INFOCOMM DEVELOPMENT AUTHORITY OF SINGAPORE

TELECOMMUNICATIONS ACT

(CHAPTER 323)

DRAFT GUIDELINES FOR INFO-COMMUNICATION FACILITIES IN BUILDINGS

DATE OF ISSUE: DD MM YY

GUIDELINES FOR INFO-COMMUNICATION FACILITIES IN BUILDINGS

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

1. INTRODUCTION

1.1 Obligations of developers or owners

(a) These Guidelines lay down the detailed specifications of the space and facilities which developers or owners of buildings are to provide under the Code of Practice for Info-Communication Facilities in Buildings 2012 ("COPIF") in order to enhance the range and/or quality of info-communication services that may be provided to their buildings by telecommunication system licensees. This document is to be read together with the COPIF which sets out the mandatory requirements in respect of the space and facilities which developers or owners are required to provide. Nothing in these Guidelines shall waive any developer or owner of its obligation to comply with the provisions of the COPIF. In the event of any conflict between the COPIF and these Guidelines, the provisions of the COPIF will prevail.

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

1.2 Rules of Construction

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

1.3 Short Title

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

2. GENERAL REQUIREMENTS FOR INFO-COMMUNICATION FACILITIES

2.1 General

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

2.2 Segregation requirements

(a) Non-electrical Plant

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

(b) Electrical Plant

Requirements of the clearance to be provided between power and telecommunication cables are as follows:

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

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

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

(iv) Separate casings, conduits, compartments ducts, etc., shall be provided for each type of telecommunication cables. Such telecommunication cables shall be separated from any electrical cables. Where telecommunication and electrical cables intersect, a 'bridge' or suitable cross-over joint piece shall be provided.

(v) In addition to (iv) above, where telecommunication and electrical cables are housed in trunking with multiple compartments, the trunking shall be designed to ensure that the cables remain in their individual compartments and the segregation between each compartment shall be continuous.

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

2.3 Diversity

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

(i) Hospitals;
(ii) Airports;
(iii) Police stations;
(iv) Fire stations;
(v) Military camps;
(vi) Power generation or control plants;
(vii) Radio and TV stations;
(viii) Computer or data centres;
(ix) Security agencies, and
(x) Financial centres.

(b) In addition to the types of buildings listed above, for buildings where the developer or owner requires diversity for its telecommunication services, a second set of lead-in pipes shall be provided.

2.4 General protection

The space and facilities provided for telecommunication cables must be able to adequately protect the cables from possible damage caused by mechanical means, exposure to weather, corrosive fumes, water or excessive dampness, accumulated dust, steam, oil, high temperature or any other conditions which may damage the cables.

2.5 Fire protection

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

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

2.6 Facility record

For the purpose of maintenance and timely restoration of services in the event of breakdown, it is essential that the exact location of the lead-in and underground pipes, main distribution frame room, telecommunication risers, cable tray routes and details of any other facilities provided by developers or owners within the building compound such as location and dimension of manholes are properly documented on plans. A laminated set or copy should also be displayed prominently and permanently inside the main distribution frame room for easy reference during maintenance works.

2.7 Inspection procedure for completed space and facilities

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

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

(i) main distribution frame rooms;

(ii) telecommunication equipment rooms;

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

(iv) telecommunication risers; and

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

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

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

(e) Where deficiencies are recorded in the inspection checklist, such deficiencies shall immediately be rectified before the deployment of installation, plant or system by licensees. However, an arrangement may be made for licensees to deploy concurrently their installation, plant or system in those space and facilities which are do not require rectification works.

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

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

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

2.8 Responsibilities of the licensees

After handing over of the space and facilities to the licensees for their deployment of installation, plant and system, the licensees shall be responsible for maintaining their installation, plant and system and the general cleanliness of the space and facilities.

2.9 Installation of telecommunication cables

(a) The developer or owner may install and maintain its telecommunication cables for its own use or for access by its tenants or lessees.

(b) The developer or owner shall engage wiring contractors, who are licensed by IDA, to install telecommunication cables in its development. The developer or owner may also enter into a commercial arrangement with any licensee to install its telecommunication cables in its development.

(c) However, in multi-tenanted buildings, tenants or lessees have the choice of getting any licensee to provide any telecommunication services. A tenant or lessee may lease the telecommunication cables provided by the developer or owner based on commercial arrangements, or they may use the cables provided by a licensee. The developer or owner shall allow any licensee to install telecommunication cables within the building to serve any tenant or lessee, should the latter require the use of such cables.

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

(e) In relation to paragraph 2.9(d), the developer or owner or its tenant must remove its telecommunication cables from the telecommunication risers at its own expense, if there is insufficient space for the licensees' use.

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

2.10 Do’s and Don’ts for Earthworks

The developer or owner shall refer to the relevant telecommunication system licensee’s list of “do’s and don’ts” in relation to the reasonable precautions to be taken when carrying out any earthworks to prevent any damage to such telecommunication system licensee’s telecommunication cable.

FORM 2.1

Date: [*dd-mmm-yyyy*]

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

Attn: Director
Interconnection & Access

Dear Sirs

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

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

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

In accordance with the requirement of the Code of Practice for Info-communication Facilities in Buildings, the endorsed joint inspection checklist is enclosed for IDA's information.

Yours faithfully

[*Developer or owner's name*]

Encl

FORM 2.1 (CONT'D)

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

PROJECT TITLE: _____
TFCC REFERENCE NO.: _____

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

(a) Main distribution frame room (MDF room)

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

(b) Telecommunication Equipment Room (TER)

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

(c) Telecommunication riser

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

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

(a) Main distribution frame (MDF room)

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

FORM 2.1 (CONT'D)

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

PROJECT TITLE: _____
TFCC REFERENCE NO.: _____

(b) Telecommunication equipment room (TER)

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

(c) Telecommunication riser

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

(d) Underground pipes

Comment:

(e) Cable trays

Comment:

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

(a) Developer or owner's Representative _____

Signature/Date _____

(b) TFCC Member (1) _____

Signature/Date _____

(c) TFCC Member (2) _____

Signature/Date _____

FORM 2.2

Date: [*dd-mmm-yyyy*]

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

Attn: Director
Interconnection & Access

Dear Sirs

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

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

I refer to my letter titled "Code of Practice for Info-communication Facilities in Buildings – Notification of Completion of Inspection of Space and Facilities" dated [*dd-mmm-yyyy*] and IDA's letter dated [*dd-mmm-yyyy*].

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

Yours faithfully

[*Developer or owner's name*]

Encl

FORM 2.2 (CONT'D)

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

PROJECT TITLE: _____
TFCC REFERENCE NO.: _____

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

(a) Main Distribution Frame (MDF) room

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

(b) Telecommunication equipment room (TER)

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

(c) Telecommunication riser

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

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

(a) Main distribution frame (MDF) room

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

FORM 2.2 (CONT'D)

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

PROJECT TITLE: _____
TFCC REFERENCE NO.: _____

(b) Telecommunication equipment room (TER)

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

(c) Telecommunication riser

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

(d) Underground pipes

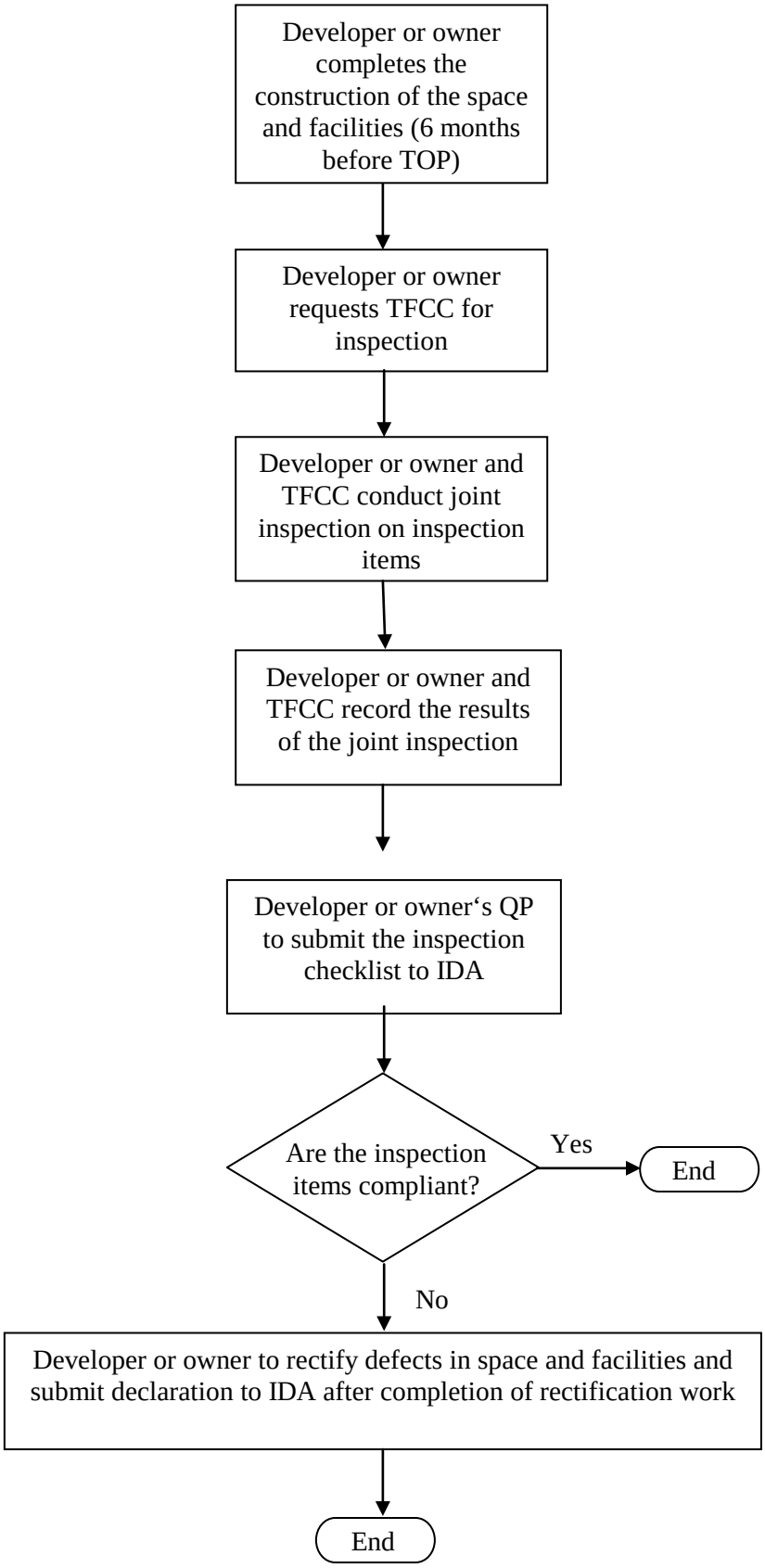
Comment:

(e) Cable trays

Comment:

CHART 2.3

INSPECTION PROCESS FLOWCHART



3. GENERAL REQUIREMENTS FOR PROVISION OF SPACE AND FACILITIES

3.1 Documentation

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

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

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

4. PROCEDURES AND REQUIREMENTS FOR PROVISION OF MOBILE SERVICE COVERAGE WITHIN DEVELOPMENTS

4.1 General

(a) Mobile telecommunication licensees operating public mobile telecommunication systems may face difficulty in providing mobile service coverage within developments, including basement levels, underground pedestrian malls, etc as building design and structure would affect the radio propagation characteristics. The difficulty faced by licensees in providing mobile service coverage within developments is particularly significant where building structures use materials unfavourable to radio signal penetration, e.g. metallic wall cladding, metalised window film, etc. As such, it may take up to a year or more for licensees to plan and deploy their installation, plant and system in the development so as to provide mobile service coverage within the development.

(b) This chapter serves to inform the developer or owner of any development of the procedures and requirements that they should follow so as to facilitate the timely provision of mobile service coverage within the development.

4.2 Responsibility of developer or owner

These guidelines do not exempt the developer or owner from obtaining:

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

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

4.3 Procedures and requirements for the provision of mobile service coverage

(a) The developer or owner may make a written request to any licensee for the provision of mobile service coverage within the development, and shall include in such written request relevant information relating to the development (e.g. type and size of the development).

(b) The developer or owner shall provide reasonable access to its premises for licensees to conduct survey and field tests to determine the extent of mobile service coverage within the development.

(c) Where the licensee(s) agrees to provide or enhance mobile service coverage within the development and the developer or owner wishes to facilitate the timely provision or enhancement of mobile service coverage, the developer or owner may, unless otherwise agreed with the licensee(s), provide the following:

(i) Antenna support structure (including mounting poles with appropriate spacing between poles) at the roof-top or suitable external walls of a building, where the antennae are to be installed at the roof-top;

(ii) A cable distribution system (with specifications to be consulted with the licensees) across the ceiling for each floor including all basement floors;

(iii) Separate sets of electrical distribution panels operating on a minimum power supply of 230V, 30A isolators at the mobile deployment space; and

(iv) Other facilities (e.g. drilling of holes between uppermost floor and the roof-top) as the licensee(s) may request.

5. PUBLIC TELEPHONE BOOTHS (Deleted)

6. ACCOMMODATION REQUIREMENTS FOR PABX/KTS/MLS (Deleted)

7. CABLE DISTRIBUTION SYSTEMS

7.1 General

(a) Cable distribution systems are the facilities provided to distribute telecommunication cables installed from the main distribution frame room or telecommunication equipment room to the telecommunication risers and from telecommunication risers to each residential or non-residential units.

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

(c) A properly designed distribution system will ensure that cables can be installed or changed at anytime, with minimum inconvenience caused to the building tenants and without affecting the structure or appearance of the building.

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

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

(i) Examples of **Concealed distribution systems** are:

(A) Under-floor duct distribution system;

(B) Raised floor system;

(C) Cellular floor distribution system;

(D) Ceiling distribution system;

(E) Perimeter raceway distribution system;

(F) Poke-through distribution system; and

(G) Conduit distribution system.

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

(ii) Examples of **Exposed distribution systems** are:

(A) Cable tray; and

(B) Exposed conduit.

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

(f) **For residential buildings**, suitable types of distribution systems are as follows:

(i) Under floor distribution system;

(ii) Perimeter raceway distribution system;

(iii) Ceiling distribution system; and

(iv) Multi-riser system.

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

(g) **Capacity of distribution system**

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

(h) **Identification of distribution system**

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

(i) **Surface cabling**

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

(j) **Segregation of service**

It is important to segregate the cabling systems to accommodate different types of telecommunication cables (e.g. coaxial and non-coaxial cables) to minimise the possibility of any interference.

(k) **Earthing of metal parts**

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

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

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

7.2 Cable distribution systems for non-residential building

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

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

(i) General:-

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

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

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

(ii) Basic requirements:-

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

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

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

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

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

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

(iii) Duct:-

(A) The size of the under-floor duct should be such that the cross-sectional area of all the cables accommodated within a duct does not exceed 30% of the cross-sectional area of the duct.

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

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

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

(iv) Junction boxes:-

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

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

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

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

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

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

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

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

(v) Responsibility of developer or owner:-

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

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

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

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

(C) Safe and easy working position.

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

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

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

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

(i) General:-

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

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

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

(ii) Basic requirements:-

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

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

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

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

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

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

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

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

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

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

(C) Safe and easy working position;

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

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

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

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

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

(C) Broadloom carpet cannot be used.

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

(i) General:-

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

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

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

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

(ii) Cellular floor system with header duct:-

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

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

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

(iii) Cellular floor system with trench header:-

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

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

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

(iv) Basic requirements:-

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

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

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

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

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

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

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

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

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

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

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

(C) Safe and easy working position; and

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

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

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

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

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

(i) General:-

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

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

(ii) Basic requirements:-

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

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

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

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

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

(iii) Responsibility of developer or owner

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

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

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

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

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

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

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

(i) General

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

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

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

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

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

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

(ii) Basic requirements

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

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

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

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

(iii) Responsibility of developer or owner:-

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

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

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

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

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

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

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

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

(i) General

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

(B) This poke-through distribution system is vulnerable to the spreading of fire, gases, and smoke from floor to floor. Therefore, the use of this system must comply with any relevant requirement specify in the fire safety code published by the relevant authority.

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

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

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

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

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

(i) General

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

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

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

(ii) Basic requirements

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

Table 7.1 Recommended capacities for conduits

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

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

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

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

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

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

(G) Flexible conduits should not be used.

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

(h) **Cable trays**

(i) Basic requirements

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

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

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

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

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

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

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

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

(I) 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;

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

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

(i) **Surface conduits**

(i) General:-

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

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

(i) General:-

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

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

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

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

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

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

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

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

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

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

Table 7.2 Suitable distribution systems for various types of premises

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

7.3 Cable distribution systems for residential buildings

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

(a) Under-floor distribution system for residential buildings

(i) General:-

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

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

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

(ii) Basic requirements:-

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

(B) For joint-usage with electrical cables, a separate compartment should be provided for telecommunication cables. The segregation requirements should be in accordance with chapter 2, paragraph 2.2 of these Guidelines.

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

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

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

(iii) Common corridor area:-

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

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

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

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

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

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

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

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

(iv) Within each residential unit:-

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

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

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

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

(v) Responsibility of developer or owner:-

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

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

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

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

(C) Safe and easy working position.

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

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

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

(b) **Perimeter raceway distribution system**

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

(c) **Ceiling distribution system**

(i) General:-

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

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

(ii) Basic requirements:-

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

(B) The dimension of the access panels should not be less than 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.

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

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

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

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

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

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

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

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

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

(B) Where many bends are required, junction boxes should be provided at these bends to permit cabling works. An access panel or removable ceiling board should be provided at every junction box location;

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

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

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

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

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

(iv) Responsibility of developer or owner:-

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

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

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

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

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

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

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

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

(d) **Multi-riser system**

(i) General:-

(A) Instead of providing one telecommunication riser in a multi-storey residential building to serve all the units on the same floor, a multi-riser system with one telecommunication riser serving one or more units per floor can be used (Figure 7.32).

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

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

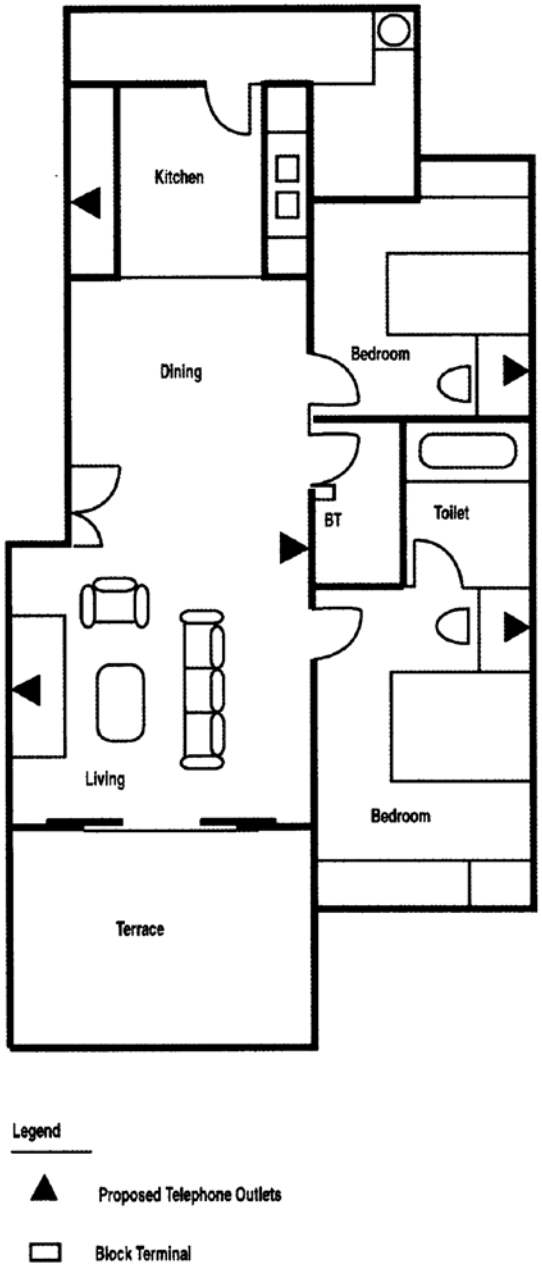


Figure 7.2: Under-floor duct distribution system

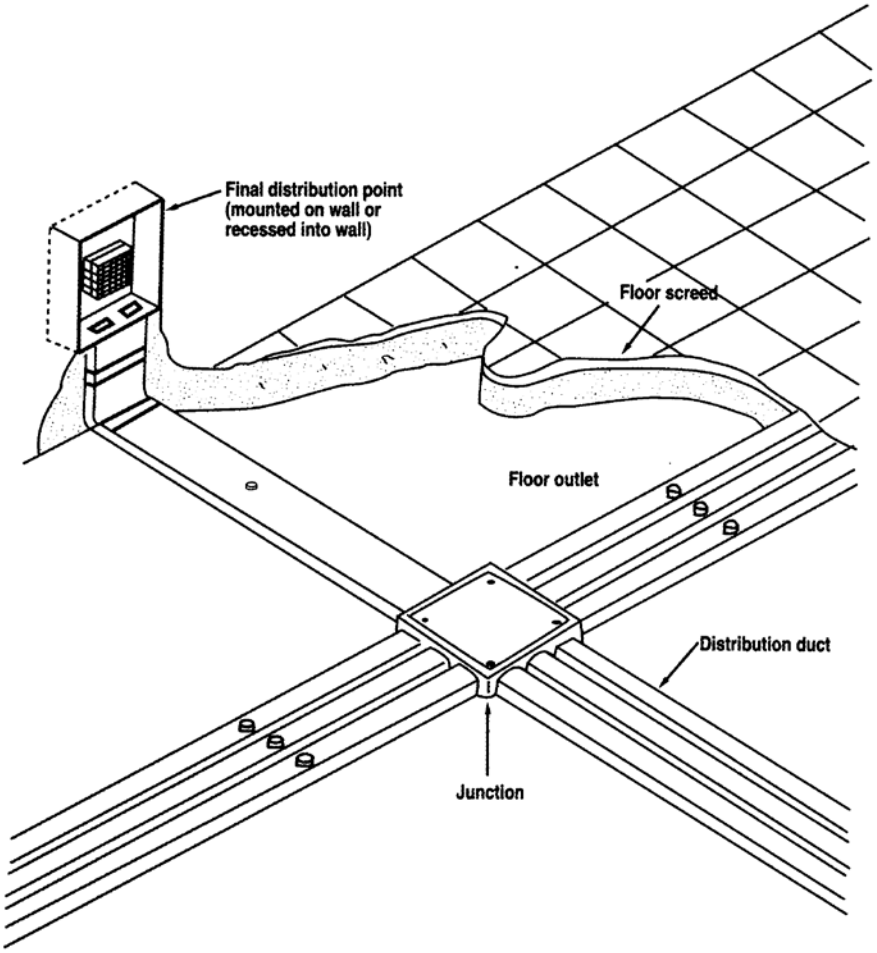


Figure 7.3: Trench duct system

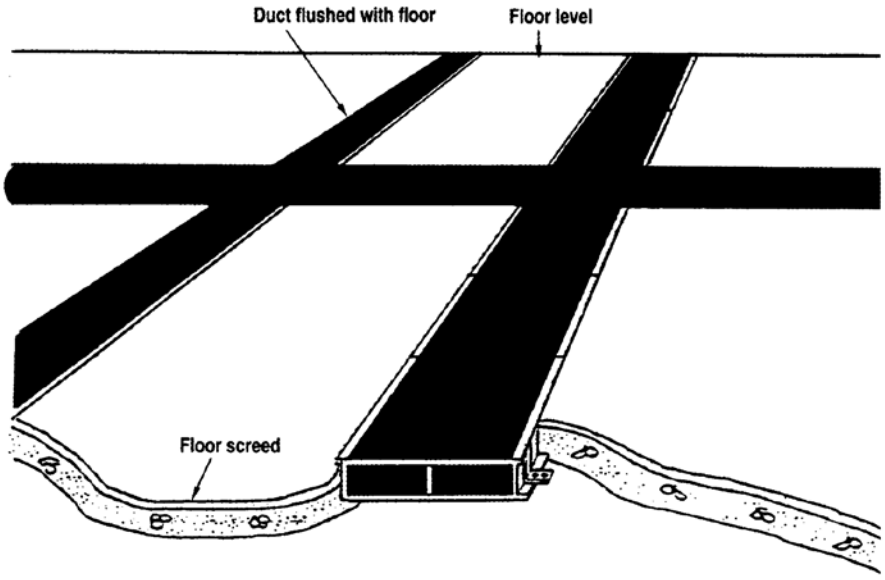


Figure 7.4: Under-floor duct extended to floor trench / flush trunking

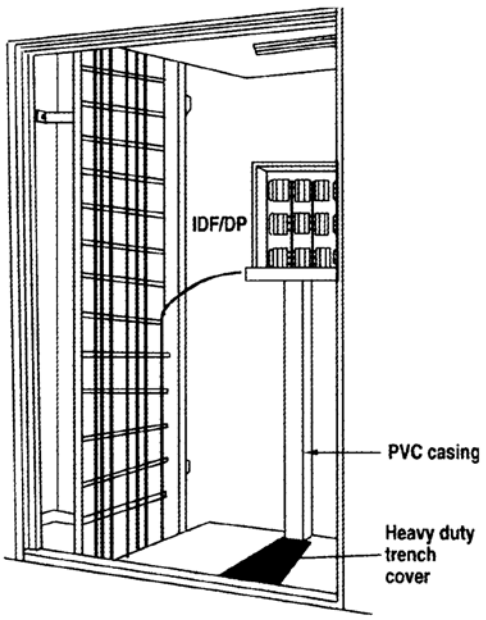


Figure 7.5: Floor trench in centre of riser

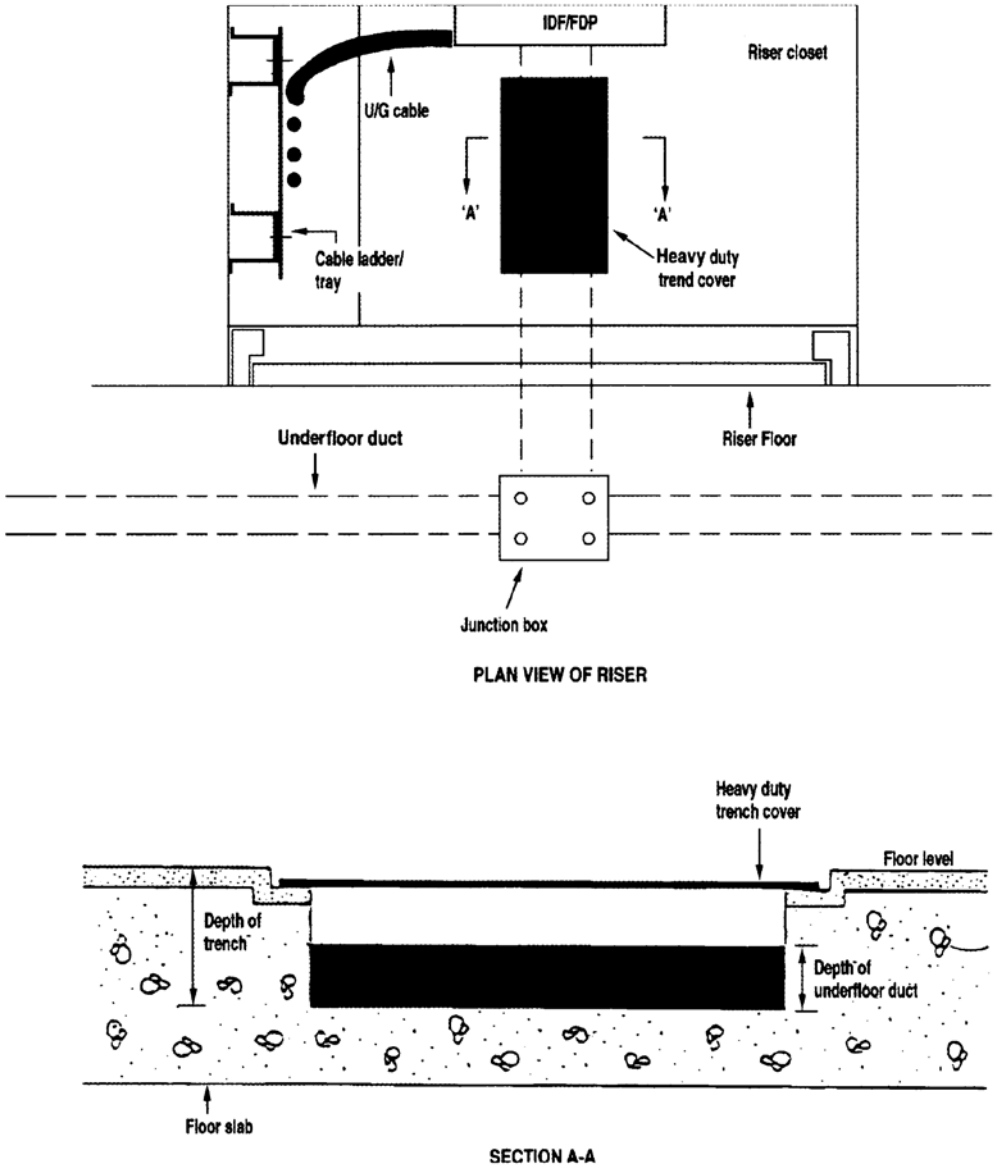


Figure 7.6: Main junction boxes along common corridor area or passageway

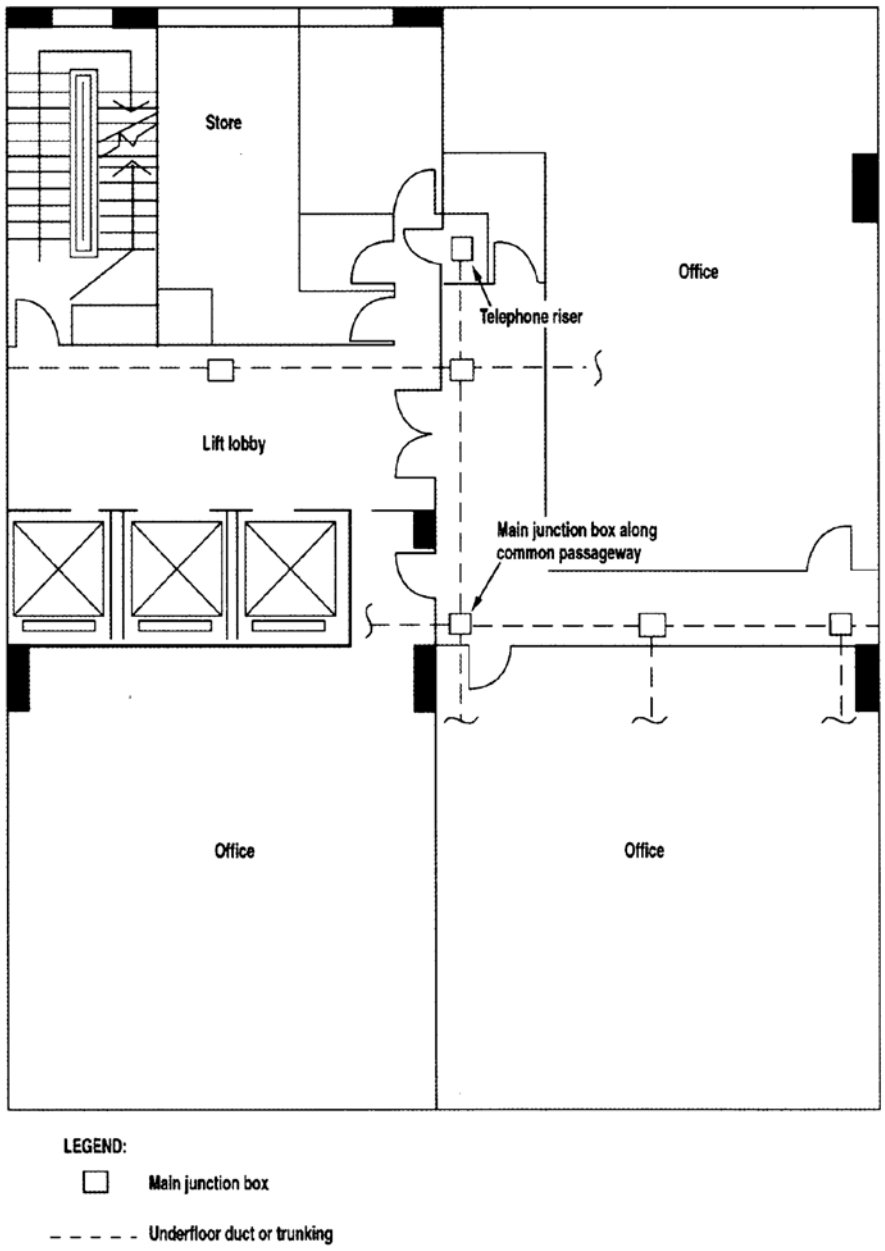


Figure 7.7: Types of distribution ducts & outlets

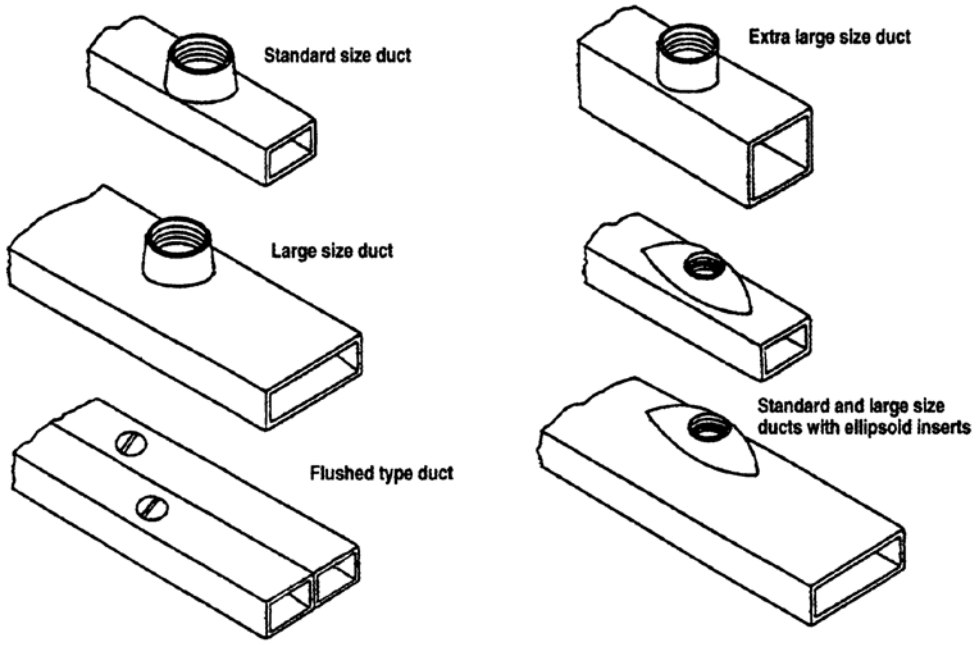


Figure 7.8: Junction boxes installed 6m apart

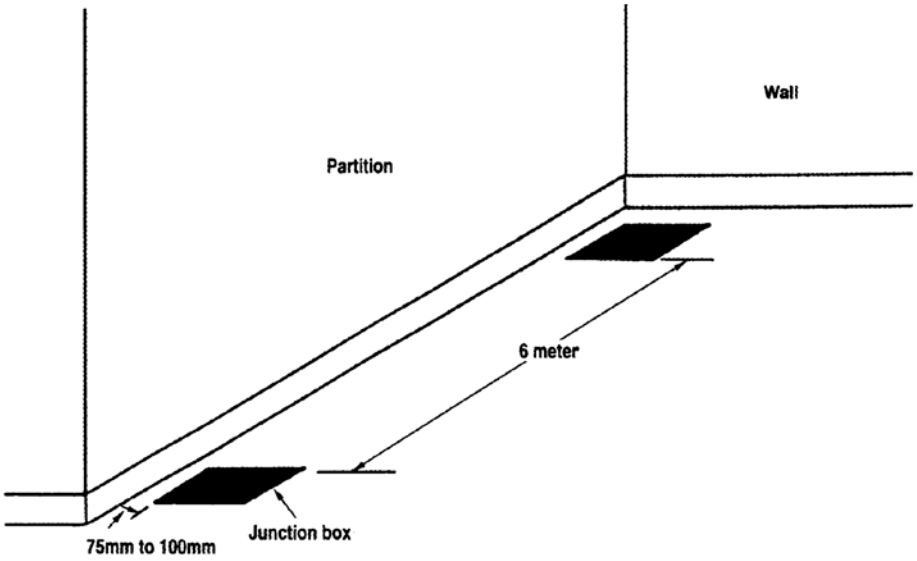


Figure 7.9: Exploded view of junction box

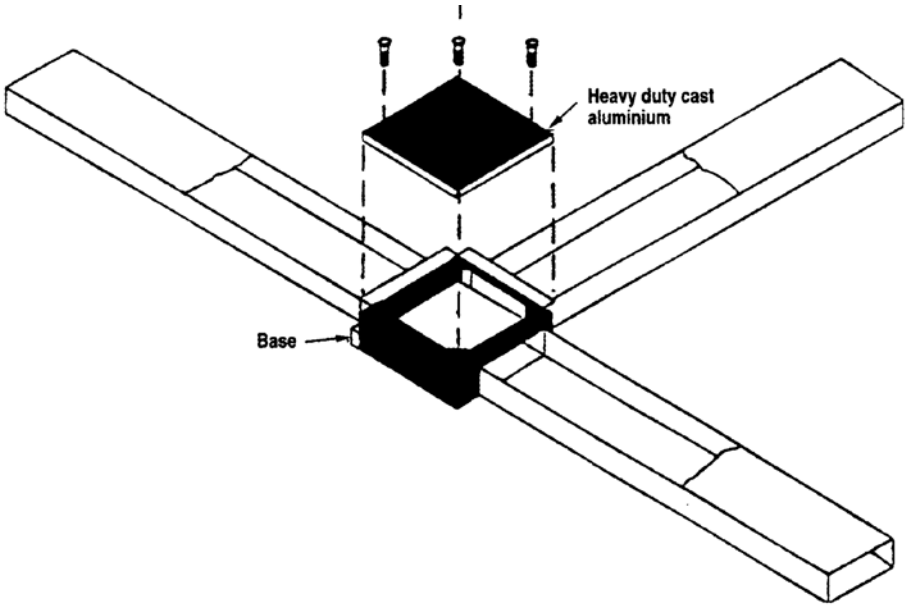


Figure 7.10: Partition sitting on junction box

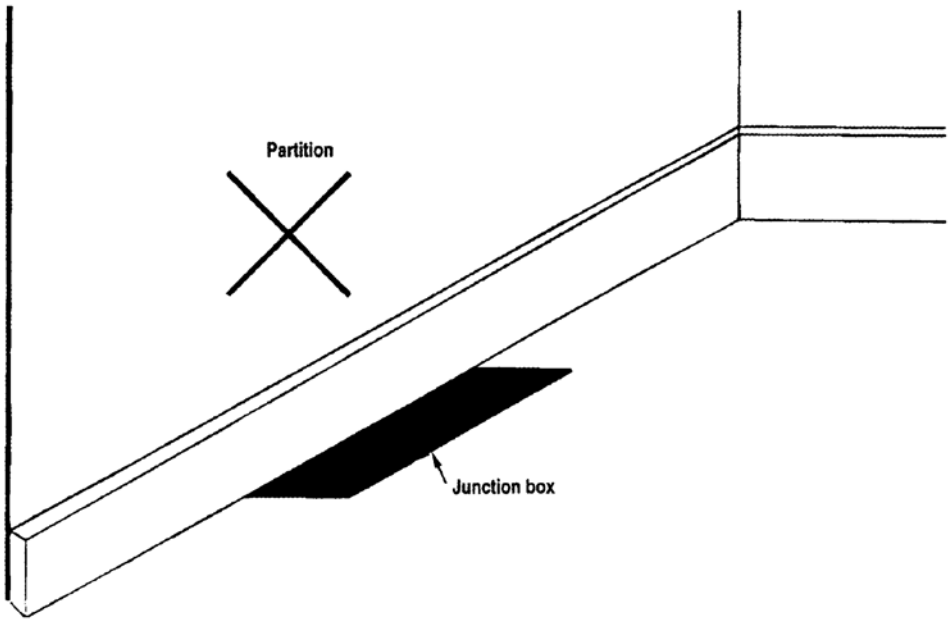


Figure 7.11: Access to junction box for carpetted floor

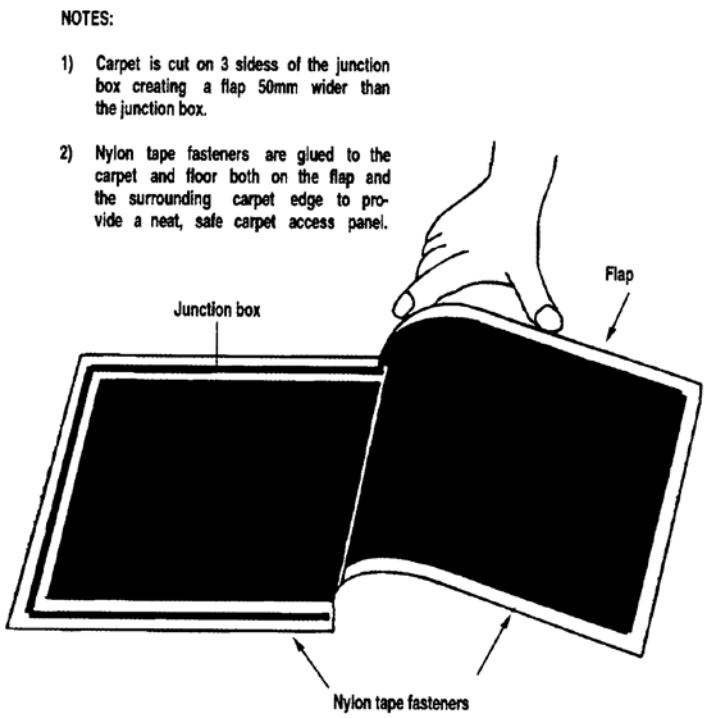


Figure 7.12: Raised floor system

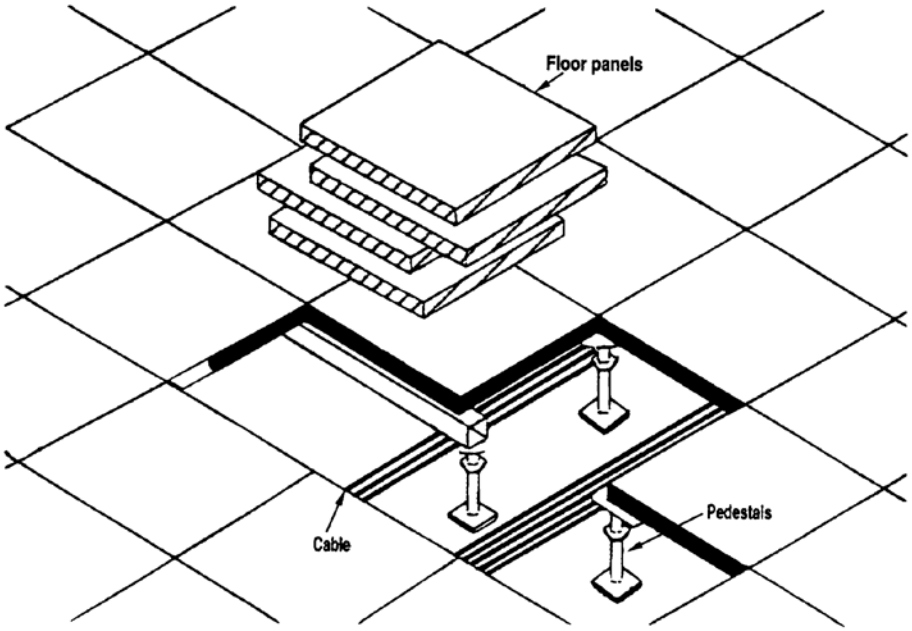


Figure 7.13: Pedestals

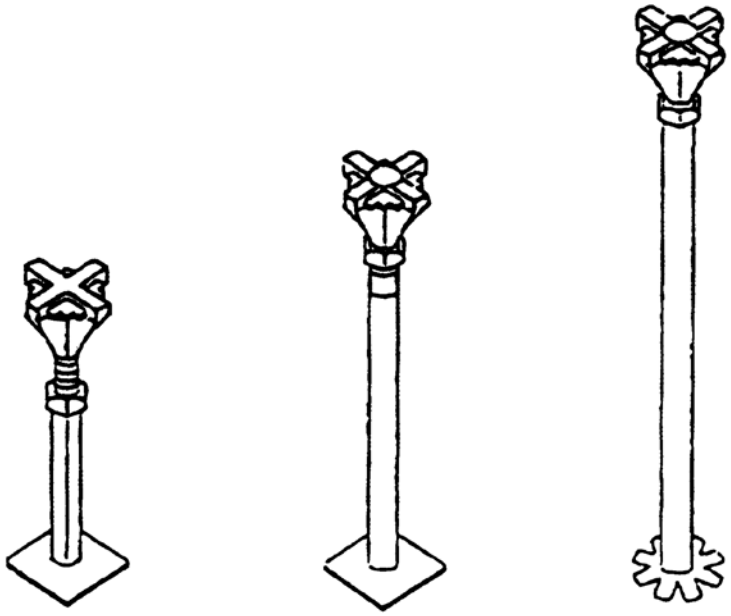


Figure 7.14: Typical section of raised floor system

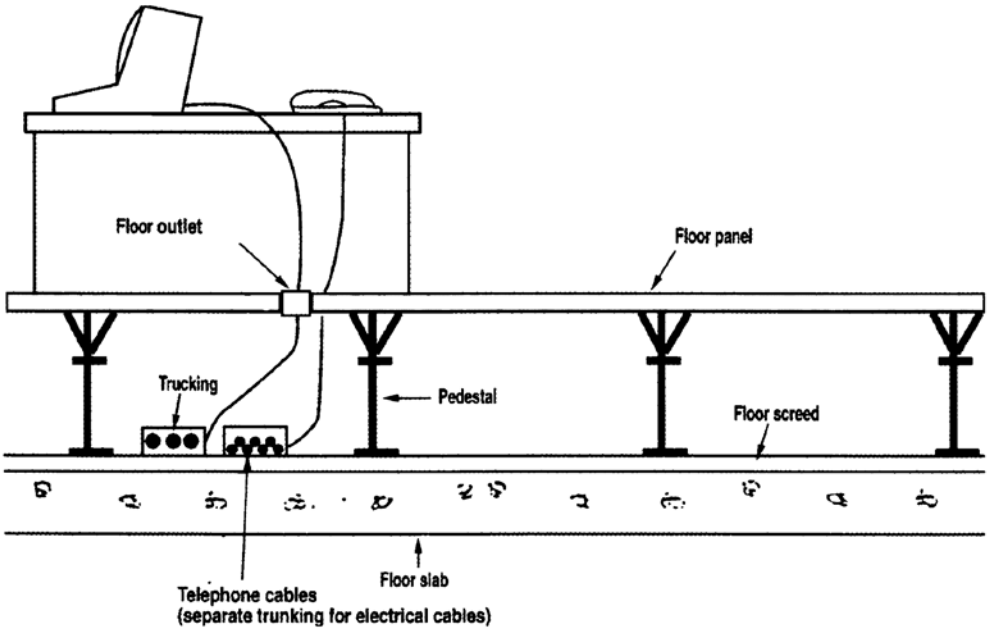


Figure 7.15: Sectional view of a cellular floor system

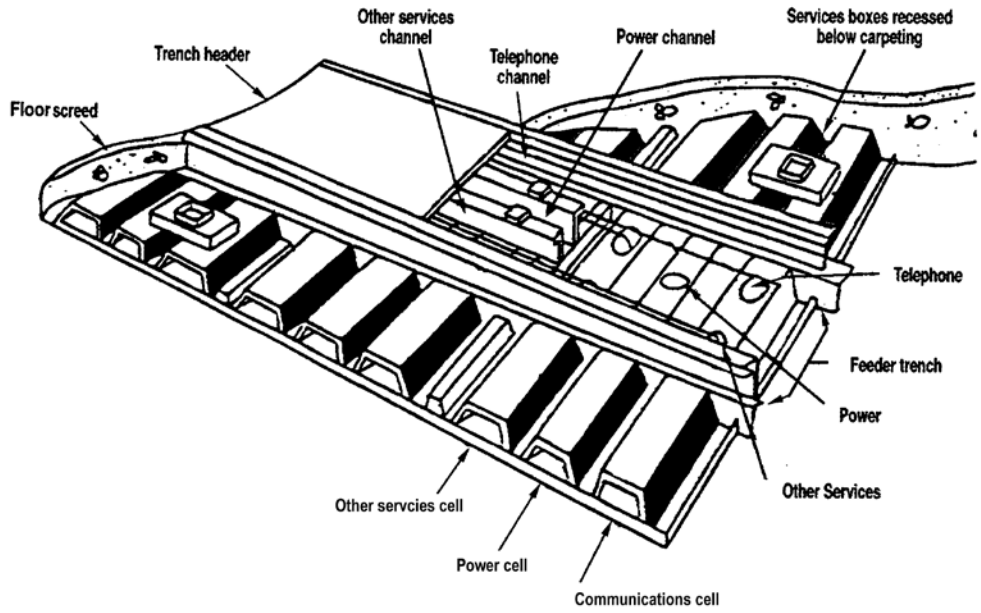


Figure 7.16: Ceiling distribution system using cable tray / trunking link with conduits & utility pole

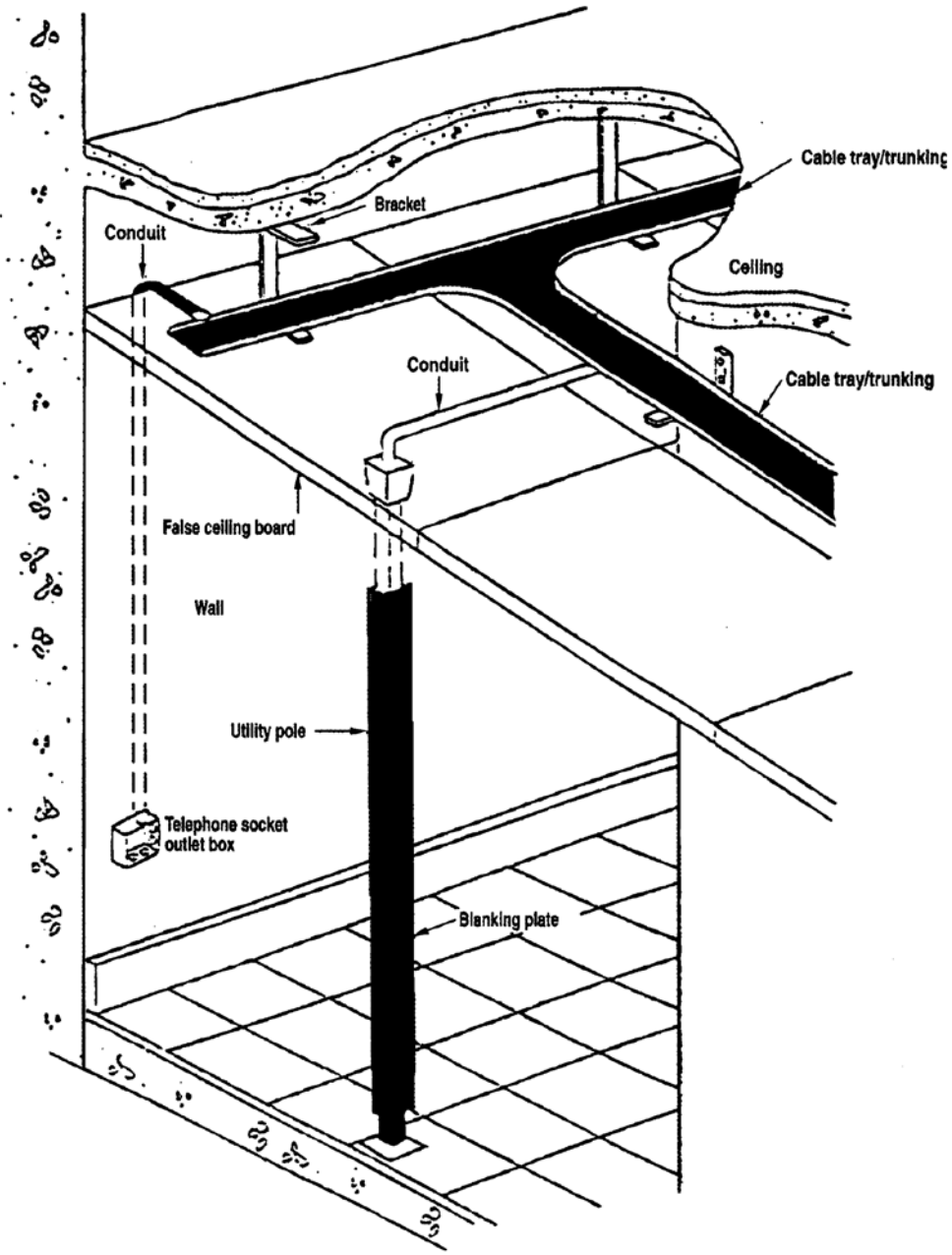


Figure 7.17: Ceiling distribution system – Typical detail of cable tray / trunking link with conduit in non-detachable false ceiling boards / strips that are not easily removable

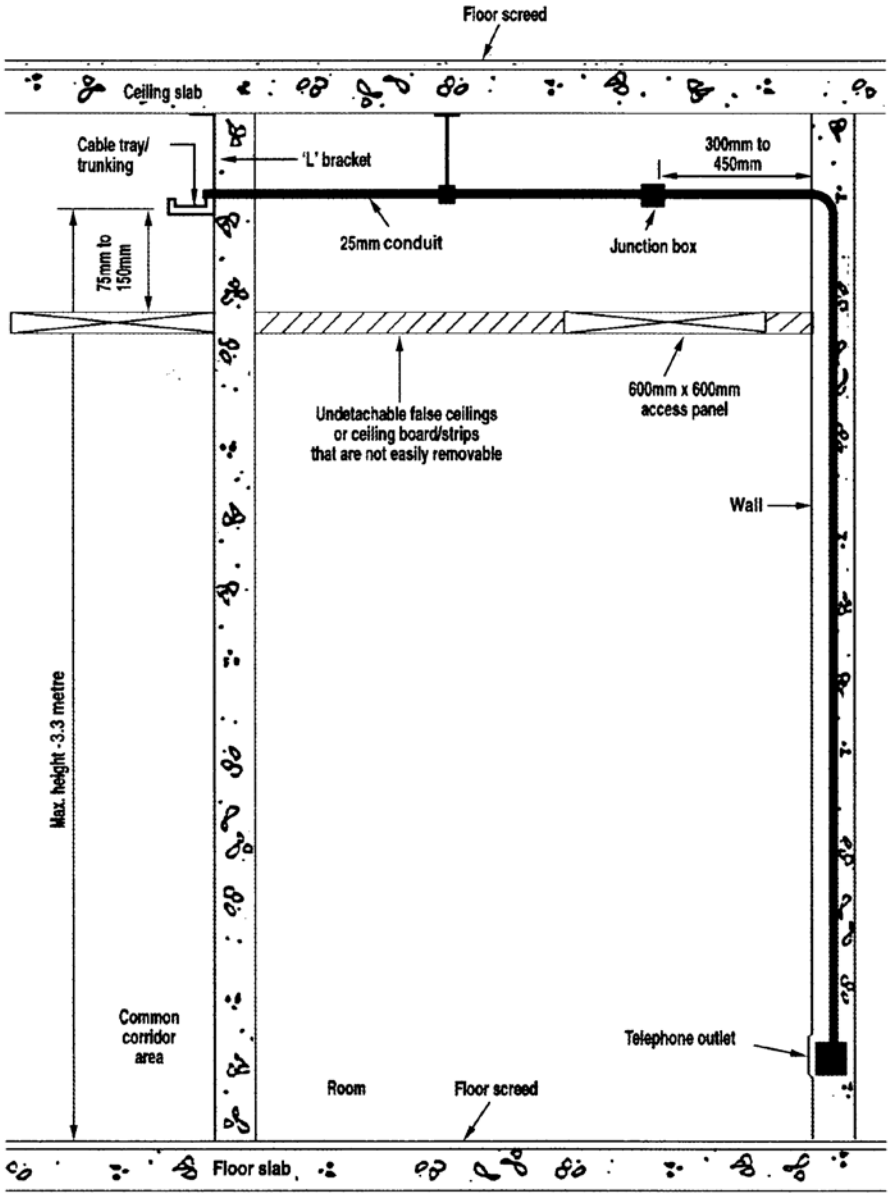
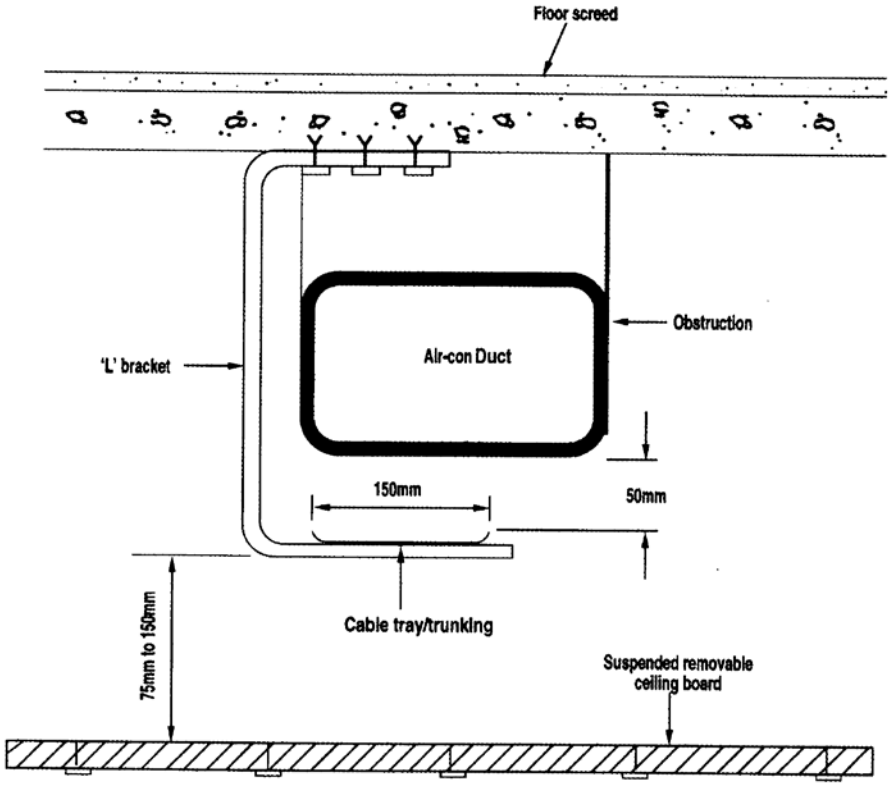


Figure 7.18: Clearance between cable tray / trunking & obstructions



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

Figure 7.19: Perimeter raceways mounted at table height level

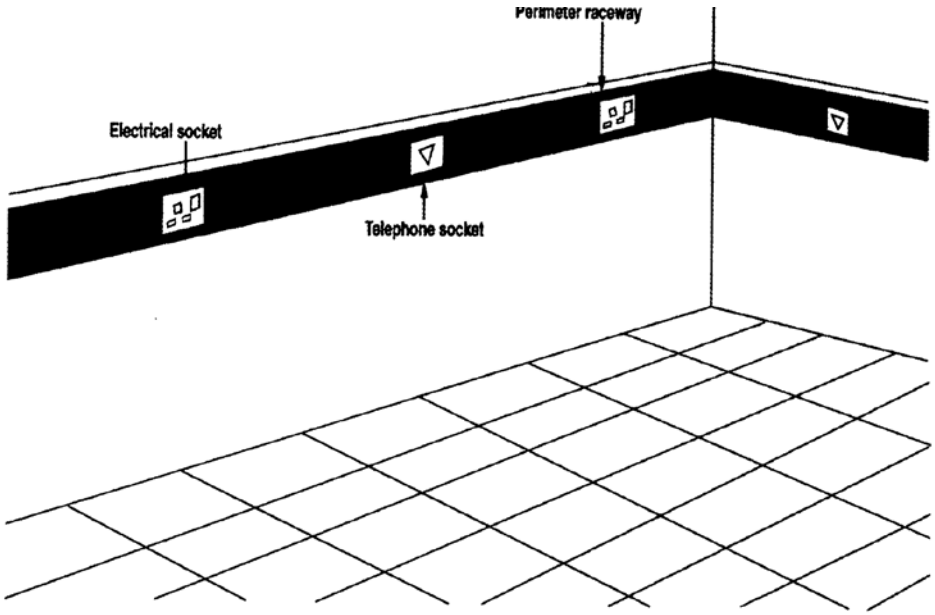


Figure 7.20: Perimeter raceways mounted at floor level

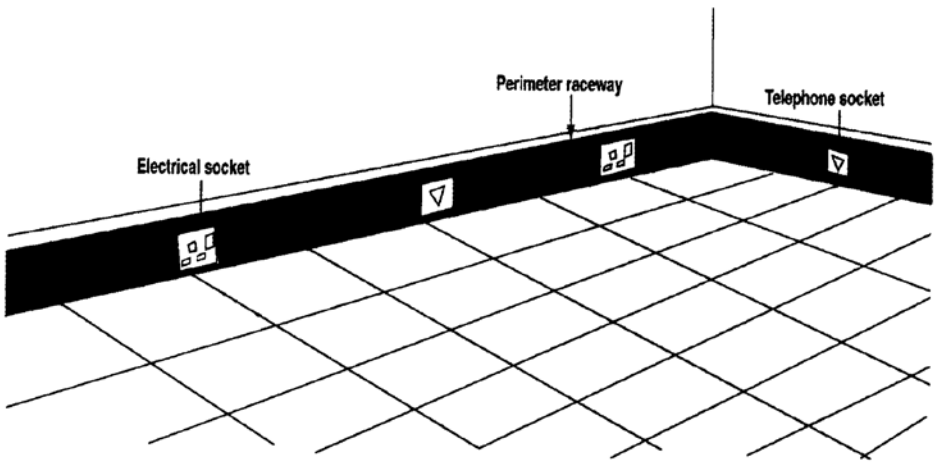


Figure 7.21: Perimeter raceways recessed into base of wall

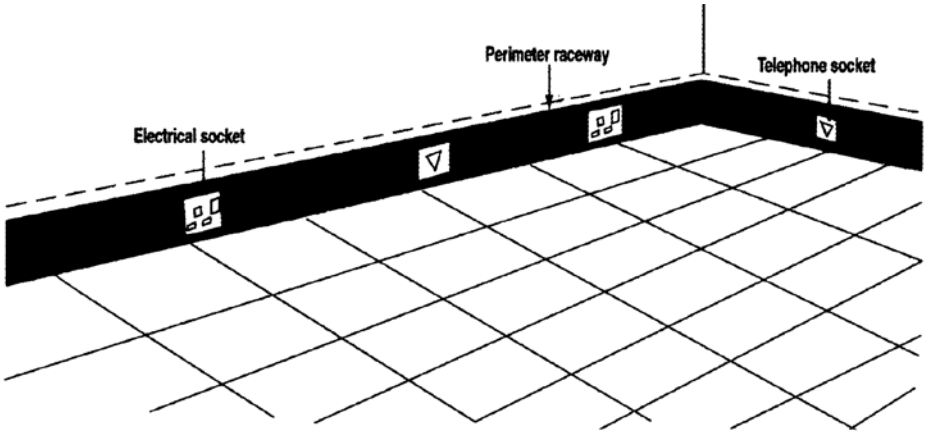
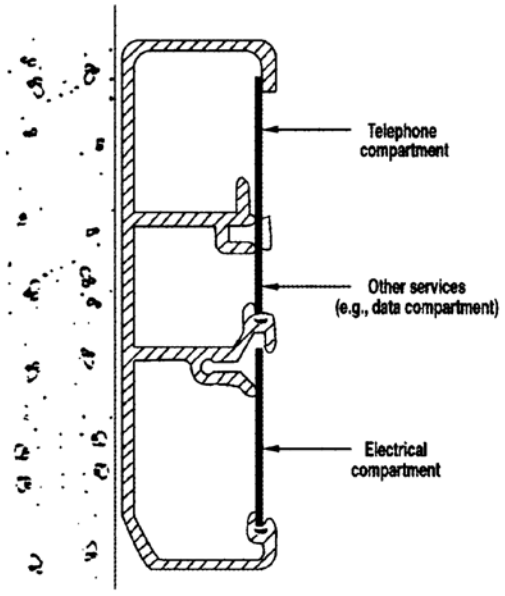


Figure 7.22: Section of a 3-compartment skirting trunking



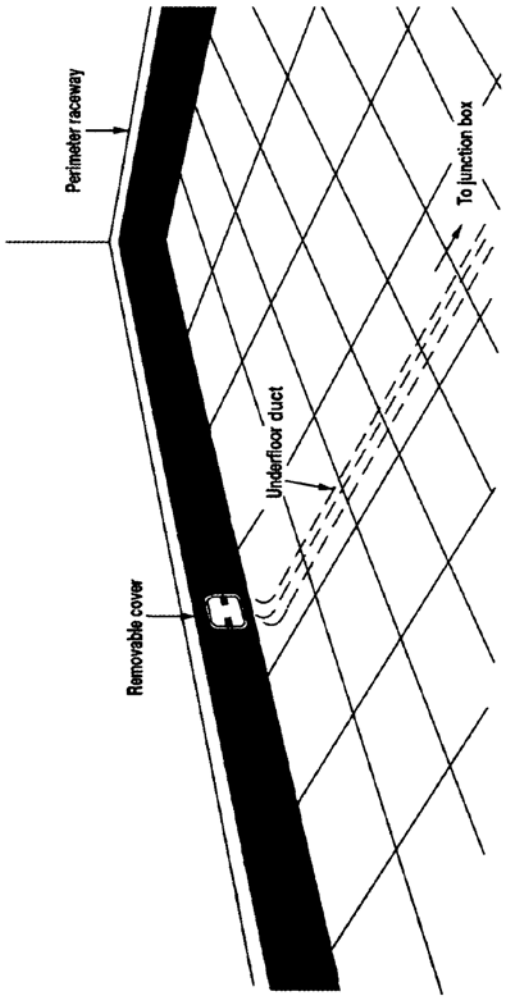


Figure 7.23: Perimeter raceways linked to under-floor duct distribution system

Figure 7.24: Poke-through system with conduit

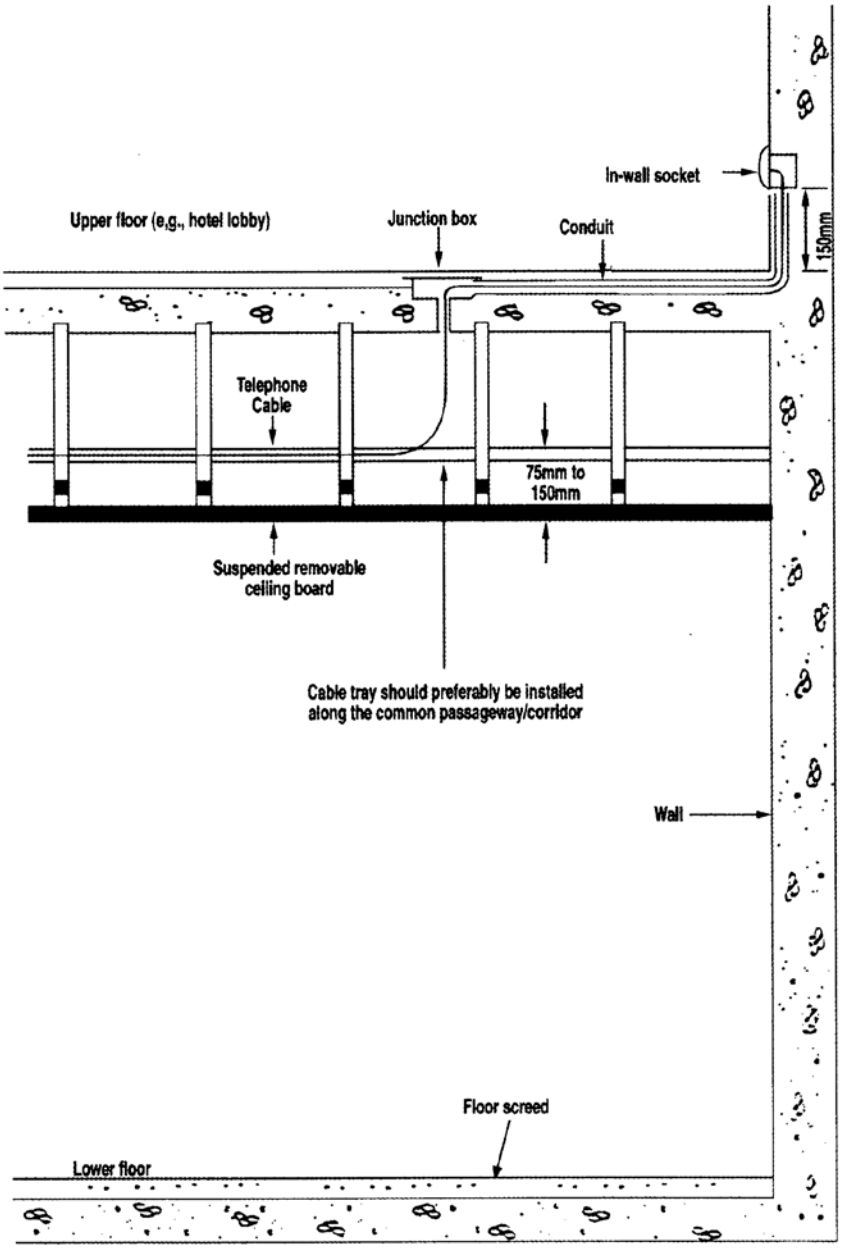


Figure 7.25: Conduit distribution system in certain areas of a hospital

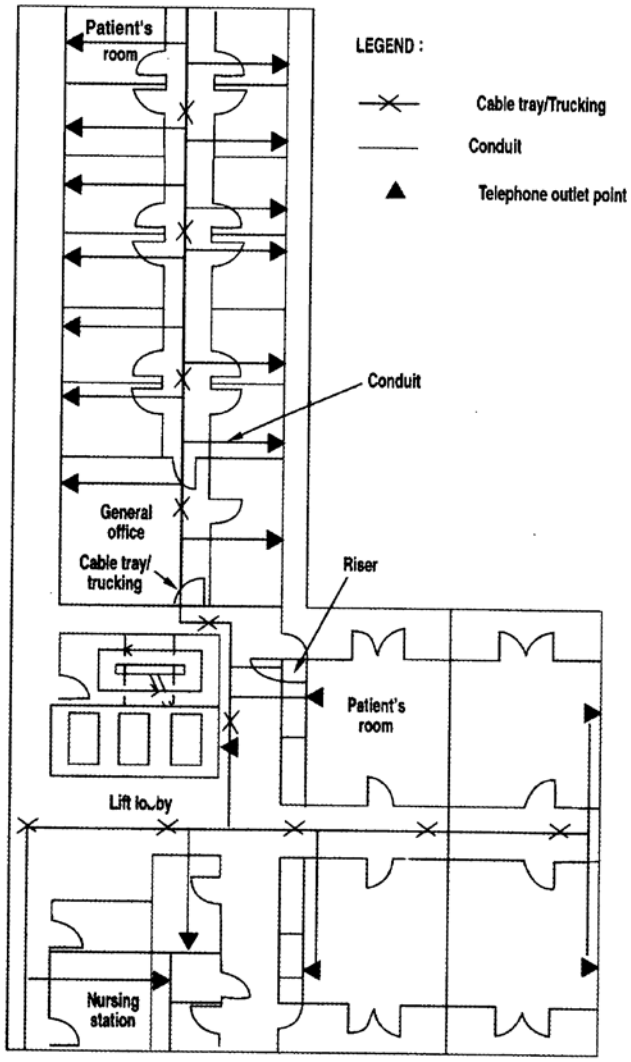


Figure 7.26: Cable tray bends & fitting with 600mm minimum radius

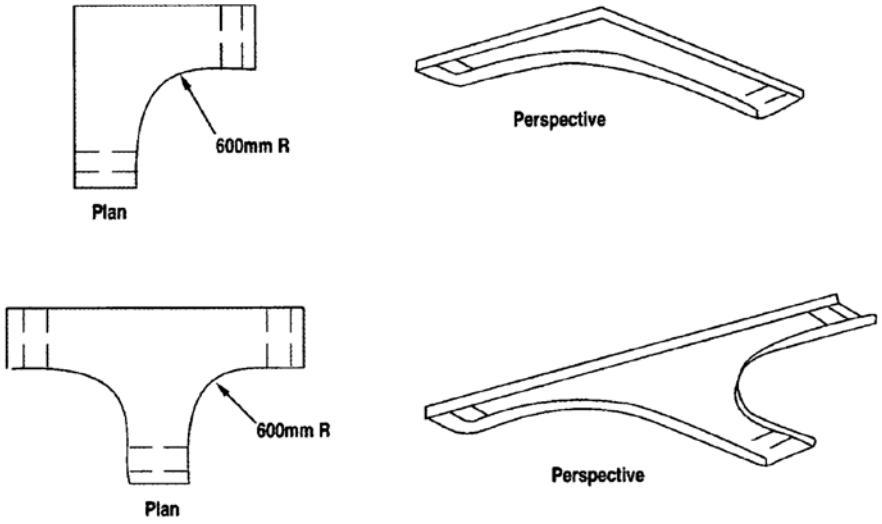


Figure 7.27: Typical example of a trunking system

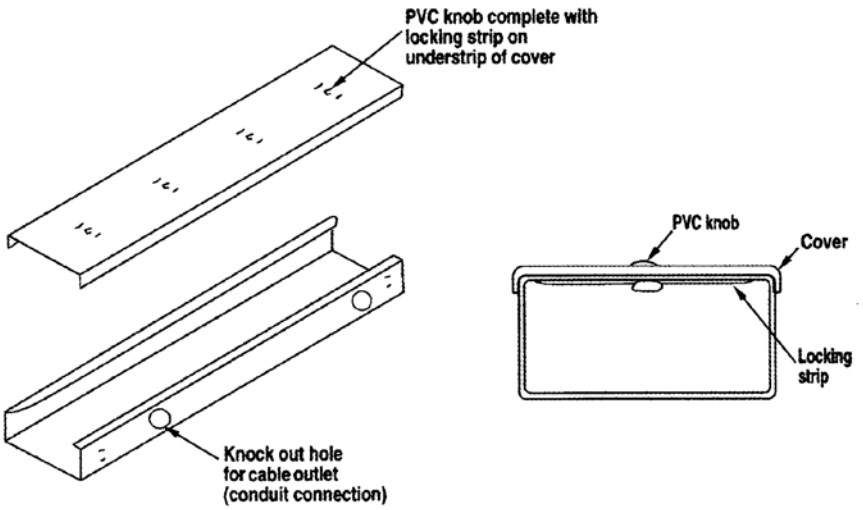


Figure 7.28: Combination of duct & conduit distribution system

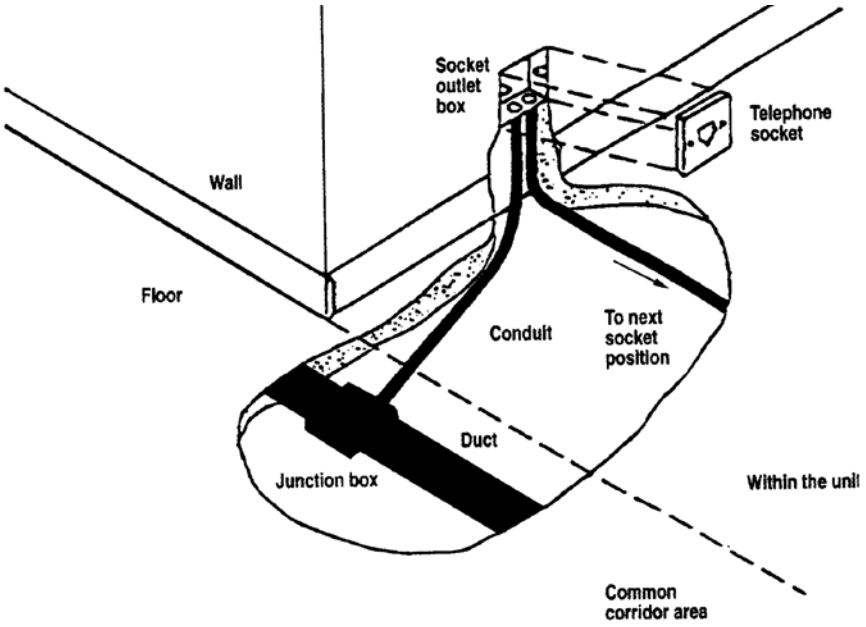
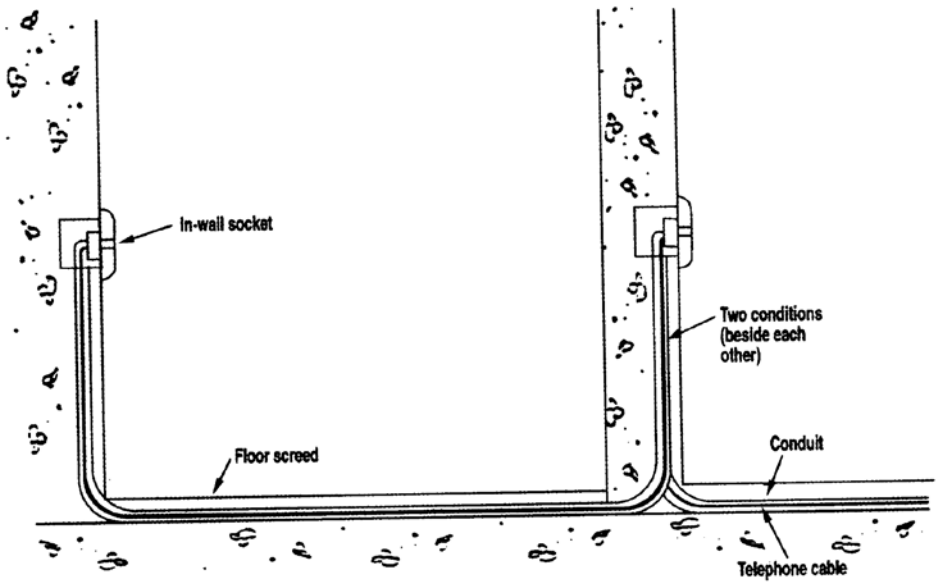


Figure 7.29: Using conduits to distribution cables



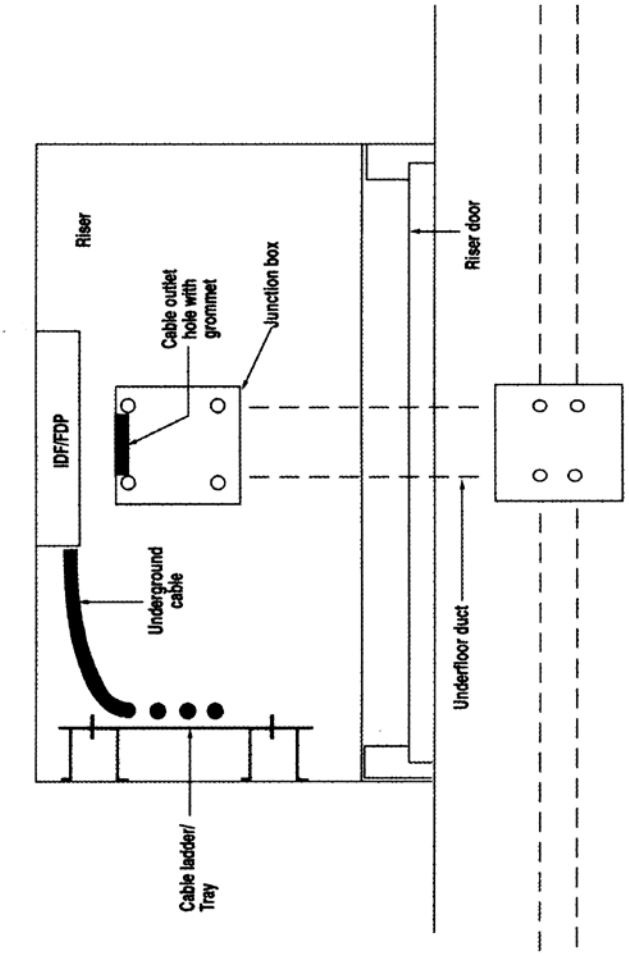


Figure 7.30: Floor duct extended into telecommunication riser

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

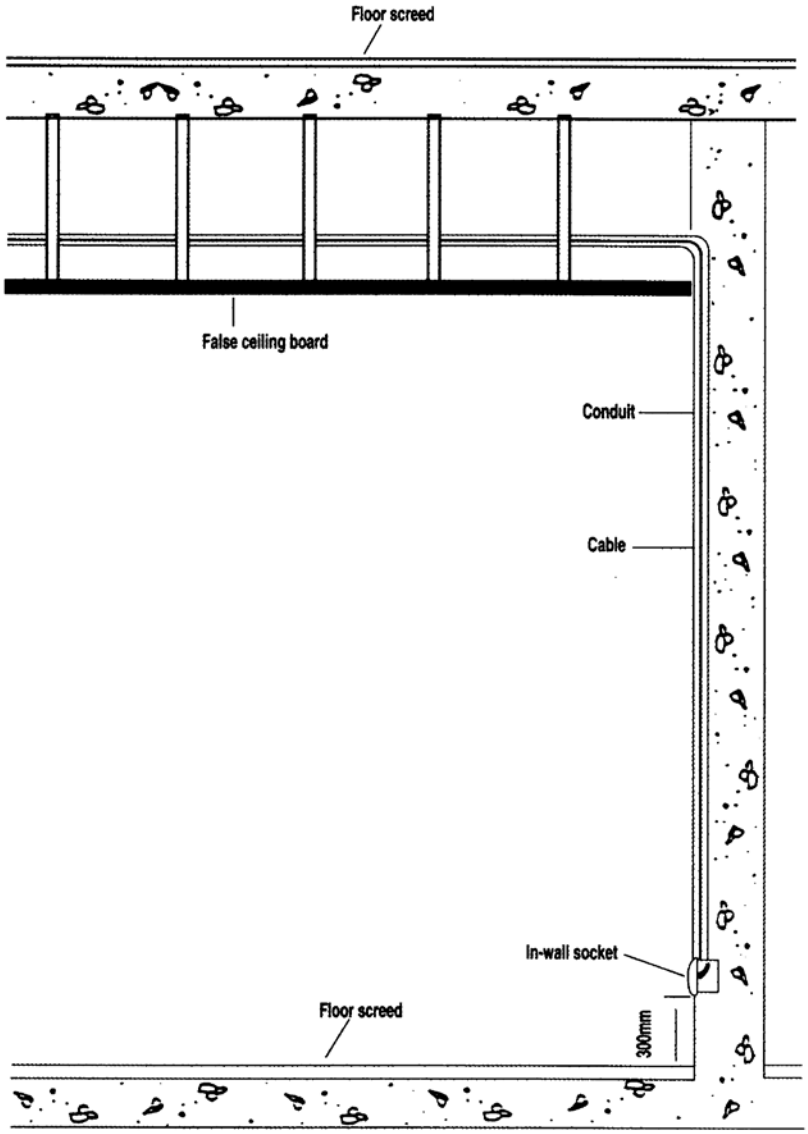
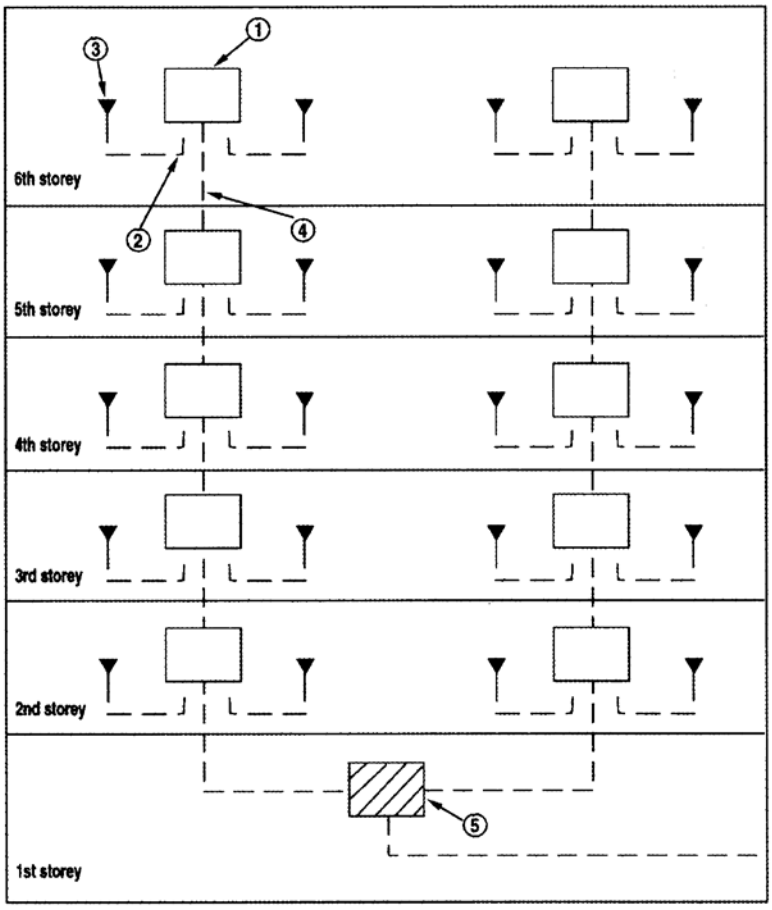


Figure 7.32: Multi-riser distribution in residential building



8. USER PREMISES CABLING AND INTERFACE POINT

8.1 Interface point for user premises cabling

(a) Internal telecommunication wiring

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

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

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

(b) Interface point

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

(c) Location of IP

The locations of IP are categorised as follows:-

(i) IP at doorstep

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

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

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

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

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

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

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

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

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

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

Figure 8.1: IP at doorstep

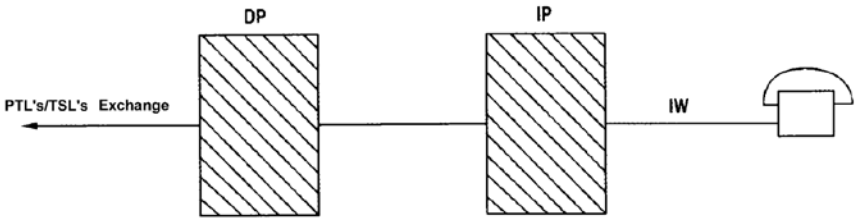


Figure 8.2: IP at DP

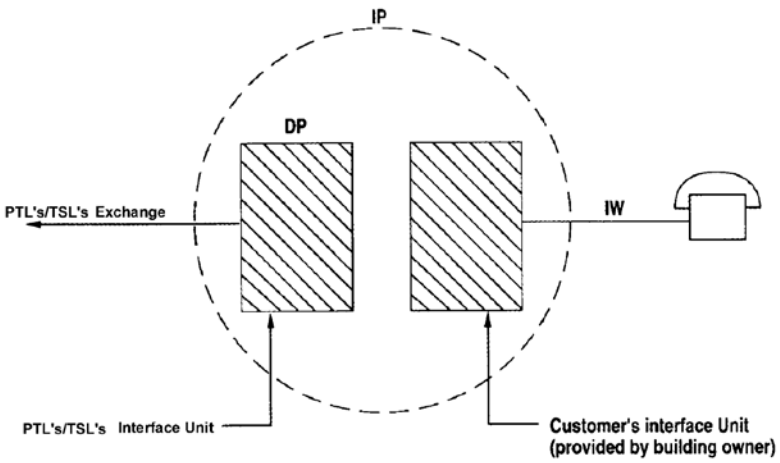


Figure 8.3: Telephone wiring configurations for residential buildings

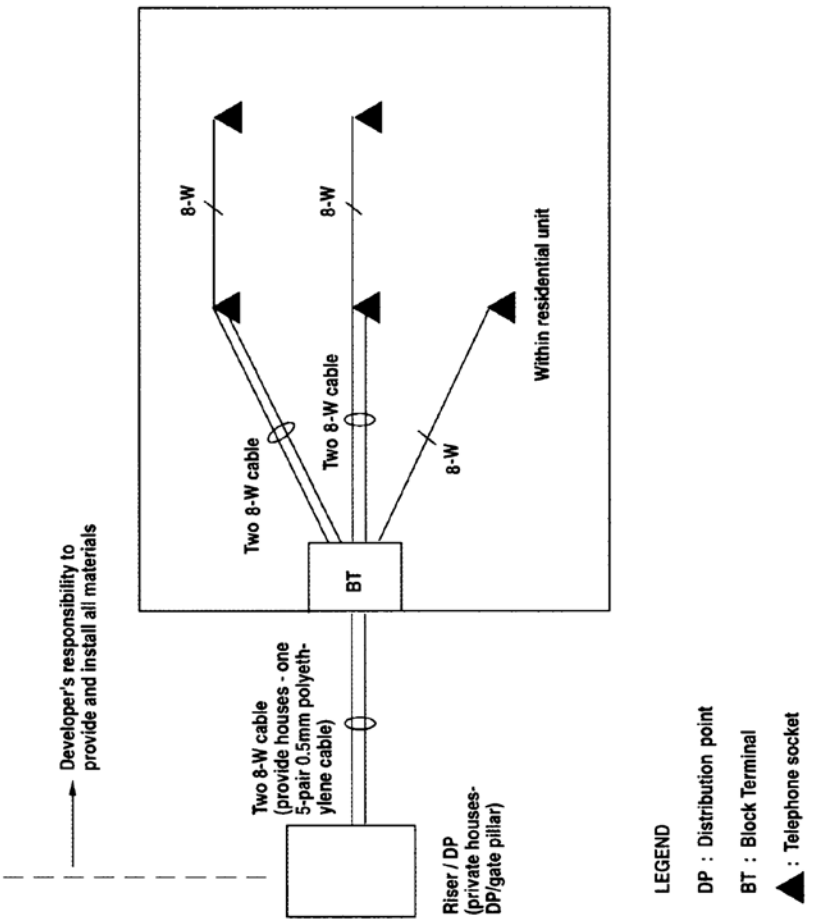
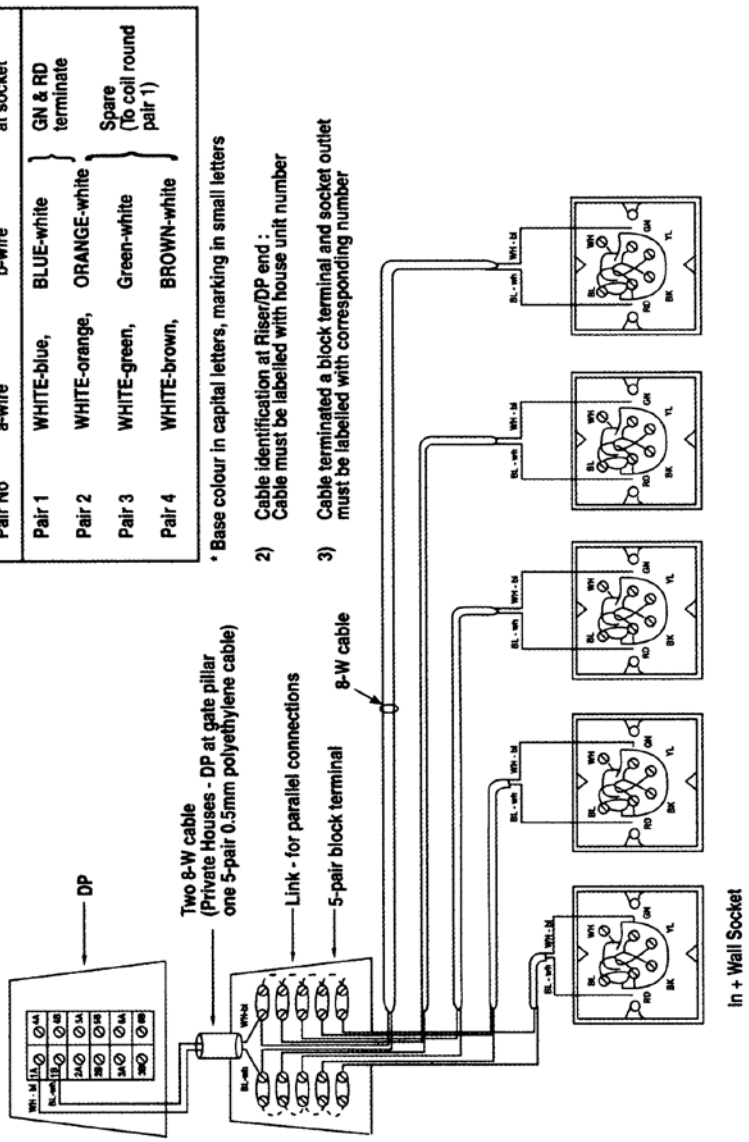


Figure 8.4: Telephone wiring configurations for residential building – Detailed connections



9. ANTENNAE AND INSTALLATION

9.1 General

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

9.2 Antennae

(a) Antennae installed for a broadband coaxial cable system shall be provided in accordance with the minimum requirements specified in Table 9.2.

Table 9.2 Minimum requirements of antennae

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

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

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

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

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

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

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

9.3 Antennae mast and mounting bracket

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

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

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

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

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

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

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

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

9.4 Protection against lightning

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

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

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

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

Notes:

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

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

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

1.1 Functions of TFCC

The functions of TFCC are as follows:

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

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

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

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

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

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

1.2 Building Plan Co-ordination & Approval Process

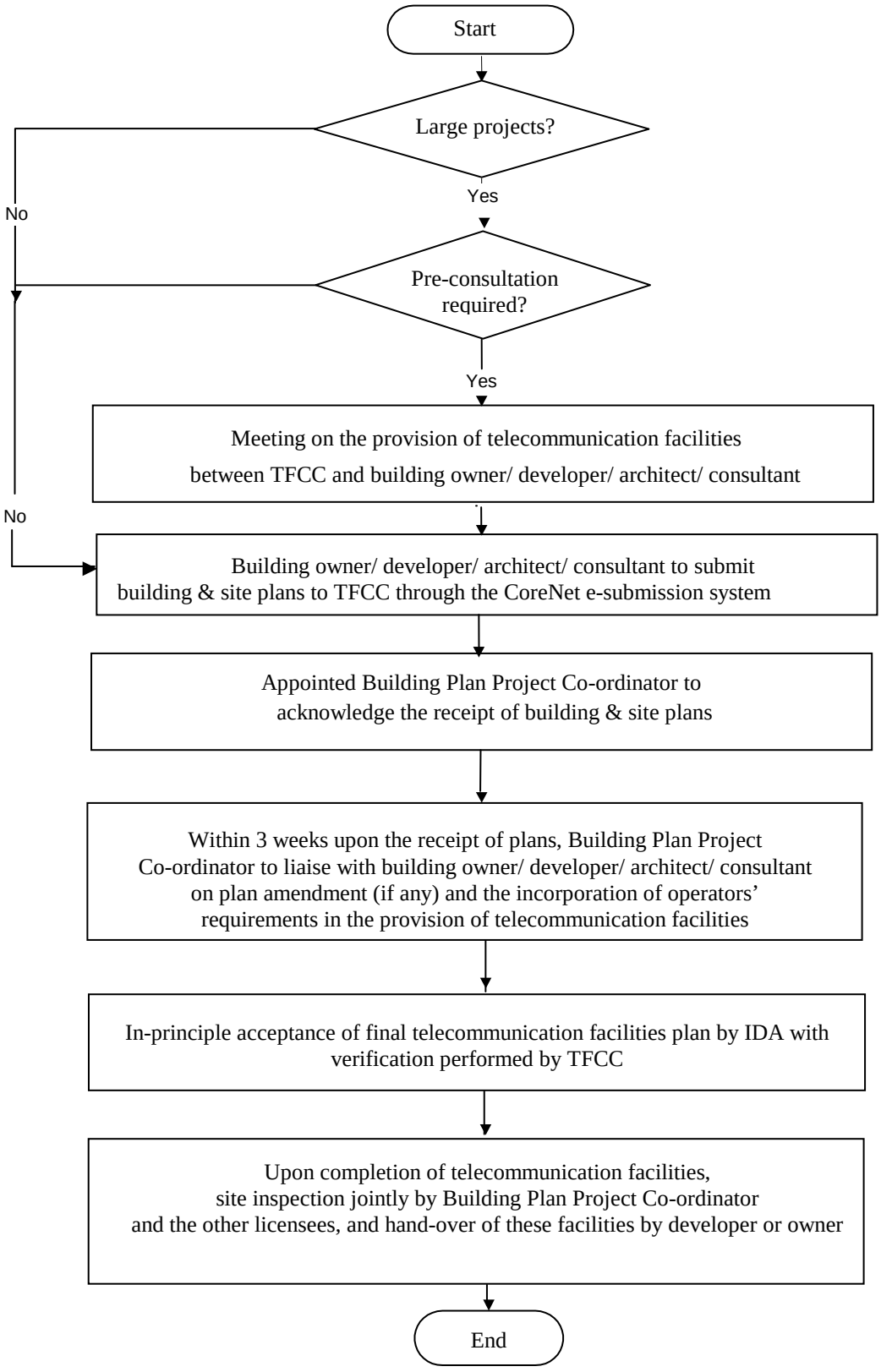
(a) For large developments, the owner or developer may require pre-consultation meeting with the TFCC on the provision of telecommunication facilities. They may contact and arrange an appointment with the Secretariat of the TFCC. The contact telephone and facsimile numbers for the Secretariat are 6848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

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

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

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

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



APPENDIX 2 DUCT SEALING SYSTEM FOR BUILDING WITH BASEMENT

2.1 Systems used

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

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

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

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

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

2.2 Suppliers

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

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

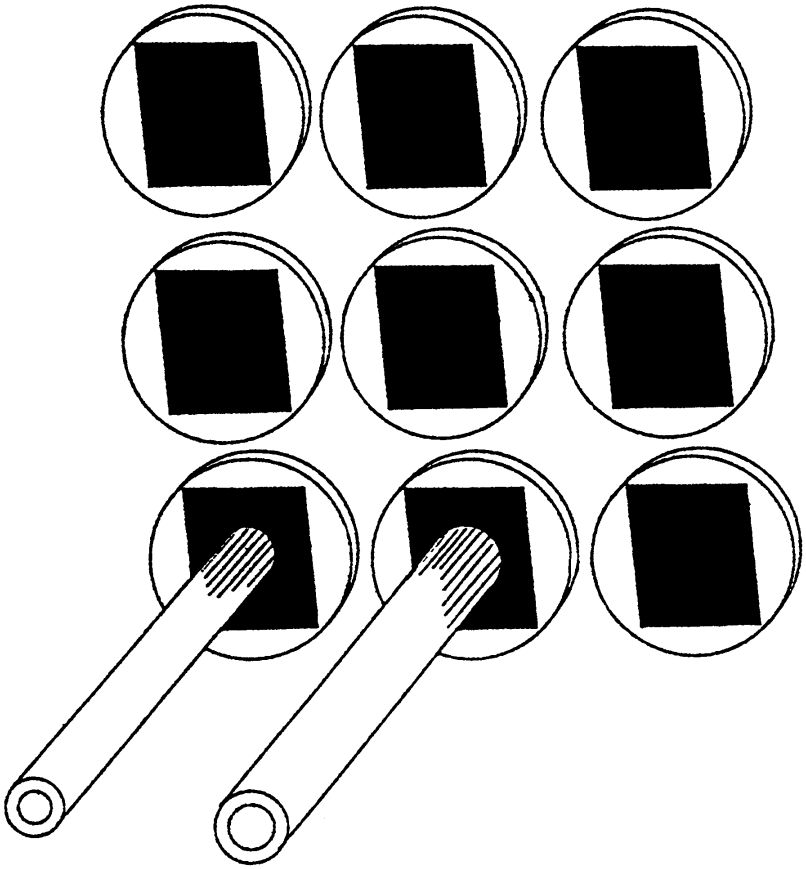
(c) BST System: Best Technology Pte Ltd, 5 Kaki Bukit Road 1, #03-03, Singapore 415936.

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

2.3 Builder's responsibility

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

FIGURE A2 PICTORAL VIEW OF CABLE DUCT SEALING SYSTEM



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

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

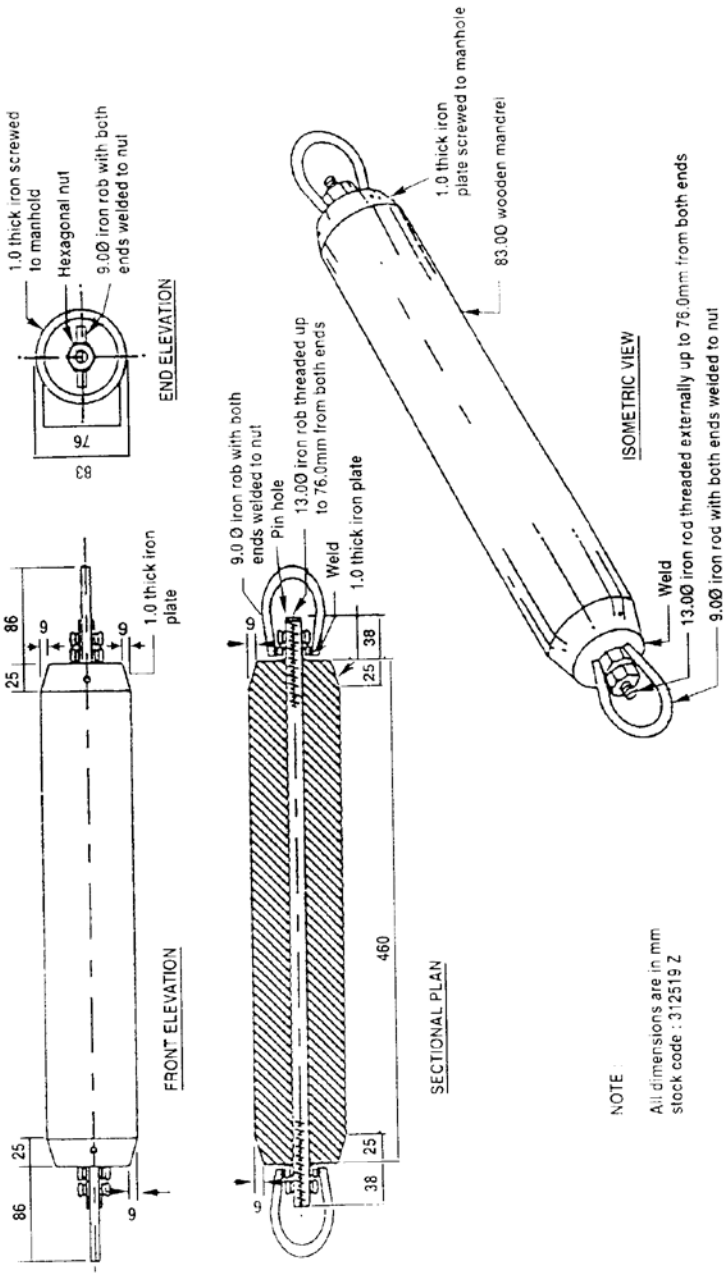
(a) 110mm diameter nominal size uPVC Pipe:

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

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

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

FIGURE A3: WOODEN MANDREL



APPENDIX 4 BROADBAND COAXIAL CABLE SYSTEM EQUIPMENT SPECIFICATIONS

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

4.1 Minimum requirement of amplifiers

The amplifiers shall meet the minimum specifications set out hereunder:

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

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

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

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

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

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

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

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

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

(i) Amplifiers shall not require automatic gain control ("AGC"), however, it is desirable to have the option of installing an AGC circuit on the initial amplifier in any network leg. This would compensate for any level variation that may be introduced from the future BCS system.

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

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

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

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

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

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

4.3 Minimum requirements of connectors and splices

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

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

(c) Suitable connectors and splices for solid sheath cables shall be used. Connectors will utilise a fixed sleeve with two separate ferrules to seize the other conductor and jacket of the cable independently. Connectors must be specifically designed for use with the coaxial cables types to be used.

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

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

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

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

APPENDIX 5 COMMISSIONING OF TEST PROCEDURES FOR BROADBAND COAXIAL CABLE SYSTEM

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

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

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

APPENDIX 6 METHODS OF MEASUREMENTS FOR BROADBAND COAXIAL CABLE SYSTEM

6.1 General

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

The following measurements are considered:

(a) Measurement of mutual isolation between system outlets;

(b) Measurement of hum;

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

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

(e) Measurement of inter-modulation;

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

(g) Measurement of chrominance – luminance delay inequality;

(h) Measurement of differential gain and phase;

(g) Measurement of signal leakage.

6.2 Measurement of mutual isolation between system outlets

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

Isolation shall be measured between:

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

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

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

6.3 Measurement of hum

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

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

6.4 Measurement of frequency response within a channel

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

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

6.5 Measurement of visual, aural carrier centre frequency

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

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

6.6 Measurement of inter-modulation

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

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

6.7 Measurement of visual carrier-to-noise ratio

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

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

6.8 Measurement of chrominance – luminance delay inequality

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

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

6.9 Measurement of differential gain and phase

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

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

6.10 Measurement of signal leakage

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

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

APPENDIX 7 TYPICAL BROADBAND COAXIAL CABLE SYSTEM SCHEMATIC FOR STRATA LANDED DWELLING-HOUSES AND MULTI-STOREY RESIDENTIAL BUILDINGS