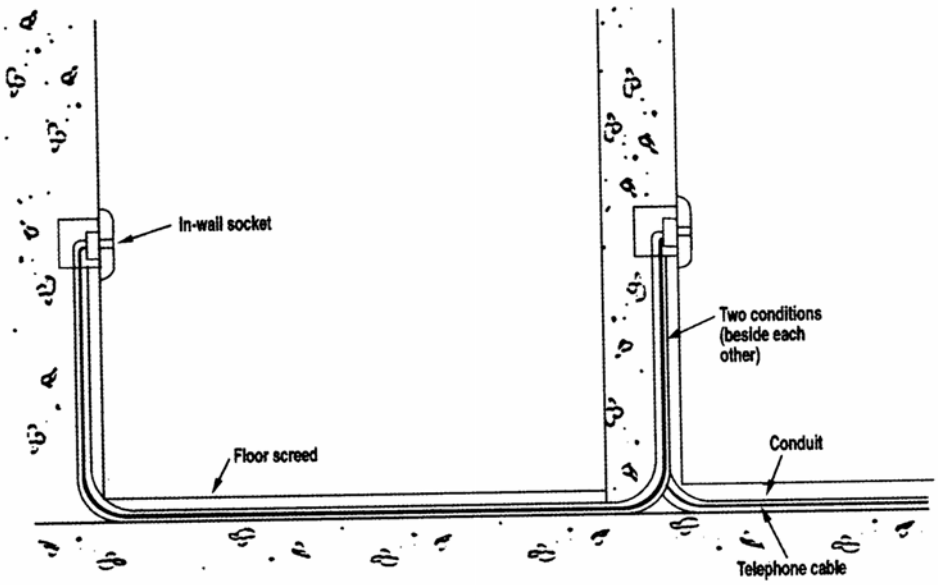


FIGURE 4-30 : FLOOR DUCT EXTENDED INTO TELEPHONE RISER

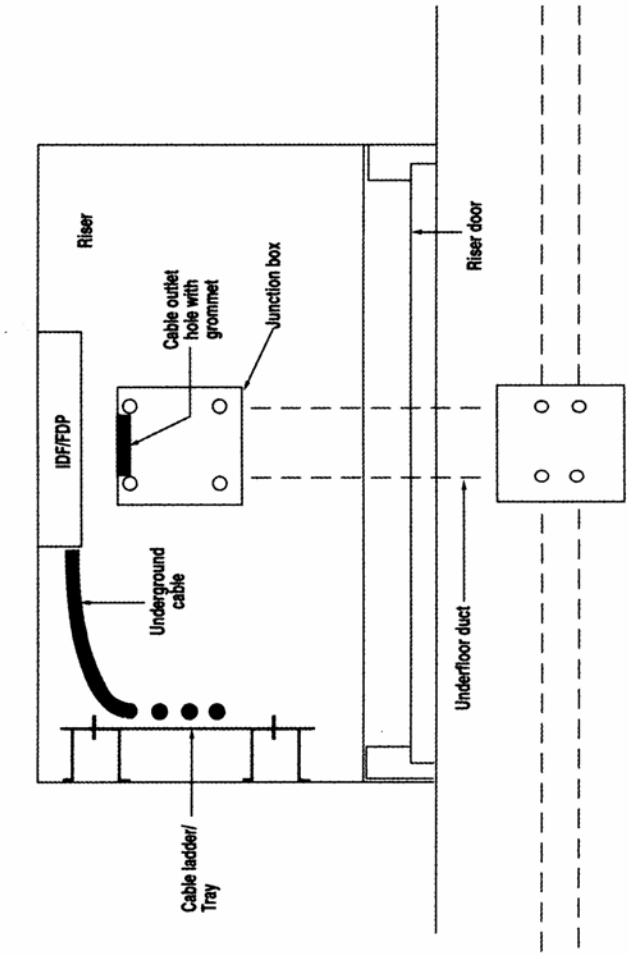


FIGURE 4-31 : CONDUIT IN FALSE CEILING & WALL TO DISTRIBUTION CABLES

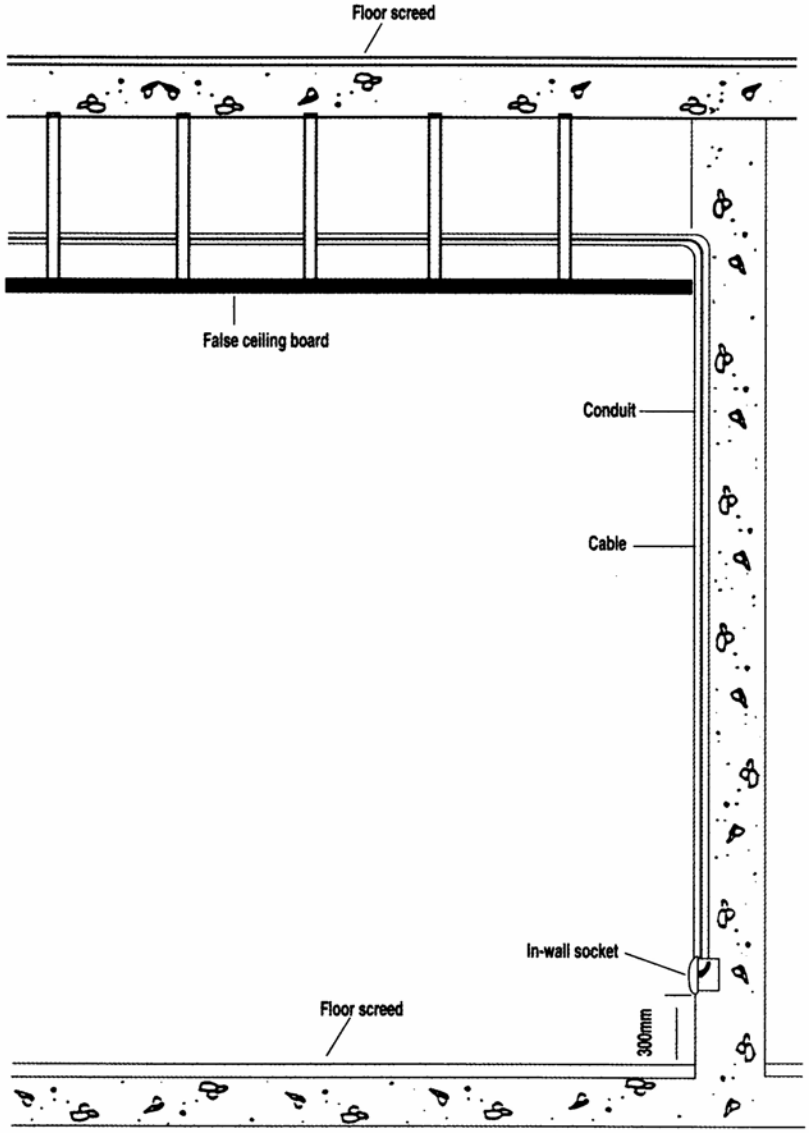
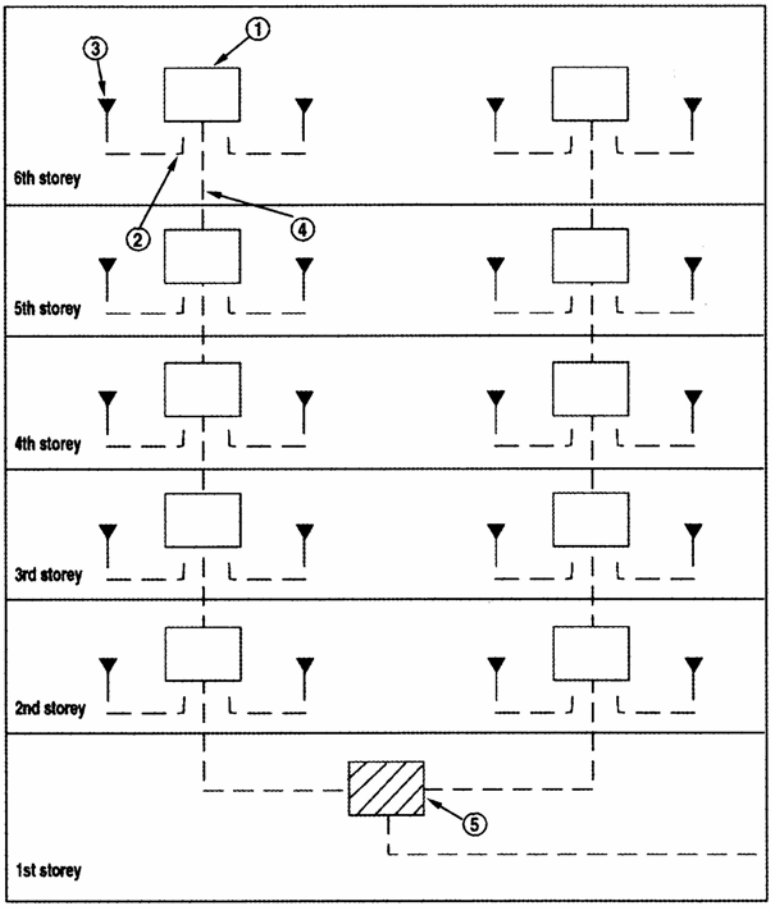


FIGURE 4-32 : MULTI-RISER DISTRIBUTION IN RESIDENTIAL BUILDING



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

PART 5 CUSTOMER PREMISES CABLING AND INTERFACE POINT

5.1 INTERFACE POINT FOR CUSTOMER PREMISES CABLING

5.1.1 Internal (Telecommunication) Wiring

Internal (Telecommunication) Wiring ("IW") means any telecommunication line, wire, cable, optical fibre, conduit or other physical medium connecting a customer'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 customer premises shall be supplied and installed by IDA licensed installers and contractors.

Under the IDA Licensing Scheme for Telecommunication Wiring Contractors and Telecommunication Wiring Installers, the telecommunication wiring contractors and installers are required to comply with the current Code of Practice for Internal Telecommunication Wiring ("IDA CPL1: 2000").

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

5.1.2 Interface point

The IP is where the public telecommunication network ends. Please refer to Figure 5-1 (IP at Doorstep) and Figure 5-2 (IP at DP).

5.1.3 Location of IP

The locations of IP are categorised as follows:

(a) IP at doorstep

The types of premises under this category are shop-houses without Management Corporation, shop-houses in HDB residential blocks, business and residential premises served by overhead wiring (except for site offices) and HDB apartments. The following guidelines should be adopted:

(i) The IP is at doorstep whereby a block terminal ("BT") will be installed by the telecommunication system licensees for every unit.

(ii) Tenants shall provide their own cabling between IP and their telecommunication equipment by engaging IDA licensed contractors.

(b) IP at DP

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

(i) The interface points are at the DP.

(ii) Management Corporation/developer or owner should provide internal telephone distribution facilities for concealing telephone cables.

(iii) Management Corporation/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.

5.2 PRECABLING IN COMMERCIAL BUILDINGS

5.2.1 Benefits derived from pre-cabling a building

With the liberalisation of the internal wiring policy, Management Corporations/developers or owners should pre-cable their buildings from the IP to the tenants' 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.

5.2.2 Recommended cable size for various premises are as shown in Table 5-1.

Table 5-1 Recommended cable size

Types of premises	Recommended cable size
Markets, Food/ Hawker Centres	An 8-wire cable per stall.
Shopping Centres	At least 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.

5.3 PRECABLING IN RESIDENTIAL BUILDINGS

5.3.1 General

(a) Developer or owner shall supply and install telecommunication cables, sockets, block terminal and all other materials (inclusive of owner's Distribution Point ("DP") box) for pre-cabling to all rooms in residential buildings. It is recommended that a minimum of two 8-wire cables be installed from DP to Block Terminal ("BT") for each unit.

(b) A block terminal shall be used as a distributing point for connection to all rooms. It shall be located inside each residential unit (Figure 5-3).

(c) The developer or owner shall install the cable from the DP in the telecommunication riser or gate pillar to each socket using a star configuration with the block terminal as a distribution point (Figure 5-3).

(d) The developer or owner shall label each cable pair at the DP 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 5-4. The telecommunication system licensees shall terminate the telecommunication cables onto their respective DPs.

(e) The telecommunication cables, sockets and block terminals may be purchased from the telecommunication system licensees or its suppliers. Where structural cabling system is installed, the specifications of cables and sockets shall be unshielded twisted-pair ("UTP") cable Category 5e or above, complying with the TIA/EIA-568-A cabling standards (See Part 7 Ethernet-To-The-Home/Office for details regarding structural cabling system).

5.4 TERMINATION OF INTERNAL WIRING

5.4.1 Termination at IP

Telecommunication wires or cables, for non-residential buildings, at the IP should be terminated onto developers or owners' block terminals, distribution cases or terminal blocks mounted on the Intermediate Distribution Frame ("IDF"). The cables should be correspondingly labelled onto the distribution cases or terminal blocks.

5.4.2 Termination at tenants' premises

Telecommunication wires or cables, for both residential and non-residential buildings, at the tenants' premises should be terminated onto termination boxes or sockets. The cables should be correspondingly labelled onto the

termination boxes. To facilitate installation and maintenance of cables, the termination box should be installed in a prominent location which is easily accessible. .

5.5 RECORD OF CABLE DISTRIBUTION SYSTEM AND DOCUMENTATION OF PRE-CABLING/INTERNAL WIRING WORK

5.5.1 The management corporation/developer or owner should keep an up-to-date set of the telecommunication cable distribution system drawings and a record of the Pre-Cabling/Internal Wirings for reference purpose.

FIGURE 5-1 : IP AT DOORSTEP

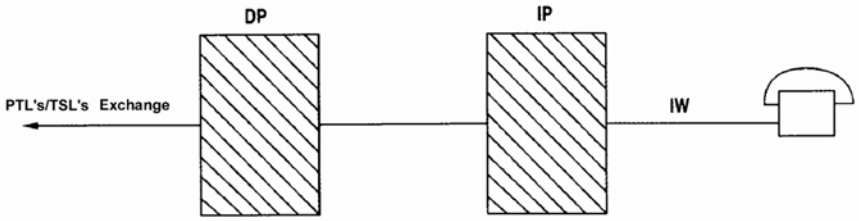


FIGURE 5-2 : IP AT DP

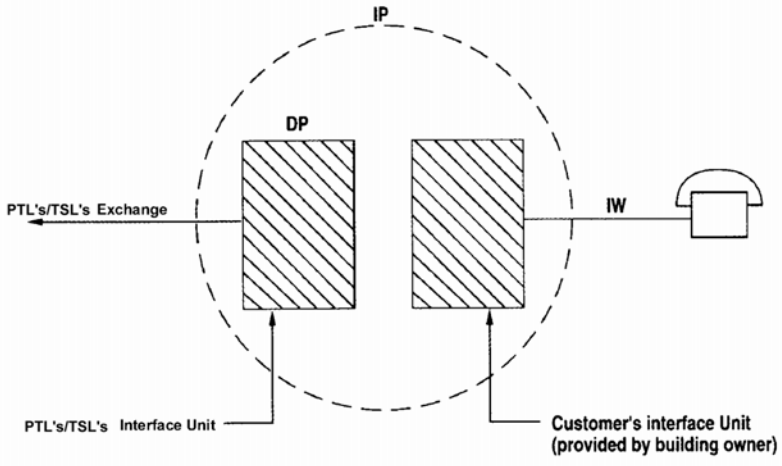


FIGURE 5-3 : TELEPHONE WIRING CONFIGURATIONS FOR RESIDENTIAL BUILDINGS

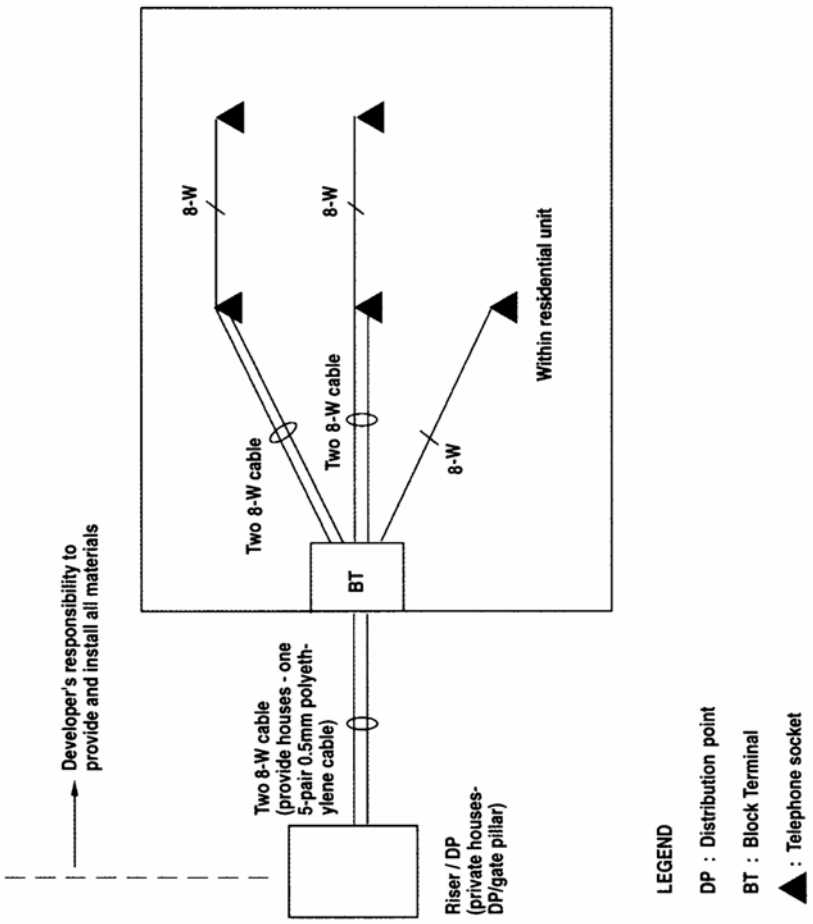
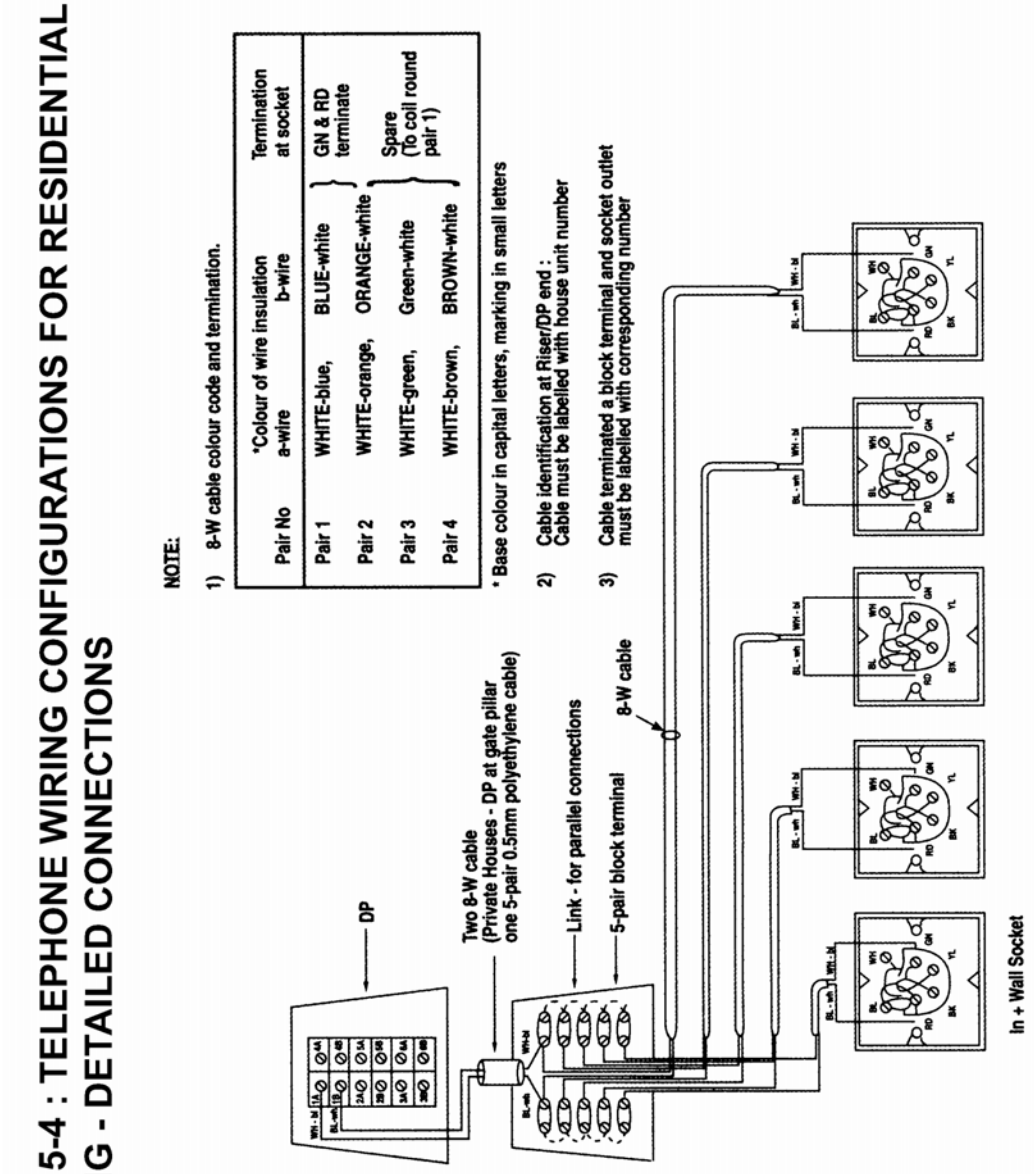


FIGURE 5-4 : TELEPHONE WIRING CONFIGURATIONS FOR RESIDENTIAL BUILDING - DETAILED CONNECTIONS



PART 6 SPECIFICATIONS OF CABLES AND SOCKETS

6.1 TELECOMMUNICATION CABLES AND ANCILLARY ACCESSORIES

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 6-1 Specifications related to telecommunication cables

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 can be downloaded from IDA's website (http://www.ida.gov.sg)

PART 7 ETHERNET-TO-THE-HOME/OFFICE

7.1 GENERAL

This part describes the recommended space and facilities which should be provided by the developer or owner for the installation of cables and equipment for the provision of Ethernet-To-The-Home ("ETTH")/Ethernet-To-The Office type of broadband services.

7.2 HORIZONTAL DISTRIBUTION FACILITIES

7.2.1 For distribution between telecommunication risers and residential units, flats or tenants' premises, separate conduits/trunking compartment must be provided for different type of telecommunication services (Broadband Coaxial Cable System ("BCS") and Ethernet). The cables can be fed into individual residential unit or flat:

(a) Through a conduit of 25mm diameter or PVC trunking of size 25mm by 25mm directly connected to the riser; or

(b) Through one or more conduits of 32mm diameter or trunking of size 32mm by 32mm (the number of conduits depends of the number of residential units, flats or tenants' premises to be served) from the riser to a junction box and then through a conduit of 25mm diameter or trunking of size 25mm by 25mm from the junction box to each residential unit, flat or tenant's premise.

7.2.2 For distribution within a residential unit, flat or tenant's premise, separate conduit or trunking compartment must be provided for different type of telecommunications services (BCS and Ethernet) within a residential unit, flat or tenant's premise and it should meet the following requirements:

(a) A 25mm diameter conduit or trunking of size 25mm by 25mm should be used to connect the first outlet (where the conduit from the riser is connected) to the second outlet, and then to the third and so on to form a series configuration by using trunking or concealed conduit box conforming to BS 4662 or equivalent;

(b) The conduits connecting one outlet to another should not exceed 1 bend; and

(c) It is preferable to have one concealed/exposed wall outlet per room.

7.3 COPPER CABLES

7.3.1 The copper cables should be of unshielded twisted pair ("UTP") cables which conform to TIA/EIA 568A specifications or equivalent. UTP cables are classified into five categories; each category is designed for different bandwidth. The cables to be installed for telecommunications services should be Category 3 or above. For the broadband service over Ethernet technologies, cables of Category 5 or above[1] should be used.

7.3.2 Typically, cable runs should not exceed 100m. The TIA/EIA specification calls for 90m maximum runs from the equipment rack to the wall outlet. An extra 10m is allowed to connect computers to the wall outlet and to connect the cable runs to patch panels.

7.4 EQUIPMENT RACKS FOR ETHERNET

7.4.1 Two types of equipment racks are possible:

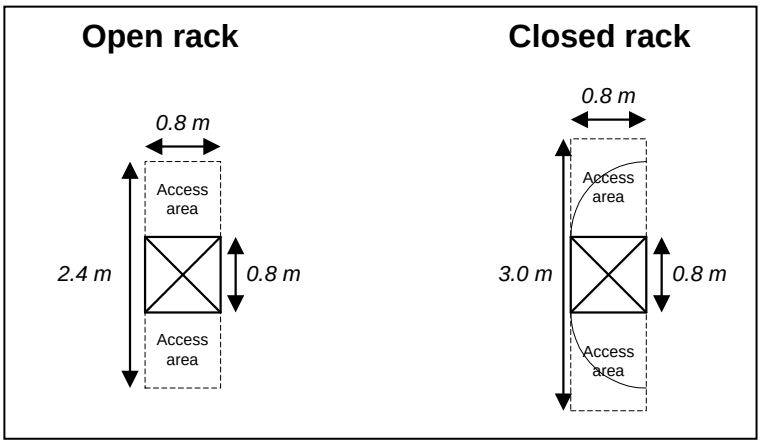
(a) Open rack; or

(b) Closed rack (with doors and side panels).

7.4.2 The maximum height of the rack is typically 42-45 RU (rack-units) which is approximately 2m.

7.4.3 The floor space catered for both types of rack should be at least 0.8m by 0.8m. For open racks, a space of 0.8m front and back should be catered for access, making total floorspace needed to be 2.4m by 0.8m. For closed rack, 1.1m should be catered for the front and back doors to swing open, making total floorspace needed to be 3m by 0.8m (see Figure 7-1).

Figure 7-1 Floorspace required for racks

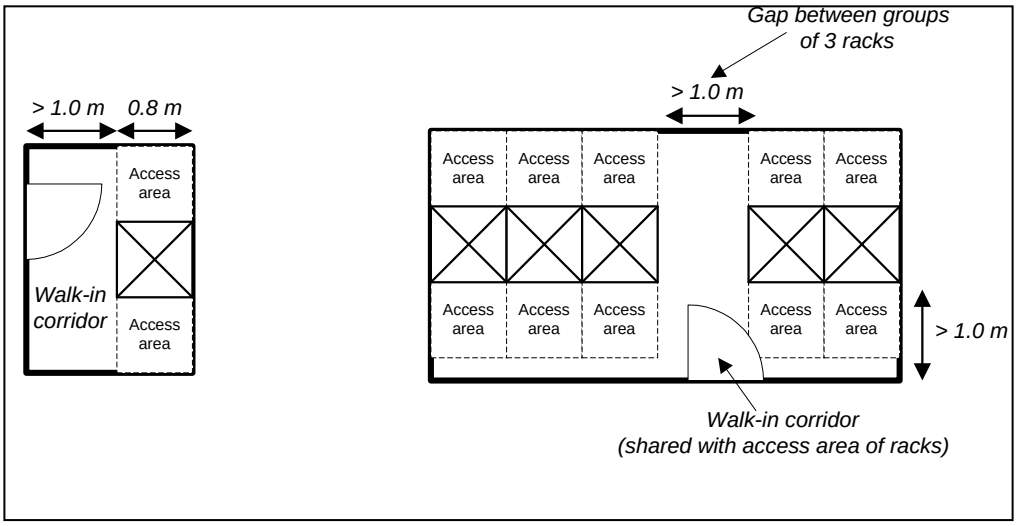


[1] Cat 5E is introduced mainly to support Gigabit Ethernet, GE (1000BASE-Tx). With the full ratification of Cat6, Cat5E is slowly entering into obsolescence.

7.5 ETHERNET EQUIPMENT ROOM

7.5.1 The size of the equipment room provided is dependent on the number of racks to be installed. Each room should have a walk-in corridor of at least the width of the room door or 1m, whichever is larger. This walk-in corridor space can be shared with the access space of the rack. Also, racks should not be grouped more than 3 in a row, with a gap of 1m between each group (see Figure 7-2).

Figure 7-2 Equipment room size



7.5.2 Please note that the uplinks in between Ethernet switches housed in the rack are mainly fibre cable. Generally, a multimode 62.5 micron fibre can reach up to 220m while a multimode 50 micron can reach up to 500m. However, the switches housed in the rack that service the wall outlet is constrained by the distance limits of 100m (including patch cord and station cord). As a rule of thumb, for any building where UTP cables are used for vertical cabling, 1 equipment room should be provided for every 10 floors apart, within the maximum limit of 100m distance between switches (both horizontal and vertical cabling).

PART 8 COMMISSIONING TEST PROCEDURES FOR BROADBAND COAXIAL CABLE SYSTEM

8.1 Upon the completion of the installation work, a thorough physical inspection should 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.

8.2 For a multi-storey building, a sample test should be conducted for every storey and telecommunication riser in the building. Tests should be completed by making measurements on all vertical cable risers on all storeys. Signals should 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 should be conducted for every storey in the building. This test should involve outlets in at least two units in the same storey. Tests should be completed by making measurements on all vertical cable risers on all storeys. Signals should be measured at the distribution panels. On each storey, signal levels should 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.

8.3 For a private residential house, a sample test should 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 residence.

PART 9 METHODS OF MEASUREMENTS OF BROADBAND COAXIAL CABLE SYSTEM

9.1 GENERAL

The basic methods of measurements should 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; and

(i) Measurement of Signal Leakage.

9.2 MEASUREMENT OF MUTUAL ISOLATION BETWEEN SYSTEM OUTLETS

9.2.1 References to system outlets should also apply to the far ends of subscribers' feeders when no system outlets are used.

Isolation should be measured between:

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

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

9.2.2 Equipment required for the test set-up should be provided and the measurement should be conducted in accordance with the recommendations of IEC 728-1.

9.3 MEASUREMENT OF HUM

9.3.1 Modulation distortion at power frequencies ("Hum") is the amplitude distortion of the desired signals caused by the modulation of these signals with components of the power source.

9.3.2 Equipment required for the test set-up should be provided and the measurement should be conducted in accordance with the recommendations of FCC 76.605(a)(10) and NTCA Recommended Practices – 2nd Edition 1993.

9.4 MEASUREMENT OF FREQUENCY RESPONSE WITHIN A CHANNEL

9.4.1 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).

9.4.2 Equipment required for the test set-up should be provided and the measurement should be conducted in accordance with the recommendations of FCC 76.605(a)(6) and NTCA Recommended Practices – 2nd Edition 1993.

9.5 MEASUREMENT OF VISUAL, AURAL CARRIER CENTRE FREQUENCY

9.5.1 Vision carrier level in a cable television system is the r.m.s. 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.

9.5.2 Equipment required for the test set-up should be provided and the measurement should be conducted in accordance with the recommendations of FCC 76.605(a)(4) and NTCA Recommended Practices – 2nd Edition 1993.

9.6 MEASUREMENT OF INTER-MODULATION

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

9.6.2 Equipment required for the test set-up should be provided and the measurement should be conducted in accordance with the recommendations of IEC 728-1 Clause 9 and NTCA Recommended Practices – 2nd Edition 1993.

9.7 MEASUREMENT OF VISUAL CARRIER TO NOISE RATION

9.7.1 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.

9.7.2 Equipment required for the test set-up should be provided and the measurement should be conducted in accordance with the recommendations of FCC 76.605(a)(7) and NTCA Recommended Practices – 2nd Edition 1993.

9.8 MEASUREMENT OF CHROMINANCE - LUMINANCE DELAY INEQUALITY

9.8.1 The Chrominance – Luminance delay inequality caused by a head-end 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.

9.8.2 Equipment required for the test set-up should be provided and the measurement should be conducted in accordance with the recommendations of FCC 76.605(a)(11)(i) and NTCA Recommended Practices – 2nd Edition 1993.

9.9 MEASUREMENT OF DIFFERENTIAL GAIN AND PHASE

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

9.9.2 Equipment required for the test set-up should be provided and the measurement should be conducted in accordance with the recommendations of FCC 76.605(a)(11)(ii)(iii) and NTCA Recommended Practices – 2nd Edition 1993.

9.10 MEASUREMENT OF SIGNAL LEAKAGE

9.10.1 The term “leakage” refers to the undesired emanation of electromagnetic energy from the cable television system.

9.10.2 Equipment required for the test set-up should be provided and the measurement should be conducted in accordance with the recommendations of FCC 76.605(a)(12) and NTCA Recommended Practices – 2nd Edition 1993.

PART 10 ANTENNAE AND INSTALLATION

10.1 GENERAL

10.1.1 This part relates to the installation and specification of antennae for the reception of TV broadcast programmes. Any queries under this part should be directed at Media Development Authority ("MDA") at Tel: 6837 9973 or fax: 6336 8023.

10.2 ANTENNAE

10.2.1 Antennae to be installed for cable-ready BCS systems should meet or exceed the minimum requirements indicated in Table 10-1 so as to enable the systems to meet the requirements of this standard.

Table 10-1 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	)

10.2.2 The antennae should be designed to withstand a wind velocity of 100 km/h.

10.2.3 Antennae elements should be made of aluminium, with clamps of diecast 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.

10.2.4 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.

10.2.5 The characteristic impedance of the antennae should be 75 ohms.

10.2.6 Stainless steel antennae should be used where heavy-duty performance is required.

10.2.7 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.

10.3 ANTENNAE MAST AND MOUNTING BRACKET

10.3.1 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.

10.3.2 The top open end of the mast should be capped to prevent ingress of water.

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

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

10.3.5 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.

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

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

10.3.8 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.

10.4 PROTECTION AGAINST LIGHTNING

10.4.1 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.

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

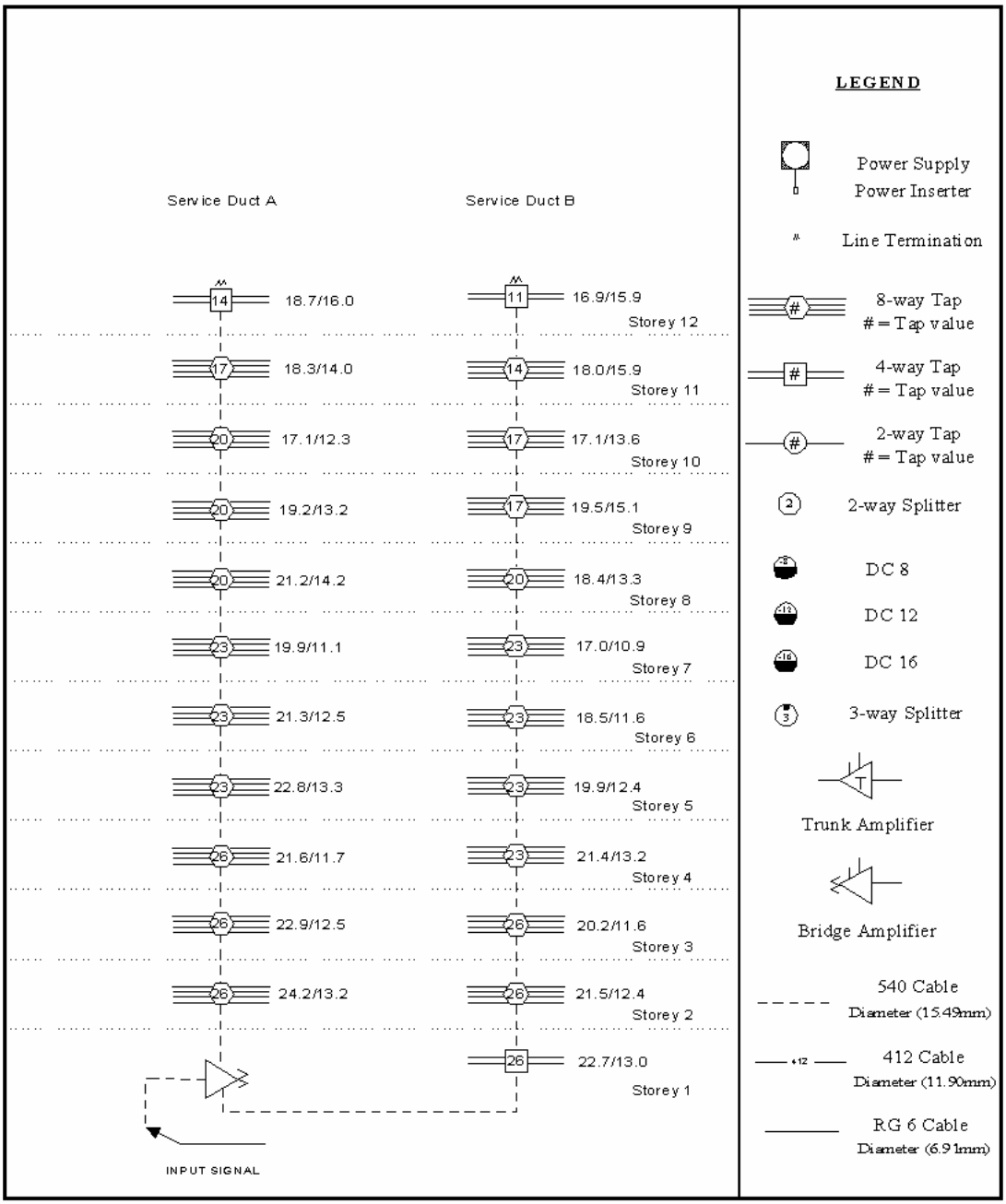
10.4.3 Metallic distribution conduits on roof-top should also be earthed.

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

Notes: 1. For building developments where cable TV services are not yet available due to technical or operational reasons, building developers or owners (as the case may be) may install antennae to enable free-to-air TV signals to be distributed through the BCS to all dwelling units until cable TV services are available from the cable TV licensee(s).

2. Where antennae are installed on the BCS, such antennae should meet the minimum requirements which are specified in this part.

ANNEX 1 TYPICAL BROADBAND COAXIAL CABLE SYSTEM RISER SCHEMATIC FOR A HIGH-RISE BUILDING



ANNEX 2 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 are the outline of the some related standards available at the point of developing this document. 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 75Ω 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 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 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 75Ω 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 75Ω 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 75Ω 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 75Ω to 300Ω – 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 75Ω 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 75Ω 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 75Ω 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.

On Premises Specifications

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 CATV signals. This will allow the local cable operator to provide CATV 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 75Ω 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 CATV 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 (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 (Device Under Test).

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 75Ω 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 75Ω 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 CATV

environment, using the technology known as the Giga Hertz Transverse Electromagnetic Mode ("GTEM") 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.