CODE OF PRACTICE FOR INFO-COMMUNICATIONS FACILITIES IN BUILDINGS

September 2000

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INTRODUCTION

This Code of Practice for Info-communications Facilities in Buildings (COPIF) comes into effect on 15 September 2000 and supersedes the Code of Practice for Telecommunication Facilities in Buildings (COP-TEL) which was published in March 1997.

The purpose of COPIF is to lay down detailed specifications and guidelines to ensure that architects and construction professionals design and build into new buildings and existing buildings proposed to be retrofitted, adequate in-building cabling facilities and space required for the operation of installations and plants used by the public telecommunication licensees (PTLs) and telecommunication system licensees (TSLs) in providing info-communication services to building occupants. COPIF is issued in consultation with the PTLs and TSLs and sets out the PTLs' and TSLs' requirements on in-building cabling facilities and space required for the provision of info-communication services.

COPIF is issued by IDA pursuant to Section 19 of the Telecommunications Act 1999. Under Section 19, any developer or owner of a building who requires any telecommunication service of a telecommunication licensee shall provide at his own expense, in accordance with such specifications as IDA may publish, such space and facilities within or on the building and access thereto, as may be necessary for the operation of any installation or plant to be used in providing the telecommunication service.

In addition to but notwithstanding COPIF, IDA also has the power under Section 21 of the Telecommunications Act 1999 to require the developer or owner of any building or land to provide such in-building facilities, space and access or any telecommunication licensee to install such installation, plant or system as the IDA may direct.

While the specifications and guidelines laid down in COPIF 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 PTLs and TSLs, COPIF is subject to revision by IDA from time to time.

Leong Keng Thai
Director-General (Telecoms)
Info-communications Development Authority of Singapore

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PART 1 GENERAL REQUIREMENTS FOR TELECOMMUNICATION FACLITIES

1.1 GENERAL

1.1.1 This part covers general requirements including the procedure for the submission of development plans by developers or owners (as the case may be), segregation of telecommunication facilities from other utilities/ services, diversity for lead-in pipes, general and fire protections, joint inspection and acceptance of telecommunication facilities, and responsibilities of PTLs/ TSLs and developers or owners (as the case may be).

1.1.2 The general requirements for broadband coaxial cable systems including the procedure for the submission of development plans by developers or owners (as the case may be) on proposed provision of facilities (in all buildings) and installation of broadband coaxial cable systems (for residential buildings) are covered in Part 2.

1.2 SUBMISSION OF DEVELOPMENT PLANS

1.2.1 Developers are advised to approach the PTLs/TSLs early during the planning stage of the building to ensure that the proposed facilities for telecommunication services are suitable for telecommunication cable installation, and adequate to meet immediate and future needs. For planning purposes, the following information is to be provided:

(a) Name and address of architect/developer;
(b) Location of development;
(c) Proposed number of units and floor area, plot ratio and car park area;
(d) Intended usage of building;
(e) Estimated commencement and completion dates;
(f) Development schedule;
(g) House numbering plan.

1.2.2 Prior to any excavation on site, the developer or its representative should purchase plans from the PTLs/TSLs to determine the location of any existing pipelines which may be affected by the development. A written request together with a copy of the site layout plan for the development is to be sent to:

Telecommunication Facility Co-ordination Committee
c/o 8 Temasek Boulevard
#14-00 Suntec Tower Three
Singapore 038988
Telephone no.: 8484338
Fascimile no.: 8256868

Note: The Telecommunication Facility Co-ordination Committee (TFCC) has been appointed by IDA as a single-contact point for building developers or owners (as the case may be) to co-ordinate with PTLs/TSLs on the submission of proposed telecommunication facilities to be provided in buildings. Members of TFCC include representatives from the PTLs/TSLs. The functions of TFCC and building plan processing and approval procedure are shown in Appendix A.1.

1.2.3 All developers or owners (as the case may be) are required to observe the Do's and Don'ts concerning earthworks on site as listed in Appendix A.2.

1.2.4 When the project has been approved by the Chief Planner, Urban Redevelopment Authority, the developer or owner (as the case may be) through its architect or project consultant shall submit the following:

1.2.4.1 **For Residential Projects:**

(a) Three copies of site plan and three sets of building floor plans showing the proposed facilities for the main in-coming cables such as lead-in pipes, MDF room and/or Telecommunication Equipment Room (TER) where applicable and vertical cabling facilities such as riser ducts, riser pipes, etc.

(b) Three sets of building floor plans showing proposed facilities for internal telephone cabling installation such as trunkings, conduits, telephone cabling configurations, types of cable, block terminals and sockets. For conventional landed housing (single bungalow, semi-detached and terrace house), detailed building floor plans inside the unit are not required but layout plans for lead-in pipes and detailed drawing of gate pillar are required in the submission.

1.2.4.2 **For Commercial Projects**

(a) Three copies of site plan and three sets of building floor plans showing the proposed facilities for the main incoming cables such as lead-in pipes, MDF room and vertical cabling facilities such as riser ducts, etc. In this submission, developers or owners (as the case may be) should also state whether they wish to opt for Telecommunication Cabling and Distribution System (TCDS, formerly known as COAM). Under this policy, the developer or owner (as the case may be) will install and maintain the cable distribution network within the building or the whole building complex, which may consist of multiple buildings. The developer or owner (as the case may be) will have to formalise this agreement with the PTLs/TSLs by signing a form obtainable from the PTLs/TSLs.

(b) Three sets of building floor plans showing the proposed facilities for internal telephone cabling installation such as trunkings, conduits, position of final distribution points, types of block terminals and sockets.

1.2.4.3 The plans are to be sent to:

Telecommunication Facility Co-ordination Committee
c/o 8 Temasek Boulevard
#14-00 Suntec Tower Three
Singapore 038988

1.2.4.4 Upon approval, one set will be returned to the architect or project consultant of the developer or owner (as the case may be) for retention.

1.3 SEGREGATION REQUIREMENTS

1.3.1 Non-electrical Plant

All manholes, ducts and cables for telecommunication services shall be kept clear of gas or water mains, service pipes and also isolated from manholes and joint boxes belonging to other services. The clearance shall be 150 mm, but in difficult situations, it may be reduced to 50 mm where the plants cross each other. Where gas and water mains are concerned, a clearance of at least 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 but methods vary in individual cases.

1.3.2 Electrical Plant

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

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

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

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

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

(e) For multi-compartment trunking with telephone and electrical cables occupying different compartments, the trunking shall be so designed to ensure that the cables remain in their individual compartments when the cover of the trunking is removed. The segregation between each compartment in the trunking shall be continuous.

(f) All metal trunking and conduits shall be effectively earthed in accordance with PUB's requirements.

1.3.3 Different Communication Cables

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

1.4 DIVERSITY

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

(a) Hospital;
(b) Airport;
(c) Police station;
(d) Fire station;
(e) Military installation;
(f) Power generation or control installation;
(g) Radio and TV station;
(h) Computer centre;
(i) Building with usable floor area above 60,000 sq. m; and
(j) Security agency.

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

1.5 GENERAL PROTECTION

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

1.6 FIRE PROTECTION

1.6.1 Water sprinkler systems must not be used in Telecom MDF rooms and telecommunication riser ducts. To comply with Singapore Fire Safety Bureau (FSB)'s condition of waiver for such installation, MDF rooms must be accessible directly from the outside of the building.

1.6.2 In addition, other forms of fire protection systems acceptable to the FSB must be provided.

1.7 FACILITY RECORD

1.7.1 For the purpose of maintenance and speedy restoration of services in the event of breakdown, it is essential that the exact location of the lead-in pipes, MDF room, riser ducts, cable tray routes and details of any other facilities provided by developers or owners (as the case may be) within the building compound such as location and

dimension of manholes are properly documented on plans, two sets of which are to be forwarded to the TFCC for record purposes. A laminated set or copy should also be displayed prominently and permanently inside the MDF room for easy reference during maintenance works.

1.8 ACCEPTANCE OF TELECOMMUNICATION FACILITIES

1.8.1 All facilities shall be completed at least six months before service is required. Joint site inspection shall be conducted to ensure that the facilities provided comply with PTLs/TSLs' requirements. The timeframe for handing over of facilities may be shortened for smaller developments and fast track projects subject to IDA's approval.

1.8.2 The developer or owner (as the case may be) shall rectify all defects detected during site inspection.

1.9 RESPONSIBILITIES OF THE PTLS/TSLS

1.9.1 After handing over of the facilities to the PTLs/TSLs, the PTLs/TSLs shall only be responsible for maintaining the pipelines up to the property boundary line and cable networks up to the interfacing point, i.e., the distribution point (DP) or Telecom' MDF room, whichever the case may be.

1.10 RESPONSIBILITIES OF BUILDING OWNERS OR DEVELOPERS

1.10.1 The developer or owner (as the case may be) shall be responsible for the provision and maintenance of all the facilities within the building including the cable trays, trunkings, ducts, etc., and ensure that they are in good serviceable condition and accessible to the PTLs/TSLs' personnel at all times. In addition, the building developer or owner (as the case may be) shall be responsible for the maintenance of all pipelines and manholes within the property compound up to the property boundary lines for one year from the date of acceptance of these facilities by PTLs/TSLs.

1.10.2 The developer or owner (as the case may be) shall be responsible for drilling through concrete floor or walls of buildings and will provide any service fittings, conduits and sleeves that form part of the facilities for telecommunication within the building.

1.10.3 Where additional cables need to be installed inside the building to meet tenants' increased demand for telephone lines, the developer or owner (as the case may be) or its representative shall promptly assist the PTLs/TSLs during the cable installation work, such as the removing and reinstating of fire stopping material sealing the floor opening inside the riser ducts or opening up of ceiling boards/panels.

1.10.4 The developer or owner (as the case may be) shall ensure that adequate security measures are taken at the riser ducts and Telecom MDF room to pre-empt trespassing by any unauthorised personnel. Under no circumstances should the Telecom MDF room be used for any other purpose such as a store room. The Telecom MDF room must also be properly maintained to keep it dust-free. The developer or owner (as the

case may be) shall hand over the MDF room and/or TER room, where applicable, to the PTLs/TSLs through the TFCC upon acceptance of the facilities by the PTLs/TSLs.

1.10.5 In the event that PTLs/TSLs are required by the developer or owner (as the case may be) to alter, remove or relocate any part or all of the MDF infrastructure and/or equipment in the MDF/TER room, the developer or owner (as the case may be) shall pay for all costs and expenses as may be incurred by PTLs/TSLs in connection therewith.

1.11 BROADBAND ENABLING CABLES

1.11.1 The developer or owner (as the case may be) may install and maintain broadband enabling optical fibre cables for its own use or for access by its tenants/ leasees for broadband services, in accordance with the guidelines as stated in Appendix A.9.

PART 2 GENERAL REQUIREMENTS FOR PROVISION OF SPACE AND FACILITIES FOR BROADBAND COAXIAL CABLE SYSTEM

2.1 GENERAL REQUIREMENTS

2.2 SUBMISSION OF DEVELOPMENT PLANS FOR BROADBAND COAXIAL CABLE SYSTEM (BCS)

2.3 DOCUMENTATION FOR BCS

PART 2 GENERAL REQUIREMENTS FOR PROVISION OF SPACE AND FACILITIES FOR BROADBAND COAXIAL CABLE SYSTEM

2.1 GENERAL REQUIREMENTS

2.1.1 Broadband coaxial cable systems (BCS) are required for distribution of cable TV and cable modem signals in buildings for broadband services. Developers or owners (as the case may be) of residential buildings are required to install a BCS at his expense in accordance with the detailed technical specifications as stated in Part 12 of this code of practice. There is also a mandatory requirement for developers or owners (as the case may be) of non-residential buildings to provide space and facilities in these buildings to facilitate the installation of BCS by telecommunication system licensee(s).

2.2 SUBMISSION OF DEVELOPMENT PLANS FOR BROADBAND COAXIAL CABLE SYSTEM (BCS)

2.2.1 Developers are advised to approach the cable system operators early during the planning stage of the building to ensure that the proposed facilities for cable services are suitable for cable system installation, and adequate to meet immediate and future needs. For planning purposes, two (2) sets of the following information are to be provided to telecommunication system licensee(s) for different type of building developments:

Apartments/ condominiums/ non-residential buildings	Conventional/strata landed housing	Single unit landed housing
1. Site plans which indicate: - lead-in pipes to each building - lead-in pipes interconnecting buildings within a development project	1. Site plans which indicate: - lead-in pipe to gate pillar & to building - lead-in pipes to manholes - pipes between manholes	1. Site plan which indicate: - lead-in pipe to gate pillar & from gate pillar to building
2. Floor plans which indicate: - location & dimensions of BCS riser	2. Floor plans which indicate: - location & dimensions of CDR - location of Telecom MDF room	2. Dwelling unit plan which indicates: - all BCS TV outlets - desired distribution point for unit types with 4 or more BCS TV points
3. Basement plans which indicate - BCS cable tray routing to risers - Location & dimensions of CDR - Location of Telecom MDF room	3. Dwelling unit plans which indicate - all BCS TV outlets - desired distribution point for unit types with 4 or more BCS TV points	
4. Dwelling unit plans which indicate: - all BCS TV outlets or commercial unit plans - desired distribution point for unit types with 4 or		

more BCS TV points		
5. Detailed riser drawing(s) which indicates: - size and location of cable tray - dimensions of hole/opening in floor slab - relevant info. on other service(s) co-located in riser		
6. Elevation drawings - one view of each block of project		
7. BCS TV outlets plans (for residential buildings only) which provide: - listing of all BCS TV outlets on every storey by unit type - listing of all non-residential BCS TV outlets by location and no. of BCS TV outlets		

2.2.2 The plans are to be sent to:

Projects Division
Broadband Engineering Services
Singapore Cable Vision Ltd
2D Ayer Rajah Crescent
Singapore 139938

2.2.3 A flowchart for the BCS compliance procedure is shown in Appendix B.8.

2.3 DOCUMENTATION FOR BCS

2.3.1 A set of as-built installation drawings for BCS shall be prepared for each residential building. The drawings should show cable routes and distances, outlet identification, detailed drawings of locked distribution panels, operating parameters of all amplifiers, designations of splitters and couplers at each location, location of power source for the amplifiers, and such other data as might be useful in maintenance and repair. In addition, there should be a planned cable route from the BCS source port to the Network Input Port.

2.3.2 The acceptance test data specified in Appendix B.2 to B.4 on test procedures should be recorded and preserved, including input frequencies and levels used for the tests.

2.3.3 Drawings and test data should be amended to show the effect of subsequent changes.

2.3.4 The owner or management committee of a building should maintain the records of the system installed.

2.3.5 All legends/symbols in the as-built drawings should be properly annotated. A copy of these drawings should be forwarded to the cable system licensee at the end of the project.

PART 3 CABLING FACILITIES TO BE PROVIDED

3.1 GENERAL

3.2 COMMERCIAL/SHOPPING COMPLEX

3.3 HOTEL

3.4 FACTORY/WAREHOUSE

3.5 FLATS/CONDOMINIUM

3.6 LANDED AND STRATA LANDED HOUSING ESTATE/ DWELLING HOUSE

3.7 OTHERS

PART 3 CABLING FACILITIES TO BE PROVIDED

3.1 GENERAL

3.1.1 It is expected that occupants in any type of building will require telecommunication services. Developers or owners (as the case may be) should envisage this need and provide the necessary facilities at their own expense. The cost is minimal if the facilities are provided during the construction stage of the building.

3.2 COMMERCIAL/SHOPPING COMPLEX

3.2.1 Multi-storey commercial/shopping cum residential complexes and multi-storey office buildings are classified under this category. The telecommunication facilities to be provided are:

(a) Lead-in pipes and the associated pipeline system, if applicable, within the property boundary line;

(b) Cable tray and/or cable ladder;

(c) Accommodation for MDF (Main Distribution Frame) i.e. the Telecom MDF room;

(d) Riser duct for accommodation of vertical cabling, IDF (Intermediate Distribution Frame) or DP (Distribution Point);

(e) Cable distribution systems;

(f) Accommodation for PABXs (Private Automatic Branch Exchanges);

(g) Accommodation/space for public telephone installation.

3.3 HOTEL

3.3.1 Telecommunication facilities to be provided in hotels are:

(a) Lead-in pipes and the associated pipeline system, if applicable, within the property boundary line;

(b) Cable tray and/or cable ladder;

(c) Accommodation for MDF (Main Distribution Frame);

(d) Riser duct for accommodation of vertical cabling, IDF (Intermediate Distribution Frame) or DP (Distribution Point);

(e) Cable distribution systems;

(f) Accommodation for PABX (Private Automatic Branch Exchange);

(g) Accommodation/space for public telephone installation.

3.4 FACTORY/WAREHOUSE

3.4.1 Such development usually comprises a number of buildings. Two systems of cable distribution are involved, namely, those within the building and those between the various buildings.

Telecommunication facilities to be provided are:

(a) Lead-in pipes and the associated pipeline system within the property boundary line;

(b) Cable tray or cable ladder;

(c) Accommodation for MDF (Main Distribution Frame);

(d) Riser duct for accommodation of vertical cabling, IDF or DP

(e) Local cabling from MDF to IDFs (between buildings) and from IDFs to DPs (within building);

(f) Cable distribution systems;

(g) Accommodation for PABX;

(h) Accommodation/space for public telephone installation.

3.5 FLATS/CONDOMINIUM

3.5.1 Multi-storey residential buildings are classified under this category.

Telecommunication facilities to be provided are:

(a) Lead-in pipes and the associated pipeline system, if applicable, within the property boundary line;

(b) Accommodation for MDF;

(c) TER (Telecommunication Equipment Room); for accommodation of optical fibre cable installation for supporting multimedia services. (See Table under Part 6.4);

(d) Riser duct or riser pipe for accommodation of vertical cabling;

(e) Accommodation for IDFs;

(f) Accommodation for DPs;

(g) Cable distribution systems; and

(h) The developer or owner (as the case may be) shall supply, install and maintain telephone cables, sockets, block terminal and all other materials for pre-cabling to all rooms of residential buildings (see Part 9.3).

3.6 LANDED AND STRATA LANDED HOUSING ESTATE/DWELLING HOUSE

3.6.1 Landed and strata landed residential houses such as bungalows, semi-detached and terrace houses are classified under this category. Telecommunication facilities to be provided are:

(a) MDF room (see Part 5 paragraph 5.1.5);

(b) Two 50 mm diameter lead-in uPVC pipes to the gate pillar of each unit and the associated pipeline system, if applicable, within the estate;

(c) A 50 mm diameter link uPVC pipe from gate pillar to the building proper for telecommunication cabling;

(d) Cable distribution system; and

(e) The developer or owner (as the case may be) shall supply, install and maintain telephone cables, sockets, block terminal and all other materials for pre-cabling to all rooms of residential buildings (see Part 9.3).

3.7 OTHERS

3.7.1 For other buildings not included herein, developers or owners (as the case may be) are urged to liaise closely with the PTLs/TSLs on the provision of telecommunication facilities.

3.7.2 Pipeline works shall be installed by contractors/suppliers registered with the Building and Construction Authority (BCA).

3.7.3 The internal wiring and cablings for PABX, KTS and MLS shall be installed by telecommunication wiring contractors and installers licensed by the Info-communications Development Authority of Singapore (IDA).

3.7.4 List of IDA licensed internal telecommunication wiring contractors and installers is available from IDA and IDA's Internet Website at http://www.ida.gov.sg.

PART 4 LEAD-IN PIPES AND PIPELINE SYSTEM WITHIN PROPERTY BOUNDARY LINES

4.1 GENERAL

4.2 REQUIREMENTS FOR LEAD-IN PIPES

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4.6 MANHOLES WITHIN SITE BOUNDARIES

4.7 MANHOLE CONSTRUCTION DRAWINGS

4.8 MANHOLE CONSTRUCTION SPECIFICATIONS

4.9 PURCHASE OF MANHOLE FRAME AND COVER AND CHANNEL BRACKETS

PART 4 LEAD-IN PIPES AND PIPELINE SYSTEM WITHIN PROPERTY BOUNDARY LINES

4.1 GENERAL

4.1.1 This section deals with the provision of pipelines within the boundary line of the building. As all buildings are invariably provided with lead-in pipes for cable entry, it is of paramount importance that this facility is provided according to the requirements detailed herein.

4.1.2 All pipeline and manholes within the building compound or boundary line shall be provided by the developer or owner (as the case may be) and is to be done by BCA registered contractors specialising in "underground pipeline for telecommunications". The PTLs/TSLs can assist by providing a list of such contractors for the developer/ building owner to consider for the pipelaying works.

4.2 REQUIREMENTS FOR LEAD-IN PIPES

4.2.1 The lead-in pipes provide physical protection to cables against damage. With lead-in pipes, cables can be placed in or replaced easily at any time.

4.2.2 The lead-in pipes shall be provided by the developer or owner (as the case may be) from the building to a point one metre beyond the existing or proposed roadside drain, whichever the case maybe. The pipes are to undercross one metre below the drain and approval from the Drainage Department (Ministry of the Environment) must be sought. The recommended gradient is 1:6 for 110 mm diameter uPVC pipe and 1:3 for 50mm or smaller diameter.

4.2.3 The lead-in pipes and manholes, if any, are for the exclusive use of PTLs/TSLs for installation of the in-coming telecommunication cables.

4.2.4 The final entry point and number of lead-in pipes shall be determined by the PTLs/TSLs.

4.2.5 A factory-made bend shall be used when there is a 90° upturn, i.e., changing from the horizontal to vertical plane. The pipe must be clipped and flushed against the wall and shall rise up to a height of 1.8m above ground unless otherwise advised by the PTLs/TSLs, see Figure 4-1 and 4-2. The specifications for 110 mm ∅ and 50 mm ∅ bend pipes are as shown in Appendix A.2(a) and A.2(b) respectively. For the straight pipe reducer from 110 mm ∅ to 50 mm ∅ and 50 mm ∅ to 25 mm ∅, refer to Appendix A.2(c) and A.2(d).

4.2.6 110 mm ∅ uPVC pipes buried in the ground shall be encased in 50mm concrete surround. Pipes with nominal diameter of less than 110mm∅ need not be encased with 50 mm concrete surround unless buried across vehicular access.

4.2.7 A nylon/polyethylene rope of 4-core or multi-strand type with overall diameter of 6 mm shall be provided in each pipe to facilitate cable pulling. Lead-in pipes shall be limited to a length of 30 m.

4.2.8 All ends of pipe shall be plugged with rubber caps to prevent entry of earth, debris or cement. The buried end of the pipe for connection to PTLs/TSLs' networks shall be capped or plugged and indicated by a marker.

4.2.9 Lead-in pipes shall be separated from power cables by not less than:

(a) 50 mm of concrete (1:2:4 mix) or
(b) 300 mm in well tamped earth.

4.2.10 Where lead-in pipes enter a building in a horizontal position, a PTL/TSL approved cable duct sealing module system such as MCT, SVT or ROX types shall be installed as shown in Appendix A.4 to prevent the ingress of water. However, as there may be instances of water seepage, it is recommended that no plant or equipment be installed below the module system. As an added precaution, a drain should be constructed below the module system to allow for proper drainage of water.

4.2.11 Lead-in pipes should not enter directly into Telecom MDF room located in basement.

4.2.12 Lead-in pipes to flats or apartment blocks shall end inside the riser ducts, flush against the wall and rise up to a minimum height of one metre.

4.3 NUMBER OF LEAD-IN PIPES TO HIGH-RISE COMMERCIAL BUILDINGS

4.3.1 All lead-in pipes to high-rise buildings shall be uPVC type with a nominal diameter of 110 mm. As a guide, the number of lead-in pipes to be provided shall depend on the usable floor area of the building as follows:

Usable Floor Area (per '000 sq. m.)	Total Nos. of Lead-in Pipes	Pipe Formation
Up to 20	8	2 X 4
20 to 40	12	3 X 4
40 to 60	18	2 sets of 3 X 3
60 to 80	24	2 sets of 3 X 4
80 to 120	36	2 sets of 3 X 6
120 to 160	48	2 sets of 4 X 6
160 to 200	60	2 sets of 5 X 6

4.3.2 Where usable floor exceeds 60,000 sq. m., two sets of lead-in pipes shall be provided for the purpose of diversity as mentioned in Part 1 paragraph 1.4.1 (i).

4.3.3 In buildings which house tenants with high telephone line demand such as money-broker, stock-broker, etc., the PTLs/TSLs shall advise the owner or developer to increase the number of lead-in pipes. It is worthwhile to note that the lead-in pipes are meant to serve the building during its life-time and it may be difficult to supplement them once the building construction work has been completed.

4.4 LEAD-IN PIPES TO LANDED/ STRATA LANDED HOUSES (E.G. BUNGALOW, SEMI-DETACHED AND TERRACE HOUSES)

4.4.1 The pipes shall be uPVC with a nominal diameter of 50mm or as otherwise determined by the PTLs/TSLs.

4.4.2 Pipes should be buried at a minimum depth of one metre and maintained throughout in a straight run. It should rise up 250mm inside the gate pillar as shown in Figure 4-3.

4.4.3 A link uPVC pipe with a nominal diameter of 50 mm is required from the gate pillar to the building for accommodating the internal telephone cable, see Figure 4-4. This 5-pair polyethylene cable can be purchased from the PTLs/TSLs.

4.4.4 Two number of 50 mm diameter lead-in uPVC pipes shall be provided to the gate pillar of each unit.

4.5 PIPELINE SYSTEM WITHIN PROPERTY BOUNDARY LINES

4.5.1 All pipeline systems provided by the developer or owner (as the case may be) shall be subject to acceptance tests by PTLs/TSLs and shall be maintained by the developer or owner (as the case may be) same for one year effective from the date of acceptance by the PTLs/TSLs [refer to Appendix A.4(a) and (b) for pipe testing and acceptance procedure].

4.5.2 Pipes are either single or multi-way. They shall be of either 50 mm ∅ (class C) complying with Singapore Standard (SS) 141 or 110 mm ∅ complying with Singapore Standard (SS) 272 (refer to Appendix A.5). All underground pipelines including joints, bend pipes and manholes shall be water-tight.

4.5.3 Pipes shall be laid at a minimum depth of one metre below the final ground level. Where site conditions do not permit, prior approval shall be obtained from the PTLs/TSLs.

4.5.4 Multi-way pipes shall be installed with spacers according to the diagrams in Appendix A.6.

4.5.5 Pipes shall be in straight run throughout the whole pipe length. If there is any change in direction, a manhole shall be provided. No 'S' bend is allowed. In the event of obstruction posed by other services or undercrossing deep culverts, the pipes shall be laid in a gradual gradient of not less than 1:6. Pipeline distance between manholes shall not be greater than 150m.

4.5.6 In the case of industrial buildings, developers or owners are to provide pipes linking the main building housing the PABX system to all other buildings within the same compound, including the guard house for installation of extension lines.

4.6 MANHOLES WITHIN SITE BOUNDARIES

4.6.1 Manholes within the development site boundaries shall be provided by developer or owner (as the case may be) and handed over to the PTLs/TSLs upon completion and acceptance.

4.7 MANHOLE CONSTRUCTION DRAWINGS

4.7.1 Drawings of various standard manhole sizes of types JX2, MX1, MX2 and MX3, are as shown in Figures 4-5 to 4-26. Details of bigger size manholes from MX4 to MX8 and non-standard or irregular manholes shall be provided by the PTLs/TSLs upon request.

4.8 MANHOLE CONSTRUCTION SPECIFICATIONS

4.8.1 The following method and specifications pertaining to manhole construction are recommended:

(a) Before any concrete is placed:

(i) The bottom of the excavation must be properly levelled and consolidated.

(ii) The bottom shall be kept dry by providing a sump-hole to accommodate water pump, and a layer of 150 mm thick hard-core materials shall be provided where necessary.

(b) Pipes shall be cast on site and manhole fitting placed as construction proceeds. Unplasticised PVC pipes with a flared mouth at one end, in accordance with Singapore Specification (SS) 272 shall be used for entry into the wall of the manhole.

(c) Pipes shall enter manhole as shown in Figures 4-5 to 4-14 & 4-19 to 4-22. The pipes shall enter the manholes at such depths as to ensure a minimum clearance of 450 mm above the floor level and/or 350 mm below the roof unless otherwise specified.

(d) Manholes shall be constructed at a depth to allow for a concrete (1:2:4) shaft wall of varying height for various manhole sizes as shown in Figures 4-15 to 4-18 & 4-21 to 4-26. Concrete for filling the recess of the frame and cover shall be of 1:2:4 mix and shall be flushed with the top of the cover. For heavy duty frame and cover, the concrete shall be filled up to the ribs without covering the ribs.

(e) Manhole walls shall be fair faced and not rendered. Any projection shall be removed, and cavities filled with cement mortar. The walls shall not be coated with cement or cement sand wash.

(f) The floor shall be given a 20 mm rendering of cement mortar with fall towards the sump-hole from all directions.

(g) Only approved formwork shall be used in manhole construction.

(h) Completed manholes, which are to be handed over to PTLs/TSLs, shall be pumped clear of water and made ready for inspection.

4.9 PURCHASE OF MANHOLE FRAMES AND COVERS AND CHANNEL BRACKETS

4.9.1 Manhole frames, covers and channel brackets shall preferably be purchased directly from authorised suppliers. However, these items are also available from the PTLs/TSLs. Forms for the request for purchase of the required items can be obtained from PTLs/TSLs.

4.9.2 For manhole construction on carriageway, heavy duty manhole covers shall be used. For manhole construction on turfed areas, medium duty manhole covers shall be used.

4.9.3 Developers or owners (as the case may be) can purchase the pipes, bend pipes or spacers from other sources provided that the specifications meet PTL/TSL's standards.

FIGURE 4-1: DETAILS OF LEAD-IN PIPES WITH BEND PIPES

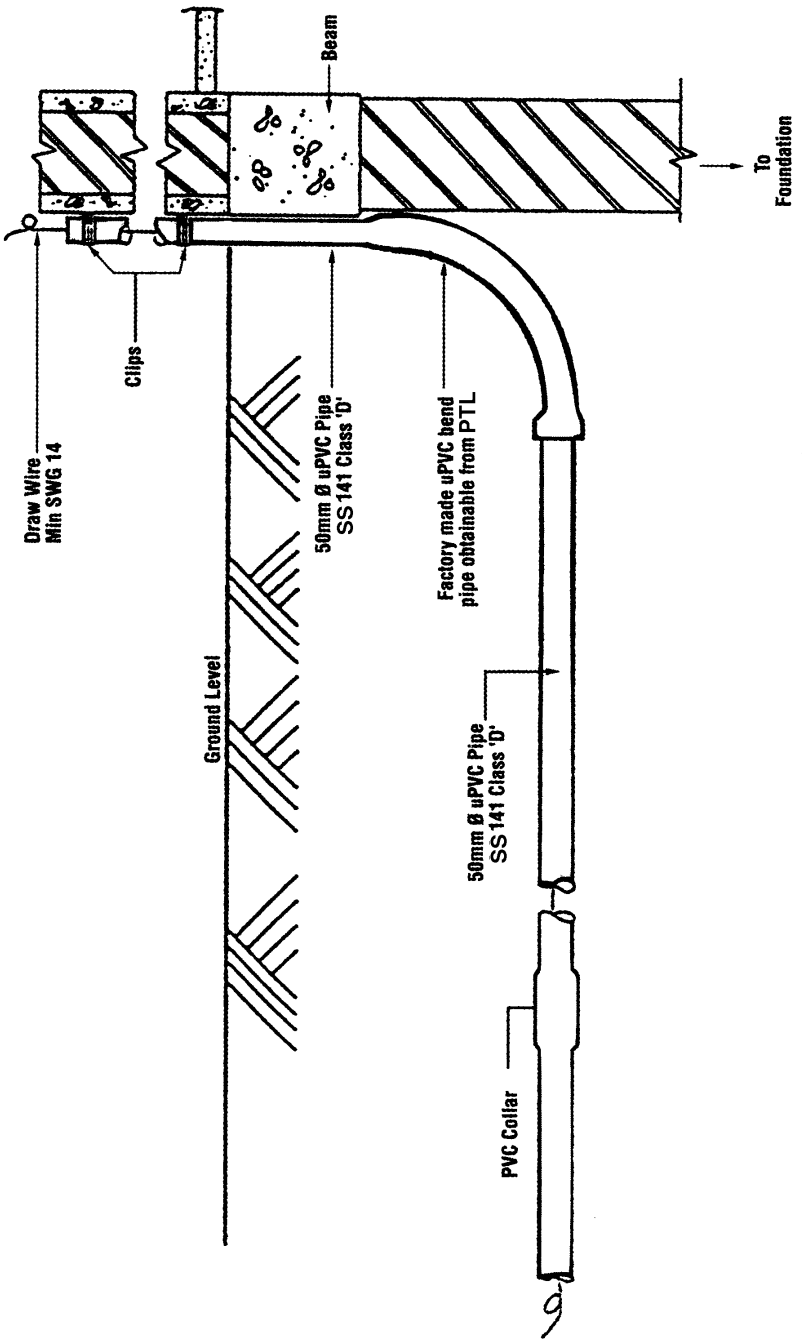


FIGURE 4-2: DETAILS OF LEAD-IN PIPES

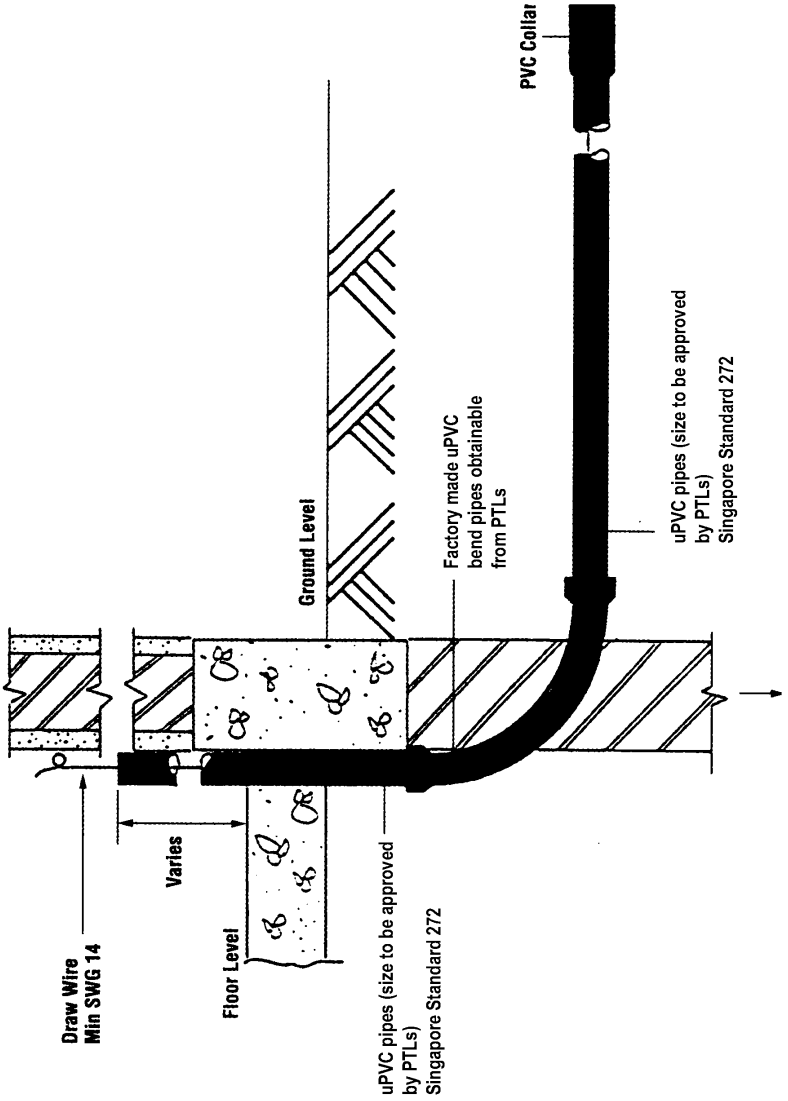


FIGURE 4-3 : TYPICAL LOCATION OF DP AT GATE PILLAR

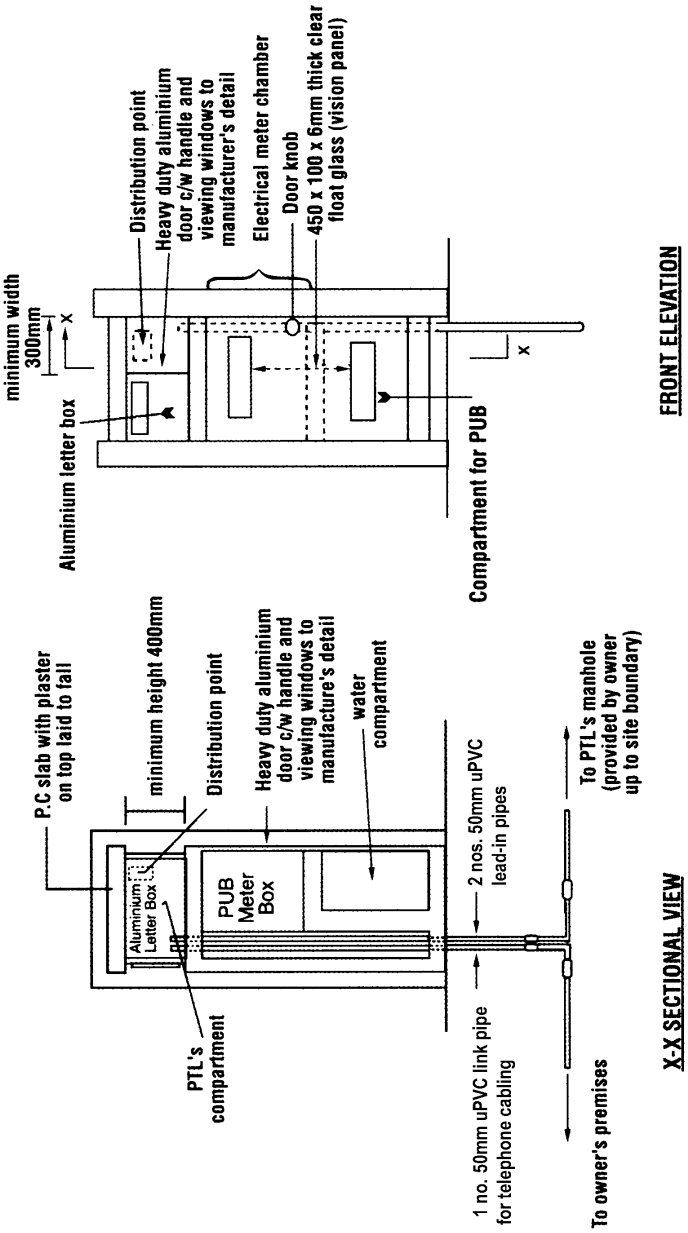


FIGURE 4-4 : PROVISION OF 50MM PVC LINK PIPE FOR LANDED/STRATA LANDED HOUSES (EG . BUNGALOW, SEMI-DETACHED AND TERRACE HOUSES)

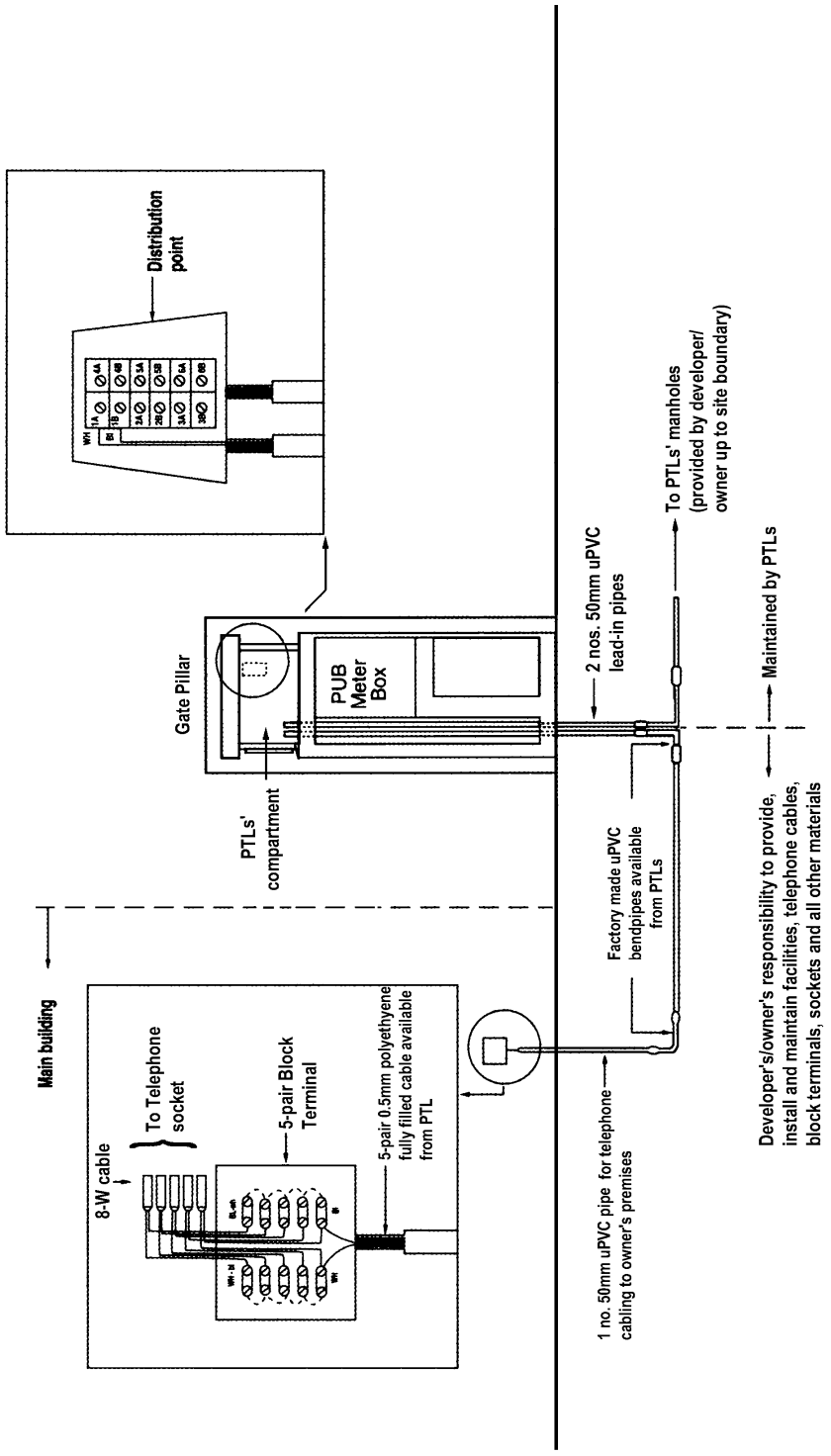


FIGURE 4-5 : MANHOLE DRAWINGS - TYPE JX2

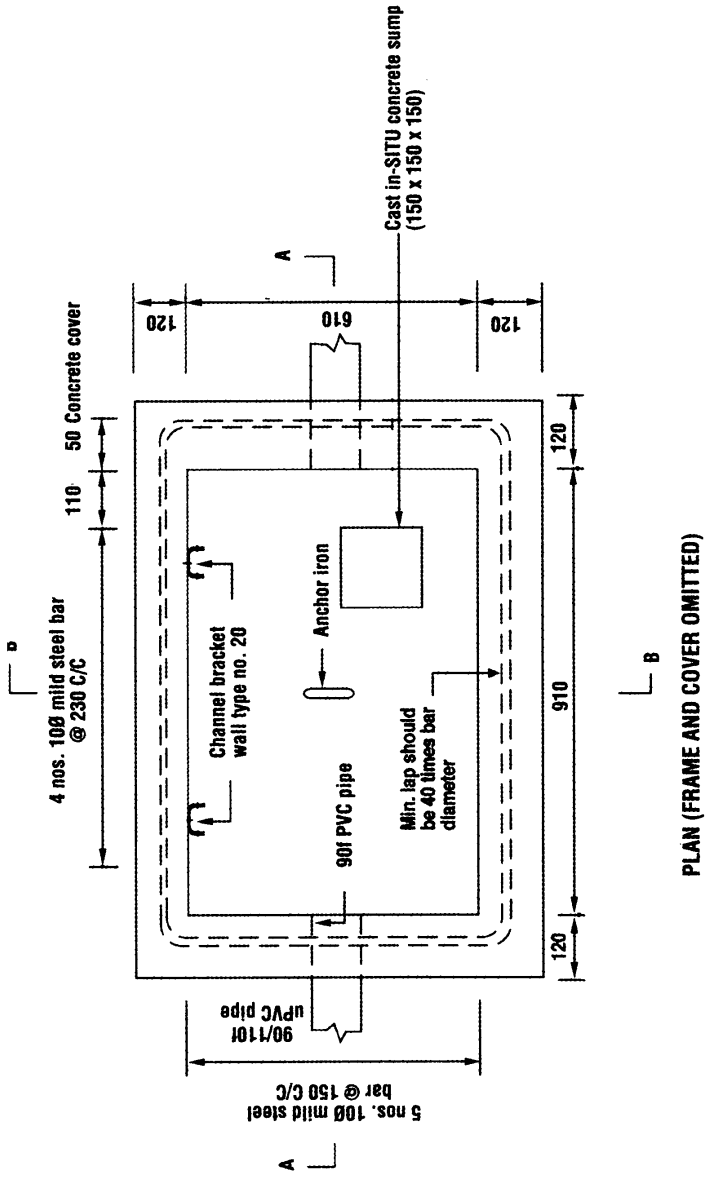
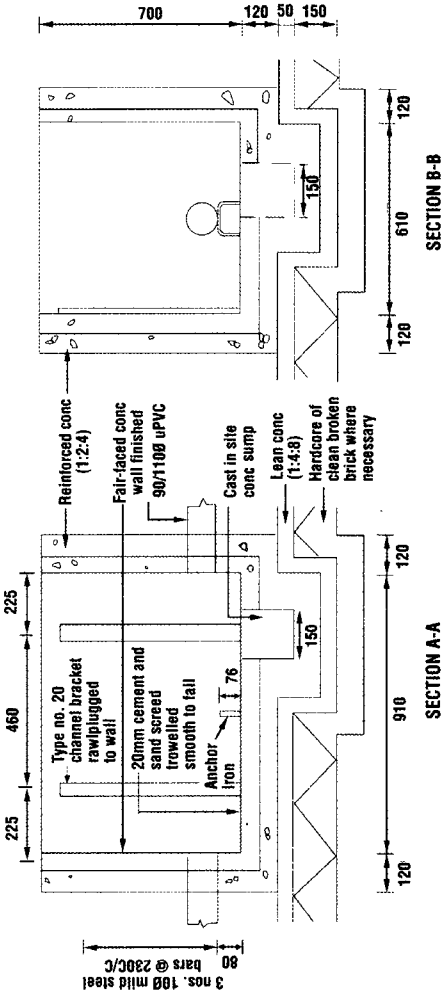


FIGURE 4-6 : MANHOLE DRAWINGS - TYPE JX2



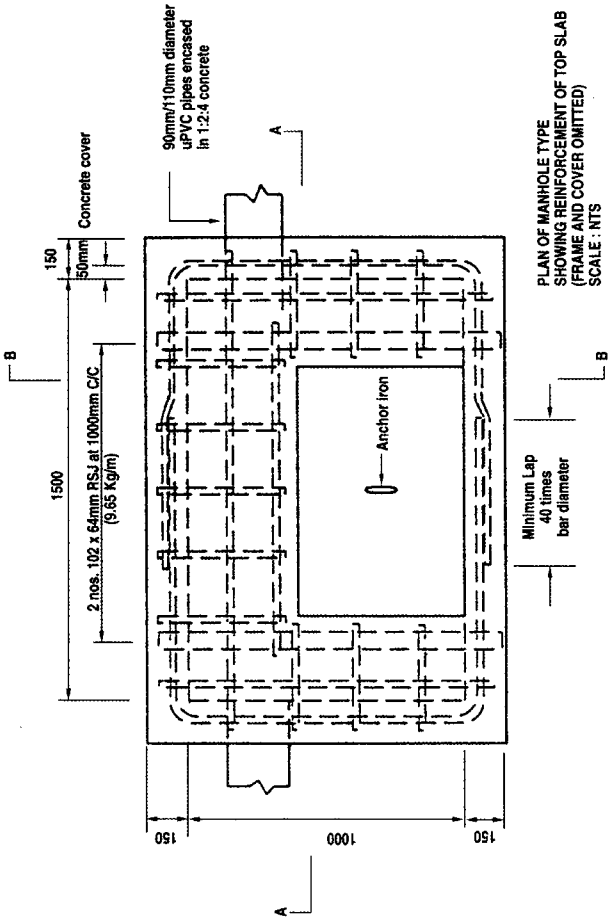


FIG.4-7: MANHOLE DRAWINGS - TYPE MX1

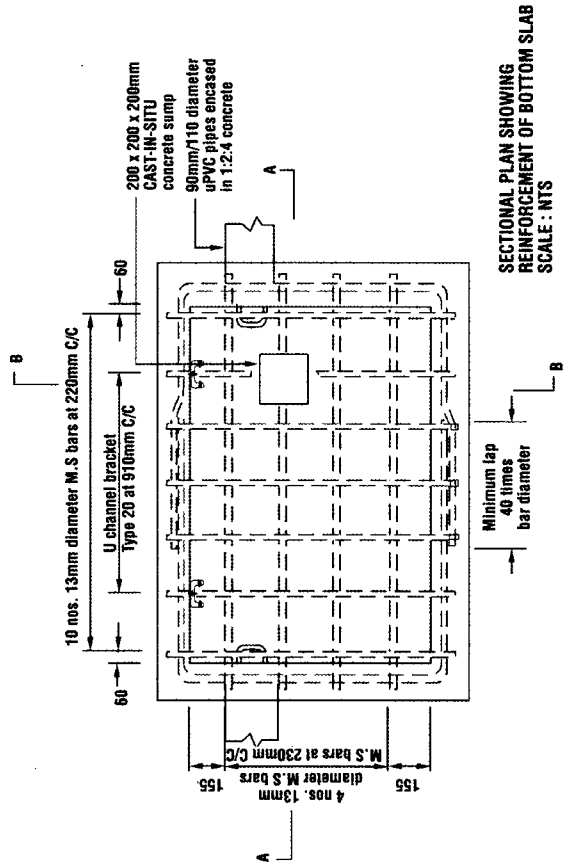


FIG.4-8: MANHOLE DRAWINGS - TYPE MX1

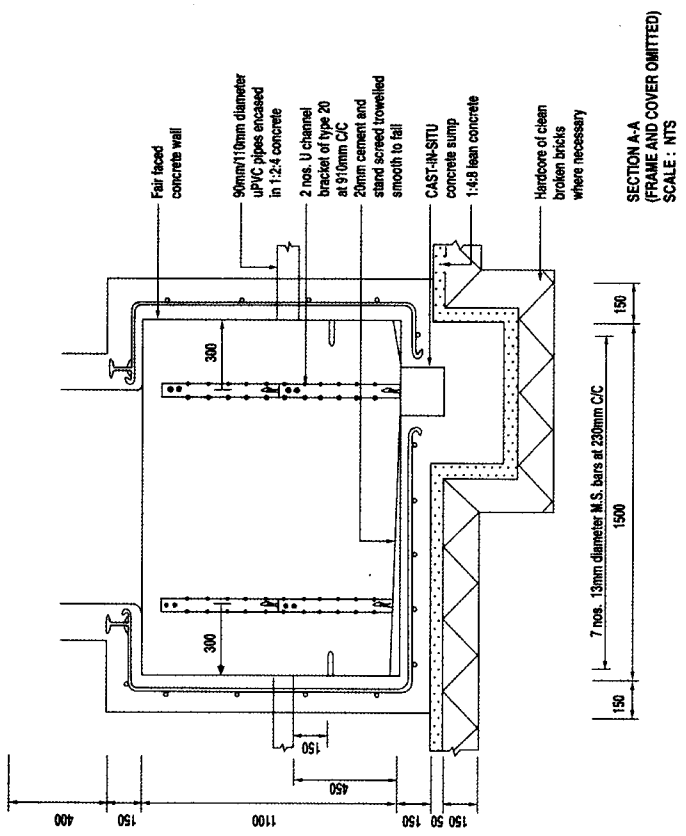
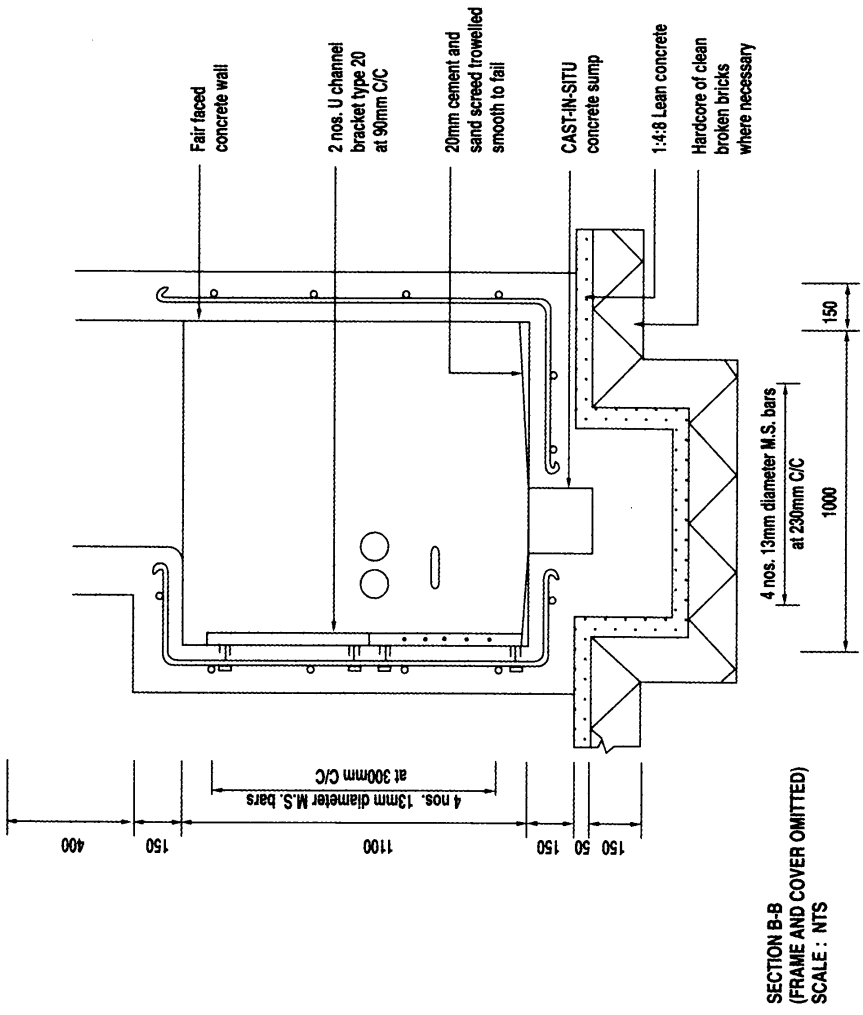


FIG.4-9: MANHOLE DRAWINGS - TYPE MX1

FIG.4-10: MANHOLE DRAWINGS - TYPE MX1



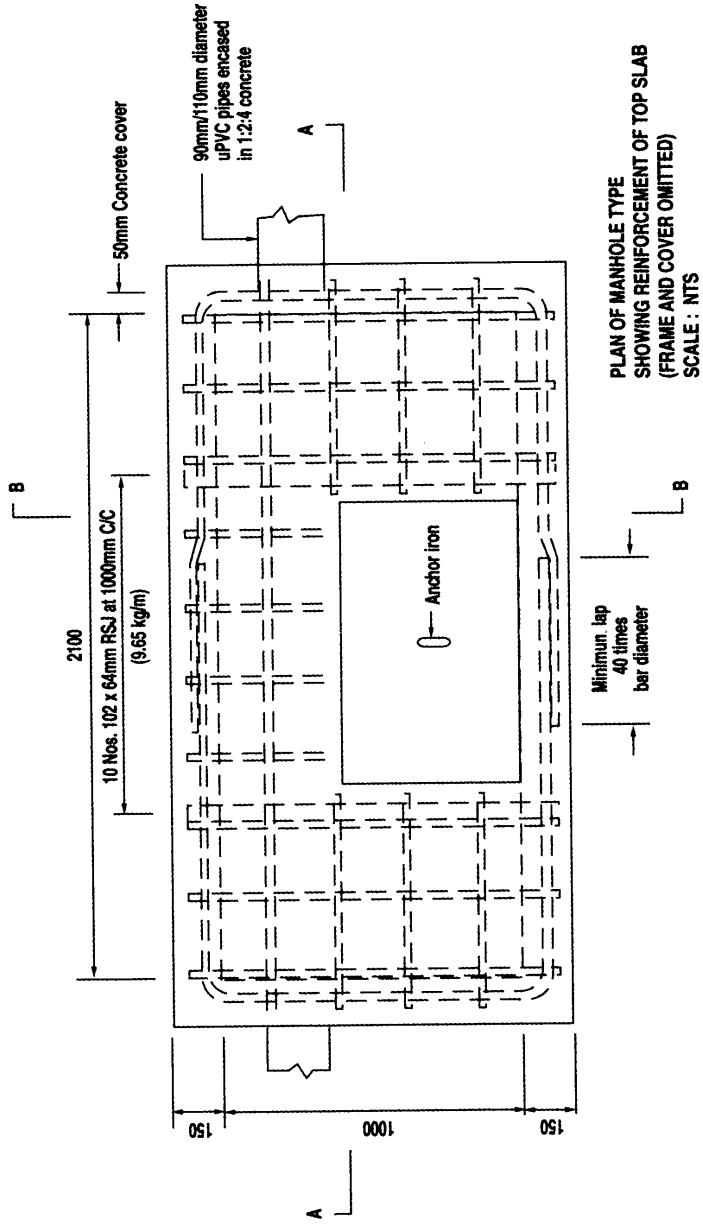


FIG.4-11: MANHOLE DRAWINGS - TYPE MX2

FIGURE 4-12: MANHOLE DRAWINGS - TYPE MX2

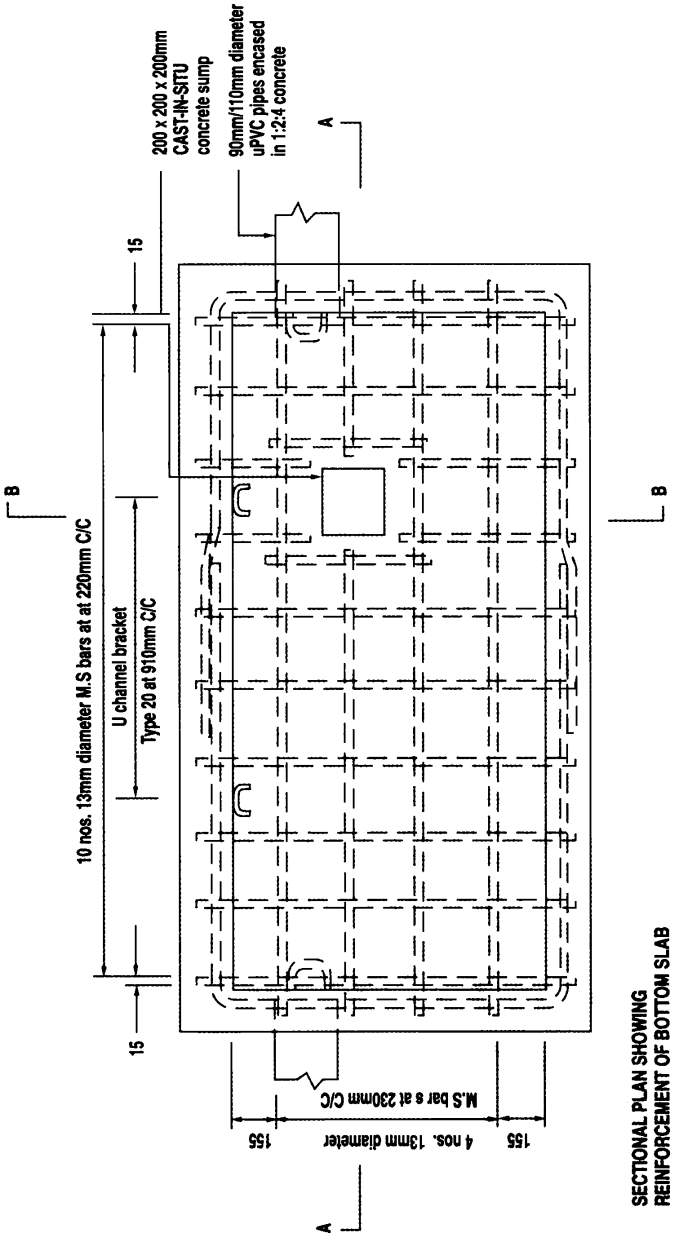


FIGURE 4-13 : MANHOLE DRAWINGS - TYPE MX2

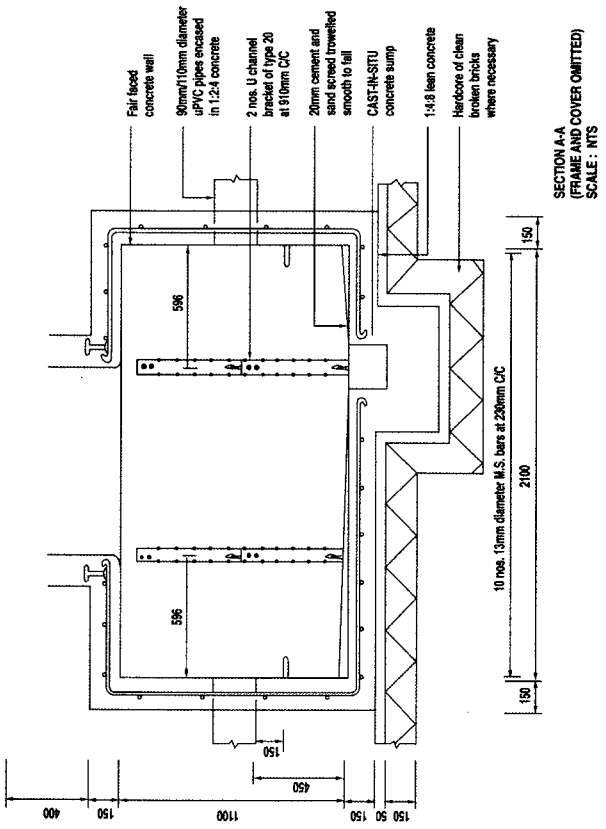


FIGURE 4-14 : MANHOLE DRAWINGS - TYPE MX2

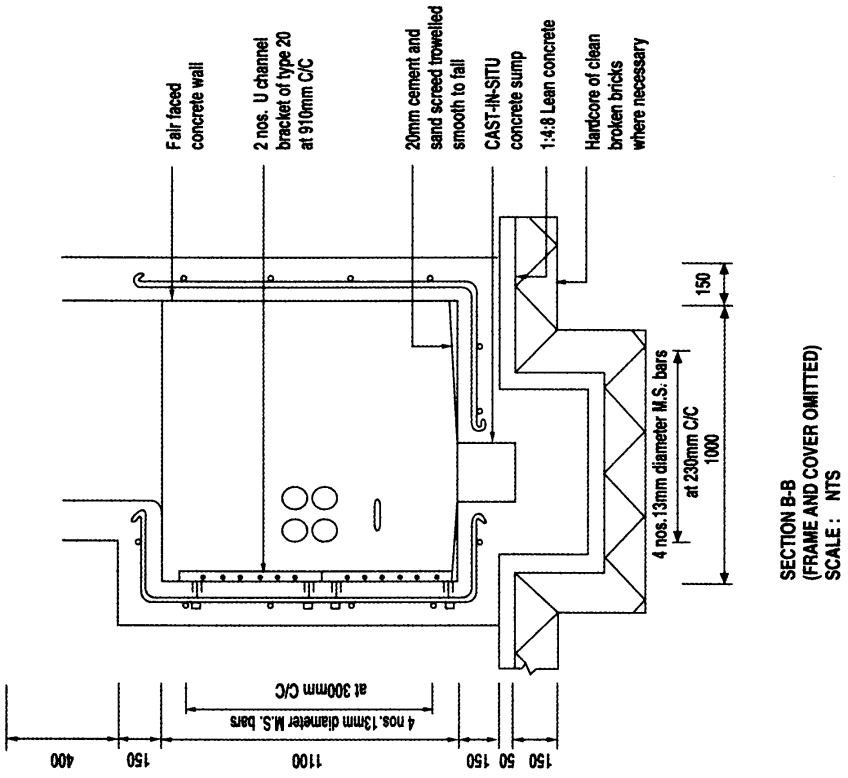


FIGURE 4-15 : MANHOLE DRAWINGS - TYPE MX1 & MX2

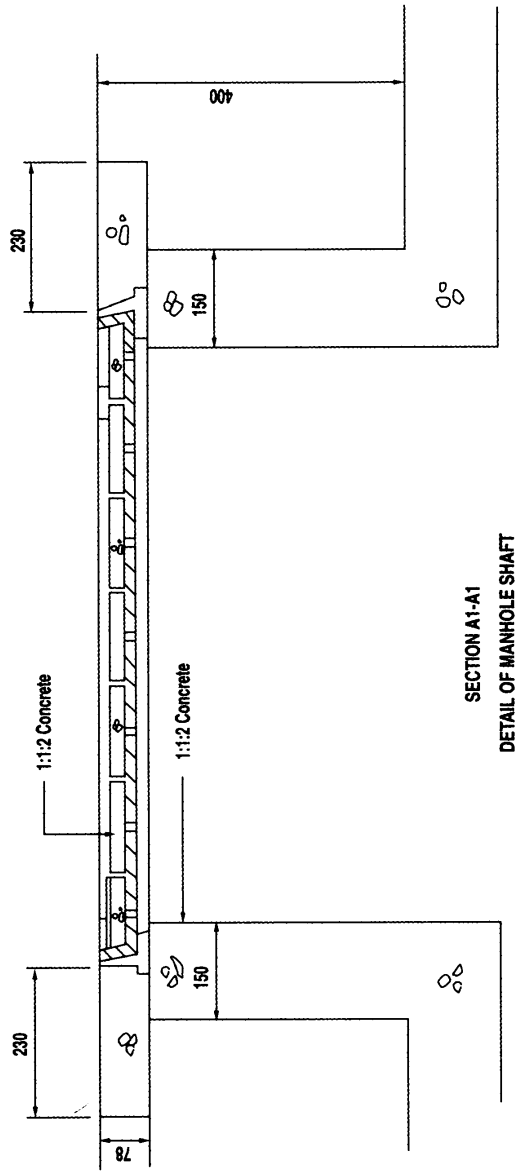


FIGURE 4-16 : MANHOLE DRAWINGS - TYPE MX1 & MX2

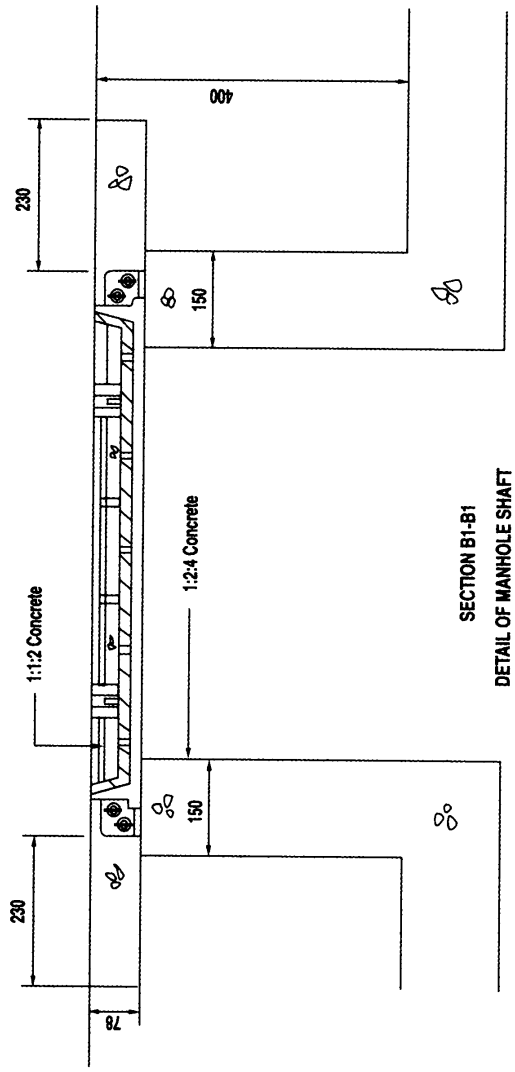


FIGURE 4-17: MANHOLE DRAWINGS - TYPE MX1 & MX2

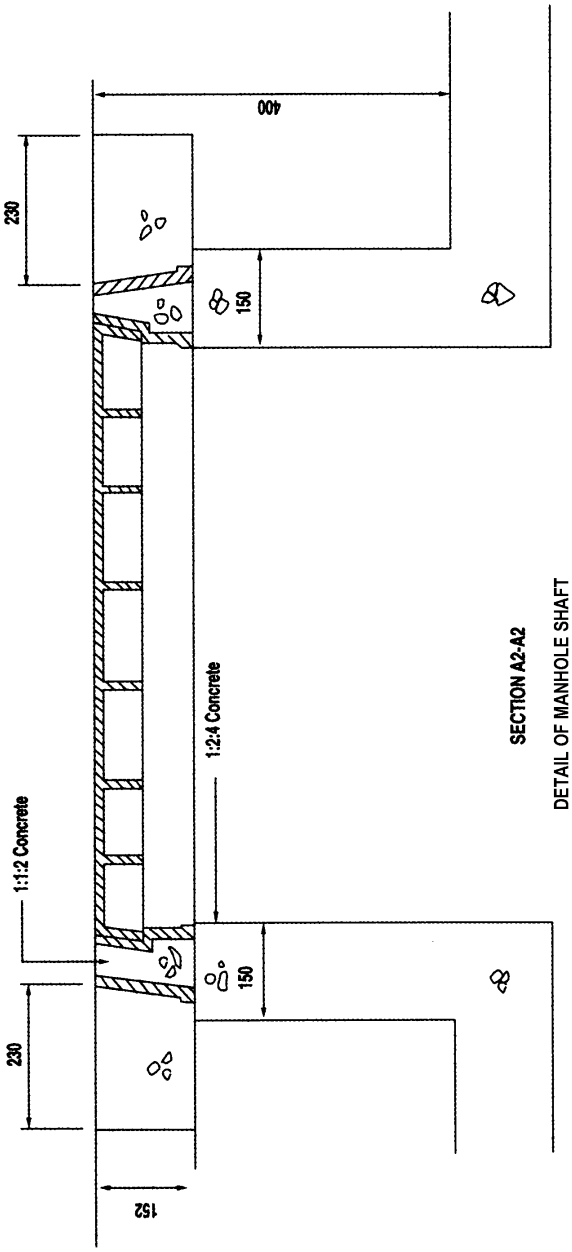


FIGURE 4-18: MANHOLE DRAWINGS - TYPE MX1 & MX2

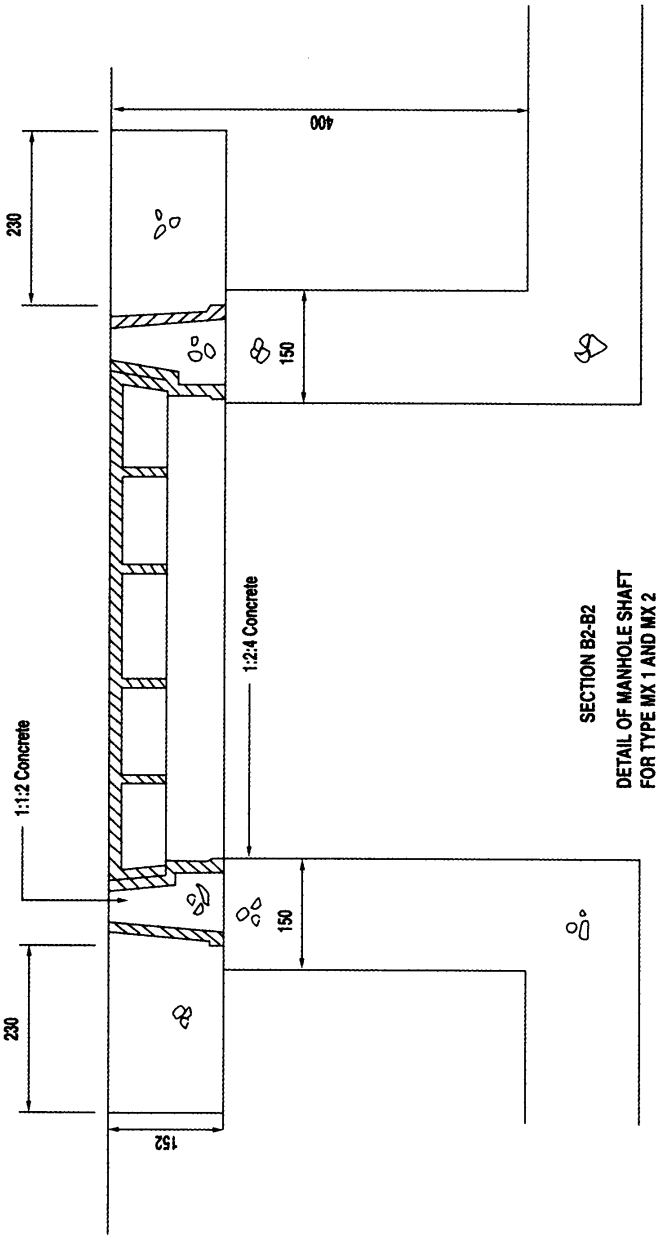


FIGURE 4-19 : MANHOLE DRAWINGS - TYPE MX3

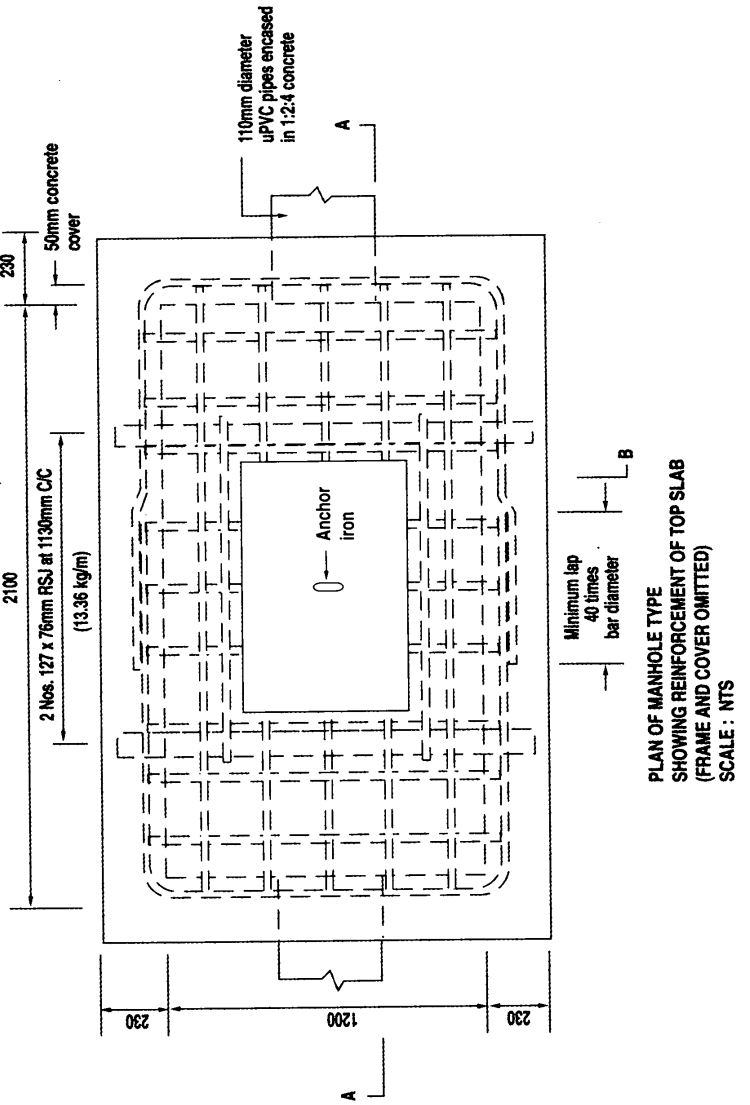


FIGURE 4-20: MANHOLE DRAWINGS - TYPE MX3

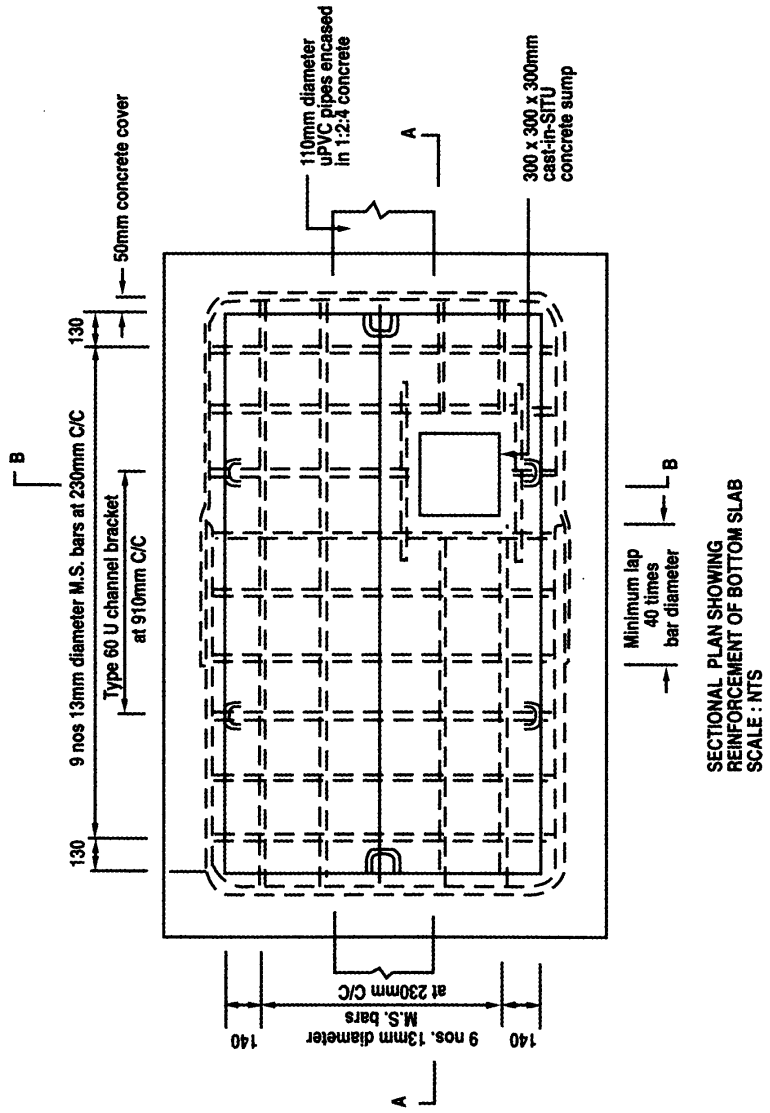


FIGURE 4-21 : MANHOLE DRAWINGS - TYPE MX3

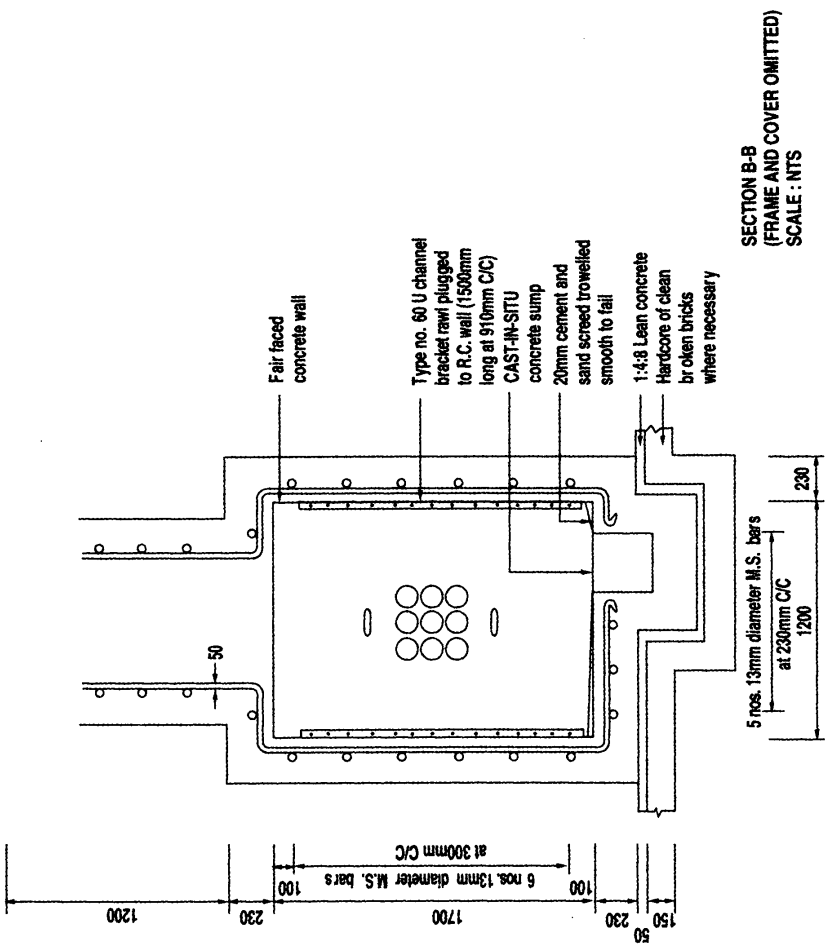


FIGURE 4-22 : MANHOLE DRAWINGS - TYPE MX3

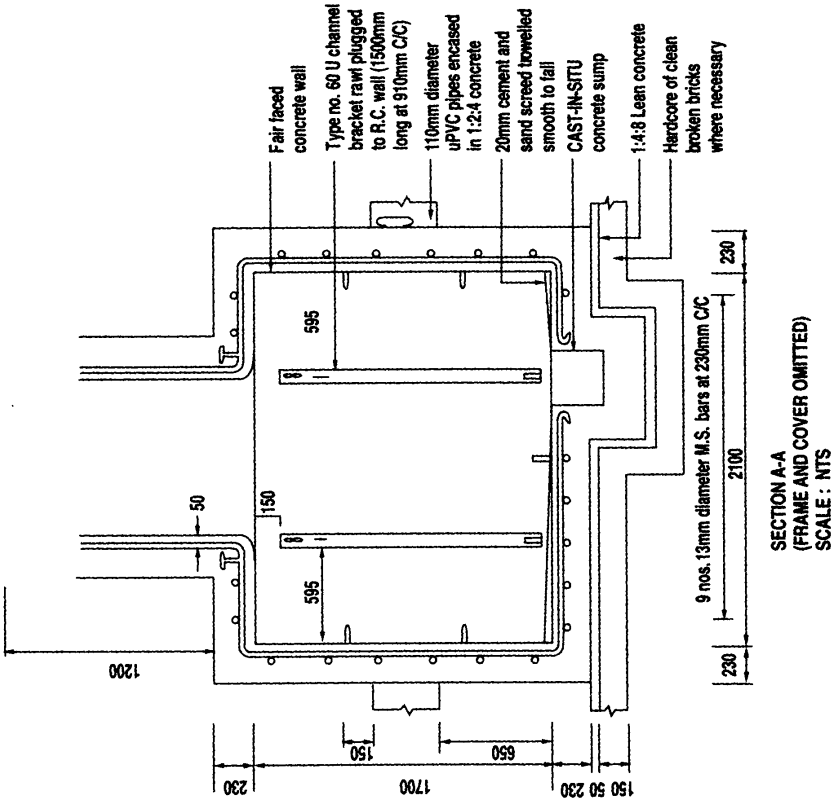


FIGURE 4-23 : MANHOLE DRAWINGS - TYPE MX3 & ABOVE

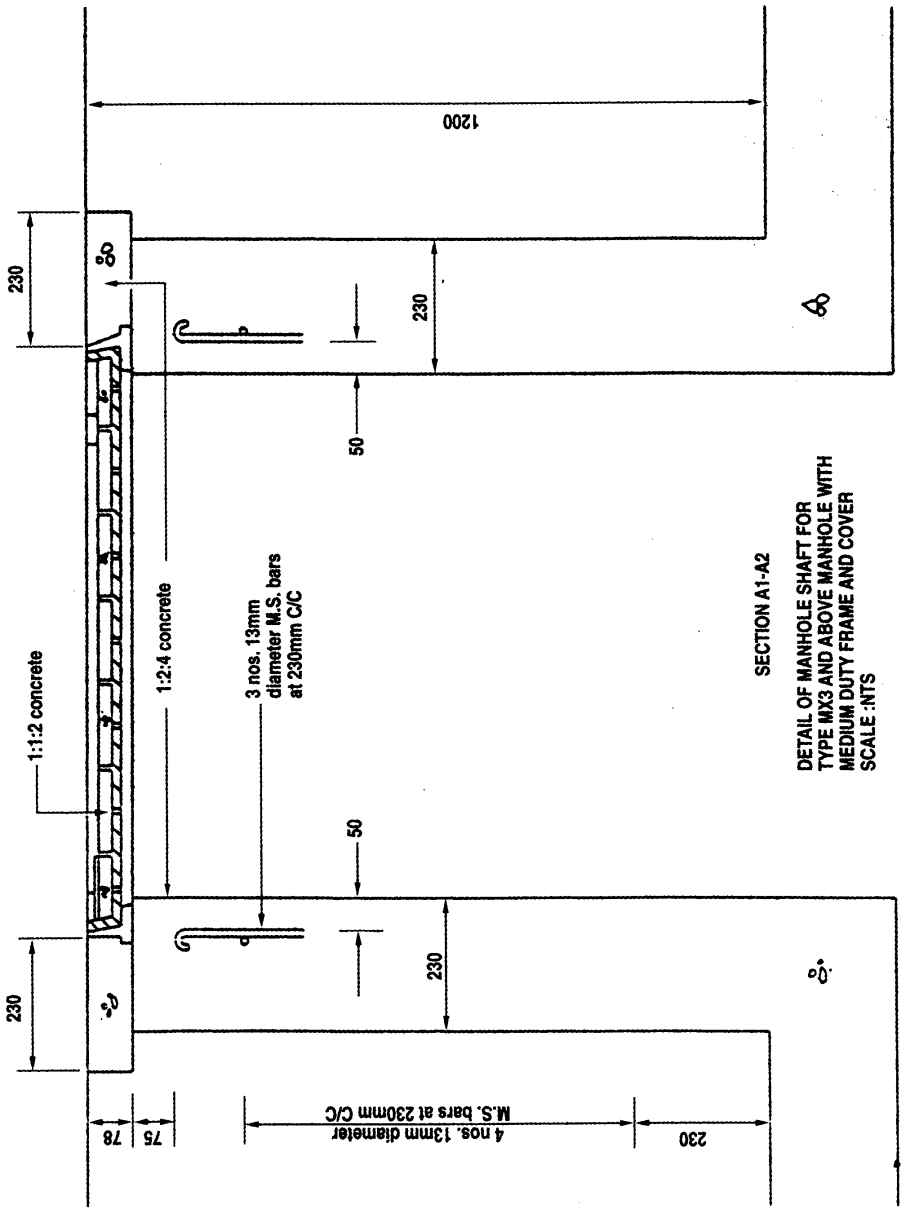


FIGURE 4-24 : MANHOLE DRAWINGS - TYPE MX3 & ABOVE

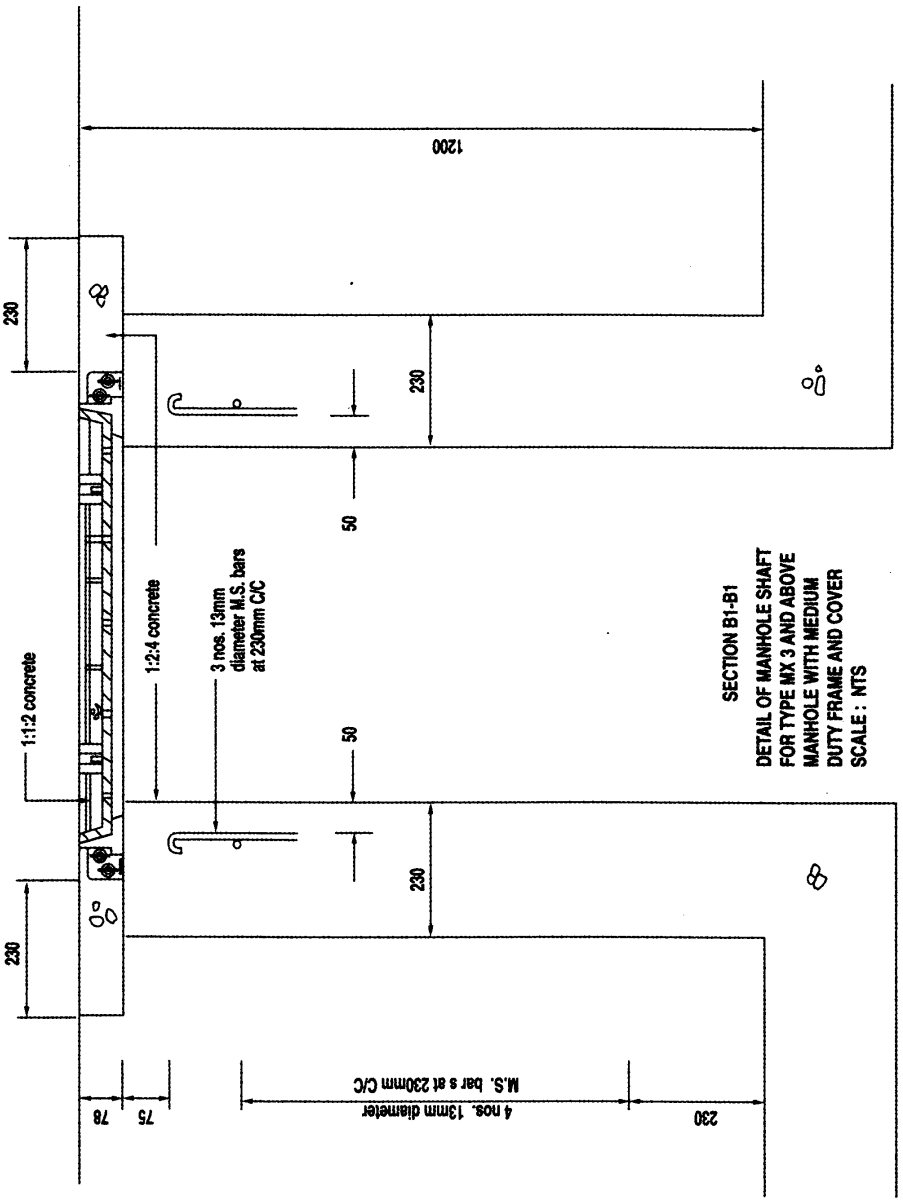


FIGURE 4-25 : MANHOLE DRAWINGS - TYPE MX3 & ABOVE

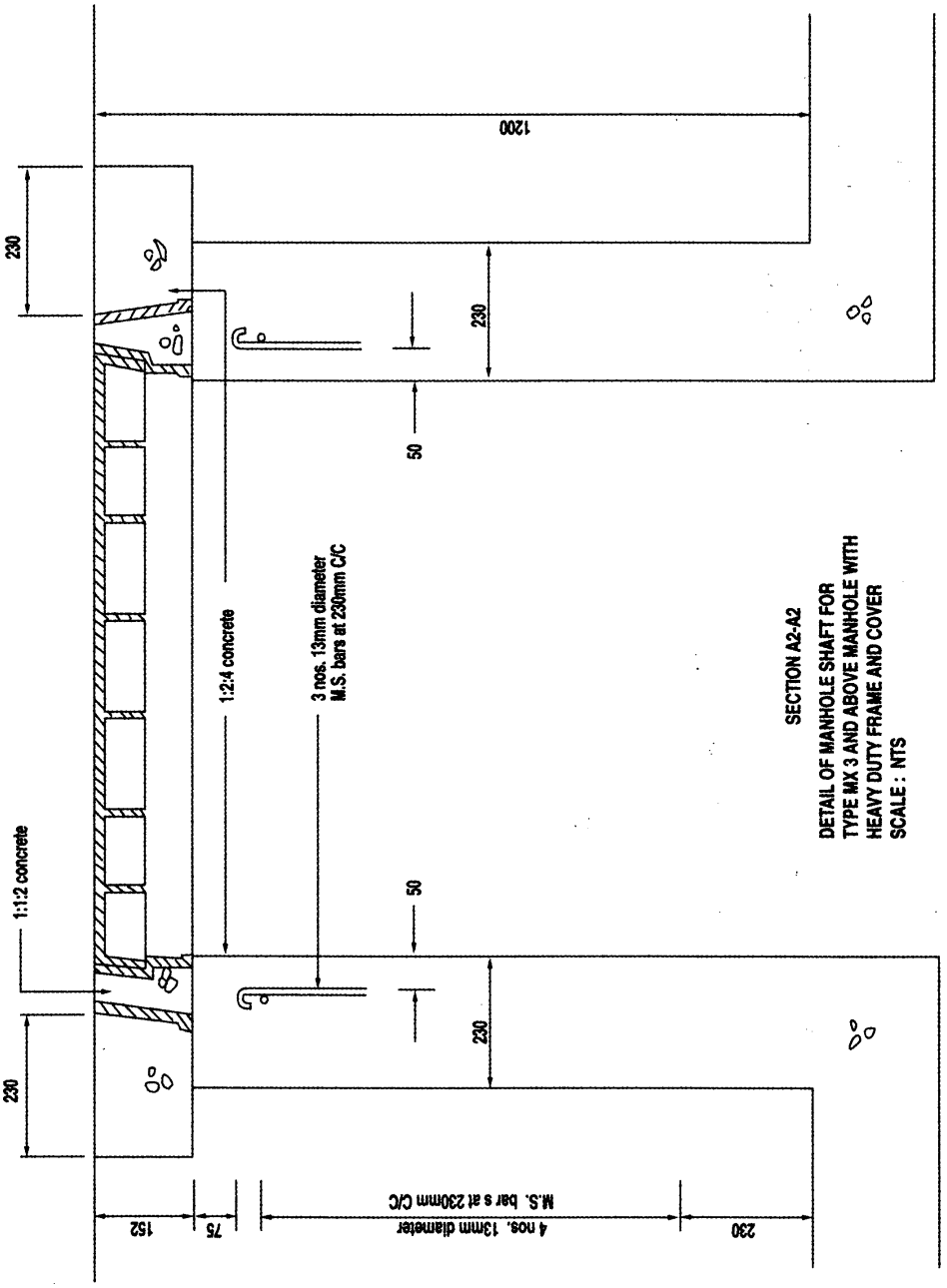
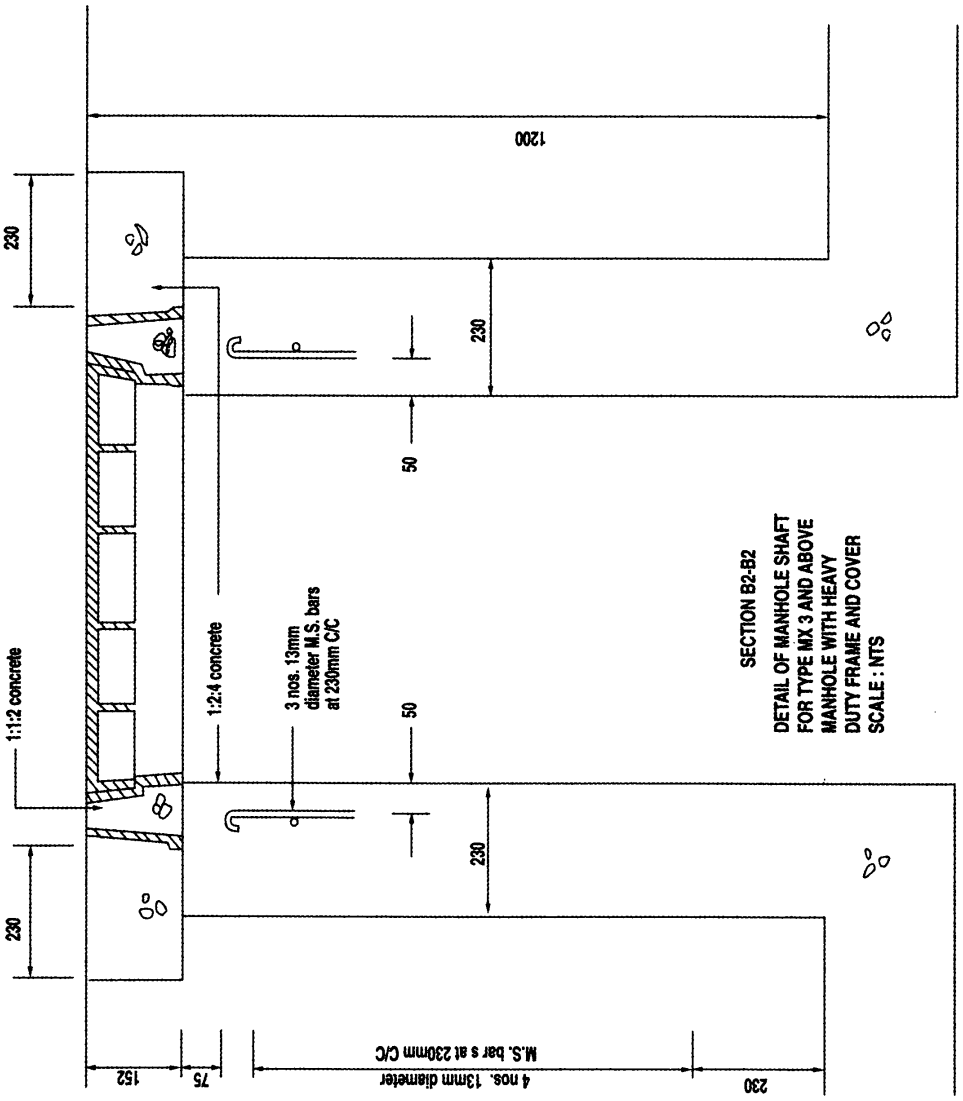


FIGURE 4-26 : MANHOLE DRAWINGS - TYPE MX3 & ABOVE



PART 5 ACCOMMODATION FOR MDF AND EQUIPMENT

5.1 GENERAL

5.2 MAIN DISTRIBUTION FRAME (MDF)

5.3 MDF ROOM LOCATION - OTHER PLANNING CONSIDERATIONS

5.4 BUILDING REQUIREMENTS

5.5 AIR-CONDITIONING REQUIREMENTS

5.6 ELECTRICAL REQUIREMENTS

5.7 EARTHING REQUIREMENTS

5.8 OTHER ENVIRONMENTAL CONDITIONS

PART 5 ACCOMMODATION FOR MDF AND EQUIPMENT

5.1 GENERAL

5.1.1 The MDF is the interconnecting point between the main incoming cables and the local distribution cables. The following guidelines are intended to assist the building planner (architect or M & E consultant) in arriving at an engineering facilities provision plan for telecommunication services acceptable to the PTLs/TSLs.

5.1.2 A room is to be provided to accommodate the MDF and telecommunication equipment. This room shall be referred to as Telecom MDF room and shall be shared by the PTLs/TSLs authorised by IDA.

5.1.3 In addition, building owners/developers shall provide a room hereinafter referred to as "Customer's MDF Room" for accommodating their own MDF and local distribution cables.

5.1.4 For single tenant buildings, the PABX system shall be installed inside the Customer's MDF Room.

5.1.5 In the case of residential developments, the size of Telecom MDF room to be provided shall be determined by the PTLs/TSLs depending on the total number of dwelling units to be served from the MDF room.

5.2 MAIN DISTRIBUTION FRAME (MDF)

5.2.1 The MDF is a vertical frame constructed with galvanised mild steel bars and angle iron, each one being referred to as a "vertical", upon which terminal blocks are mounted. In general, there are two types of MDF construction, i.e.:

(a) Single-sided MDF are mounted on the wall. The detailed construction drawings are as illustrated in Figure 5-1.

(b) Double-sided MDF are mounted on the floor. The detailed construction drawings are illustrated in Figure 5-2.

5.2.2 Room Sizes

(a) The floor space required for the MDF room is as tabulated below:

Usable Floor Area ('000 sq. m)	Telecom MDF Room (sq. m)	Customer's MDF Room (sq. m)
Under 2	13 to 20	7.5 [3.0 m X 2.5 m]
2 - 12	20 to 30	9 [3.0 m X 3.0 m]
12 - 25	30 to 40	10.5 [3.5 m X 3.0 m]
25 - 50	40 to 60	20 [5.0 m X 4.0 m]
50 - 75	60 to 80	24 [6.0 m X 4.0 m]
75 - 100	80 to 100	35 [10.0 m X 3.5 m]

(b) For big development projects or buildings exceeding 30 storeys in height, provision of more than one Telecom MDF room is required.

(c) The floor space for the Telecom MDF room as shown in the above table is meant for reference only. The shape of the room is subject to the PTLs/TSLs' approval.

5.3 MDF ROOM LOCATION - OTHER PLANNING CONSIDERATIONS

5.3.1 The Telecom MDF room shall be located so that it is readily accessible to authorised personnel at all times. Hence, it should be accessible directly from the outside of the building as mentioned specifically in Part 1 paragraph 1.6.1 so as to comply with FSB's condition of waiver for water sprinkler installation in the MDF room.

5.3.2 MDF rooms should not be located in the following environment:

(a) MDF room in basement is generally unacceptable as it is susceptible to flooding, dampness and dirt unless adequate protection against such eventualities is provided. Preferably, it should be situated at the street or first floor level. However, in buildings with more than one basement, MDF room located at the top most basement floor may be considered;

(b) Located under a car parking area, washroom or toilet where it is again susceptible to dampness or moisture;

(c) Where it is subject to perceptible vibration such as the movement of vehicles or operation of mechanical equipment. The tolerance of the installed equipment to vibration shall be less than 0.05G, where G is the acceleration due to gravity (G=9.81 metres per second square); and

(d) Where it is subject to discharge of steam, fumes, gases or dust. Otherwise, sealing is needed to protect the equipment from such an environment.

5.3.3 All other services shall not share or pass through the Telecom MDF room, e.g. water pipe, chilled water pipe, gas pipe, etc.

5.3.4 When planning the Telecom MDF room location, due consideration should also be given to the feasibility of linking it to riser ducts via cable trays.

5.3.5 The Telecom MDF room shall preferably be as close as possible to the riser duct(s).

5.4 BUILDING REQUIREMENTS

5.4.1 The room shall be constructed in concrete with brick wall, plastered and painted a light colour.

5.4.2 A clear headroom of 3.5m is required to accommodate both the equipment racks and overhead cable trays.

5.4.3 The floor must be structurally designed to withstand the loading of equipment and batteries within safety limits. A floor loading design of 480kg/sq.m. will be sufficient.

5.4.4 Vinyl tile finishes for the floor is preferred, otherwise, it should at least be properly screeded.

5.5 AIR-CONDITIONING REQUIREMENTS

5.5.1 **For commercial project:**

(i) In the Telecom MDF room where telecommunication multiplexing equipment is installed, air-conditioning is preferable and the recommended environmental condition inside the room should be:

(a) Temperature: 22°C ± 2°C;
(b) Relative Humidity: < 70%.

(ii) If the air-conditioning is not from a central system which is protected against power failure, then a window air-condition unit or Direct Expansion (DX) unit is preferred and its power supply should be backed up by the standby generator in the building.

(iii) The heat load of the equipment is estimated at 300 watts/sq. m.

5.5.2 **For residential development**:

The Telecom MDF Room must be adequately ventilated if an air-conditioner is not provided.

5.6 ELECTRICAL REQUIREMENTS

5.6.1 Sufficient 230V 50Hz AC single-phase 13 amp power points and 30 amp isolators are to be provided to power the PTLs/TSLs' telecommunication equipment. At least four 30 amp isolators and four 13 amp power points are required to be provided inside the MDF room. For buildings without standby generators, the 30 amp isolators shall be connected to power sockets for connection to portable generators in the event of extended power failure. A manually activated switch shall be provided to effect the changeover. ELCB with earth leakage current of l00mA and MCBs shall be provided.

5.6.2 Batteries will be used by PTLs/TSLs to backup the equipment against power failure of short duration. However, it is strongly recommended that the power supply to the Telecom' MDF room, especially that to the rectifier, be connected to the standby generator, if any, in the building.

5.6.3 The illumination level shall be at least 450 lux on the vertical plane of all rack and frame surfaces. Fluorescent tube lighting is preferred.

5.7 EARTHING REQUIREMENTS

5.7.1 For earthing of the Telecom MDF, the owner should provide a building ground grid of 1 ohm or less without the use of salts. This earthing point is to be used for communication equipment only and all systems must be bonded together properly.

5.7.2 This earthing point shall be connected to the earth electrode system via earth cable with a cross section area of not less than 50 sq. mm, as recommended by ITU-T handbook on earthing of telecommunication installations. The earth bar shall be at least 460 mm long with 6 mm ∅ screw holes spaced at 60 mm centre to centre.

5.7.3 The developer or owner (as the case may be) shall submit the certified test result of the earth system together with actual layout diagrams showing the earth system arrangement to the PTLs/TSLs during the handing over of the Telecom MDF room.

5.7.4 The developer or owner (as the case may be) shall maintain the earth system throughout the lifetime of the building.

5.8 OTHER ENVIRONMENTAL CONDITIONS

5.8.1 Reasonable control of dust particles must be exercised, with particle sizes 50 microns at the most.

5.8.2 Fire safety measures conforming to FSB's requirements shall be provided in the Telecom MDF room where telecommunication equipment is installed. No sprinkler is allowed.

FIGURE 5-1 : SINGLE - SIDED MAIN DISTRIBUTION FRAME

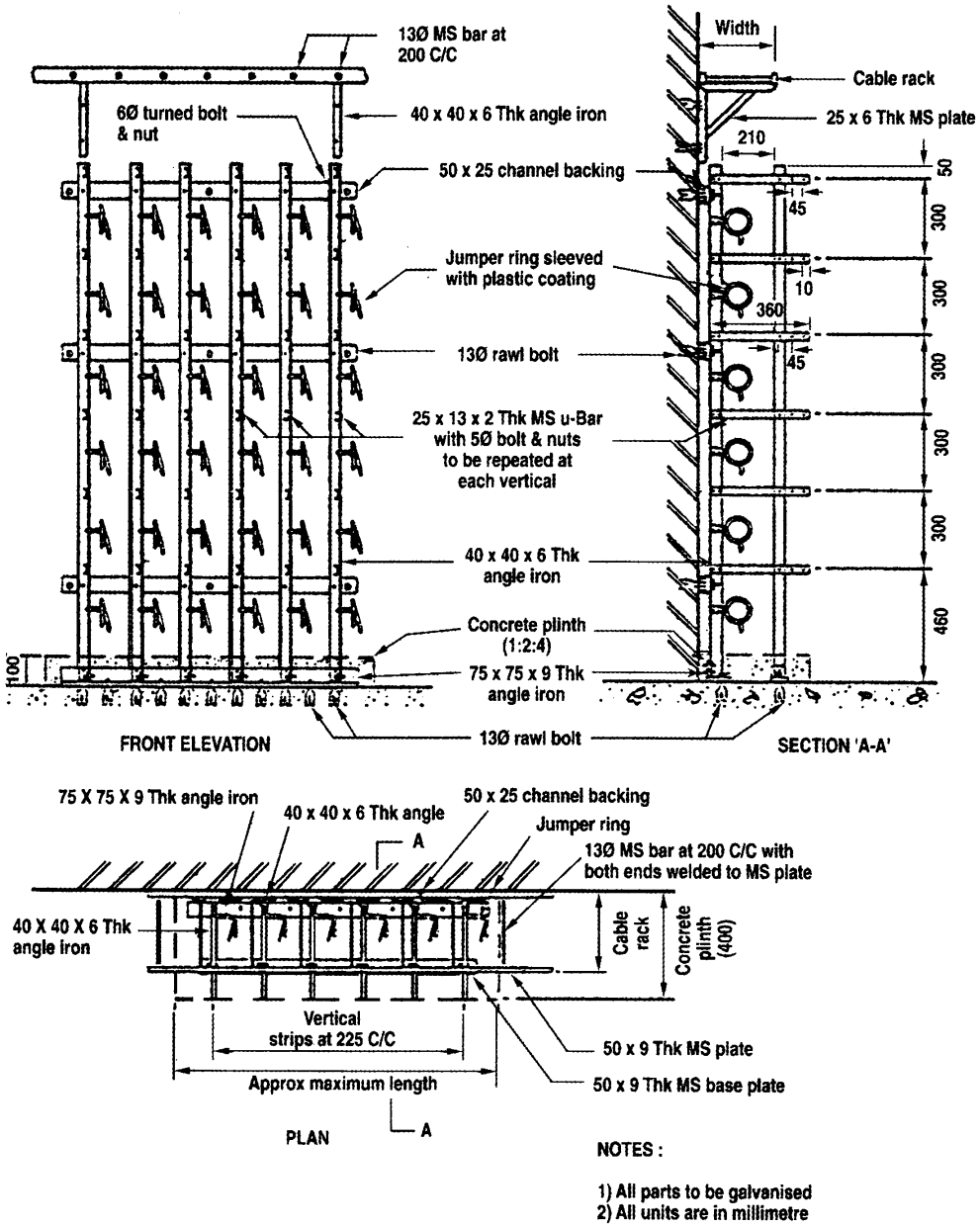
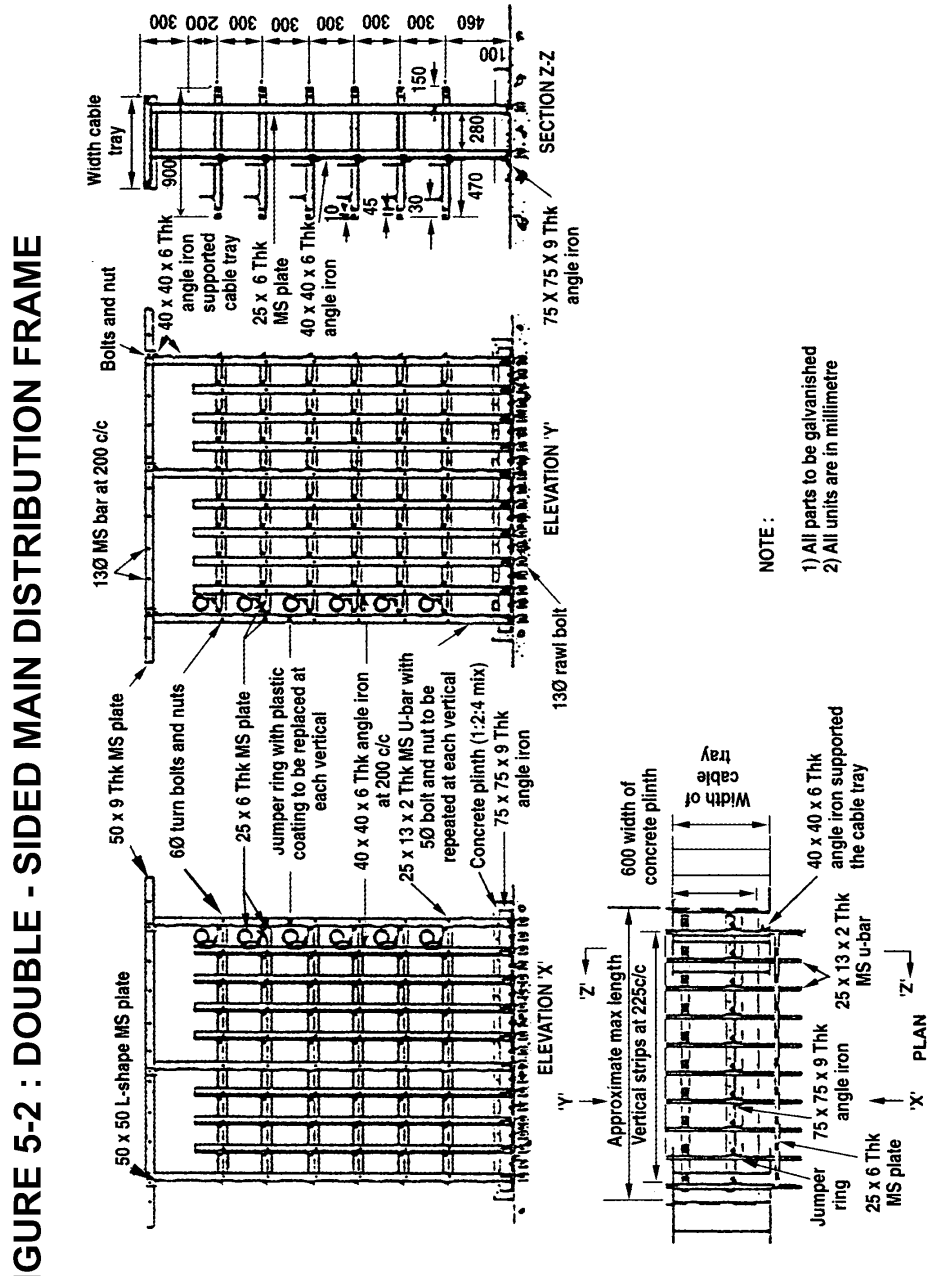


FIGURE 5-2 : DOUBLE - SIDED MAIN DISTRIBUTION FRAME



PART 6 RISER DUCT & TELECOMMUNICATION EQUIPMENT ROOM

6.1 GENERAL

6.2 REQUIREMENTS FOR RISER DUCT

6.3 RISER DUCT DESIGN

6.4 TELECOMMUNICATION EQUIPMENT ROOM (TER) FOR FLATS AND CONDOMINIUMS

PART 6 RISER DUCT & TELECOMMUNICATION EQUIPMENT ROOM

6.1 GENERAL

6.1.1 The riser duct is a system consisting of compartments vertically aligned and usually beginning from the first storey or basement and extending through to the topmost level of the building. It serves to accommodate local cables from the Telecom MDF room or Telecommunication Equipment Room (TER) to various floors of the building. The local cables terminate onto the IDFs or DP on each floor in the riser duct.

6.1.2 To cater for computer links between floors, developers should provide a separate communication duct for this usage as well as other circuits for Public Address System or tenants' TCDS or computer networking cables.

6.1.3 In the absence of the communication riser duct, approvals from both IDA and the Management Corporation are to be sought for using the riser ducts which are designated for the PTLs/TSLs' and other IDA-authorised telecommunication licensees' exclusive use.

6.1.4 In addition to the requirements for riser ducts and TER as specified in this Part 6, requirements for the provision of Coaxial Distribution Room (CDR) and riser duct space for broadband coaxial cable system (BCS) are specified in Part 12 of this code of practice.

6.2 REQUIREMENTS FOR RISER DUCT

6.2.1 General requirements for riser duct are as follows:

(a) Riser shafts have to be located in a direct vertical line wherever possible throughout the building.

(b) At each floor level, a door, which can be fully opened outwards throughout the entire width of the duct, is required for easy access. The door shall be of standard height, i.e. 2100 mm. Where the width exceeds 1800 mm, it shall be of double leaves. In all cases, the fire-rating of the doors are to comply with FSB's requirement.

(c) A cable tray or ladder is required in the riser duct to facilitate the installation of cables. Refer to Part 7 paragraph 7.2.8 for detailed requirements for cable tray.

(d) There shall be a 100 mm high concrete skirting/kerb around the riser duct opening/slot or at the doors of the riser duct on each floor to prevent the ingress of water.

(e) A master key system shall be provided for all doors of the riser duct.

(f) Adequate lighting (450 lux) is required in the riser duct. One 13 amp power point is required on each floor inside the riser duct.

(g) A slot or opening is required on each floor directly below a cable tray or ladder in a riser duct for inter-floor cabling. In a commercial building, such slots or openings shall be of the dimensions 600mm x 150mm or equivalent cross-sectional area.

(h) The wall of the riser duct shall be smoothly plastered and painted a light colour.

(i) At vertical intervals of not exceeding 15m, the riser duct openings/slots on floors shall be sealed with a fire-resistant material approved by the FSB and having the fire rating of at least half-an-hour. The building owner shall provide openings through the fire resistant material if additional cables are required to be installed and thereafter, to seal the opening after the cables have been installed.

(j) The riser duct must be interlinked to the cable distribution system by openings or conduits.

(k) The riser duct shall be for the exclusive use of PTLs/TSLs and telecommunication licensees aurthorised by IDA.

6.3 RISER DUCT DESIGN

6.3.1 The number of riser ducts to be provided will depend on the floor area to be served. Generally, the serving radius of each riser duct is not to exceed 40m. Each and every riser duct is to be labelled as “Telecom Riser” and numbered for easy reference and identification. A pre-cabling schedule showing the addresses of users to be served against the respective riser duct as shown in Table below is to be forwarded to the PTLs/TSLs three (3) months prior to building completion or earlier.

Serving Riser Duct No.	Address of Units

6.3.2 Developer or owner (as the case may be) is to ensure that the pre-cabling to all units by their licensed telecommunication wiring contractors are done strictly to the pre-cabling schedule.

6.3.3 It is also the responsibility of the developer or owner (as the case may be) to provide IDFs inside the riser duct for termination of both cables and internal wiring. Its positioning and method of construction are as shown in Figures 6-1 and 6-2 respectively.

6.3.4 For commercial and industrial building buildings, the size of riser duct shall depend on usable floor area as follows:

Up to 60, 000 sq.m : 1100 mm x 600 mm

More than 60, 000 sq. m: 1600 mm x 800 mm

6.3.5 For residential buildings, the size of riser duct shall be 600 mm x 600 mm.

6.4 TELECOMMUNICATION EQUIPMENT ROOM (TER) FOR FLATS AND CONDOMINIUMS

6.4.1 To cater for the provision of telephone and broadband services via fibre-based transmission equipment, a telecommunication equipment room (TER) of the following size is to be provided in each block of private apartments or condominiums.

No. of Units	Size of TER
2 to 9 units	2 m x 2 m
10 to 19 units	2 m x 3 m
20 to 59 units	3 m x 3 m
60 to 120 units	3 m x 4 m
Above 120 units	4 m x 4 m

6.4.2 The specifications for building, electrical and earthing requirements for the TER are as follows:

(a) High level vents for natural ventilation;

(b) It should not be located under or near wet area. Floor to be raised 100 mm to prevent ingress of water and screeded. Alternatively, a kerb, 100mm high, shall be provided;

(c) Internal walls to be plastered and painted a light colour;

(d) For 19 or less dwelling units, two nos. of 15 amp and two nos. of twin-13 amp power points are to be provided; or
For 20 units and above, two no. of 30 amp isolators and two nos. of twin-13 amp power points are to be provided.

(e) Two 40-watt fluorescent tube lamps, with on/off switch. Circuit breaker to be located inside the TER;

(f) For earthing requirements inside the TER, see Part 5 paragraphs 5.7.1 and 5.7.2.

(g) The number of 110 mm ∅ uPVC lead-in pipes to be provided shall be as follows:

No. of Units	No. of Lead-in Pipes
2 to 19 units	4 (2 x 2)
20 to 120 units	6 (2 x 3)
Above 120 units	8 (2 x 4)

Note: Where a MDF room is provided in a residential block which is linked by underground telecommunication uPVC pipes to other TER(s) within the same residential development boundary, the number of lead-in pipes to be provided to the MDF room shall be increased as determined by the TFCC.

FIGURE 6-1 : TYPICAL LAYOUT FOR RISER DUCT IN COMMERCIAL BUILDING

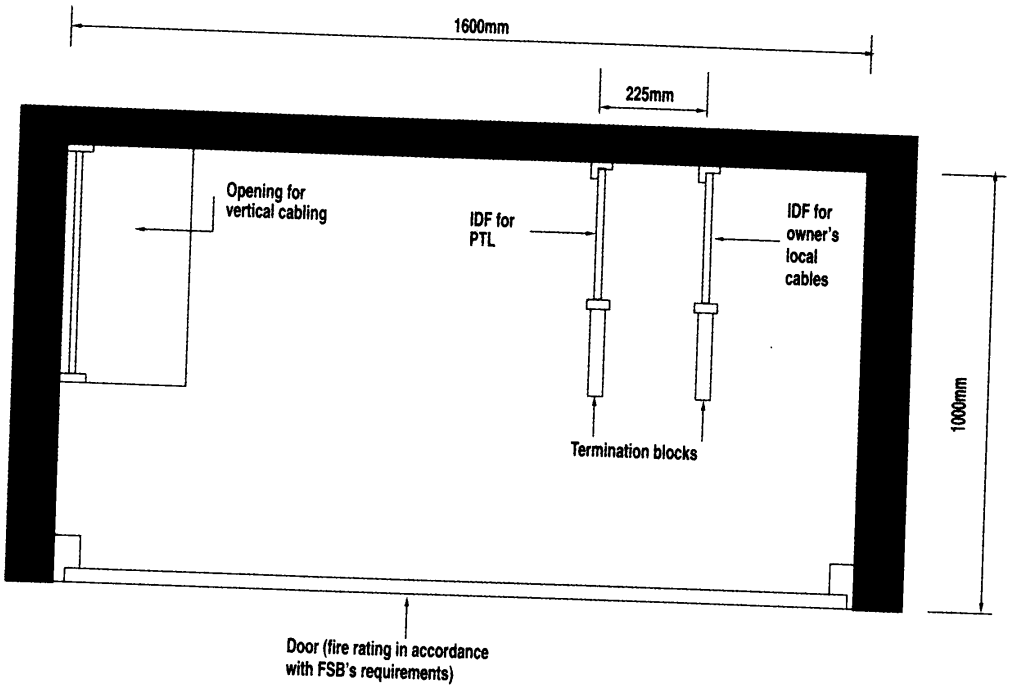
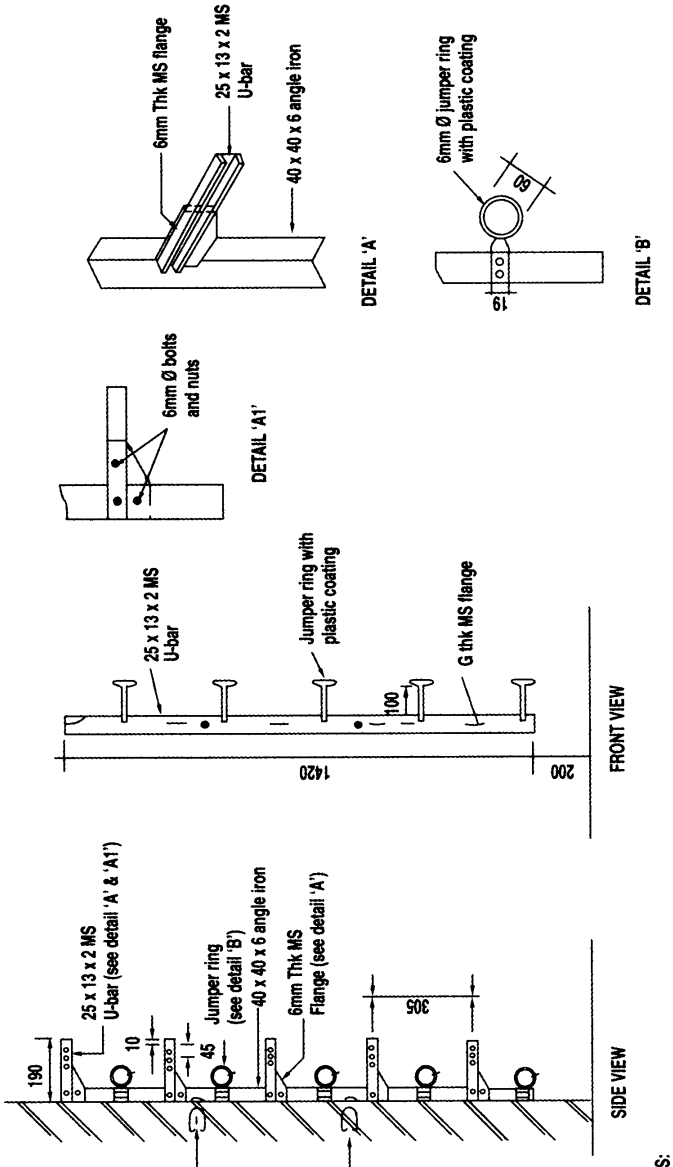


FIGURE 6-2 : DETAIL OF IDF INSTALLATION



NOTES:

1) Unless otherwise specified, all materials used for the construction of the IDF shall be mild steel conforming to BS 4360 or equivalent.

2) The IDF is to be painted with one anti-rust coat followed by one primer coat and finish by one spray paint of beige colour and conform to BS 10 B15.

3) The bolts and nuts shall conform to BS 4395 part 1 equivalent.

4) All dimension in millimetres unless otherwise stated.

PART 7 IN-BUILDING RADIO COVERAGE FOR PUBLIC MOBILE SERVICES

7.1 GENERAL

7.2 RESPONSIBILITY OF DEVELOPERS OR OWNERS

7.3 OFFICIAL REQUEST TO PCMTS/PRPS LICENSEES

7.4 ENQUIRIES

PART 7 IN-BUILDING RADIO COVERAGE FOR PUBLIC MOBILE SERVICES

7.1 GENERAL

7.1.1 While the Public Cellular Mobile Telephone Service (PCMTS)/Public Radio Paging Service (PRPS) licensees endeavour to provide island-wide coverage for public mobile services, it is constrained by radio propagation characteristics from extending the coverage into buildings and their basements. The difficulty to provide in-building coverage is significant where building structures use materials unfavourable to radio signal penetration, e.g., metallic wall cladding, metalised window film, etc.

7.1.2 The PCMTS/PRPS licensees shall endeavour to provide adequate signal strength outdoors, i.e., outside the building coverage.

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

7.2 RESPONSIBILITY OF DEVELOPERS OR OWNERS

7.2.1 These guidelines shall not exempt the building developers or owners (as the case may be) and/or their contractors from obtaining:

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

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

7.3 OFFICIAL REQUEST TO PCMTS/PRPS LICENSEES

7.3.1 The building developer or owner may make an official request to the PCMTS/PRPS licensees for consideration to install radio equipment to improve in-building coverage.

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

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

7.3.4 In the event that the PCMTS/PRPS licensees undertake the in-building coverage improvement work, the building developer or owner (as the case may be) shall provide an equipment room and antenna support structure ready for installation of radio equipment. The details are as follows:

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

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

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

(d) A PVC cable duct of 110 mm diameter across the ceiling above each floor including basement;

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

(f) Commercial (PUB) AC power supply of 30A, 230 volts terminated at a distribution board in the equipment room.

7.4 ENQUIRIES

7.4.1 Any enquiry on these guidelines and technical specifications can be made to the PCMTS/PRPS licensees.

PART 8 CABLE DISTRIBUTION SYSTEMS

8.1 GENERAL

8.2 CABLE DISTRIBUTION SYSTEMS FOR NON-RESIDENTIAL BUILDINGS

8.2.1 Underfloor Duct Distribution System

8.2.2 Raised Floor Distribution System

8.2.3 Cellular Floor Distribution System

8.2.4 Ceiling Distribution System

8.2.5 Perimeter Raceway Distribution System

8.2.6 Poke-Through Distribution System

8.2.7 Conduit Distribution System

8.2.8 Cable Trays

8.2.9 Surface Conduits

8.2.10 Exposed Trunkings

8.2.11 Concealed Cabling In Office Furniture

8.2.12 Suitable Distribution Systems For Various Types Of Premises

8.3 CABLE DISTRIBUTION SYSTEMS FOR RESIDENTIAL BUILDINGS

8.3.1 Under Floor Distribution System

8.3.2 Perimeter Raceway Distribution System

8.3.3 Ceiling Distribution System

8.3.4 Multi-Riser System

PART 8 CABLE DISTRIBUTION SYSTEMS

8.1 GENERAL

8.1.1 Cable distribution systems are the facilities provided to distribute telephone cables installed from the MDF to the riser ducts and the telephone outlets.

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

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

Therefore, where it is possible to plan the position of the outlets, for example in residential buildings, it is advisable to plan for as many outlets as desired (Figure 8-1).

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

8.1.4.1 Non-residential buildings comprise:

(a) Multi-storey office, shopping cum residential complex;
(b) Multi-storey office building;
(c) Hotel;
(d) Factory/warehouse;
(e) Others, e.g., food centres, markets, hospitals, cinemas, club houses, religious buildings, shophouses, etc.

8.1.4.2 Residential buildings comprise:

(a) Multi-storey residential buildings (e.g. flats, private apartments, condominiums);

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

8.1.5 **Cable Distribution Systems For Non-Residential Buildings**

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

8.1.5.1 Concealed Distribution Systems:

(a) Underfloor 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.

Certain commercial buildings may require a combination of two or more of the above mentioned systems for distributing telephone cables.

8.1.5.2 Exposed Distribution Systems:

(a) Cable tray;
(b) Exposed conduit;
(c) Exposed trunking.

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

8.1.6 Cable Distribution Systems For Residential Buildings

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

(a) Under floor distribution system;
(b) Perimeter raceway distribution system;
(c) Ceiling distribution system;
(d) Multi-riser system.

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

8.1.7 Capacity Of Distribution System

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

8.1.8 Identification Of Distribution System

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

8.1.9 Surface Cabling

It is important to note that for concealed cables that become defective after installation and are not accessible, the PTLs/TSLs shall replace the cables using the

surface cabling method, unless additional facilities suitable for concealed cabling are provided.

8.1.10 **Earthing Of Metal Parts**

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

(a) CP5: Code of Practice on 'Wiring of Electrical Equipment of Buildings'; and
(b) CP16: Code of Practice on 'Earthing'

8.2 CABLE DISTRIBUTION SYSTEMS FOR NON-RESIDENTIAL BUILDINGS

The requirements of the various types of distribution systems suitable for use in commercial buildings are as follows:

8.2.1 **Underfloor Duct Distribution System For Non-residential Buildings**

8.2.1.1 General

(a) Underfloor duct distribution system, when properly designed is a good method for distributing telephone cables (Figure 8-2).

(b) The system suitable for use in commercial buildings may be designed with total access or with junction box access.

(c) A system designed with total access throughout its entire length to enable easy installation and maintenance of cables is known as the trench duct system (Figure 8-3).

8.2.1.2 Basic Requirements

Underfloor duct systems shall comply with the following basic requirements:

(a) The duct shall extend into the telephone riser and link to the floor trench (Figures 8-4 & 8-5).

(b) The system shall be designed to enable access with little or no disruption to the tenants. Access to the system shall be from the floor it is designed to serve, and not from the adjacent floor.

(c) The system shall be designed with the main junction boxes along the common corridor area or passageway. (Figure 8-6)

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

(e) The system shall be provided with floor outlets to lead the telephone cables out of the ducts. (Figure 8-7)

(f) For an underfloor duct system with junction box access, the thickness of the floor screed on top of the ducts shall not exceed 40 mm for ease in carrying out cabling work.

8.2.1.3 Duct

(a) The size of the underfloor duct shall 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. Appendix A.7 lists the dimensions of the different types of cable used.

(b) The underfloor duct shall be made of either high impact rigid PVC or galvanised metal or steel of welded construction and of sufficient thickness.

(c) The duct shall be of a minimum internal height of 25 mm.

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

8.2.1.4 Junction Boxes

(a) The system shall be provided with junction boxes at all junctions and bends to enable drawing of telephone cables. The distance between two junction boxes in a straight run shall preferably not exceed six metres (Figure 8-8).

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

(c) The size of the junction box shall increase proportionately with that of the floor ducts.

(d) The cover of the junction box should preferably be square. Junction box covers shall be secured to the junction box by means of screws or other acceptable means (Figure 8-9). The screws shall remain intact on the junction box cover when the cover is removed.

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

(f) All junction boxes and telephone outlets shall be readily accessible at all times. Walls or partitions shall not be constructed on top of them (Figure 8-10).

(g) For carpeted floors, appropriate slits shall be made on the carpet at all junction boxes and floor outlets to enable access to the floor ducts. Figure 8-11 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 supplement 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 shall be done along the edges of the cover.

8.2.1.5 Responsibility of Building Owners

(a) The building developer or owner (as the case may be) shall install and maintain the outlets and junction boxes.

8.2.1.6 Advantages of Underfloor Duct System

(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.

(c) Safe and easy working position.

8.2.1.7 Disadvantages of Underfloor Duct System

(a) Junction boxes or header ducts must be made accessible even when covered with carpet.

(b) Water can seep through the junction boxes and damage the cable.

8.2.2 Raised Floor Distribution System For Non-residential Buildings

8.2.2.1 General

(a) A raised floor distribution system is a floor assembly superimposed upon an existing floor. Telephone cables are distributed in the space between the two floors (Figure 8-12).

(b) Raised Floor System is usually used in computer rooms and offices with a high number of telephones.

(c) The floor assembly consists of a series of square modules of steel plates or panels or concrete slabs resting upon pedestals (Figure 8-13).

8.2.2.2 Basic Requirements

Raised floor systems shall comply with the following 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 25 mm below the floor panel.

(b) Trunking or cable tray shall preferably be provided to segregate telephone cables from electrical cables and cables of other services placed below the raised floor.

8.2.2.3 Responsibilities Of Building Owner

(a) The building owner shall provide concealed floor fittings or suitable outlets for the telephone cables.

(b) The building owner shall provide the trunking or cable tray required to segregate telephone cables from electrical cables and cables of other services placed below the raised floor. (Figure 8-14)

(c) The building owner shall be responsible for removing and replacing floor panels.

(d) The building owner shall possess the necessary fitting devices for removing or replacing the floor panels.

8.2.2.4 Advantages of Raised Floor Distribution System

(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 telephone requirements can be easily catered for.

(e) Can accommodate a large number of cables.

8.2.2.5 Disadvantages of Raised Floor Distribution System

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

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

(c) Broadloom carpet cannot be used.

8.2.3 Cellular Floor Distribution System For Non-residential Buildings

8.2.3.1 General

(a) A cellular floor distribution system serves as a structural floor as well as a system for distributing telephone cables and cables of other services. Figure 8-15 shows the different compartments of a typical cellular floor system.

(b) The cellular floor distribution system comprises two main components:

(i) Distribution Cells
These are mainly constructed of steel but concrete distribution cells can also be used.

(ii) Header duct or Trench header
These are used to link the distribution cells to the telephone riser.

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

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

8.2.3.2 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 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 telephone riser, it is important that adequate capacity be provided.

8.2.3.3 Cellular Floor System With Trench Header

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

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

8.2.3.4 Basic Requirements

Cellular floor systems shall comply with the following basic requirements:

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

(b) No partition shall 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 shall meet the telecommunication needs of the building. Generally, it is recommended that every 1.8 sq. m. of the floor space should have at least one preset insert unit.

8.2.3.5 Responsibilities Of Building Owner

(a) The building owner shall remove the covers of the trench header and any furniture resting on the covers, when telephone installation or maintenance is being carried out.

(b) The building owner shall possess the necessary equipment for removing trench header covers and detecting the preset insert units.

(c) The building owner shall locate and make available the individual preset insert unit connected to the cell to enable installation of telephone cables.

(d) The building owner shall undertake to drill the concrete floor and install afterset inserts at locations where telephone services are required and preset insert units are not available.

8.2.3.6 Advantages of Cellular Floor System

(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.

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

8.2.3.7 Disadvantages of Cellular Floor System

(a) More coordination is required. This is because the preset insert units need to be located prior to telephone installation.

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

8.2.4 Ceiling Distribution System For Non-residential Buildings

8.2.4.1 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 8-16).

(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.

8.2.4.2 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 shall be provided for easy and unrestricted access to the cable trays (Figure 8-17).

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

(b) 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 8-18 shall be maintained.

(c) The cable trays and trunkings shall be in accordance with the specifications described in paragraphs 8.2.8. and 8.2.10 respectively.

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

8.2.4.3 Responsibility of Building Owner

(a) The building developer or owner (as the case may be) shall be responsible for removing and replacing ceiling boards.

8.2.4.4 Advantages of Ceiling Distribution System

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

8.2.4.5 Disadvantages of Ceiling Distribution System

(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.

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

8.2.5 Perimeter Raceway Distribution System For Non-residential Buildings

8.2.5.1 General

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

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

They can also be mounted at any height along the wall provided that these raceways will not be obstructed by signboards, etc., to be erected by potential tenants or shop-owners (Figures 8-19, 8-20 and 8-21).

(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, telephone and cables of other services (Figure 8-22).

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

8.2.5.2 Basic Requirements

(a) The perimeter raceways shall be provided with removable covers placed at a regular interval of two metres. The power and telephone sockets shall preferably remain intact on the case of the raceway when the covers are removed.

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

(c) Fittings for mounting telephone sockets shall be provided.

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

8.2.5.3 Responsibility Of Building Owner

The building owner shall be responsible for removing any object that may obstruct the removal of the covers from the raceways.

8.2.5.4 Advantages of Perimeter Raceway System

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

(b) Telephone outlets may be conveniently placed anywhere along the raceway.

8.2.5.5 Disadvantages of Perimeter Raceway System

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

(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 underfloor ducts need to be incorporated.

8.2.6 **Poke-Through Distribution System For Non-residential Buildings**

8.2.6.1 General

(a) In poke-through systems, the telephone 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 8-24).

(b) This system is vulnerable to the spreading of fire, gases, and smoke from floor to floor. Therefore, the use of this system must comply with Fire Safety Bureau (FSB)'s requirements.

8.2.6.2 Disadvantages Of Poke-Through System

The poke-through system has many disadvantages and is therefore not recommended for use. Disadvantages of poke-through system are as follows:

When holes are drilled through the floor slab, they:

(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 telephone services to tenants on the floor above.

8.2.7 **Conduit Distribution System For Non-residential Buildings**

8.2.7.1 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 8-25).

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

8.2.7.2 Basic Requirements

(a) The size of the conduit shall 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 8-1.

(b) Conduits shall preferably be of at least 25 mm diameter.

(c) Conduits provided shall be as straight as possible and shall be rigidly mounted.

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

(e) Where it is not practical to have a junction box at a bend, the bend shall 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 shall preferably be not more than two metres.

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

(g) Flexible conduits shall not be used.

(h) Conduits shall be free from internal roughness, sharp edges, moisture and dirt.

Conduit Size mm	Recommended numbers of cable							
	4-w	6-w	8-w	5-pr	10-pr	20-pr	40-pr	80-pr
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

Table 8-1 : Recommended Capacities For Conduits

8.2.8 **Cable Trays**

8.2.8.1 Basic Requirements

(a) The material used for the cable tray shall be perforated and galvanised.

(b) All cable trays shall be truly aligned and securely mounted.

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

(d) Cable trays shall be straight run, and for any change in direction, the bend shall have a minimum radius of 600 mm (Figure 8-26).

(e) No bolts, screws or sharp objects shall 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 shall be separated for their entire length by a clearance as specified in

paragraph 1.3.2. The high-tension cable shall be clearly indicated by signs or symbols.

(h) The maximum height of cable trays for horizontal cabling shall not exceed 3.3 metres from the floor level.

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

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

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

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

8.2.9 **Surface Conduits**

8.2.9.1 General

(a) The requirements for conduits, mounted and exposed along walls are similar to conduits that are concealed underfloor or in the ceiling. Please see paragraph 8.2.7 for detailed requirements.

(b) For surface mounted conduits, the maximum height of the conduits for horizontal cabling shall not exceed 3.3 metres from the floor level.

8.2.10 **Exposed Trunkings**

8.2.10.1 Basic Requirements

(a) The size of the trunking shall be such that the cross-sectional area of all the cables placed in the trunking does not exceed 30% of the cross-sectional area of the trunking. Please refer to Table 8-1 for the amount of cables of various sizes that can be installed in conduits of various sizes.

(b) Trunking provided shall be as straight as possible and shall be rigidly mounted.

(c) The maximum height of the trunking for horizontal cabling shall not exceed 3.3 metres from the floor level.

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

(e) The cover of the trunking shall preferably be friction fit or secured by simple device (not screws) to permit easy access (Figure 8-27).

(f) Outlets shall be provided along the side of the trunking.

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

(h) Segregation of telephone cables from electrical cables shall be in accordance with paragraph 1.3.2.

8.2.11 **Concealed Cabling In Office Furniture**

8.2.11.1 General

Office furniture with built-in channels to conceal cables are 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.

8.2.11.2 Basic Requirements

To ensure a safe and efficient system, this office furniture shall meet the following basic requirements:

(a) The cable channel shall be easily accessible for the installation of cables by the PTLs/TSLs' or the tenants' wiring contractors.

(b) Segregation of telephone cables and power cables shall be maintained.

(c) If metal channels or ducts are used, they shall be earthed according to the following PUB's specifications:

(i) CP5: 'Code of Practice on Wiring of Electrical Equipment of Buildings'; and

(ii) CP16: 'Code of Practice on Earthing'.

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

(e) The furniture shall be positioned as close to the socket outlet points as possible.

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

(g) The furniture should preferably be provided with telephone sockets that comply with the mechanical specification of the FCC (Federal

Communications Commission) specifications Part 68 Sub-Part F (Paragraph 3 of Appendix A.7).

8.2.12 **Suitable Distribution Systems For Various Types Of Premises**

The suitable distribution systems for various premises are as shown below in Table 8-2.

TABLE 8-2

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

8.3 CABLE DISTRIBUTION SYSTEMS FOR RESIDENTIAL BUILDINGS

The requirements of the various types of distribution systems suitable for use in residential buildings are as follows:

8.3.1 Underfloor Distribution System For Residential Buildings

8.3.1.1 General

(a) Underfloor distribution system suitable for use in residential buildings are 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 riser. Junction boxes are provided at all junctions and bends (Figure 8-28).

(c) Within each residential unit, conduits are used to distribute the cables to various telephone outlets in each room within the unit (Figure 8-29).

8.3.1.2 Basic Requirements

(a) The duct or conduit at common corridor areas shall extend into the riser (Figure 8-30).

(b) For joint-usage with electrical cables, a separate compartment shall be provided for telephone cables. The segregation requirements shall be in accordance with Part 1 paragraph 1.3.2.

(c) Underfloor ducts or conduits shall be made of either galvanised metal or high impact rigid PVC.

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

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

8.3.1.3 Common Corridor Area

(a) The system shall be provided with junction boxes at all junctions and bends to enable drawing of telephone cables. The distance between two junction boxes in a straight run shall preferably not exceed six metres. (Figure 8-8).

(b) Where it is not practical to have a junction box at a bend, the bend shall 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 shall increase proportionately with that of the floor ducts.

(d) The cover of the junction box should preferably be square. Junction box covers shall be secured to the junction box by means of screws or other means acceptable to the PTL/TSL. The screw shall remain intact on the junction box cover when the cover is removed.

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

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

(g) All junction boxes shall be readily accessible at all times.

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

8.3.1.4 Within Each Residential Unit

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

(b) Conduits shall preferably be of at least 25 mm diameter.

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

(d) The conduit shall be as straight as possible and shall be rigidly mounted.

8.3.1.5 Responsibility Of Property Management

(a) The property management shall be responsible for opening the junction box cover, when required by PTLs/TSLs to provide telephone service.

8.3.1.6 Advantages Of Underfloor System

(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.

(c) Safe and easy working position.

8.3.1.7 Disadvantages of Underfloor Distribution System

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

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

8.3.2 Perimeter Raceway Distribution System

8.3.2.1 General

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 8.2.5.

8.3.3 Ceiling Distribution System

8.3.3.1 General

(a) Cable trays or conduits are used to distribute telephone 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.

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

8.3.3.2 Basic Requirements

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

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

(b) All cable trays shall be truly aligned and securely mounted.

(c) Cable trays shall not be routed through toilets, high-tension (HT) switch rooms, and other unaccessible areas.

(d) “L” brackets for supporting cable trays shall be installed in the same direction.

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

(f) Where cable trays run alongside or across electrical cable, segregation according to the specifications stipulated in Part 1 paragraph 1.3.2 shall be compiled with.

(g) The maximum height of cable trays for horizontal cabling shall preferably not exceed 3.3 metres from the floor level.

(h) There shall be a minimum clearance of 50 mm between the cable tray and any obstruction above it. The space between the tray and false ceiling shall be between 75 mm and 150 mm (Fig 8-18).

8.3.3.3 Within Each Residential Unit

(a) Where conduits are used to distribute telephone cables above a false ceiling, the following requirements shall be compiled with:

(i) Each conduit can have a maximum of two "L" bends. The bends shall be smooth and gradual. Prefabricated gradual bends shall be preferred. The distance between any two bends shall preferably not exceed two metres.

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

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

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

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

(b) Conduit shall be used to lead the cable from false ceiling to each socket outlet on the wall (Figure 8-31).

(c) The socket outlet shall be located at least 300 mm above floor level.

8.3.3.4 Responsibility Of Property Management

(a) The property management shall be responsible for removing and replacing ceiling boards to enable the PTL/TSL serviceman to have access to the cables above the false ceiling.

8.3.3.5 Advantages Of Ceiling Distribution System

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

8.3.3.6 Disadvantages Of Ceiling Distribution System

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

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

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

8.3.4 **Multi-riser System**

8.3.4.1 General

(a) Instead of providing one riser in a high-rise apartment building to serve all the units on the same floor, a multi-riser system with one riser serving one or more units per floor can be used (Fig 8-32).

(b) The riser shall 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 to the telephone locations.

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FIGURE 8-1 : LOCATION OF TELEPHONE OUTLETS & BLOCK TERMINAL IN A RESIDENTIAL UNIT

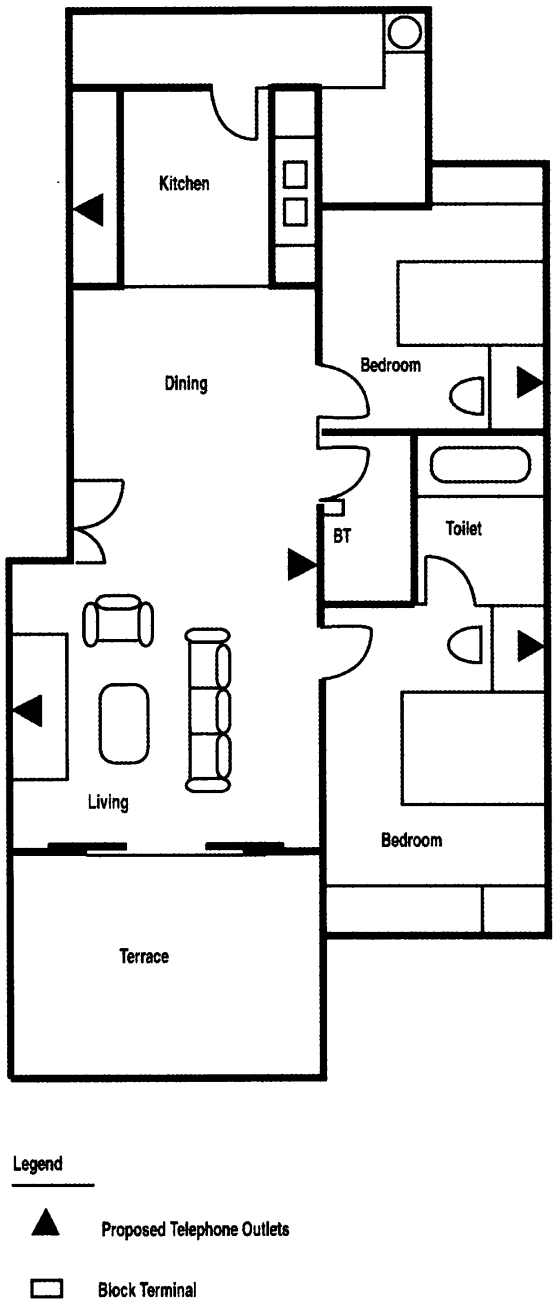


FIGURE 8-2 : UNDERFLOOR DUCT DISTRIBUTION SYSTEM

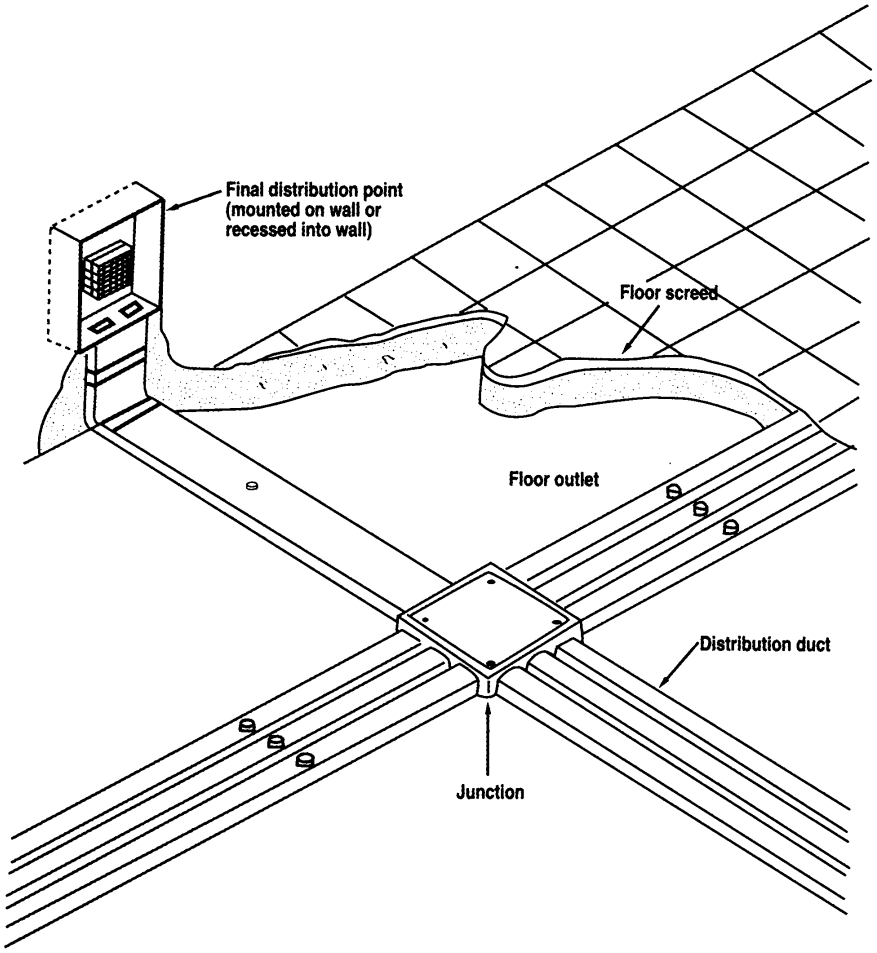


FIGURE 8-3 : TRENCH DUCT SYSTEM

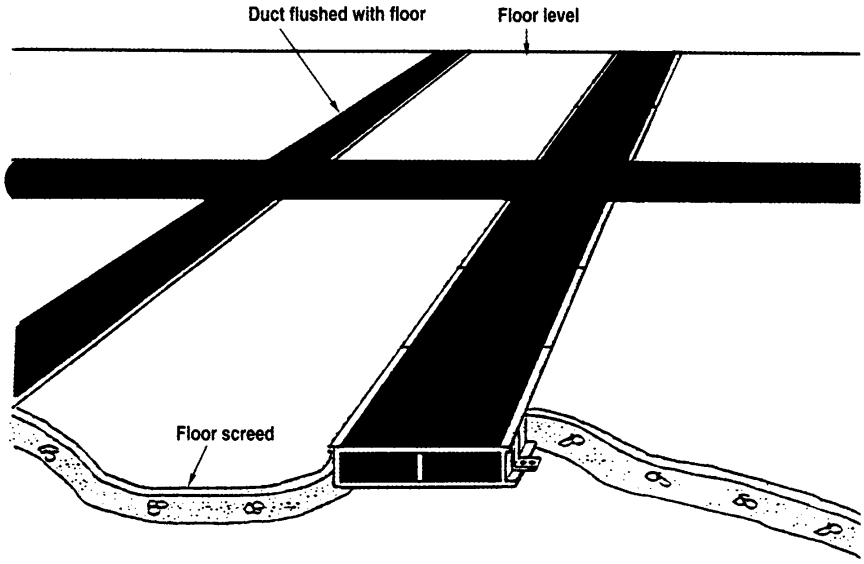


FIGURE 8-4 : UNDERFLOOR DUCT EXTENDED TO FLOOR TRENCH / FLUSH TRUNKING

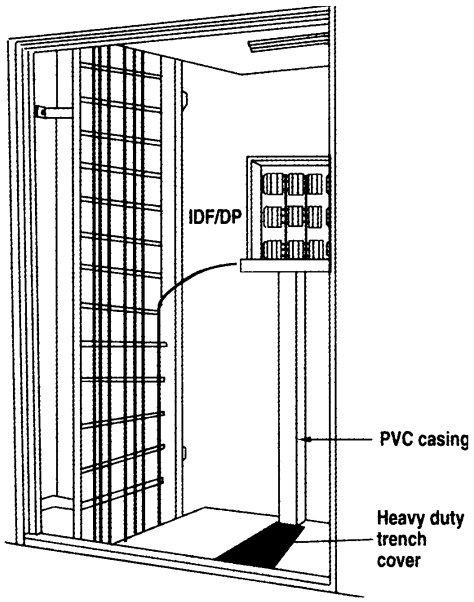
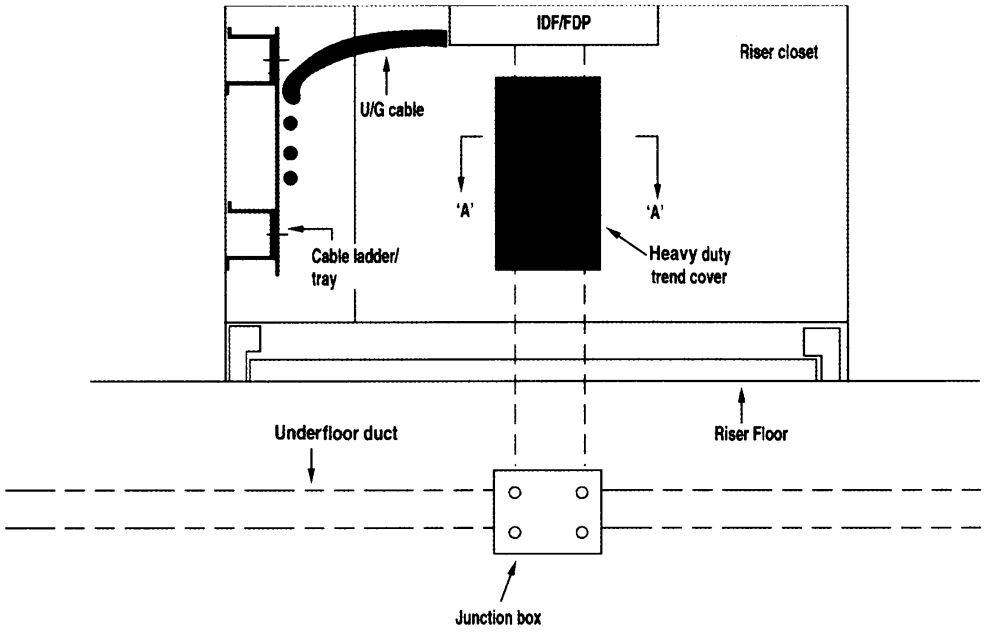
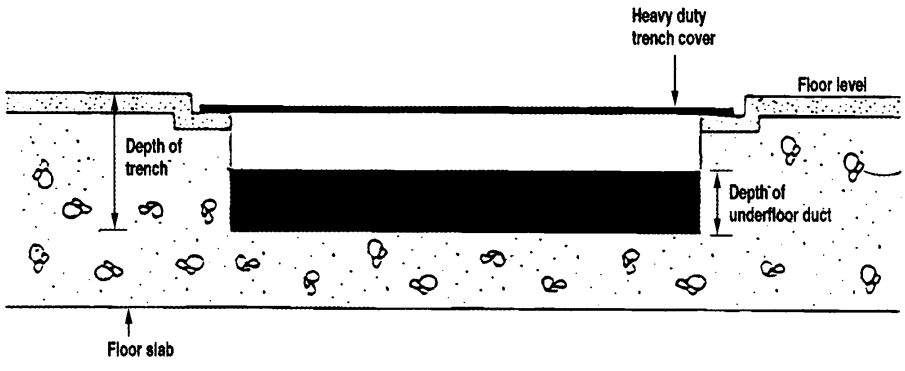


FIGURE 8-5 : FLOOR TRENCH IN CENTRE OR RISER



PLAN VIEW OF RISER



SECTION A-A

FIGURE 8-6 : MAIN JUNCTION BOXES ALONG COMMON CORRIDOR AREA OR PASSAGEWAY

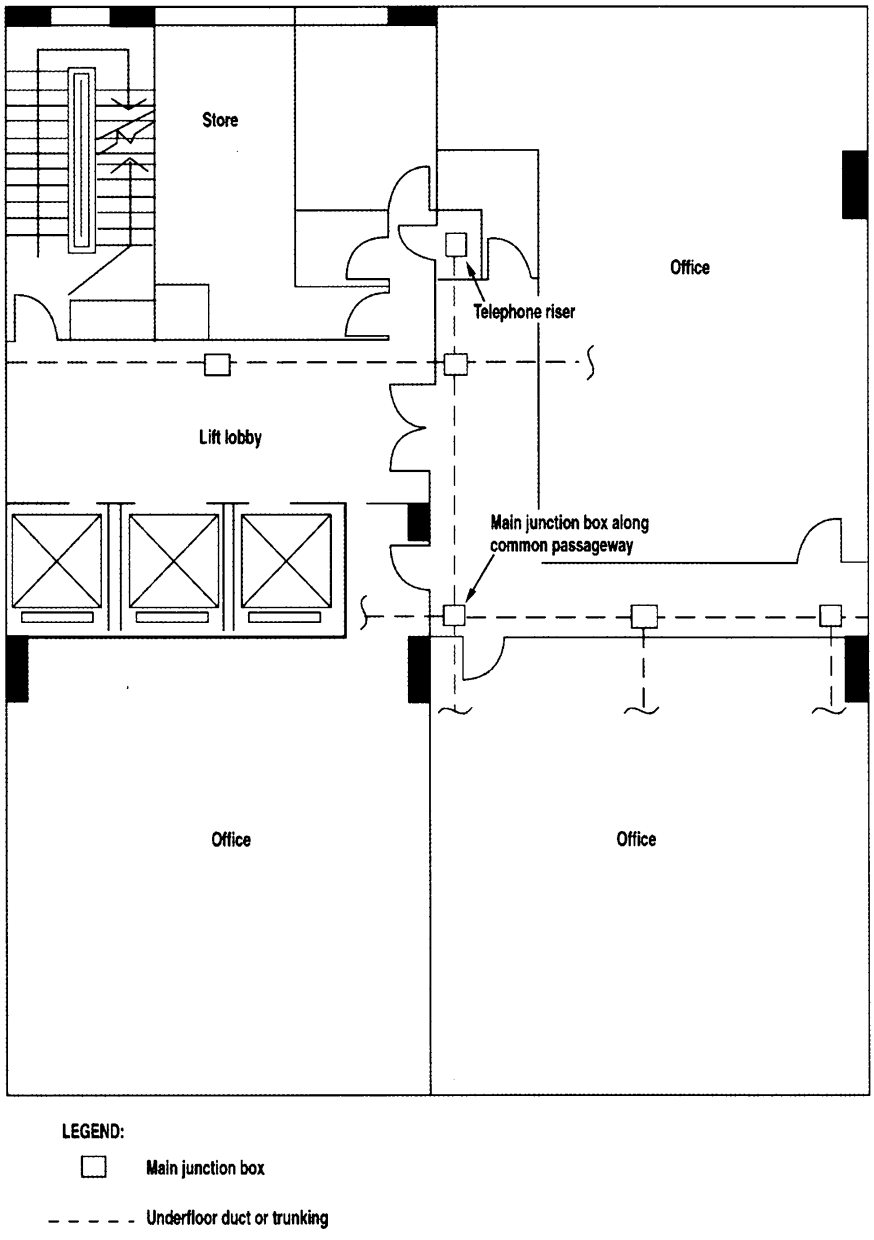


FIGURE 8-7 : TYPES OF DISTRIBUTION DUCTS AND OUTLETS

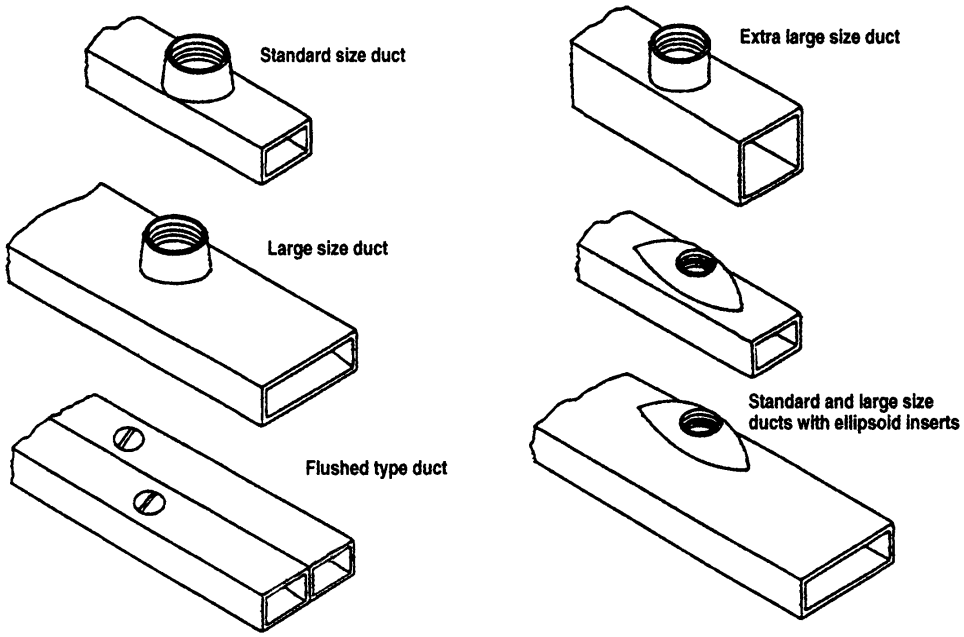


FIGURE 8-8 : JUNCTION BOXES INSTALLED 6 METRES APART

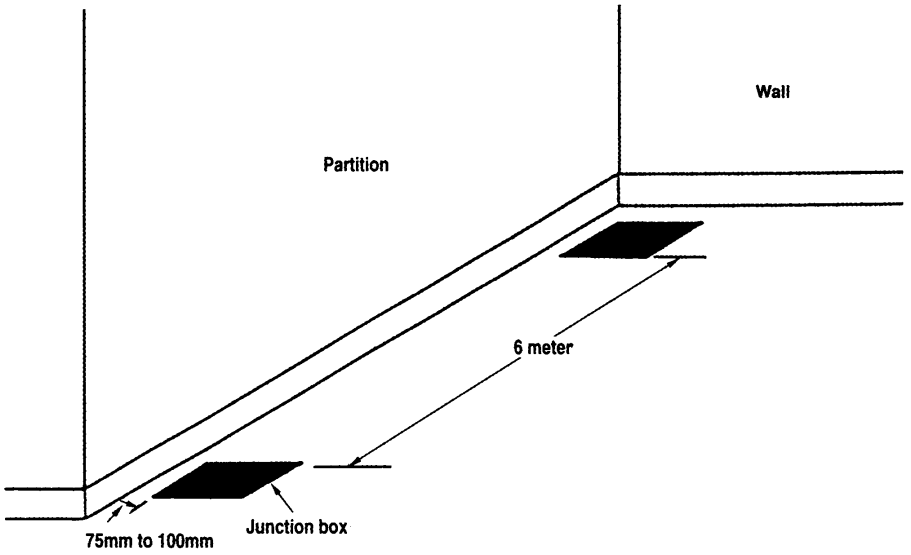


FIGURE 8-9 : EXPLODED VIEW OF JUNCTION BOX

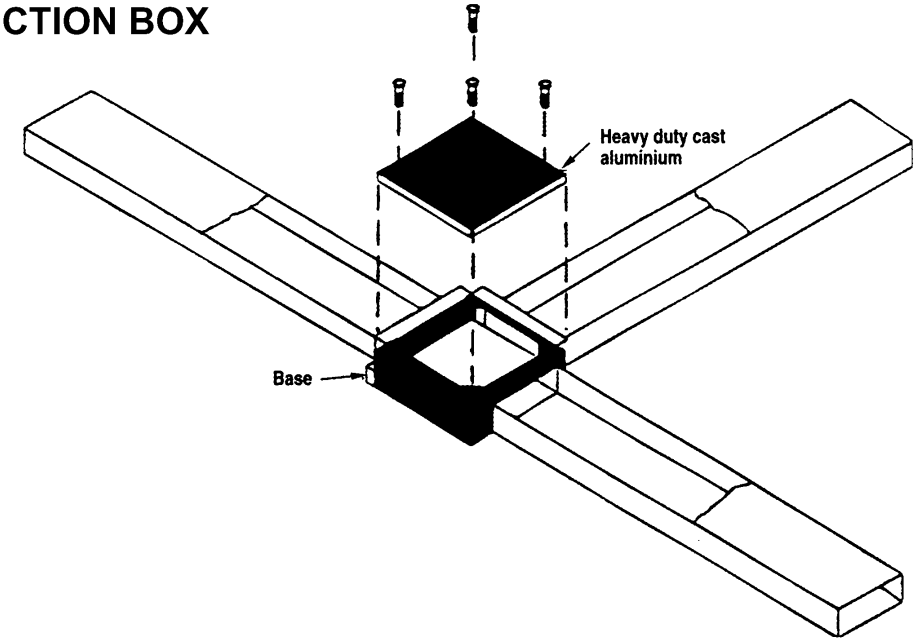


FIGURE 8-10 : PARTITION SITTING ON JUNCTION BOX

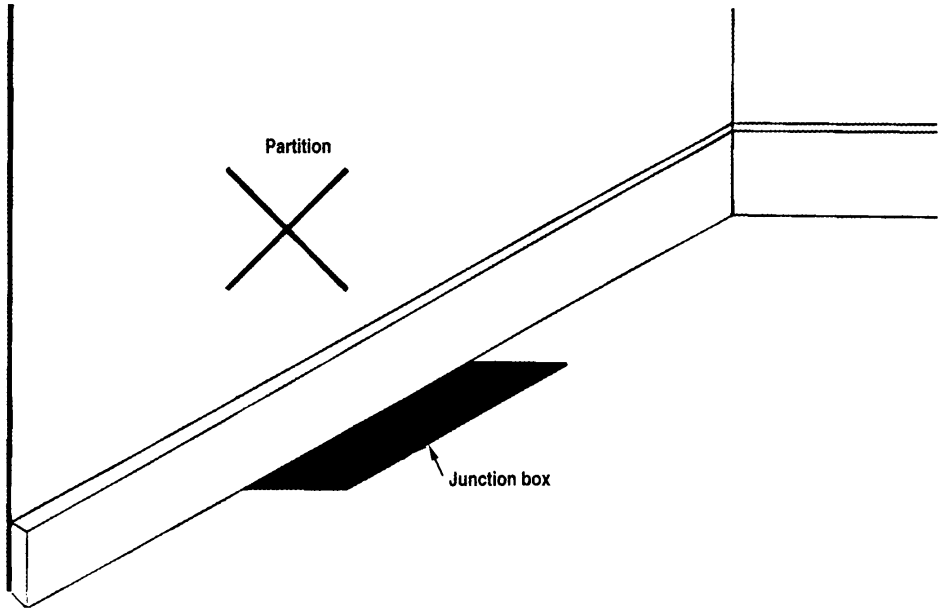


FIGURE 8-11 : ACCESS TO JUNCTION BOX FOR CARPETTED FLOOR

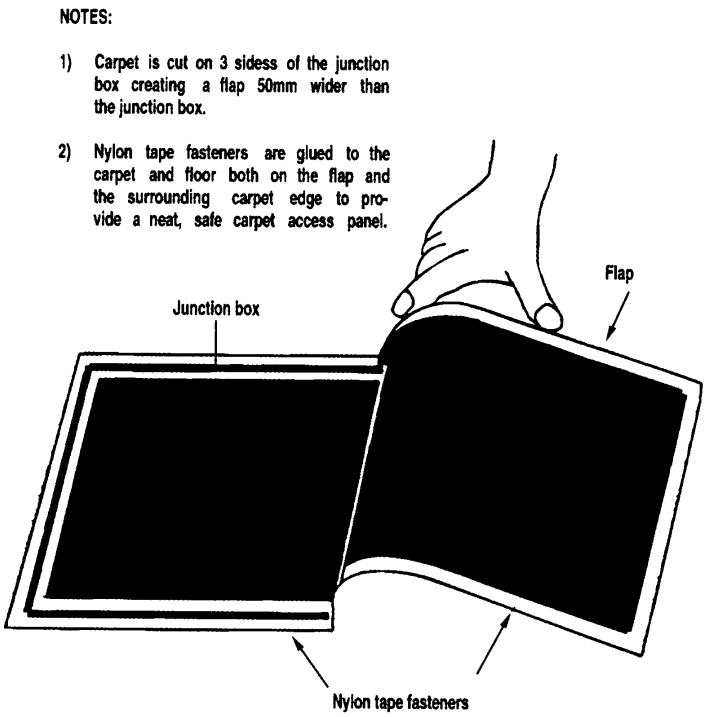


FIGURE 8-12 : RAISED FLOOR SYSTEM

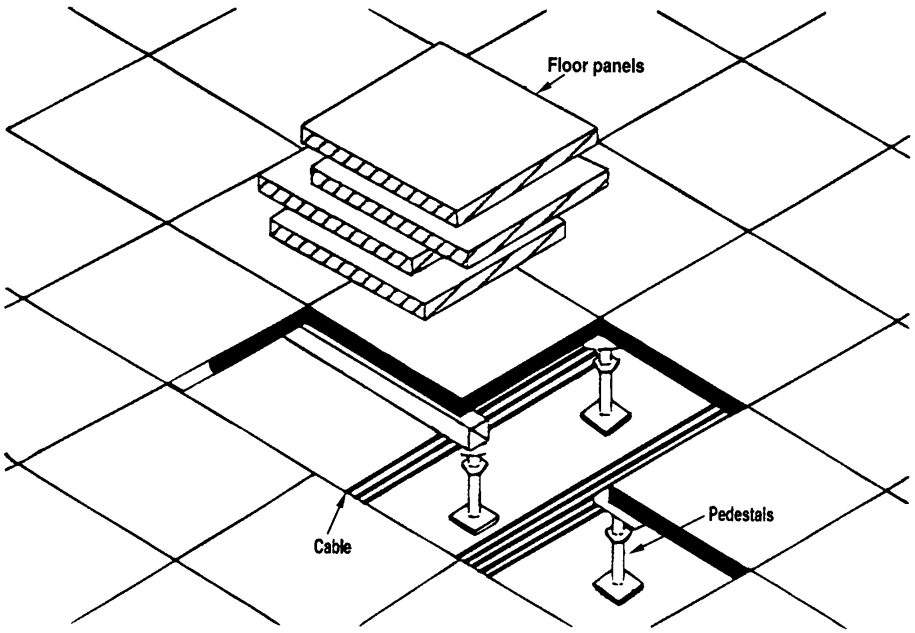


FIGURE 8-13 : PEDESTALS

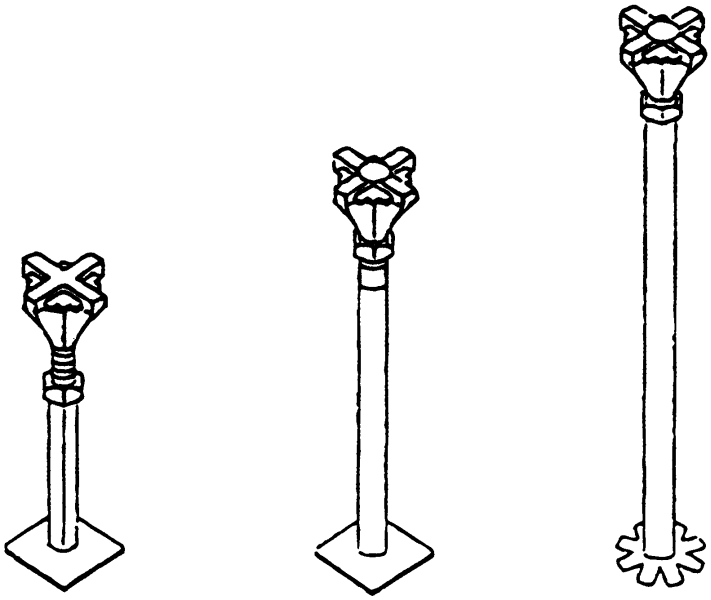


FIGURE 8-14 : TYPICAL SECTION OF RAISED FLOOR SYSTEM

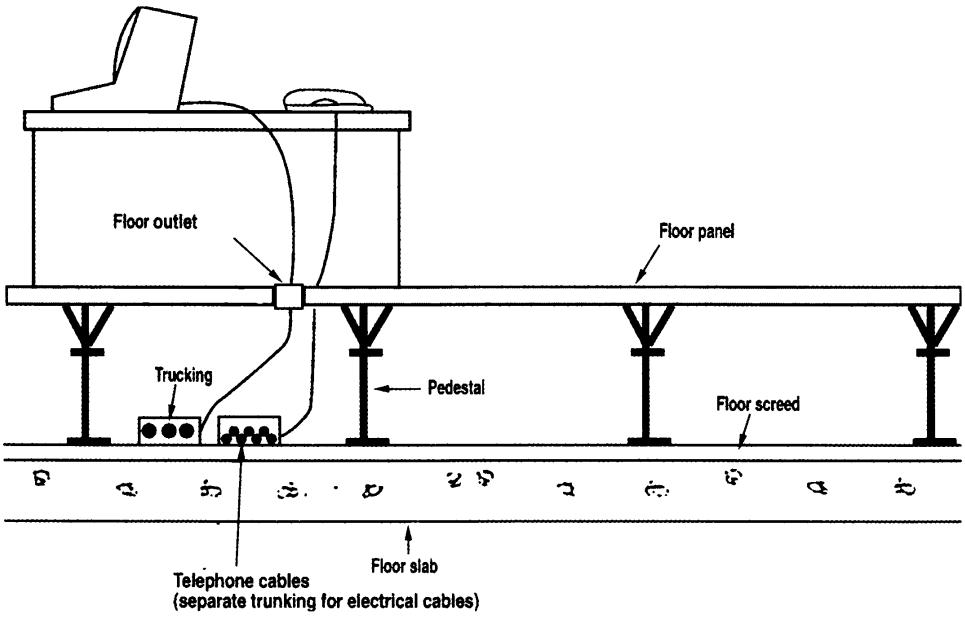


FIGURE 8-15 : SECTIONAL VIEW OF A CELLULAR FLOOR SYSTEM

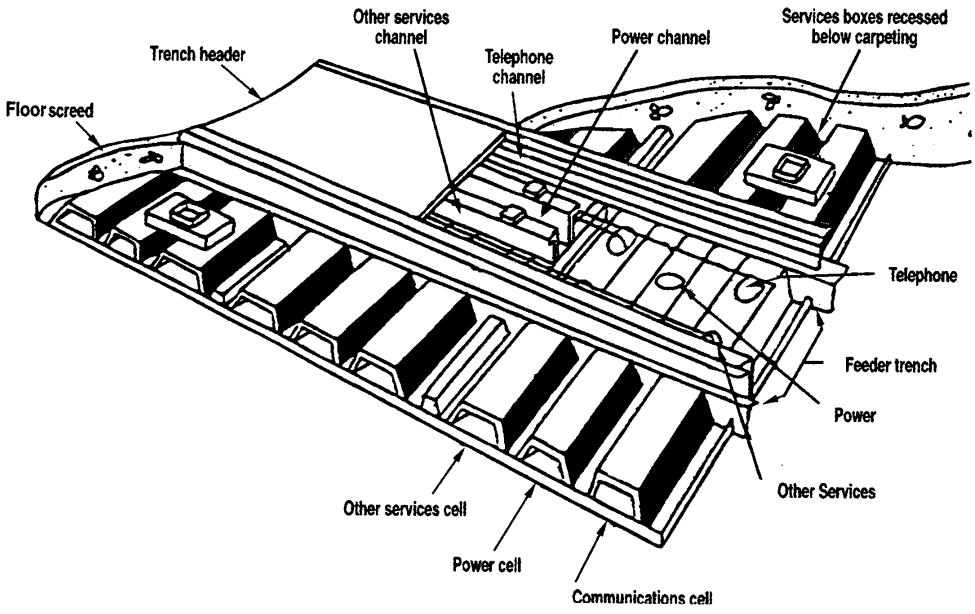


FIGURE 8-16 : CEILING DISTRIBUTION SYSTEM USING CABLE TRAY/ TRUNKING LINK WITH CONDUITS & UTILITY POLE

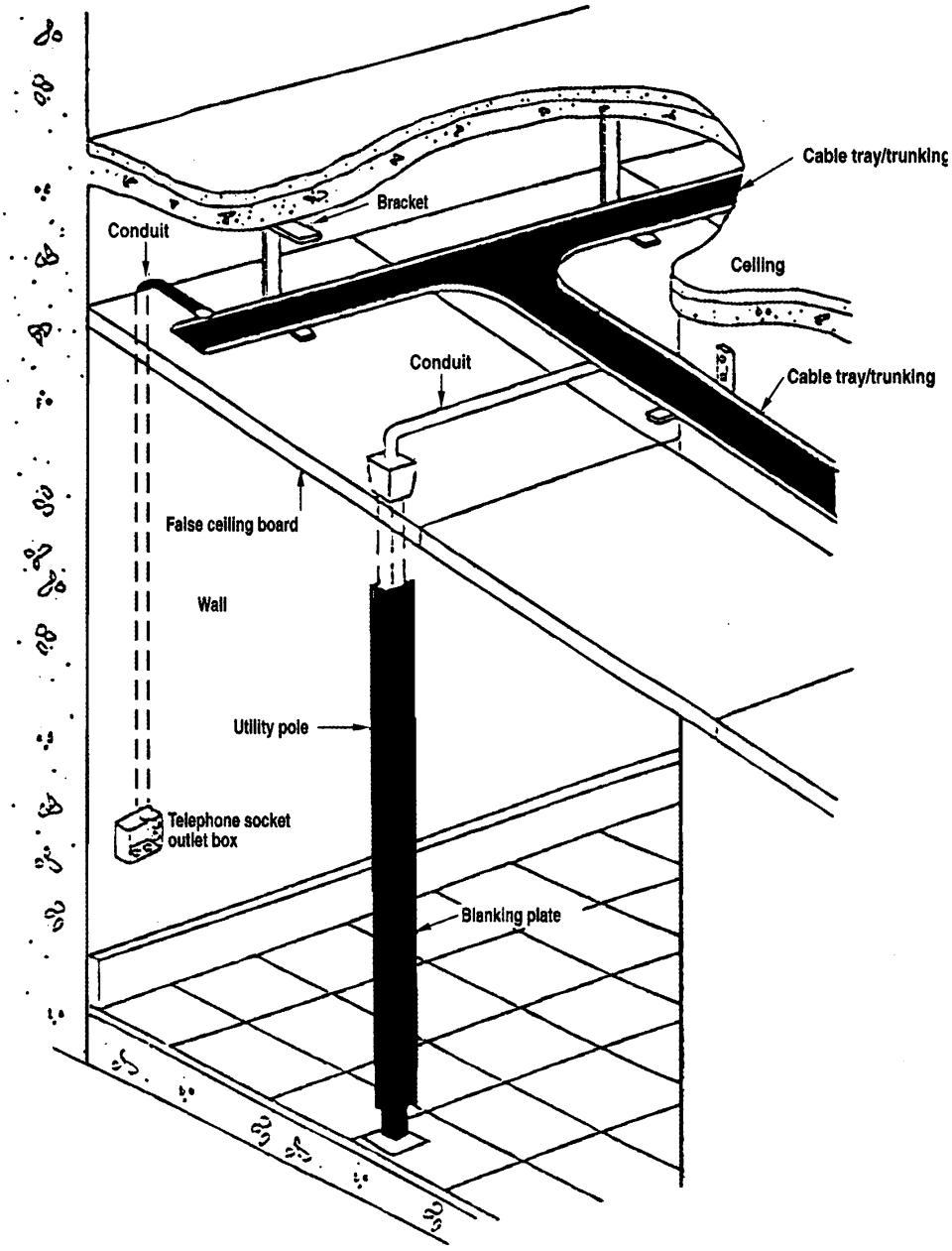


FIGURE 8-17 : CEILING DISTRIBUTION SYSTEM - TYPICAL DETAIL OF CABLE TRAY/TRUNKING LINK WITH CONDUIT IN UNDETACHABLE FALSE CEILING BOARDS/ STRIPS THAT ARE NOT EASILY REMOVABLE

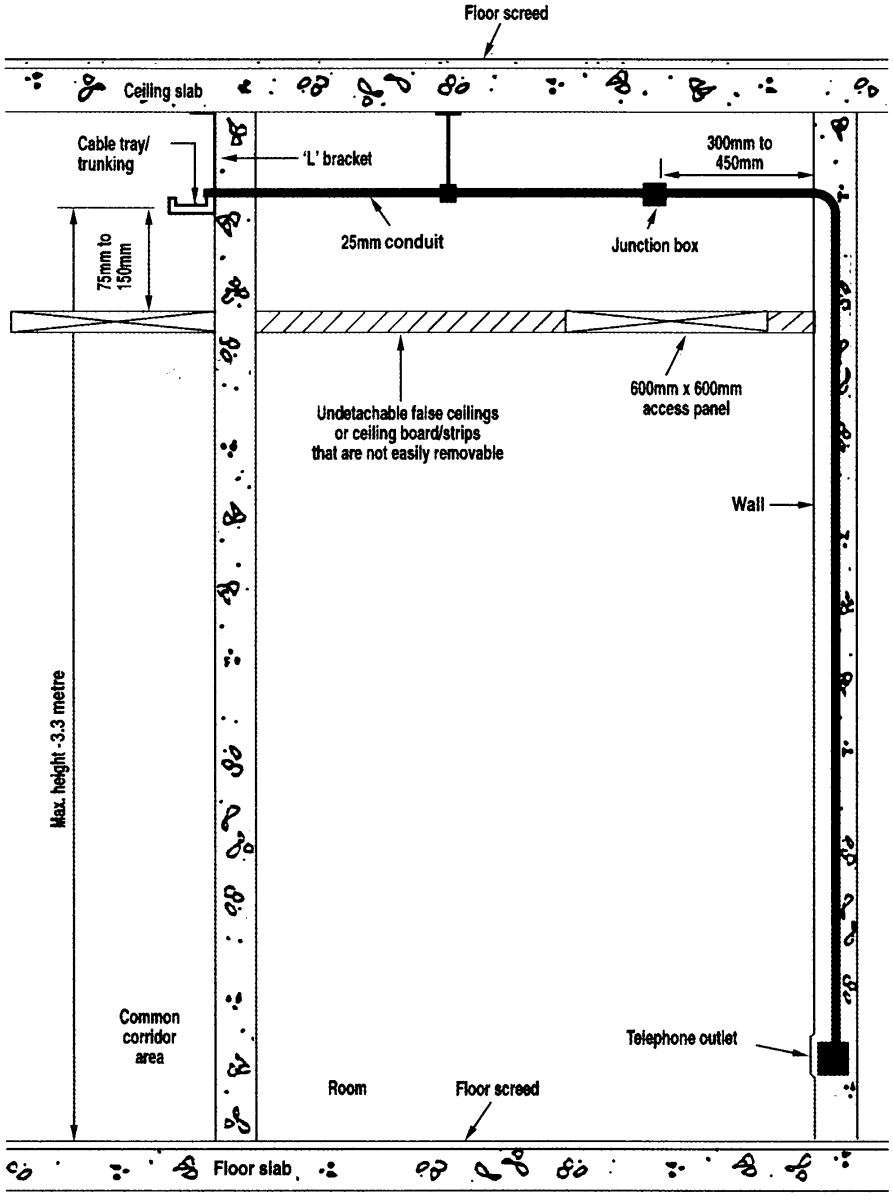
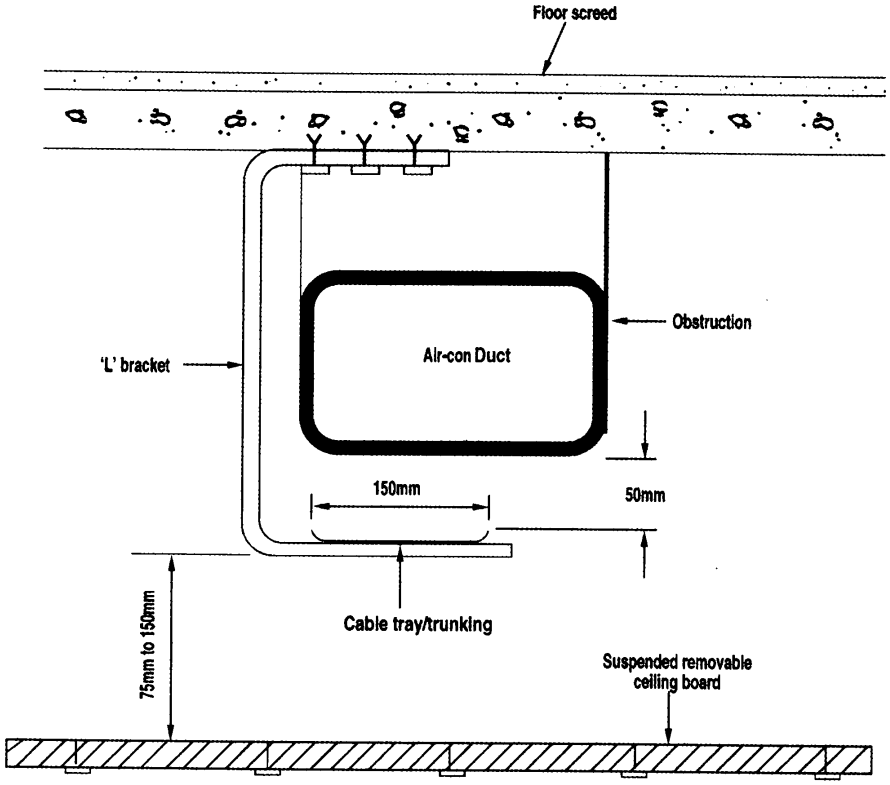


FIGURE 8-18 : CLEAREANCE BETWEEN CABLE TRAY / TRUNKING AND OBSTRUCTIONS



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

FIGURE 8-19 : PERIMETER RACEWAYS MOUNTED AT TABLE HEIGHT LEVEL

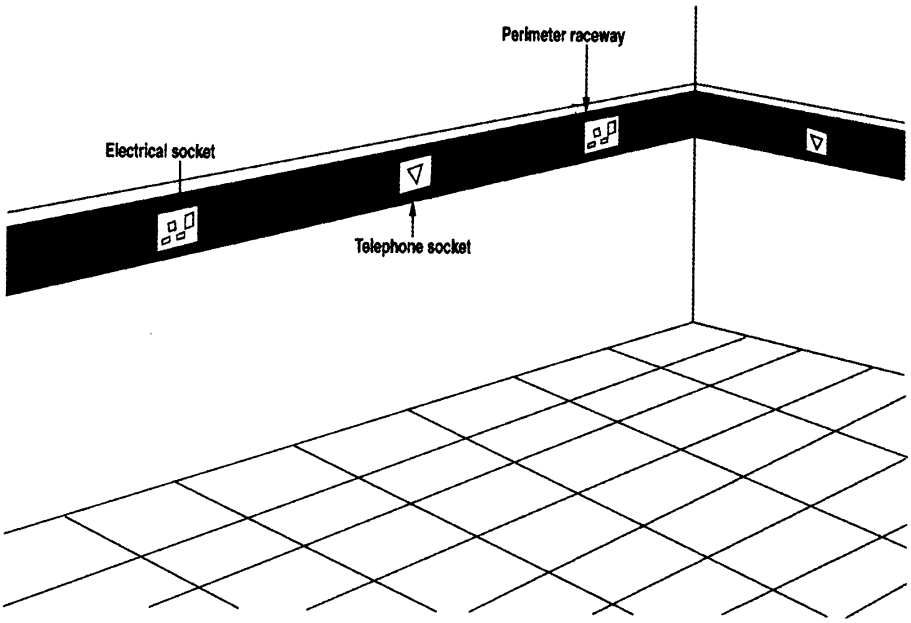


FIGURE 8-20 : PERIMETER RACEWAYS MOUNTED AT FLOOR LEVEL

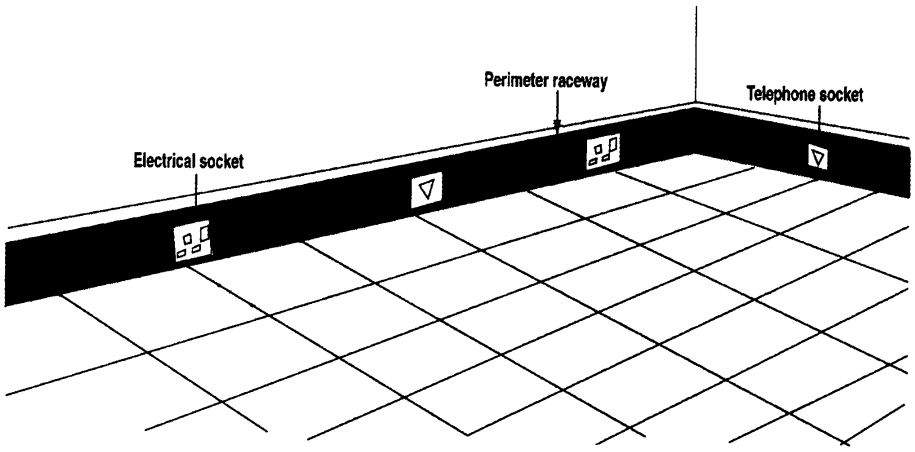


FIGURE 8-21 : PERIMETER RACEWAYS RECESSED INTO BASE OF WALL

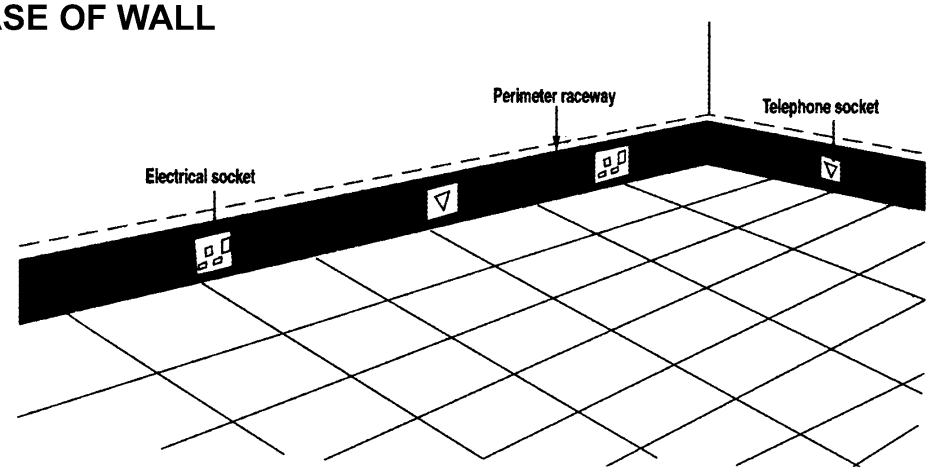


FIGURE 8-22 : SECTION OF A THREE - COMPARTMENT SKIRTING TRUNKING

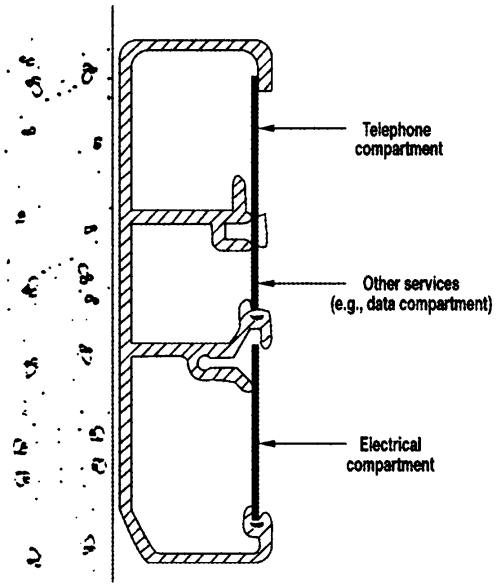


FIGURE 8-23 : PERIMETER RACEWAYS LINKED TO UNDERFLOOR DUCT DISTRIBUTION SYSTEM

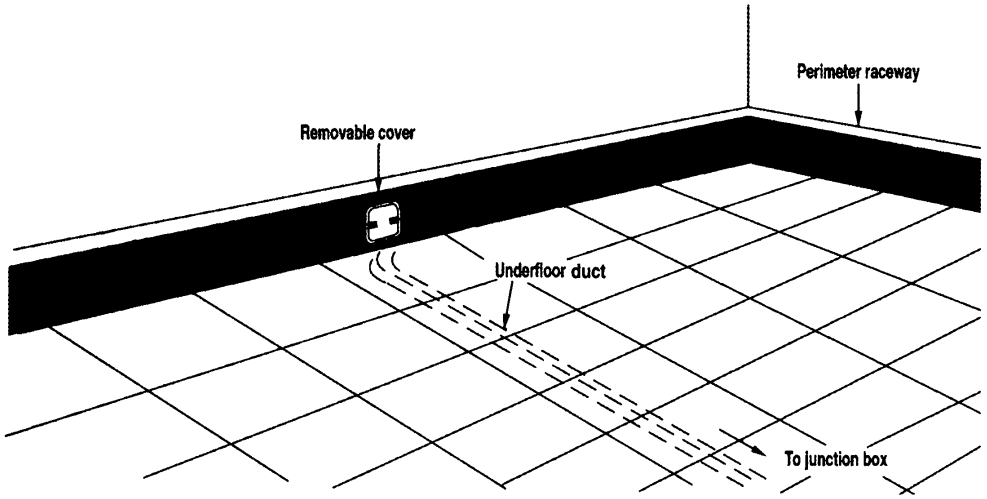


FIGURE 8-24 : POKE - THROUGH SYSTEM WITH CONDUIT

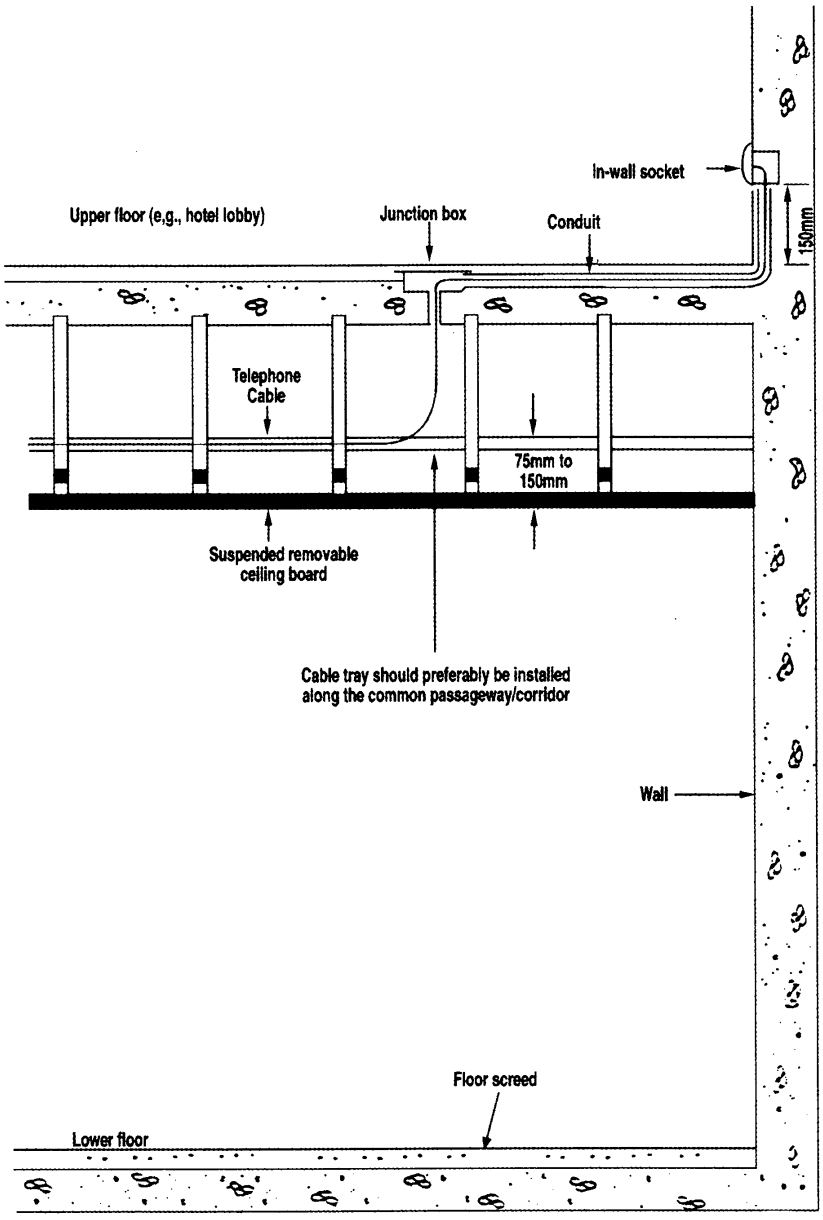


FIGURE 8-25 : CONDUIT DISTRIBUTION SYSTEM IN CERTAIN AREAS OF A HOSPITAL

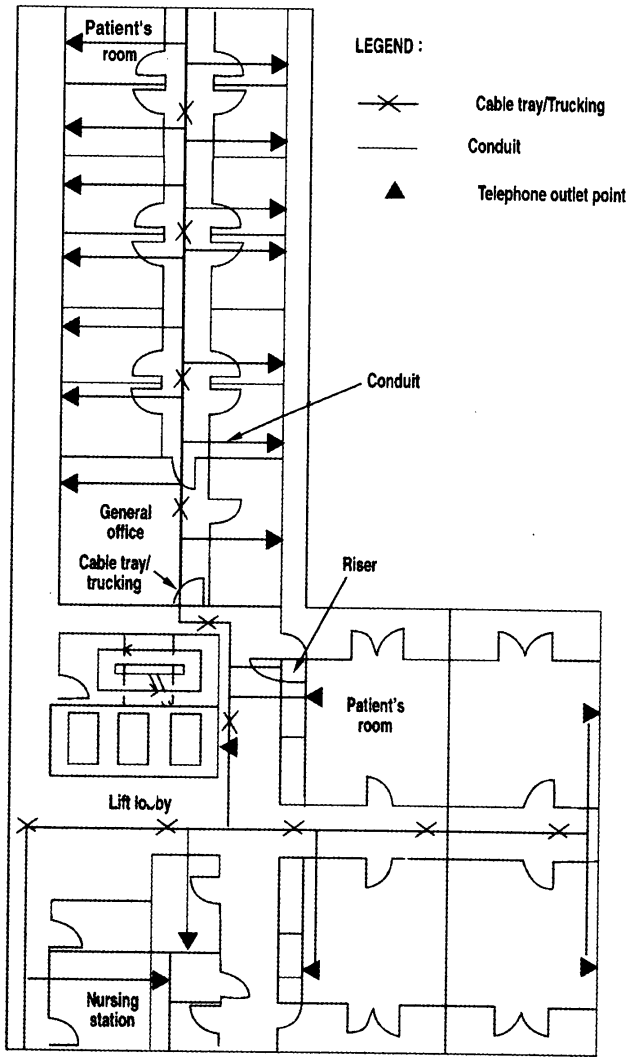


FIGURE 8-26 : CABLE TRAY BENDS & FITTING WITH 600MM MINIMUM RADIUS

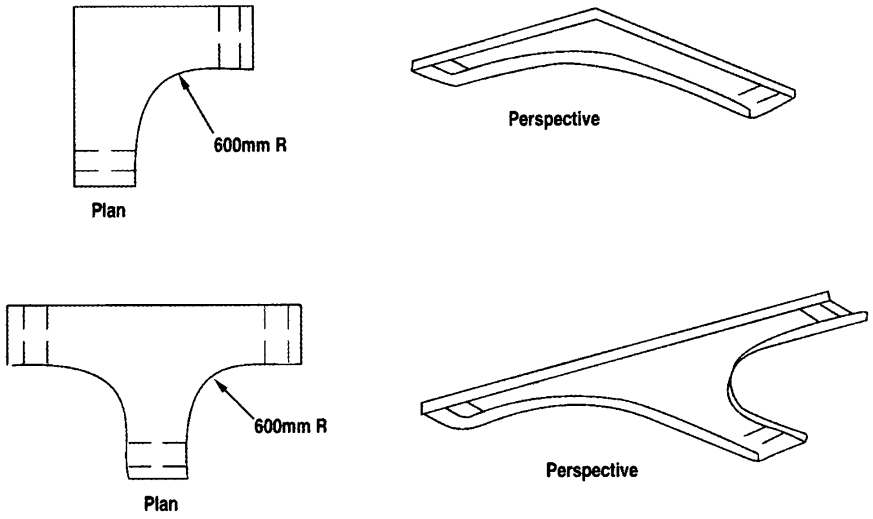


FIGURE 8-27 : TYPICAL EXAMPLE OF A TRUNKING SYSTEM

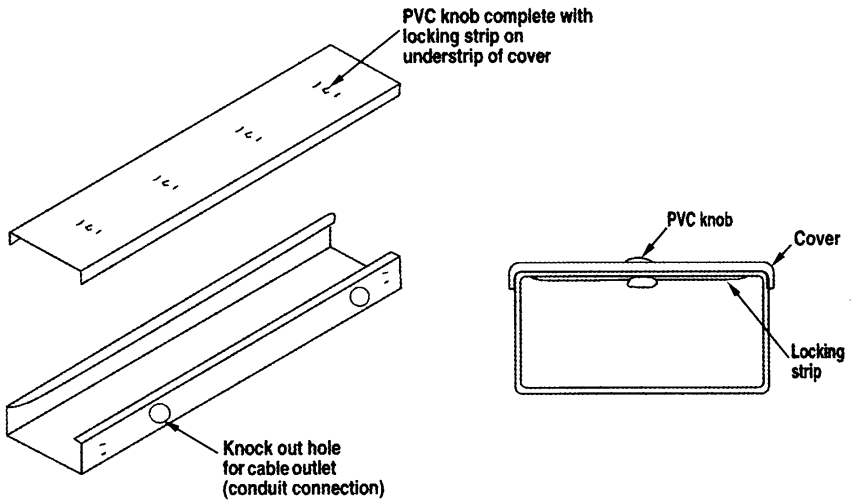


FIGURE 8-28 : COMBINATON OF DUCT & CONDUIT DISTRIBUTION SYSTEM

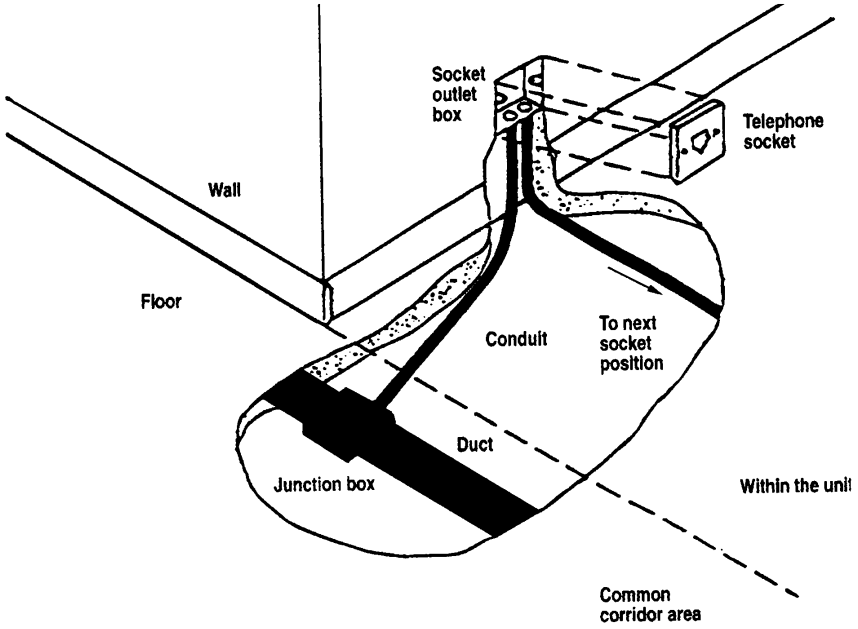


FIGURE 8-29 : USING CONDUITS TO DISTRIBUTION CABLES

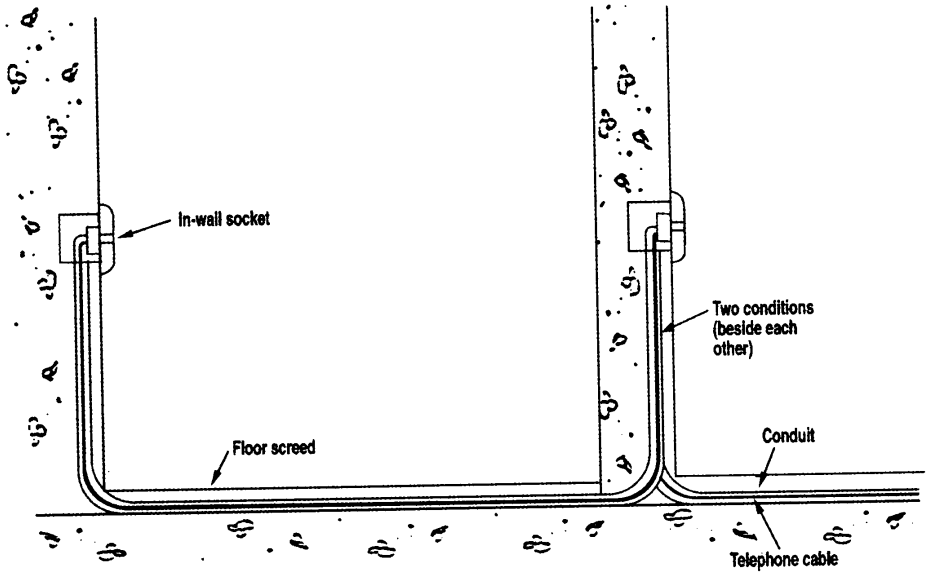


FIGURE 8-30 : FLOOR DUCT EXTENDED INTO TELEPHONE RISER

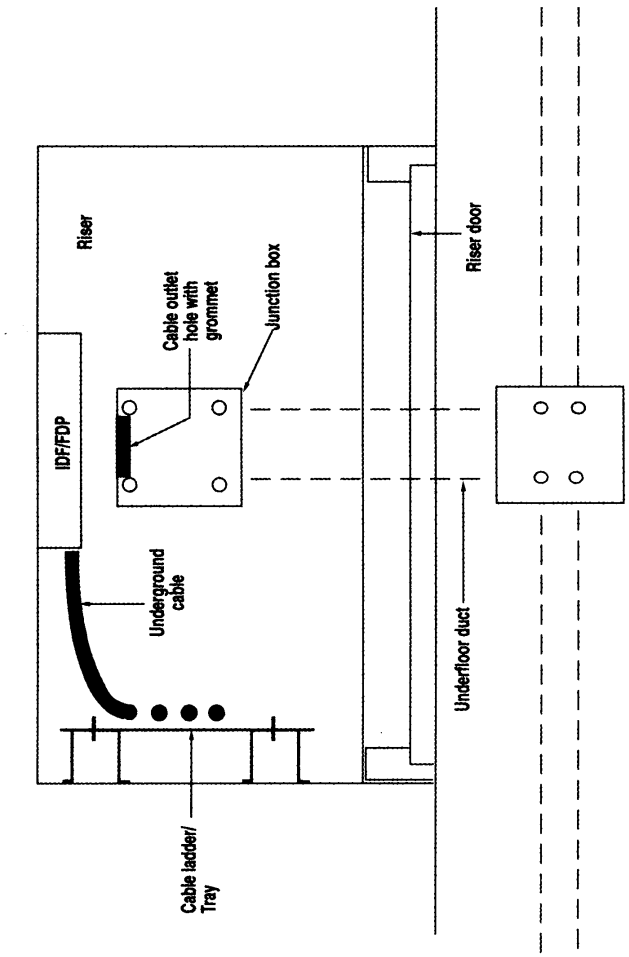


FIGURE 8-31 : CONDUIT IN FALSE CEILING & WALL TO DISTRIBUTION CABLES

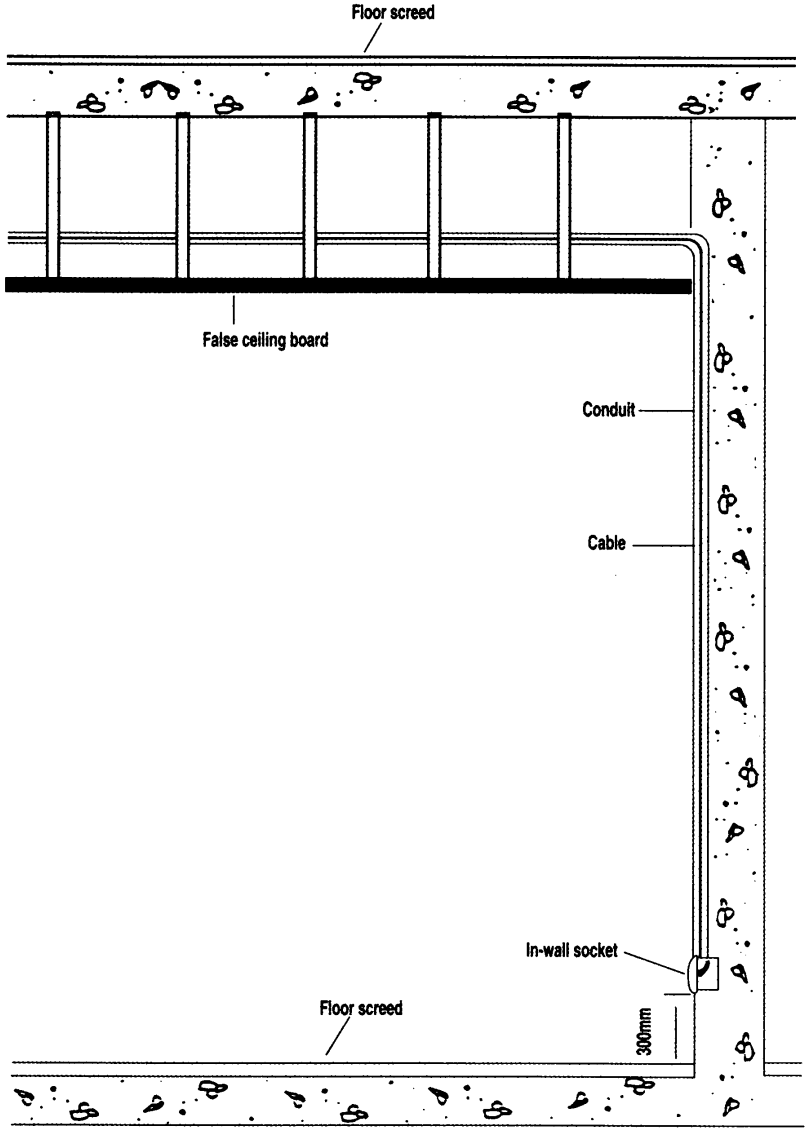
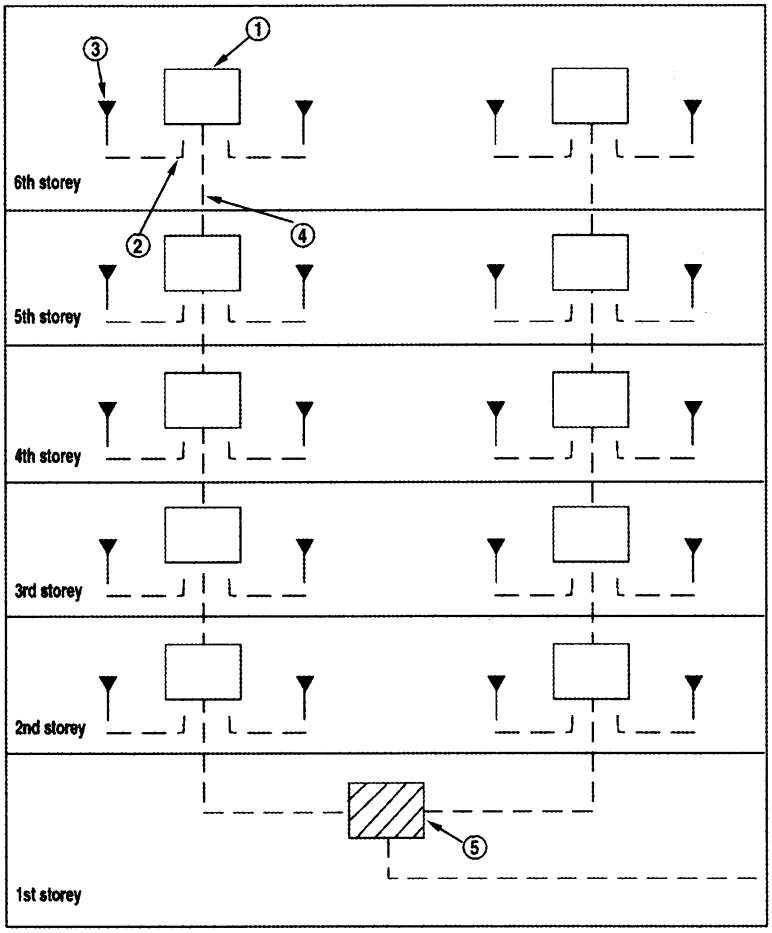


FIGURE 8-32 : MULTI-RISER DISTRIBUTION IN RESIDENTIAL BUILDING



LEGEND:

① Distribution point

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

③ Telephone outlets

④ Cable riser (ducts and conduits)

⑤ MDF room

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PART 9 CUSTOMER PREMISES CABLING AND INTERFACE POINT (IP)

9.1 INTERFACE POINT FOR CUSTOMER PREMISES CABLING

9.2 PRECABLING IN COMMERCIAL BUILDINGS

9.3 PRECABLING IN RESIDENTIAL BUILDINGS

9.4 TERMINATION OF INTERNAL WIRING

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

PART 9 CUSTOMER PREMISES CABLING AND INTERFACE POINT (IP)

9.1 INTERFACE POINT FOR CUSTOMER PREMISES CABLING

9.1.1 Internal (Telecommunication) Wiring (IW)

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

Under the IDA Licensing Scheme for Telecommunication Wiring Contractors and Telecommunication Wiring Installers, the telecommunication wiring contractors and installers are required to comply with the Code of Practice for Internal Telecommunication Wiring (IDA CP L1:1996).

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

9.1.2 Interface Point (IP)

The Interface Point is where the public telecommunication network ends. Please refer to Figure 9-1 (IP At Doorstep) and Figure 9-2 (IP At DP).

9.1.3 Location of IP

The locations of IP are categorised as follows:

(i) IP At Doorstep

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

(a) The IP is at doorstep whereby a block terminal (BT) will be installed by the PTLs/TSLs for every unit.

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

(ii) IP At DP

The types of premises under this category are shopping centres, office complexes, factories (terrace/flatted), HDB shopping/office complexes, markets, food/hawker centres, multiple buildings within a compound (campus layout), landed/strata landed houses (bungalow semi-detached terrace), private

and HDB apartments provided with concealed wiring served directly from DP in the riser duct. The following guidelines are to be adopted:

(a) The interface points are at the DP.

(b) Building owners or Management Corporation should provide internal telephone distribution facilities for concealing telephone cables.

(c) The building owner or Management Corporation 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, risers, etc.

9.2 PRECABLING IN NON-RESIDENTIAL BUILDINGS

9.2.1 Benefits derived from pre-cabling a building

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

9.2.2 Recommended cable size for various premises

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

9.3 PRECABLING IN RESIDENTIAL BUILDINGS

9.3.1 General

(a) Developer shall supply and install telephone cables, sockets, block terminal and all other materials for pre-cabling to all rooms in residential buildings.

(b) A block terminal shall be used as a distributing point for connection to all rooms. It shall be located inside each residential unit (Figure 9-3).

(c) The developer or owner (as the case may be) shall install the cable from the Distribution Point (DP) in the riser or gate pillar to each socket using a star configuration with the block terminal as a distribution point (Figure 9-3).

(d) The developer or owner (as the case may be) shall label each cable pair at the Distribution Point (DP) end and the telephone socket and block terminal ends, to enable identification of cable pairs. The developer or owner (as the case may be) shall terminate the telephone cable onto the telephone sockets and block terminals according to the detailed connections in Figure 9-4. The PTLs/TSLs shall terminate the telephone cables onto their respective Distribution Points (DPs).

(e) The telephone cables, sockets and block terminals can be purchased from the PTLs/TSLs or its suppliers. The specifications of cables and sockets are as indicated in Appendix A.7.

9.4 TERMINATION OF INTERNAL WIRING

9.4.1 Termination At IP

Telephone wires or cables at the IP should be terminated onto block terminals, distribution cases (discases) or terminal blocks mounted on the Intermediate Distribution Frame (IDF). The cables should be correspondingly labeled onto the discases or terminal blocks.

9.4.2 Termination At Tenants' Premises

Telephone wires or cables at the tenants' premises should be terminated onto termination boxes or sockets. The cables should be correspondingly labeled onto the termination boxes. To facilitate installation and maintenance of cables, the termination box should be installed next to the Earth Leakage Circuit Breaker (ELCB) or Main Circuit Breaker (MCB) with proper segregation between telephone and electrical cablings.

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

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

FIGURE 9-1 : IP AT DOORSTEP

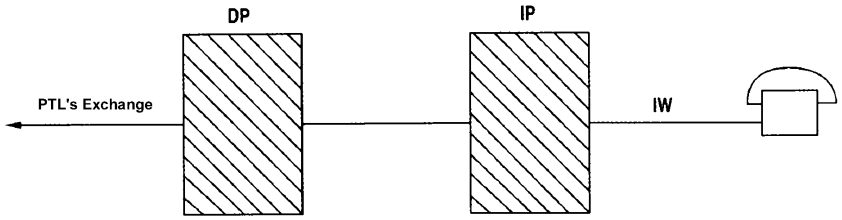


FIGURE 9-2 : IP AT DP

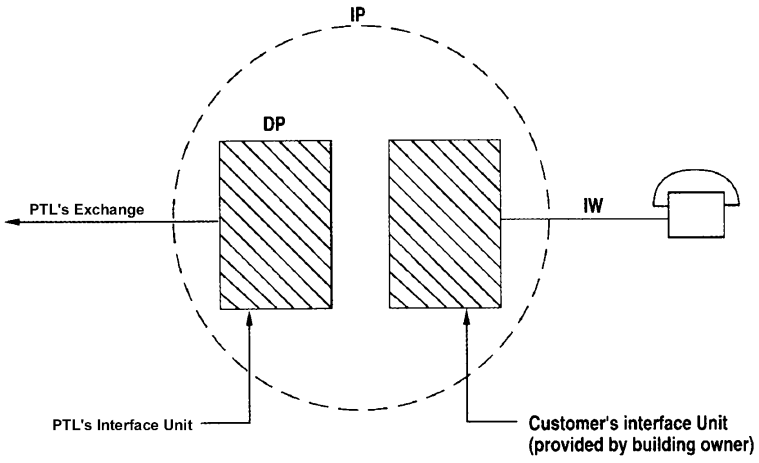


FIGURE 9-3 : TELEPHONE WIRING CONFIGURATIONS FOR RESIDENTIAL BUILDINGS

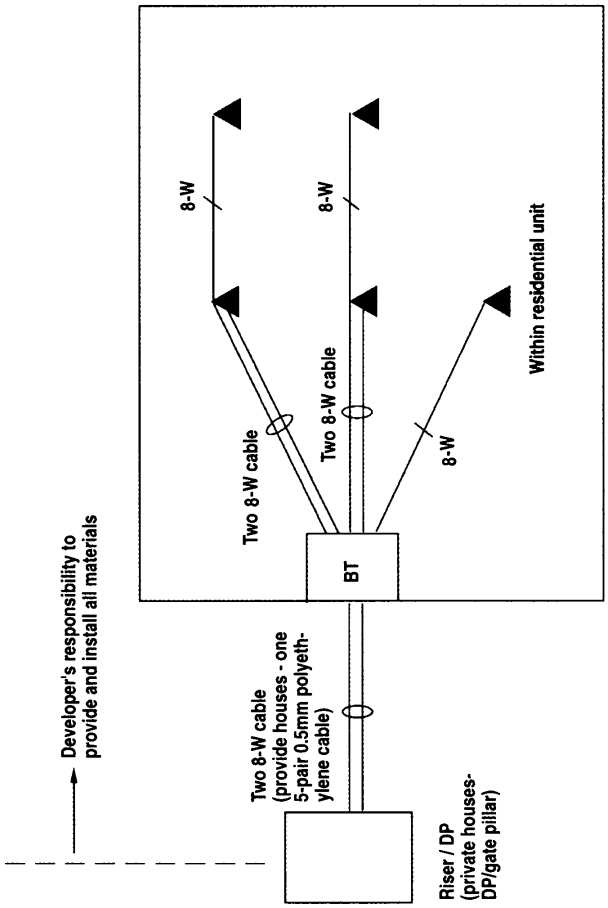
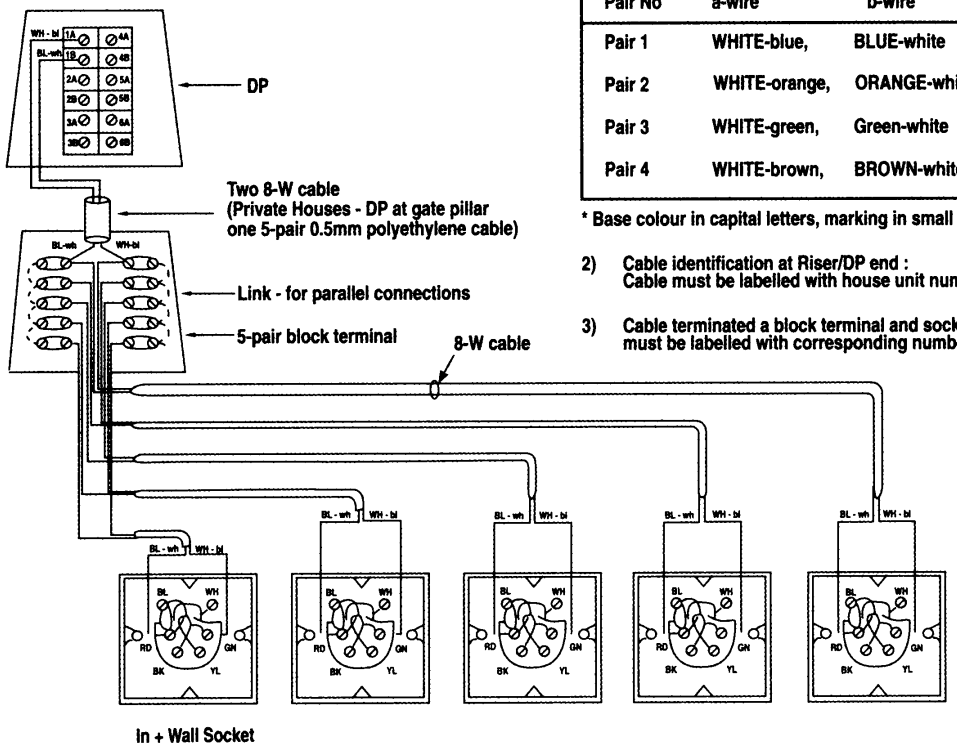


FIGURE 9-4 : TELEPHONE WIRING CONFIGURATIONS FOR RESIDENTIAL BUILDING - DETAILED CONNECTIONS



NOTE:

1) 8-W cable colour code and termination.

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

* Base colour in capital letters, marking in small letters

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

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

PART 10 PUBLIC TELEPHONE BOOTHS

10.1 PROCEDURES FOR REQUESTING INSTALLATION OF PUBLIC TELEPHONE BOOTHS

PART 10 PUBLIC TELEPHONE BOOTHS

10.1 PROCEDURES FOR REQUESTING INSTALLATION OF PUBLIC TELEPHONE BOOTHS

10.1.1 Building developers or owners (as the case may be) are encouraged to cater and plan for sufficient public telephones within a public or commercial complex.

10.1.2 Telephone cabling routes, if wall-mounted, should preferably be concealed and outlets should be 1220 mm above finished floor level and approximately 1600 mm apart for multiple installations. This is illustrated in Figure 9-1. For free-standing installation, spacing of floor outlets would be based on the dimensions of booths but generally could be 915 mm apart.

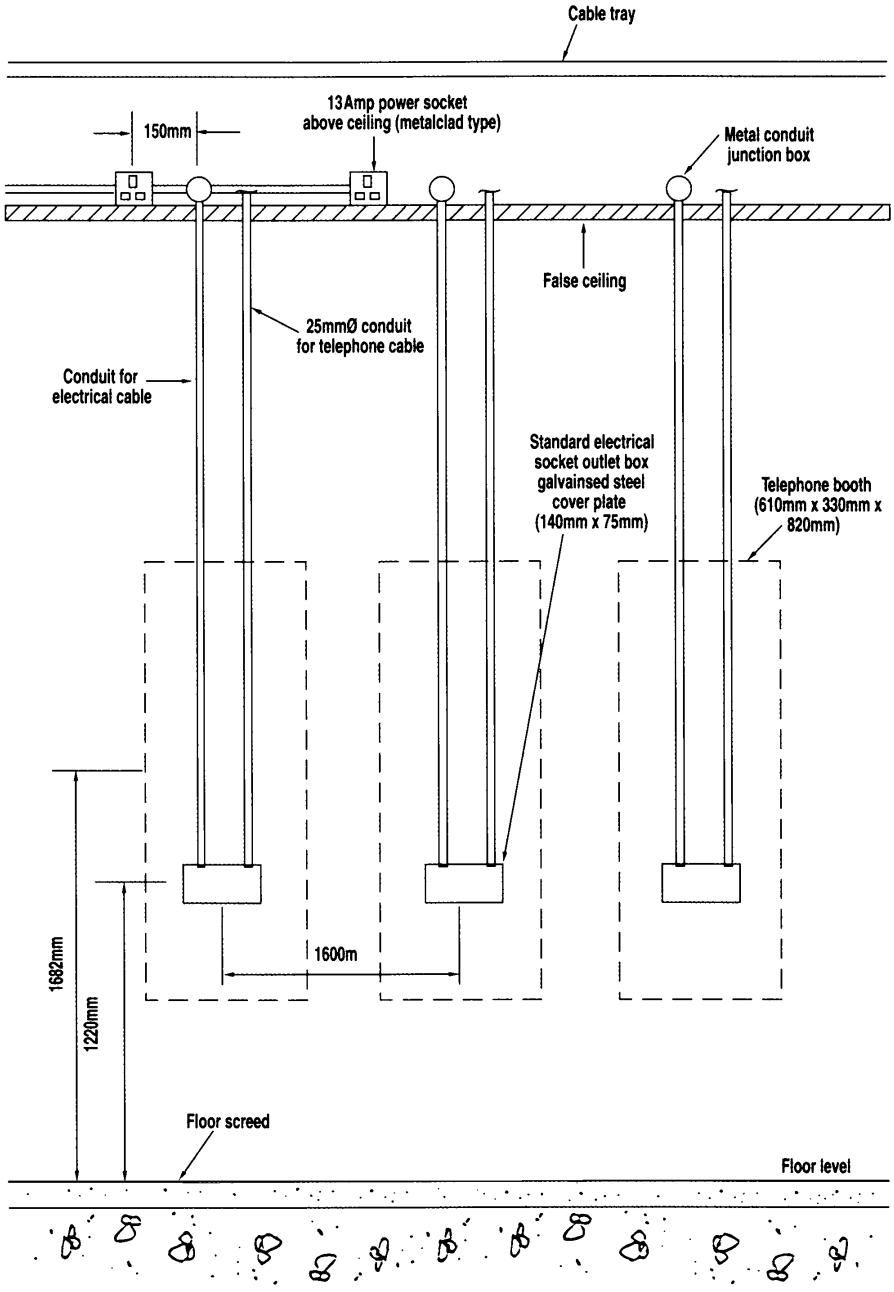
10.1.3 Building developers or owners (as the case may be) could also decide to have their own public telephone booth design. In which case, a full set of drawings of the proposed booth must be submitted to the PTLs/TSLs for consideration and study on its compatibility with the existing telephone instruments.

10.1.4 Developers/building owners should make provision for a 13 amp power supply socket near to the telephone outlet where the public telephones are proposed. Separate concealed power conduits should be laid and outlets should be provided at each booth's position at 1220 mm above finished floor level, as shown in Figure 9-1.

10.1.5 Two sets of complete building floor plans with the proposed installation of public telephone booths should be submitted to the PTLs/TSLs for consideration and agreement.

10.1.6 To enable the building to be provided and equipped with the latest public telephone services and value-added features, building developers or owners (as the case may be) should furnish information related to the tenant structure, amenities available within the building/complexes for PTLs/TSLs' early planning and discussion.

FIGURE 10-1 : TYPICAL CONDUIT FOR WALL MOUNTED PUBLIC TELEPHONE BOOTH



PART 11 ACCOMMODATION REQUIREMENTS FOR PABX/KTS/MLS

11.1 GENERAL

11.2 ACCOMMODATION REQUIREMENTS

11.3 SEPARATE ROOM

PART 11 ACCOMMODATION REQUIREMENTS FOR PABX/KTS/MLS

11.1 GENERAL

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

11.1.2 The accommodation requirements specified here are designed to provide the environmental conditions necessary to ensure continuous satisfactory performance of the equipment and expeditious maintenance service by the PTLs/TSLs.

11.1.3 Generally, for a telephone switching system with an ultimate capacity exceeding 100 extensions, a separate room exclusively occupied by the equipment may be required. (See paragraph 11.3)

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

11.2 ACCOMMODATION REQUIREMENTS

11.2.1 During the operation of the telephone switching system, the accommodation for the standby battery and the Customer's MDF (Main Distribution Frame) should:

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

(b) be air-conditioned with a recommended temperature of 20°± 2°C. This excludes the standby battery and MDF/IDF rooms, where air-conditioning is not required but the maximum temperature should not exceed 28°C.

However, the MDF/IDF and battery room should be well ventilated with filtered air (for the standby battery room, the air change rate should be a minimum rate of 20 air changes per hour; to ensure this, the installation of a ventilation/exhaust fan is necessary);

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

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

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

(f) not be used as a dressing room, storage room or any other purposes other than the accommodation of the equipment and its associated accessories;

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

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

(i) provide a power point within two metres of the equipment for the use of maintenance staff;

(j) not have a water sprinkler in the room and rooms associated with the accessories;

(k) the equipment should be away from photostating machines or any other equipment or materials which either generate or store strong electrostatic fields;

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

(m) if the equipment is floor standing, the floor covering should not either impede the movement of the cabinet or store electrostatic charges;

11.3 SEPARATE ROOM

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

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

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

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

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

PART 12 REQUIREMENTS FOR PROPER INSTALLATION OF BROADBAND COAXIAL CABLE SYSTEM (BCS)

12.1 GENERAL

12.2 PERFORMANCE REQUIREMENTS FOR SYSTEMS OPERATING BETWEEN 5 MHz TO 824 MHz

12.3 NETWORK TOPOLOGY

12.4 CABLES

12.5 SAFETY

12.6 INSTALLATION PRACTICES AND PROCEDURES

12.7 WORKMANSHIPS

12.8 SPACE AND OTHER PROVISIONS IN BUILDINGS FOR THE CONSTRUCTION OF BCS SYSTEM.

12.9 OTHER DETAILS

PART 12 REQUIREMENTS FOR PROPER INSTALLATION OF BROADBAND COAXIAL CABLE SYSTEM (BCS)

12.1 GENERAL

12.1.1 This document covers recommendations for the erection, cabling, safety, and performance requirements of the broadband coaxial cable system for the transmission of signal operating between 5 MHz and 824 MHz.

12.1.2 The objective of this document is to provide the detailed technical specifications relating to the installation safety and performance of broadband coaxial cable sub-system for buildings that are to be made Cable-Ready, i.e. to be interconnected to the nation wide broadband coaxial cable system.

12.1.3 When a coaxial cable sub-system is made Cable-Ready, i.e. technical qualified to be interconnected to the nation-wide broadband coaxial cable system, based on the requirement as specified in this document, there should be no major wiring change. However, the installation of additional passive and active devices such as filters, decoders, reverse signal path amplifiers, interdiction equipment etc. may be required in order to keep abreast of technological changes and new technical requirements. Minor adjustments of the signal levels at various distribution points may also be required. There will be no change to the subscribers' feeders.

12.1.4 Necessary provisioning is critical for the proper transmission broadband two-way interactive applications on the current coaxial cable system, especially on the reverse path. The entire broadband coaxial cable system radio frequencies (RF) resources can be classified into two distinct categories as follows:

- Downstream Bandwidth (50-824MHz)
- Upstream Bandwidth (5-42 MHz)

The upstream bandwidth or return path capacity from the customers' equipment to the network head-end is an important info-communications resource for the provision of broadband interactive services. The downstream is the forward transmission path for signals transmitted to the customers' premises while the upstream is the upward or return path for signals received in the reverse directions.

The various requirements highlighted in this document basically intended to provide the common reference for the provisioning, installation, safety and performance of a qualified coaxial cable system.

12.1.5 The terminology of the technical terms used in this document is in Appendix B.1.

12.2 PERFORMANCE REQUIREMENTS FOR SYSTEMS OPERATING BETWEEN 5 MHZ TO 824 MHZ

12.2.1 Objective

The objective of the requirements included in this document is to ensure that the system performance limits are well optimised for the transmission of both the upstream and downstream signals. Most of the technical requirements in this document are in-line and comply with the published standards (see Appendix B.6 for reference of the related standards) developed by the Society of Cable Telecommunications Engineers (SCTE), which is an accredited standards developing organisation of the American National Standards Institute (ANSI). However, given the specific conditions of the local broadband coaxial cable operations, the requirement herein stated shall apply, over and above the work of SCTE. IDA will also reserve the right to revise the various requirements as the technology evolved over time given its advanced developments.

12.2.2 General Requirements

All requirements refer to the performance limits that shall be obtained between the input(s) to the head end or head ends and any system outlet when terminated in a resistance equal to the nominal load impedance of the system, unless otherwise specified. To cater for future bi-directional operation, all system components shall also be suitable for bi-directional operation with the reverse path in the frequency range 5-42 MHz. Where system outlets are not used, the above applies at the subscriber's end of the subscriber's feeder. In paragraph 12.2 all references to "system outlet" shall also apply to this case.

12.2.3 Impedance

The nominal impedance of the system shall be 75 ohms. It should be noted that this value applies to all coaxial feeder cables and system outlets and should be used as the reference impedance in level measurements.

12.2.4 Carrier Levels At System Outlets

12.2.4.1 Minimum And Maximum Carrier Levels

The minimum and maximum carrier levels will depend on many factors, including the performance of typical receivers in use, local installation practices and the ambient signal levels. Notwithstanding the above, the maximum levels shall not be exceeded and the minimum levels shall not be less than those shown in Table 12.1.

Table 12.1. Carrier signal levels at system outlets

Frequency Range and Service	Max. Level (dBμV)	**Min. Level** (dBμV)	Definitions
(i) 54-824 MHz television	80	60 (FCC 76.605-a-3)	These levels are expressed as the r.m.s. voltage of each carrier at the peak of the modulation envelope when measured at the system outlet across an external 75 ohm termination or relative to 75 ohms
(ii) FM sound VHF Band (mono)	75	40	These levels are expressed as the r.m.s value of each FM carrier when measured at the system FM outlet across an external 75 ohm termination or relative to 75 ohms.
FM sound VHF Band (stereo)	75	50	

Note: Where successive FM channels are at an interval of 300 KHz the maximum FM level shall not exceed 66 dBμV and where the interval is 400 kHz, the level shall not exceed 74 dBμV.

12.2.4.2 Carrier Level Differences

The differences in carrier levels shall not exceed the values given in Table 12.2.

If FM signals are present at the system outlet intended for television signals, the level of any carrier shall be at least 3 dB lower than the lowest television signal level at the outlet.

Table 12.2. Maximum level difference at each system outlet between distributed television channels

Frequency Range	**Maximum Level Differences (dB)**
(i) 54 MHz to 824 MHz	16 (FCC76.605-a-4ii)
(ii) Adjacent Channel	3 (FCC76.605-a-4I)
(iii) Any 60 MHz range	6

12.2.5 **Mutual Isolation Between System Outlets**

12.2.5.1 General

The isolation at any signal frequency between the TV sockets of the two system outlets connected separately to a spur feeder via separate subscriber's feeders shall be equal to or greater than 33 dB. The isolation between any TV and FM sockets (other than the two sockets at the same outlet) shall exceed 46 dB.

12.2.5.2 Additional Requirements If Unwanted Frequencies Are Unavoidable.

When the channel allocations or channel conversions are such that the television or FM receivers' local oscillator fundamental or harmonic frequencies fall in the FM or television channels, the isolation at any signal frequency between two system outlets connected to a spur feeder via separate subscribers' feeders shall be at least 46 dB.

Where the local oscillator signals fall in a FM channel, the signal level of the FM channel at the system outlet shall be at least 54 dBμV.

12.2.6 Frequency Response within A Television Channel at Any System Outlet

12.2.6.1 Amplitude Response

The amplitude response as a function of frequency for the entire system shall be such that the variation in gain over any television channel (bandwidth appropriate to the television system in use) is not more than ± 2dB relative to that at the vision carrier frequency, and gain shall not vary by more than 0.5 dB within any frequency range of 0.5 MHz. (FCC 76.605-a-6)

Note : Reception difficulties may impose selectively requirements on head end equipment which may cause these limits to be exceeded.

12.2.6.2 Phase Response

The group delay variation within any TV channel shall not be more than 50 ns.

12.2.7 Frequency Stability Of Distributed Carrier Signals

Where a signal is not distributed at the received frequency or is locally generated, the variation of the carrier frequency from the declared nominal due to the system equipment shall not exceed ± 30 kHz for a television signal or ± 12 kHz for a FM sound signal. Where the system carrier frequencies are generated locally, the frequency difference between vision and sound carrier for any one channel shall be maintained within ± 2 kHz of the nominal for the television system in use. When adjacent television channels are used, the frequency variation of each of the vision carrier shall not exceed ± 20 kHz.

12.2.8 Generation Of Spurious Signals

Frequency converters shall conform to CISPR Publication 13 in respect to the level of R.F. voltage produced at their signal terminals at the fundamental and harmonic frequencies of their oscillators.

Note: Where the local oscillator frequencies and harmonics are such that interference to the distributed frequencies is possible, additional measures to reduce unwanted R.F voltage may be necessary.

12.2.9 Intermediate Frequency Interference

At any system outlet, the level of any signal in the I.F range of the television receivers shall be at least 10 dB lower than the lowest VHF television signal level and not higher than the lowest UHF television signal level.

12.2.10 **Random Noise**

The carrier to noise ratio for systems from the head end input to the system outlets (see paragraph 12.2.2) shall be not less than the value shown in Table 12.3. This carrier to noise ratio should be obtained with a test signal applied at the system input equal in level to that normally available at that point except where the normal input is less than the minimum shown in Table 12.1, in which case the minimum levels given in that table should be used.

Table 12.3. minimum carrier to noise ratio for TV and FM systems outlets

System		Min. Carrier to Noise Ratio (dB)	Noise Bandwidth (MHz)
(i)	625-lines System B, G	47	5
(ii)	FM sound (mono)	41	0.20
(iii)	FM sound (stereo)	51	0.20

Note 1: Carrier to noise ratio expressed in decibels is defined as:

$$\frac{C}{N} = 20\log\left(\frac{\text{carrier voltage}}{\text{noise voltage}}\right)$$

Where the carrier voltage is the r.m.s value of the vision carrier at the peak of the modulation envelope of the r.m.s value of the FM sound carrier, and the noise voltage is the r.m.s value of the random noise in that channel.

Note 2: This value applies when the level at the system outlet is the minimum given in Table 12.1.

12.2.11 **Interference To Television Channels**

12.2.11.1 Single-frequency Interference To Television Channels

This paragraph refers to single-frequency interference that may result from inter-modulation or the presence of interfering signals.

At any system outlet the level of any unwanted signal generated within the system shall be such that the lowest carrier to interference ratio within a wanted television channel shall be not less than 60 dB, where this ratio is expressed as:

$$20\log\left(\frac{\text{r.m.s of vision carrier signal voltage}}{\text{r.m.s of interference voltage}}\right)$$

and the voltages have those values occur at the peak of the modulation envelopes. However, where a frequency assignment taking account of known future off-air and distributed channels is adopted so that interference signals fall only in the less sensitive areas of the television channel spectra, a limit lower than that given above may be acceptable.

12.2.11.2 Multiple-Frequency Intermodulation Interference

At any system outlet, the level of the multiple frequency intermodulation interference, in any wanted television channel, shall be such that the carrier to interference ratio shall be not less than 65 dB for 30 channel loading, measured according to IEC 728-1 Clause 9.

12.2.12 **Cross-modulation Between Television Channels**

At any system outlet the peak-to-peak amplitude of any unwanted modulation on a wanted carrier shall be at least 60 dB below the peak-to-peak amplitude of the wanted modulation for 30 Channels loading.

12.2.13 **Differential Gain And Phase In Television Channels**

The differential gain and phase in any television channel shall not exceed the figures as given in Table 12.4.

Table 12.4. Differential gain and phase in Television Channels

System	Max. Differential gain	Max. Differential Phase
PAL	10 %	5^{0}

12.2.14 **Echoes In Television Channels**

The echo rating as determined at any system outlet when measured by the method defined in Appendix C of CP39:1994 shall not exceed 4%.

12.2.15 **Data Signal Transmission**

12.2.15.1 In the context of this sub-clause “data” is taken as any pulse modulation digitally encoded signal regardless of original information format.

12.2.15.2 Data Signals Carried In The Vertical Interval Of A Television Signal

- Data echo rating
The data echo rating on any television channel employed to carry such signals within the vertical interval shall not exceed 4%.

- Data delay inequality
The data delay inequality in any television channel employed to carry such signals in the vertical interval shall not exceed 50 ns.

12.2.16 **Hum Modulation Of Carriers In Television Channels**

At any system outlet the spurious modulation of any vision carrier at the frequency of the supply mains and harmonics thereof shall be such that the reference modulation to hum modulation ratio is not less than 46 dB.

When the reference modulation is a vision signal, its amplitude is that of the peak-to-peak composite signal, from peak white to sync tip.

12.2.17 Radiation From Individual System Components

The radiation from any individual component to be used in the system shall not exceed 1 x 10^{-10} W (-70 dBmW) within the operating frequency range of that system, when measured in accordance with pr EN 50083-2:1992 unless otherwise stated.

12.2.18 **Immunity To External Fields**

12.2.18.1 Immunity Of Complete System

The immunity of the system shall be such that at any system outlet (see paragraph 12.2.2) on any distributed channel, the ratio of carrier to interfering signal (caused by an external field) shall be not less than the limits given for single-frequency interference in paragraph 12.2.11.1.

12.2.18.2 Immunity Of Individual System Components

The immunity of individual system components shall be such that, when measured in accordance with Clause 17 of IEC 728-1, the r.f. wanted to unwanted signal ratio is better than 64 dB for vision programmes and 50 dB for sound programmes.

12.2.19 **Chrominance / Luminance Delay Inequality**

At any system outlet (see paragraph 12.2.2) on any television channel, the difference in transmission delay between luminance and chrominance information shall not exceed 170 ns. (FCC 76.605-a-11)

12.2.20 **FM Radio : Additional Performance Requirements**

12.2.20.1 Amplitude Response Within An FM Channel

The amplitude response as a function of frequency for the entire system shall be such that the maximum amplitude variation over any FM channel (bandwidth appropriate for the transmission system in use) is not more than 3 dB with the slope not exceeding 0.3 dB per 10 kHz within 75 kHz of the carrier.

12.2.20.2 Adjacent Channel Spacing

The minimum spacing between adjacent unmodulated carriers shall be not less than 400 kHz for high fidelity transmission and not less than 300 kHz for other FM services.

12.2.20.3 Relative Level Of Adjacent Carriers

The level difference between two carriers in the VHF band allocated to FM broadcasting shall not exceed 8 dB. The level difference between carriers on adjacent channels with less than 600 kHz spacing shall not exceed 6 dB.

12.2.20.4 Regulation Of Power Supplies

The outputs of the power supplies for the amplifiers shall be regulated or stabilised such that a variation of 10% of the main supply shall not change the system performance characteristics.

12.3 NETWORK TOPOLOGY

The network input port shall be designed for proper BCS network operation with input levels and TV channel loading as follows:

(a) at 824 MHz - Between 14 and 25 dBmV

(b) at 54 MHz - Between 11 and 25 dBmV

(c) Channel loading - 60 PAL TV Channels

12.3.1 Wiring Facilities for BCS Cables

Suitable cable routes, such as trunking, conduits, risers, etc. as well as means of mechanical protection to the CATV cables shall be provided for the wiring of a complete CATV system. The cable routes shall have as few bends as practical.

12.3.2 Routing To Subscriber's Premises

The passive device (Tap/Tee) feeding the system outlets in each residential unit shall be connected to a dedicated subscriber feeder cable from the nearest distribution panel/box.

Subscriber feeder cables shall be installed in conduits throughout its entire length so that they cannot be accessed by unauthorised person(s). Where multiple feeder cables are bunched together, cable trunking, with adequate covers may be used in lieu of conduit.

No splices or termination between the passive device and the system outlet shall be made in the subscriber feeder cable, except within residential unit.

All subscriber feeder cables shall be properly labelled and clearly marked at the distribution panel. The labels or marking shall designate the particular unit address to which each subscriber feeder cable is connected.

12.3.3 Distribution Panels And Boxes

The distribution panel/ boxes shall be lockable and securely mounted to the building wall. The distribution panel need not be lockable if it is securely mounted on the riser/shaft.

All connectors shall be located within the locked distribution panel/box to ensure effective shielding against RF ingress and egress.

The lockable panel/box shall be able to accommodate the required number of in-line negative traps, accessories and amplifiers.

12.4 CABLES

Coaxial cables shall be used for the installation of a BCS system. The cables used meet or exceed the minimum requirement stated herein:

12.4.1 Subscriber Feeder (Drop) Cables (Above Ground)

General Requirements

(a) Characteristic impedance : 75Ω ± 2Ω
(b) Velocity of propagation : 85%
(c) Structural return loss : exceed 20 dB (47-824 MHz)
(d) The center conductor shall be copper-clad steel or Beryllium copper alloy or hard drawn copper. It shall have a solid single core. It shall be compliant to the specifications of the SCTE for broadband coaxial cable systems.
(e) The dielectric shall be gas expanded foam polyethylene.
(f) The shielding shall consist of an aluminum-polypropylene-aluminum (or equivalent) laminated tape longitudinally wrapped with an overlap around the dielectric and shall be bonded to the dielectric with a layer of adhesive to provide 100% coverage and long-term reliability of shielding performance.
(g) The outer jacket shall be polyvinyl chloride (PVC) for dry environment and polyethylene (PE) for damp environment.
(h) The screening effectiveness shall be either :
    (i) greater than 90 dB at 200 MHz when measured using the Dipole Antennae Procedure (see NCTA Recommended Practices for Measurements on Cable TV Systems, 2nd Edition, Part 1, Section J), or
    (ii) greater than 80 dB at 200 MHz when measured using the Absorbing Clamp method (see pr EN 50083-2:1992).
(i) The cables used shall be able to withstand long term operation in high humidity environments without deterioration.

(j) Suitable centre conductor with corrosion prevention should preferably be incorporated to reduce corrosion or oxidation of the centre conductor's copper surface.

12.4.2 Main Cables (Above Ground)

General Requirements :

(a) All main cables shall be hard-line (solid outer conductor) cables.
(b) The characteristics impedance shall be 75Ω ± 2Ω.
(c) Velocity of propagation, more than 87%.
(d) Structural return loss (measured with the cable under test terminated in its conjugate impedance) shall exceed 20 dB at any frequency in the band 47-824 MHz.
(e) The dielectric shall be gas expanded foam polyethylene or other dielectric of similar electrical properties. The cable with equivalent dielectric shall be in every respect no less effective than that with gas expanded foam polyethylene.
(f) The dielectric shall be bonded to the outer conductor with an adhesive coating.
(g) For installations where cables must bend extensively or must bend at a radius of less than 10cm, only cables with outer jacket bonded to the outer conductor shall be used. Care must be taken not to bend the cables beyond their specified minimum bending radius. For such installations, .412 size cable with full bonding of jacket to outer conductor and outer conductor to dielectric is recommended.

12.4.3 Underground Cables

Underground cable joint shall be avoided. Where it is absolutely required, suitable connectors shall be used. The joints shall be sealed with waterproofing compound.

The underground coaxial cables shall meet or exceed the requirements stated herein:

(a) All underground main cables shall be hardline (solid outer conductor).
(b) The characteristics impedance shall be 75Ω ± 2Ω.
(c) Velocity of propagation, more than 87%
(d) Structural return loss (measured with the cable under test terminated in its conjugate impedance) shall exceed 30 dB at any frequency in the band 47-824 MHz.
(e) The dielectric shall be gas expanded foam polyethylene.
(f) The underground cables shall be water-proof and weather resistant.

12.5 SAFETY

12.5.1 Safety Requirement

A cabled distribution system shall be so designed, constructed and installed as to present no danger, either in normal use or under fault conditions to subscribers, personnel working on or externally inspecting the system, or to any other person, providing particularly:

(a) personal protection against electric shock;

(b) personal protection against physical injury;

(c) protection against fire

Note: The above does not apply to authorised personnel working on the apparatus, which may involve the exposure of live parts by the removal of protective covers.

12.5.2 **Main-supplied Apparatus**

(a) The devices used in a cabled distribution system shall meet the requirements of SS 143 and the requirements of the Public Utilities Board, Singapore. In addition, the special requirements of sub-paragraphs (b) and (c) of paragraph 12.5.2 shall be met.

(b) All mains connected apparatus shall employ a mains transformer complying with the insulation requirement given in SS 143.

(c) Apparatus installed outdoors and operated from supply mains shall be contained in an appropriate drip-proof, splash-proof or water-tight enclosure so as to provide the degree of protection against moisture.

12.5.3 **Safety Bonding Terminals**

All amplifier housing, metallic mounting bay and racks shall be provided with an external safety bonding terminal complying with the relevant paragraphs of SS 143.

Note: Taps, splitters etc may also be fitted with bonding terminals.

12.5.4 **Connection To Supply Main**

(a) Connection of apparatus to the supply mains shall conform to the requirements of the local electricity supply authority i.e. the Public Utilities Board (PUB).

(b) In the absence of any specific requirements by PUB, the following shall apply:

(i) The bonding terminal of the apparatus shall be connected to the earth conductor of the mains; and

(ii) If the design of the apparatus do not require it to be earthed, it shall then be clearly labelled and shall be isolated or enclosed with insulated materials.

Note: If different potentials build up between the earth conductor and the electrical earth of each apparatus, balancing current might flow, and critical parts might be overheated.

12.5.5 **Feeders Bonding**

(a) Metal enclosures especially those containing live equipment shall be bonded in accordance with the requirements of PUB. All units within the enclosure shall be bonded to the enclosure.

(b) The outer conductors of coaxial cables entering or leaving a building shall be carefully bonded to the earth conductors of the mains.

(c) The outer conductor and its connections between any system outlet and any other outlet or bonding shall be able to carry a current of 30 A for 5 seconds.

(d) Provisions shall be made to maintain bonding while units are changed or removed.

(e) The conductor connected to the bonding terminal shall be mechanically stable, and have a cross-sectional area of at least 4 mm^2.

(f) The maximum value of earth-loop impedance shall comply with the PUB's requirement concerning earth leakage protection.

(g) Every connection of an earthing lead to an earthing point shall be readily accessible and soundly made by the use of clamps or soldered joints.

12.5.6 **Proximity To Power Distribution Systems**

(a) The cabled network shall be adequately protected against inadvertent contact with, or induction from electrical power distribution systems.

(b) PUB's requirements concerning the proximity of the cabled network to electrical power distribution systems and installations of any high-voltage network shall be strictly observed in all respects and at all times.

12.5.7 **Remote Power Supply (Over The Coaxial Cable)**

(a) The nominal r.m.s. voltage between the inner conductor and the outer conductor of the coaxial cable shall not exceed 65 volts.

(b) The installation for the remote power supply including the coaxial cable shall comply with PUB's requirement.

12.5.8 **Weather Protection**

All apparatus and cables exposed to weather, corrosive atmosphere or other adverse conditions shall be so constructed or protected as may be necessary to prevent danger from arising from such exposure.

12.6 INSTALLATION PRACTICES AND PROCEDURES

12.6.1 Protection against moisture: the entire network shall be tightly sealed mechanically to prevent moisture from entering the electronic devices and coaxial cables.

12.6.2 Protection against corrosion shall be provided to metallic housing and devices. This is achieved by using any or all of the following methods:

(a) Using corrosion-resistant material, such as stainless steel;

(b) Galvanic protection;

(c) Protective coating such as painting with rust-inhibiting paints;

(d) Other suitable corrosion prevention measures.

Where protective coatings are used, care should be taken to ensure electrical continuity.

12.6.3 **Operating Ambient Conditions**

All equipment shall be capable of continuous operation at ambient temperature up to 45°C and relative humidity 100%.

12.7 WORKMANSHIP

12.7.1 All materials used shall be securely attached to permanent building walls or other structural members.

12.7.2 It is important to ensure that all F-type connectors are installed properly.

12.7.3 Adequate measures should be undertaken to ensure protection against moisture and corrosion. (see paragraphs 12.6.1 and 12.6.2)

12.7.4 Whilst installing the heat-shrink tubing over the connectors, particular attention should be paid to the need to ensure that the tubing has been shrunk uniformly and that the adhesive is effective throughout.

12.8 SPACE AND OTHER PROVISIONS IN BUILDINGS FOR THE CONSTRUCTION OF BCS SYSTEM

12.8.1 General

Suitable space and facilities shall be provided within the building for the installation of the source port, amplifiers and distribution panels.

12.8.2 Requirement For All New Condominium And Apartment Building

12.8.2.1 A Coaxial Distribution Room (CDR) of dimensions 1m (W) x 0.5m (D) x 2.7m (H) shall be allocated to the CATV telecommunication system licensee(s) per complex. The CDR is preferably to be located next or adjacent to the Telecom MDF room. The CDR size may be varied subject to IDA's approval.

(a) The CDR shall be well ventilated, dry and secured by an appropriate lock. In particular, it shall be protected against rain or flooding.

(b) Power Supply for CDR – 3 nos. of 13 Amp single phase AC outlet shall be provided in the CDR. A separate Distribution Box (DB) shall also be provided.

(c) Earth Bar / Rod – 1 no. of clean earth with less then 1 ohm shall be provided in the CDR.

12.8.2.2 The above specifications are the minimum requirements for the immediate supply of CATV and cable modem signals, with no built-in expansion capabilities. To provide for future requirements either by having them built at the onset or factor them into the design of the housing development:

(a) the provision of a CDR in every building; and
(b) the provision of an expanded CDR with room size of 2 m x 3 m with full height.

12.8.2.3 <u>BCS Riser Closets</u>

(a) The risers are location where the vertical coaxial cable is installed and it is from these risers that the subscriber feeder cable to each unit is laid. Amplifiers, taps and splitters are installed in a riser closet.

(b) There should be sufficient number of risers appropriately located in the building(s) erected or to be erected on the housing development to ensure that the actual length of the television cable installed to every unit in a building from a riser is not more than 50 m.

(c) Riser space of 450 mm (W) x 300 mm (D) is to be provided for BCS equipment. Other services are not to locate their equipment in this riser space.

(d) 100 mm galvanised tray shall be provided vertically through the riser.

12.8.2.4 Lead-In-Pipe

(a) Housing developers are required to provide lead-in-pipes for the buildings.

(b) Lead-In-Pipe for condominium and apartment building – refer to Figure 12-1.

(c) Housing developers are required to provide 2 nos. of UPVC pipes for the buildings.

(d) Each stand alone building is to be linked to the Coaxial Distribution Room (CDR) via a lead-in-pipe from the telecommunication manhole.

(e) A pull rope shall be made available as part of each lead-in-pipe.

(f) The external diameter of the lead-in-pipe shall be no smaller than 110 mm. To allow stiff cables to be installed, there shall be no more than two (2) bends in each complete section of the lead-in-pipe, and the bend shall be of at least one (1) meter radius.

(g) The lead-in-pipe is to be constructed of a non-combustible, non-conducting material that can maintain its structural integrity over time. The lead-in-pipe shall comply to SS: 272

(h) The entry point of the lead-in-pipe at a building should be directly at a riser closet if possible, unless the entry point is where the CDR is located. Otherwise, the point of entry should be against an indoor wall. The location should be such that it is feasible to distribute stiff cables from this location to the rest of the risers in the building.

12.8.3 **Requirement For Landed And Strata Landed Properties**

12.8.3.1 For landed and strata landed properties, it is necessary to make certain provisions on the premises to facilitate convenient connection to utility services. Similarly the provisions specified below are required for convenient connection to the cable network. The requirements for different types of landed housing projects are summarised in Table 12-5:

Table 12-5

Landed/strata landed housing	Single-unit landed housing
a) Feeder cables between TV outlets and a n-way splitter which is installed in an utility room;	a) Feeder cables between TV outlets and a n-way splitter which is installed in an utility room;
b) A 50mm diameter lead-in uPVC pipe from a manhole to the gate	b) A 50mm diameter lead-in uPVC pipe from a point 1m beyond the

pillar of each house, and from the gate pillar to the utility room. (see paragraph 12.8.3.3)	road-side drain to the gate pillar of the house, and from the gate pillar to the utility room.
c) A CDR room (see paragraph 12.8.3.6.)	
d) A pedestal for every manhole which is connected by lead-in pipes. (See paragraphs 12.8.3.4 & 12.8.3.5	

12.8.3.2 Lead-in-pipes connecting to telecommunications pipeline system needs to be in accordance with Figure 12-2.

12.8.3.3 A 50 mm diameter uPVC lead-in-pipe shall be laid from the manhole constructed for telecommunication services to the gate pillar of each house for use by the BCS connection.

12.8.3.4 A pedestal shall be constructed for every manhole which has lead-in pipes. The coaxial drop cables from the pedestal shall service only the houses with lead-in pipes terminating at the nearby manhole. The drop cables from the pedestal shall not use the pipes between manholes to serve houses with lead-in pipes terminating at the adjacent manholes.

12.8.3.5 2 nos. of 110 mm diameter uPVC pipe shall be provided between the manhole constructed for telecommunication services and CATV pedestal, for use by the CATV telecommunication system licensee(s). All pipes and conduits shall not have more than two (2) bends between openings, and the radius of all bends shall be at least twenty times the radius of the conduit or pipe.

12.8.3.6 CDR shall be provided within the MDF room compound. The CDR should not be less than 1m wide x 1 m deep x 2.5 m high. The CDR requires:

(a) four nos. of 110 mm UPVC pipes to the nearest manhole;
(b) three nos. of 13 AMP single phase AC outlet with separate Distribution Box (DB) provided; and
(c) one clean earth with less than 1 ohm.

12.8.4 **Requirement For Non-Residential Buildings**

12.8.4.1 If BCS is not required for a non-residential building, then all space and infrastructure (lead-in-pipes, CDR, riser space/trunking/tray, etc) must be provided so as to permit future installation of the system at any time in the future, and with minimal disturbance to tenants. All documents mentioned in Part 2 of this document, except those pertaining to BCS's TV outlets, must be submitted to the telecommunication system licensee(s) for approval.

12.8.4.2 Recommended Practice

Given the technological changes from time to time, it is therefore necessary for building developers or owners (as the case may be) to consult with the telecommunication system licensee(s) when designing and installing their in-building BCS systems.

12.8.5 Requirement For New Buildings Six-Storeys And Above

12.8.5.1 Tap-off Points

For all developments (including residential and non-residential) that are six-storeys and above, there is an additional requirement for tap-off pipe(s) from the Broadband Coaxial Cable System to be provided by developers. These are to facilitate the tapping of good TV signals for low-rise and landed developments in the neighbourhood whose TV signal may be blocked, or suffer from effects of the surrounding. The tap-off pipe(s) shall be laid from the CDR to the boundaries of he development.

(a) The number of tap-off pipe(s) to be provided shall depend on the gross development site area of the housing development and shall be computed as tabulated below:

Development Gross site area	No. of tap-off pipes required
Less than 10,000 m^2	1
10,000 to 40,000 m^2	2
40,001 to 90,000 m^2	3
More than 90,000 m^2	4

(b) Where more than one tap-off pipe is to be provided, the tap-off pipe(s) shall be located as distant as possible from each other at the boundaries of the housing development.

(c) The tap-off pipe(s) shall be located such that contractors authorised by the relevant authority for the purpose of tapping a TV signal, are able to have direct and convenient access to them.

(d) The tap-off pipe(s) shall be made available for external connection, as may from time to time be directed by the relevant authority.

12.8 OTHER DETAILS

Other relevant technical details and reference materials can be found under Appendices B.1 to B.7:

Appendix B.1: Definitions of terms;

Appendix B.2: Equipment specifications;

Appendix B.3: Commissioning of test procedures;

Appendix B.4: Methods of measurements;

Appendix B.5: Typical BCS riser schematic for a high-rise building;

Appendix B.6: Description of some standards developed by the SCTE; and

Appendix B.7: Antennae and installation (non-mandatory for BCS system).

Figure 12-1. Lead-In Pipes for BCS in Residential and Non-residential Buildings

Estate Boundary

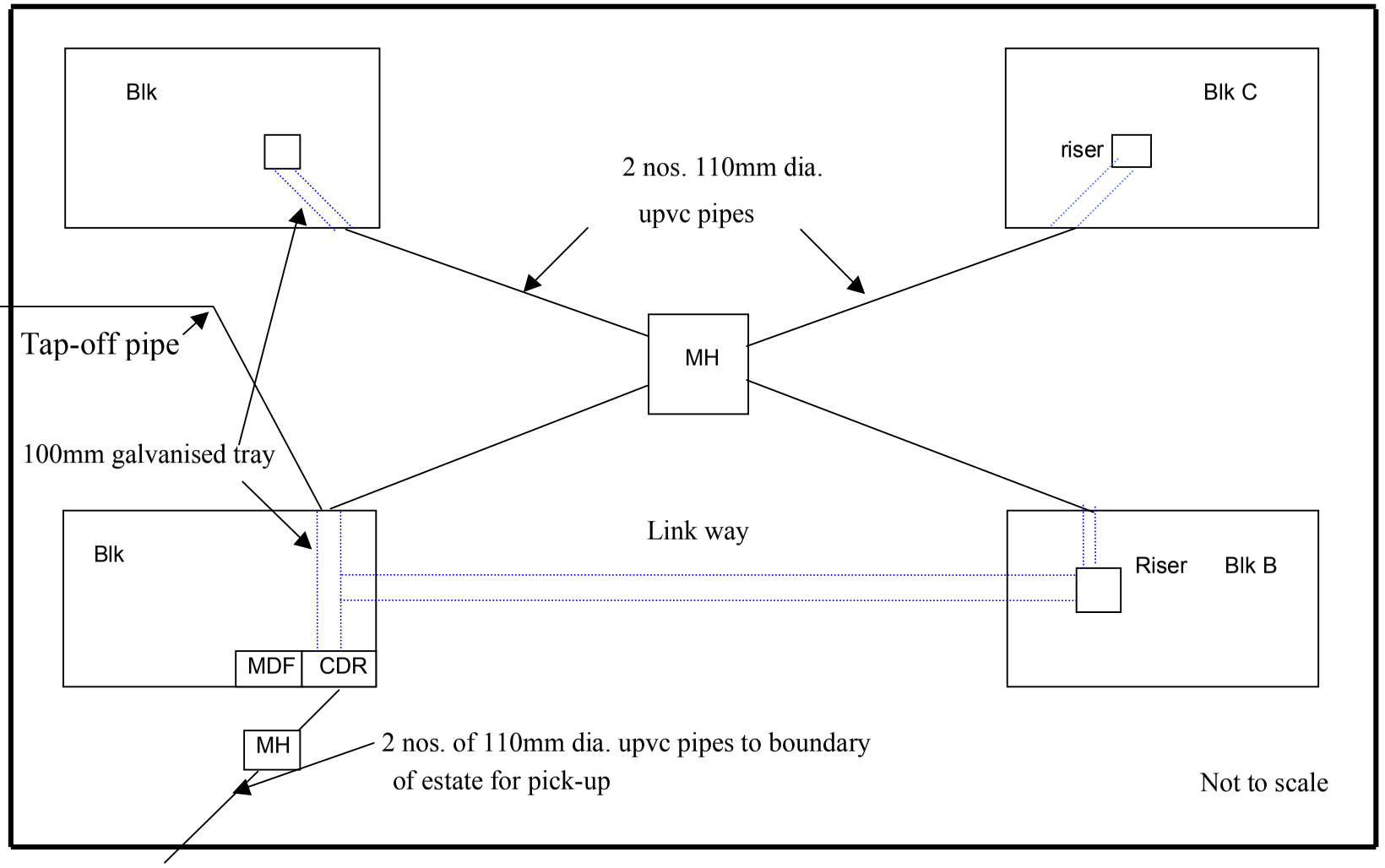


Figure 12-2. Lead-In Pipe Connection within Residential Building Development to Telecom Network