TELECOMMUNICATIONS ACT
(CHAPTER 323)

CODE OF PRACTICE
FOR INFO-COMMUNICATIONS FACILITIES IN BUILDINGS

In the exercise of the powers conferred by section 26(1)(*f*) and 26(2)(*b*) of the Telecommunications Acts, the Info-communications Development Authority of Singapore hereby issues the following Code:

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1. PRELIMINARY

1.1 Citation and Commencement

1.1.1 This Code may be cited as the COPIF 2005 and shall come into operation on _____ 2005.

1.2 Goals of this Code

1.2.1 This Code is intended to:

(a) ensure that developers or owners of buildings construct and maintain adequate space and facilities within their buildings and lands so as to facilitate the efficient deployment and operation of installation, plant and systems used for the provision of telecommunication services to the buildings;

(b) promote the expedient deployment of installation, plant and systems into buildings by multiple telecommunication system licensees so as to increase the range of telecommunication services available to the occupants of the buildings; and

(c) ensure that telecommunication system licensees who install their installation, plant and systems within the space and facilities provided by developers or owners of buildings do so in a fair and efficient manner so as not to prevent or hinder other licensees from providing their services to the buildings.

1.3 Legal Effect of this Code

1.3.1 This Code shall apply to different categories of developers or owners as follows:

(a) <u>Developers or Owners of Buildings to be Developed</u>

Every developer or owner who is granted any of the following types of permission from the Urban Redevelopment Authority ("URA") to develop a building, on or after the Effective Date of this Code, namely:

(i) written permission;

(ii) planning clearance; or

(iii) acknowledgment under the plan lodgement scheme,

(hereinafter collectively referred to as "development permissions")

must comply with the applicable provisions in sections 3 to 10 of this Code.

(b) Developers or Owners of Buildings under Development

Every developer or owner who has been granted any development permissions before the Effective Date of this Code but whose building is still under development at the Effective Date of this Code, must either:

(i) provide the space and facilities specified in the Code of Practice for Info-communications in Buildings issued by IDA in September 2000 ("COPIF 2000") in which case he must also comply with section 2 of this Code, or

(ii) comply with the applicable provisions in sections 3 to 10 of this Code.

For the purpose of this category, a building is regarded as being still under development if it has not been issued a certificate of statutory completion by the Commissioner of Building Control.

(c) Developers or Owners of Developed Buildings

Every developer or owner whose building is completely developed before the Effective Date of this Code must comply with section 2 of this Code. For the purpose of this category, a building is regarded as being completely developed if it has been issued a certificate of statutory completion by the Commissioner of Building Control.

1.3.2 This Code shall apply to every telecommunication system licensee who:

(a) installs its installation, plant or system within the space and facilities provided by developers or owners pursuant to this Code, or

(b) installs its installation, plant or system within the space and facilities provided by developers or owners pursuant to previous codes of practices, guidelines or specifications.

Every such telecommunication system licensee must comply with section 11 of this Code.

1.3.3 Failure to comply with this Code is an offence under section 26(8) of the Telecommunications Act.

1.3.4 The obligations contained in this Code are in addition to those contained in the Info-communication Authority of Singapore Act (Cap. 137A) ("IDA Act"), the Telecommunications Act, as well as other regulations, directions, licenses or codes of practice issued by IDA. To the extent that any provision of this Code is inconsistent with the terms of the IDA Act, Telecommunications Act, or the terms of any license issued by IDA, the provisions of the IDA Act, Telecommunications Act or licenses shall prevail. To the extent that this Code is inconsistent with the provision of any code of practice issued by IDA or its predecessor, the

Telecommunications Authority of Singapore, the terms of this Code shall prevail. If any provision of this Code is held to be unlawful, all other provisions will remain in full force and effect.

1.3.5 Nothing in this Code shall restrict or limit IDA's right to issue a direction under section 21 of the Telecommunications Act, including a direction requiring a developer or owner to provide space and facilities within his building and land, whether or not such space and facilities are specified in this Code.

1.4 Exemptions

1.4.1 Where good cause is shown, IDA may grant exemptions from specific provisions of this Code. A person who seeks to be exempted shall write to IDA with supporting reasons for his request. An exemption may be on a one-time basis, temporary, permanent, for a fixed period or effective until the occurrence of a specific event. Where appropriate, IDA may grant exemptions subject to compliance with specified conditions.

1.4.2 No exemption purported to be granted by any other person, including the TFCC or any telecommunication system licensee, whether on behalf of IDA or otherwise, shall be valid or binding on IDA.

1.5 Right to Modify

1.5.1 IDA may modify this Code on its own initiative at any time.

1.6 Revocation of Prior Code

1.6.1 The COPIF 2000 is cancelled save that for developers or owners referred to in sub-section 1.3.2(b) who elect to comply with the COPIF 2000, the applicable provisions of the COPIF 2000 shall continue in effect for the purpose of their compliance.

1.7 Revocation of Previous Exemptions

1.7.1 Any exemptions previously granted to developers or owners in relation to any previous codes of practices, guidelines or specifications shall not apply to buildings that have been granted development permissions by the URA on or after the Effective Date of this Code.

1.8 Guidelines

1.8.1 IDA has published a set of advisory guidelines entitled "Guidelines Relating to Info-communications Facilities in Buildings" to complement this Code. The guidelines set out the optional space and facilities which developers or owners are encouraged to provide to enhance the roll-out of services to their buildings.

1.9 Definitions

In this Code, unless the context otherwise requires –

(a) "building" means any building in respect of which the permission of the Urban Redevelopment Authority is required before development of such building can be carried out and a reference to a building shall include the land on or in which the building is situate;

(b) "Effective Date" means the date this Code comes into effect;

(c) "developer or owner" includes any Government body or statutory corporation that develops or owns a building;

(d) "previous codes of practices, guidelines or specifications" include:

(i) the COPIF 2000;

(ii) the Code of Practice for Telecommunication Facilities in Buildings issued by IDA's predecessor, the Telecommunication Authority of Singapore ("TAS"), in March 1997;

(iii) the Revised Guidelines for the Provision of Telecommunication Facilities by Developers issued by Singapore Telecommunications Ltd in 1994; and

(iv) the Guidelines for the Provision of Telecommunication Facilities by Developers issued by TAS in 1988 and all other codes of practices, specifications or guidelines issued prior to 1988 which specified the space and facilities to be provided by developers or owners for the provision of telecommunication services to their buildings.

(e) "Telecommunication Facility Co-ordination Committee" or "TFCC" means the committee referred to in sub-section 3.5;

(f) "Telecommunications (Non-BCS)" means all telecommunications except telecommunications transmitted, emitted or received via a broadband coaxial cable system ("BCS"); and

(g) "telecommunication system licensee" has the meaning specified in the Telecommunications Act and includes a person designated as a public telecommunication licensee under section 6 of the Telecommunications Act.

2. PROVISIONS APPLICABLE TO DEVELOPERS OR OWNERS OF BUILDINGS UNDER DEVELOPMENT AND DEVELOPED BUILDINGS

2.1 Overview

2.1.1 For developers or owners who received the URA's development permissions prior to the Effective Date of this Code and whose buildings are still under development at such date, IDA does not require them to change their building plans to conform to this Code. Such developers or owners may choose to adopt the specifications in this Code, in which case they shall be bound to observe all the applicable provisions in sections 3 to 10 of this Code. However, if they choose not to adopt this Code, they must comply with the specifications set out in the COPIF 2000 regarding the space and facilities which they are to provide for their buildings. In addition, they are required to comply with the provisions in this section.

2.1.2 For developers or owners whose buildings have already been completed before the Effective Date of this Code, IDA also does not require them to carry out any renovation or alteration works to bring their buildings into conformity with this Code. Such developers or owners are deemed to have provided sufficient space and facilities so long as they were provided in accordance with the previous codes of practices, guidelines or specifications that applied to these developments. Nevertheless, these developers or owners are required to comply with the provisions in this section.

2.2 No Imposition of Charges for Use of Space and Facilities

2.2.1 Unless otherwise directed by IDA, no developer or owner who provides space and facilities pursuant to any previous codes of practices, guidelines or specifications shall be entitled to impose any charge or collect any rent from any telecommunication system licensee who install its installation, plant and system within such space and facilities for the provision of telecommunication services. Without limitation, no charges or rent are to be imposed for the licensee's use of the following space and facilities:

(a) Main Distribution Frame ("MDF") rooms;

(b) Telecommunication Equipment rooms ("TER") (including Coaxial Distribution Room);

(c) Telecommunication Risers (including riser for BCS);

(d) Lead-in pipes and pipeline systems within the development boundary lines; and

(e) Cabling distribution system within buildings.

2.2.2 For the avoidance of doubt, the duty of the developer or owner to provide the space and facilities does not include an obligation to bear any charges for utilities (e.g. electricity) required to operate the installation, plant and systems that are

installed within the space and facilities by telecommunication system licensees. In this regard, developers or owners may make arrangements with telecommunication system licensees to pass on such utility charges to them.

2.3 Duty to Ensure Continued Provision and Maintenance of Space and Facilities

2.3.1 Developers or owners shall also be responsible for ensuring the continued provision and maintenance of the space and facilities at their own expense. In this regard, developers or owners are to ensure that they:

(a) do not use or allow the space and facilities to be used for any other purpose (e.g. storeroom) apart from accommodating the installation, plant and systems of telecommunication system licensees;

(b) implement reasonable measures to safeguard the security of MDF rooms, TERs and telecommunication risers and to prevent interference or trespassing by any unauthorised personnel; and

(c) maintain the space and facilities in good and serviceable condition, including keeping it clean and tidy and repairing any part or portion of the space and facilities that fall into disrepair. For the avoidance of doubt, this requirement shall apply to all underground pipeline systems provided by developers or owners.

2.3.2 Without prejudice to sub-section 2.3.1, no developer or owner shall:

(a) install his own main distribution frame, local distribution cables or any other equipment, whether telecommunication related or otherwise, in the MDF room or TER, or

(b) use the telecommunication risers for the purpose of accommodating public address systems, computer networking cables or for any other purpose.

2.3.3 A developer's responsibility to ensure the continued provision and maintenance of the space and facilities shall pass on to and be assumed by the person(s) who purchase or acquire the developer's interest in the building. In the case of subdivided buildings, the management corporations established under the Land Titles (Strata) Act (Cap. 158) shall be responsible for the continued provision and maintenance of the space and facilities located in the common property. In the case of Housing Development Board ("HDB") estates managed by Town Councils, the HDB shall ensure that the Town Councils perform these duties accordingly.

2.4 Duty to Assist in the Installation of Plant

2.4.1 In the event that new or additional telecommunication installation or plant is required to be installed within the space and facilities of the building, the developer or owner shall provide reasonable assistance to the telecommunication system licensee to facilitate such installation work.

3. PROVISIONS APPLICABLE TO DEVELOPERS OR OWNERS OF BUILDINGS TO BE DEVELOPED

3.1 Overview

3.1.1 Sections 3 to 10 of this Code apply to:

(a) developers or owners who receive the URA's development permissions on or after the Effective Date of this Code, and

(b) developers or owners who received the URA's development permissions before the Effective Date of this Code but who choose to voluntarily adopt this Code in respect of the space and facilities to be provided for their buildings.

This section outlines the types of space and facilities that are to be provided by the above-mentioned developers or owners and sets out their general responsibilities in relation thereto. It also sets out the procedures to be complied with by developers and owners in respect of the submission of building plans and the conduct of inspections.

3.2 Responsibility for Compliance

3.2.1 The responsibility for compliance with this Code rests solely on developers or owners. Accordingly, developers or owners are to ensure that the construction professionals whom they engage for the building works (architects, engineers, consultants, contractors, etc) observe the requirements of this Code in the planning and execution of the building works. No developer or owner shall be absolved or excused on account of any failure by his construction professional to observe these requirements.

3.3 Allocation of Costs

3.3.1 Where a developer or owner is required to provide and maintain any space or facilities within his building and land under this Code, such developer or owner shall provide and maintain such space or facilities at his own expense.

3.3.2 Unless otherwise directed by IDA, no developer or owner shall be entitled to impose any charge or collect any rent from any telecommunication system licensee for using the space and facilities required to be provided under this Code to install its installation, plant and systems for the provision of telecommunication services.

3.3.3 For the avoidance of doubt, the duty of the developer or owner to provide the space and facilities does not include an obligation to bear any charges for utilities (e.g. electricity) required to operate the installation, plant and systems that are installed within the space and facilities by telecommunication system licensees. In this regard, developers or owners may make arrangements with telecommunication system licensees to pass on such utility charges to them.

3.4 Reference Guide to Space and Facilities to be Provided

3.4.1 The space and facilities that are to be provided by developers or owners is dependant on the nature of the building. Table 3.4.1 below sets out the different types of buildings and the corresponding space and facilities to be provided.

Table 3.4.1 Space and Facilities to be Provided

Building Type	Space and Facilities to be Provided (Refer to Section 4 for Details and Related Requirements)	Detailed Specifications in
Cluster or Strata Landed Houses	Lead-in pipes to gate pillar and pipes from gate pillar into building	Section 5
	Main Distribution Frame ("MDF") Room	Section 6
	Internal wirings and associated Cabling Distribution System within building(s)	Section 9
	BCS within building and up to gate pillar	Section 10
Single-Unit Landed Houses (refer to section 3.5 if services are not required)	Lead-in pipes to gate pillar and pipes from gate pillar into building	Section 5
	Internal wirings and associated Cabling Distribution System within building(s)	Section 9
	BCS within building and up to gate pillar	Section 10
Residential Multi-Storey Buildings	Lead-in pipes and pipeline system within development boundary lines	Section 5
	MDF room	Section 6
	Telecommunication Equipment Room ("TER") in each apartment block	Section 7
	Telecommunication riser(s) and cable trays (or pipelines) between telecommunication riser(s) and MDF room/TER	Section 8
	Internal wirings and associated Cabling Distribution System within building(s)	Section 9
	BCS	Section 10
Non-Residential Buildings	Lead-in pipes and pipeline system within development boundary lines	Section 5
	MDF room	Section 6
	Telecommunication riser(s) and cable trays (or pipelines) between telecommunication riser(s) and MDF room/TER	Section 8
	Cabling Distribution System within building(s)	Section 9

3.4.2 In the event of any doubts with regard to the building type or type of space and facilities to be provided, developers or owners are to refer to IDA for clarifications.

3.5 Single-Unit Landed Houses that do not require Telecommunication Services

3.5.1 An owner of a single-unit landed house who does not require basic telephone services and/or cable services for the building shall not have to provide the relevant space and facilities. Such owner shall submit to IDA a declaration in the form attached at **Annex A.1** (Declaration of Services Not Required). By this declaration, the owner is deemed to have fully understood the consequences of his decision not to provide for the relevant space and facilities.

3.6 Role of the Telecommunication Facility Co-ordination Committee

3.6.1 The TFCC is appointed and authorised by IDA to carry out the following functions:

(a) to serve as a single-contact point for developers or owners to submit their building plans (see procedure in sub-section 3.7) and to provide guidance on matters related to the space and facilities to be provided under this Code. Such guidance shall be limited to matters regarding location and orientation of MDF rooms, TERs, telecommunication risers, cable trays as well as the route of underground pipeline and direction of lead-in pipes, and

(b) to conduct inspections of the space and facilities after they have been constructed (see procedure in sub-section 3.8).

3.6.2 Members of the TFCC are comprised of representatives from telecommunication system licensees, including public telecommunication licensees. IDA may itself perform any of the functions of the TFCC at any time.

3.6.3 The TFCC's role is to promote compliance with this Code by providing an additional safeguard against breaches. However, the TFCC does not act as a representative or agent of IDA. Accordingly,

(a) the TFCC is not competent to grant developers or owners exemptions of any nature whatsoever from the requirements of this Code, and

(b) notwithstanding any inspections of the space and facilities by the TFCC, IDA shall not be precluded from taking action against any developer or owner for any non-compliance that is subsequently discovered.

3.6.4 In the event of any doubts in their dealings with the TFCC, developers or owners should always consult IDA for clarification.

3.7 Submission of Building Plans Prior to Construction

3.7.1 All developers or owners who intend to carry out building works must ensure that their building plans fully incorporate the requirements of this Code. This is to ensure that the provisioning of the requisite space and facilities is integrated into the construction phase of the building so as to prevent wastage, inconvenience and delay that may occur where non-compliant buildings need to be altered after building works are already completed.

3.7.2 Developers or owners are to submit their building plans to the TFCC at an early stage of the construction works.

3.7.3 The following information is to be submitted for all building plans regardless of the building category:

(a) Names and addresses of the developer or owner;

(b) Names and addresses of the construction professionals engaged for the building works, including the architect, the M&E consultant and contractors;

(b) Location of the building;

(c) Proposed number of units and floor area, plot ratio and car park area;

(d) Intended use of the building;

(e) Estimated commencement and completion dates of the building works;

(f) Building works schedule, and

(g) House numbering plan.

3.7.4 In addition to the information in sub-section 3.7.3, developers or owners are to submit the following information based on their building type as follows:

(a) <u>For Cluster or Strata Landed Houses</u>

(1) Site plans indicating the following facilities for telecommunication:

(i) Lead-in pipes to gate pillar. The lead-in pipes shall be connected to manholes constructed by developers or owners along access roads within the development boundary. The number of pipes for telecommunication and those set aside and reserved for BCS must be indicated;

(ii) Pipes from the gate pillar into the building;

(iii) Underground pipes between manholes within the development boundary, and

(iv) Where basement car park is planned in strata-landed housing development, cable trays shall be provided, instead of pipes between manholes. The cable tray routing must be indicated;

(2) Floor plans indicating the locations and internal dimensions of MDF room (i.e. length, width and height excluding the space occupied by beams and columns).

(3) Dwelling units plan indicating the following:

(i) Telephone & BCS outlets, and

(ii) Desired distribution point for unit types with four (4) or more BCS outlets.

(b) For Single-Unit Landed Houses

(1) Site plans indicating the following:

(i) Lead-in pipes to gate pillar. The number of pipes for telecommunication and those set aside and reserved for BCS must be indicated, and

(ii) Pipes from the gate pillar into the building.

(2) Dwelling units plan indicating the following:

(i) Telephone outlets, and

(ii) Desired distribution point for unit types with four (4) or more BCS outlets.

(c) For Residential Multi-Storey Buildings and Non-Residential Buildings

(1) Site plans indicating the following:

(i) Lead-in pipes to each building. The number of pipes for telecommunication and those set aside and reserved for BCS must be indicated, and

(ii) Lead-in pipes interconnecting buildings within a development boundary. The number of pipes for telecommunication and those set aside and reserved for BCS must be indicated.

(2) Floor plans indicating the following:

(i) Location and dimensions of telecommunication risers, and

(ii) Location and internal dimensions of MDF room (i.e. length, width and height excluding the space occupied by beams and columns).

(3) Basement plans indicating the cable tray routing to telecommunication risers.

(4) Dwelling units plan indicating the following:

(i) Telephone and BCS outlets, and

(ii) Desired BCS distribution point for unit types with four (4) or more BCS outlets.

(5) Detailed telecommunication riser plan indicating the following:

(i) Size and location of cable trays, and

(ii) Dimension of cabling hole/opening in floor slab.

3.7.5 The building plans including the softcopy of drawings & cover letter, detailing the information required under sub-sections 3.7.3 to 3.7.4, shall be submitted electronically to the TFCC via Building Construction Authority's ("BCA") CORENET e-Submission system.

3.7.6 The TFCC will acknowledge the receipt of the submission by issuing a reference number. This reference number, together with Project Reference Number, shall be used for any future correspondence.

3.7.7 The submission of the building plans is intended to assist telecommunication system licensees to plan their operations and to optimise infrastructure deployment. The acknowledgment of receipt of any building plans shall not constitute an approval or endorsement by the TFCC or IDA that the plans are in compliance with this Code.

3.8 Time for Completion of Space and Facilities

3.8.1 All requisite space and facilities shall be completed at least six (6) months before any telecommunication service is required. IDA may, on a case by case basis, shorten this timeframe to three (3) months for smaller developments and fast track projects.

3.9 Inspection Procedure for Completed Space and Facilities

3.9.1 This section shall not apply to developers or owners of Single-Unit Landed Housing.

3.9.2 Upon their completion, the developer or owner shall make arrangement with TFCC to conduct a joint site inspection of the space and facilities together with the representatives of the developer or owner (the "Joint Inspection"). Such request for joint-site inspection shall also be copied to IDA for information.

3.9.3 The Joint Inspection shall be confined to the following space and facilities:

(a) MDF room and lead-in pipes;

(b) Telecommunication Equipment Room(s) ("TER") and lead-in pipes; and

(c) Telecommunication Riser(s).

(hereinafter collectively referred to as the "Inspection Items")

3.9.4 Any deficiency in the Inspection Items discovered during the Joint Inspection shall be clearly recorded on the checklist attached at **Annex A.2** (the "Inspection Checklist"). The Checklist is to be signed by both parties and submitted to IDA by the developer or owner. Notwithstanding the participation of the TFCC, the developer or owner is responsible for ensuring the accuracy of the information recorded on the checklist.

3.9.5 Where there are no deficiencies in the Inspection Items, the developer or owner may proceed to arrange with those telecommunication system licensees whose services he requires to install their installation, plant or system within the space and facilities for the provision of services to the building.

3.9.6 Where any deficiencies are discovered in the Inspection Items, the developer or owner shall rectify those deficiencies without delay. The developer and owner may nevertheless concurrently arrange for telecommunication system licensees to install their installation, plant and systems at those areas which are compliant so as not to delay the installation process. However, no installation shall be permitted to be carried out at those areas which require rectification. In the event that any unauthorised installation is carried out, IDA may require its removal at the expense of the developer or owner in order for rectification works to proceed.

3.9.7 Once all deficiencies recorded during the Joint Inspection have been rectified, the developer or owner shall arrange with the TFCC for a re-inspection of the space and facilities (the "Joint Re-Inspection"). Upon confirmation that the Inspection Items are fully compliant with this Code, the developer or owner shall re-submit a duly signed Inspection Checklist to IDA to record such compliance.

3.9.8 A flow chart depicting the inspection process can be found in **Annex A.3**.

3.9.9 Developers or owners should note that the Joint Inspection and Joint Re-inspection are not exhaustive and are limited to those items of criticality identified in the Inspection Checklist. With regard to all other space and facilities required to be provided under this Code, developers or owners are responsible for independently ensuring due compliance. IDA reserves the right to require any developer or owner to rectify at any time any non-compliant feature that IDA may subsequently discover.

3.10 Provision of Access to the Space and Facilities

3.10.1 Developers or owners shall grant telecommunication system licensees reasonable access to their buildings and lands so as to enable such licensees to install and operate their installation, plant and systems to serve the buildings, including carrying out any necessary repair, maintenance and upgrading works.

3.11 Continued Provision and Maintenance of Space and Facilities

3.11.1 Apart from constructing the requisite space and facilities, developers or owners shall also be responsible for ensuring their continued provision and maintenance at their expense. In this regard, developers or owners are to ensure that they:

(a) do not use or allow the space and facilities to be used for any other purpose (e.g. storeroom) aside from accommodating the installation, plant and systems of telecommunication system licensees;

(b) implement reasonable measures to safeguard the security of MDF room(s), TER(s) and telecommunication riser(s) and to prevent interference or trespassing by any unauthorised personnel; and

(c) maintain the space and facilities in good and serviceable condition, including keeping it clean and tidy and restoring any part or portion of the space and facilities that fall into disrepair. The above maintenance requirement also applies to the underground pipeline system(s) that are provided.

3.11.2 A developer's responsibility to ensure the continued provision and maintenance of the space and facilities shall pass on to and be assumed by the person(s) who purchase or acquire the developer's interest in the building. In the case of subdivided buildings, the management corporations established under the Land Titles (Strata) Act (Cap. 158) shall be responsible for the continued provision and maintenance of the space and facilities located in the common property. In the case of Housing Development Board ("HDB") estates managed by Town Councils, the HDB shall ensure that the Town Councils perform these duties accordingly.

3.12 Duty to Assist in the Installation of Plant

3.12.1 In the event that new or additional telecommunication installation or plant is required to be installed within the space and facilities of the building, the developer or owner shall provide reasonable assistance to the telecommunication system licensee to facilitate such installation work.

4. SPACE AND FACILITIES REQUIREMENTS

4.1 Overview

4.1.1 This section explains the corresponding space and facilities to be provided for each type of building and sets out the general technical and related requirements which developers or owners are to observe when providing the same.

4.2 Building Categories and Corresponding Space and Facilities

4.2.1 Cluster or Strata Landed Houses and Single-Unit Landed Houses

4.2.1.1 Buildings such as detached houses (bungalows), semi-detached houses, terrace houses, strata detached houses (strata bungalows), strata semi-detached houses, strata terrace houses, mixed strata landed housing and townhouses are classified under this category. The space and facilities to be provided are:

(a) Lead-in pipes to the gate pillar of each unit and the associated pipeline system, if applicable, within the estate (i.e. from gate pillar to outside drain, under-crossing the outside drain), and

(b) Pipes from gate pillar to the building property for telecommunication cabling (i.e. from gate pillar to property's utility or store room).

4.2.1.2 For buildings with basements (e.g. townhouses), two cable trays, one to be used for Telecommunications (Non-BCS) purposes of width of 200mm and one to be used for BCS purposes of width of 100mm, shall be provided in place of pipeline system;

4.2.1.3 For clustered landed and strata landed housing developments, MDF rooms shall also be provided.

4.2.2 Residential Multi-Storey Buildings

4.2.2.1 Buildings such as condominiums flats and public housing flats are classified under this category. The space and facilities to be provided are:

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

(b) MDF room;

(c) TER;

(d) Two cable trays, one with 300mm width to be used for Telecommunications (Non-BCS) purposes and one with 100mm width to be used for BCS purposes, are to be provided between telecommunication riser(s) and MDF room/TER. As an alternative to cable trays, two metal trunking, one to be used for Telecommunications (Non-BCS) purposes of

dimensions 400mm by 100mm and one to be used for BCS purposes of dimensions 200mm by 100mm, between telecommunication riser(s) and MDF room/TER may be provided;

(e) Telecommunication riser(s) for accommodating vertical cabling, distribution point ("DP") and/or tap/splitter box, and

(f) Cable Distribution System and internal telephone wiring and BCS to telephone points and TV sockets.

4.2.3 Non-Residential Buildings

4.2.3.1 The following buildings fall under this category (non-exhaustive):

(a) Commercial buildings such as office block, shopping complex, convention/exhibition centre and food centre. These may include mixed commercial developments comprising a combination of commercial activities such as shopping podium with an office tower block;

(b) Hotels and other accommodation facilities such as boarding/guest houses, serviced apartments, student's hostels, worker's dormitory;

(c) Single-user industrial/warehouse/utilities/telecommunication development;

(d) Multiple-user industrial/warehouse/utilities/telecommunication development;

(e) Business park development;

(f) Warehouse retail/Industrial retail building;

(g) Places of worship;

(h) Civic and community institutions including police stations, community clubs/centres, homes for the aged, associations, libraries and museums;

(i) Educational institutions including primary/secondary schools, junior colleges, universities, polytechnics, foreign and specialist schools (e.g. school for disabled); and

(j) Hospitals.

4.2.3.2 The space and facilities to be provided are:

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

(b) Two cable trays, one to be used for Telecommunications (Non-BCS) purposes and one to be used for BCS purposes, are to be provided between

telecommunication riser(s) and MDF room where underground pipeline system is not applicable. For building of up to 25 storeys, the width of the Telecommunications (Non-BCS) cable tray and BCS cable tray are to be 450mm and 100mm respectively. For building of more than 25 storeys, the width of the Telecommunications (Non-BCS) cable tray and BCS cable tray are to be 600mm and 200mm respectively;

(c) MDF room;

(d) Telecommunication riser(s) for accommodating vertical cabling, intermediate distribution frame ("IDF") or DP and/or tap/splitter box: and

(e) Cable Distribution System.

4.2.4 Mixed Non-Residential and Residential Buildings

4.2.4.1 Developers and owners of buildings that comprise a mix of non-residential and residential elements (e.g. a building which comprises a shopping podium with an apartment tower block) shall be required to comply with the relevant requirements applicable to each portion of the building as may be appropriate. In other words, developers or owners shall provide separate sets of the requisite space and facilities to cater for the non-residential and residential elements of the building. In the event of any uncertainty as to the space and facilities to be provided, developers or owners are to seek clarification from IDA.

4.2.5 Non-Residential Single-Tenanted Buildings

4.2.5.1 For single-tenanted non-residential buildings which have less than 2,000m^2 of usable floor area for telecommunication services and whose demand for telephone lines does not exceed 50, the space and facilities to be provided are:

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

(b) Two cable trays, one to be used for Telecommunications (Non-BCS) purposes of width of 200mm and one to be used for BCS purposes of width of 100mm, between telecommunication riser(s) and MDF room/TER where underground pipeline system is not applicable;

(c) MDF room;

(d) Telecommunication riser(s) for accommodation of vertical cabling, IDF or DP and/or tap/splitter box; and

(e) Cable Distribution System.

4.3 Provisioning to be Inclusive of all Necessary Fittings, Materials and Works

4.3.1 The obligation of developers or owners to provide the facilities is inclusive of the requirement to supply, install and maintain the telecommunication cables, sockets and all other materials required for the pre-cabling of their buildings.

4.3.2 The developer or owner shall be responsible for providing all service fittings, conduits and sleeves that form part of the facilities he is required to provide even if they are not expressly identified in this Code. If the passageways required for the installation of the facilities have not been prepared during the construction of the building, the developer or owner shall carry out all drilling works though the concrete floors or walls of buildings as may be necessary.

4.4 Segregation Requirements

4.4.1 Non-electrical Plant

4.4.1.1 All manholes, ducts and cables for telecommunication services shall be kept clear of gas and water mains, service pipes and also isolated from manholes and joint boxes belonging to non-telecommunication service providers. The clearance shall at all times be 150mm but may be reduced to 50mm only 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, pipes and crossing bridges constructed wholly or partly of steel) shall be insulated electrically from the steelwork throughout its entire length.

4.4.2 Electrical Plant

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

(a) For high voltage single-core cables (exceeding 400V), the minimum clearance shall be 460mm;

(b) For high voltage multi-core cables (exceeding 400V), the minimum clearance shall be 300mm. Where a clearance of 300mm cannot be obtained, a slab of concrete shall be inserted between the two sets of cables; and

(c) For low and medium voltage cables (less than 400V), the minimum clearance shall be 50mm. Where a clearance of 50mm cannot be obtained, insulation sheets of non-combustible material shall be placed between the two sets of cables.

4.4.2.2 In the cases where cables are concealed in casings, conduits, trunkings and ducts, developers or owners shall provide separate casings, conduits, trunkings and ducts for the telecommunication and electrical cables. Where the cables intersect, a 'bridge' or suitable cross-over joint piece shall be provided.

4.4.2.3 For multi-compartment trunking (i.e. each compartment housing different cables) housing telecommunication and electrical cables, the multi-compartment trunking shall be so designed to ensure that the cables remain in their individual compartments when the cover of the trunking is removed. In addition, the segregation between each compartment in the trunking shall be continuous.

4.4.2.4 All metal trunking and conduits shall be effectively earthed in accordance with the Energy Market Authority's ("EMA") requirements.

4.4.3 Different Communication Cables

4.4.3.1 It is necessary to segregate between cables used for telecommunication services from cables used for other services deployed (e.g. intercom system and data cables) by developers or owners to prevent possible interference and for the purpose of easy identification.

4.5 Diversity Requirements

4.5.1 An additional set of lead-in pipes shall be provided at a different location from the first set of lead-in pipes 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; and

(h) Non-residential building with usable floor area above 60,000 m^2.

4.6 General Protection Requirements

4.6.1 Accommodation provided for telecommunication cables/wires and equipment 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 harmful substances.

4.7 Fire Protection Requirements

4.7.1 Water sprinkler systems must not be installed in MDF rooms, TERs and telecommunication risers. MDF rooms and TERs must be accessible directly from the outside of the building.

4.7.2 The MDF rooms/TERs and telecommunication riser(s) shall be compartmentalised and shall have the requisite fire resistance rating in accordance with the current Fire Code. Door(s) to the MDF rooms/TERs shall have the same or higher fire resistance rating as the compartment wall. The minimum fire resistance rating of the door to the telecommunication riser(s) shall be half of fire resistance rating of telecommunication riser's wall.

4.7.3 Automatic detectors, other than those with water sprinkler system, shall be installed within the MDF room/TER and telecommunication riser(s) in accordance with the Fire Code.

4.7.4 If the sprinkler system/automatic fire alarm system is not required to be installed in the building in accordance with the Fire Code, the automatic detector is not required to be provided in the MDF room/TER and telecommunication riser(s).

4.8 Record-keeping Requirements

4.8.1 The documentation required for the telecommunication facilities are as follows:

(a) 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, telecommunication risers, cable tray routes and details of any other facilities provided by developers or owners within the building compound such as location and dimension of manholes are properly documented on plans, one set of which is to be forwarded to the TFCC (via the CoreNet e-submission system) for record purposes; and

(b) A laminated set or copy must also be displayed prominently and permanently inside the MDF room for easy reference during maintenance works. All legends/symbols in the as-built drawings shall be properly annotated.

4.8.2 In addition to the above, the BCS facilities also require the following documentation:

(a) A set of as-built installation drawings for BCS shall also be prepared for each building. The drawings shall show cable routes and distances, outlet identification, detail 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;

(b) The acceptance test data specified in **Annex B.3** and **Annex B.4** on test procedures shall be recorded and preserved, including input frequencies and levels used for the test;

(c) Drawings and test data shall be amended to show the effect of subsequent changes; and

(d) The developer or owner must maintain the records of the system installed.

5. REQUIREMENTS FOR LEAD-IN PIPES AND PIPELINE SYSTEM

5.1 Overview

5.1.1 This section deals with the requirements relating to the provision of:

(a) lead-in pipes to allow for cable entry into a building, and

(b) where applicable, an underground pipeline system, including the associated manholes, connecting together the lead-in pipes of multiple buildings situated within a single development boundary.

5.1.2 Developers or owners are to ensure that all necessary lead-in pipes, pipelines and manholes are constructed by contractors who are registered with the Building and Control Authority ("BCA") under ME14 (Mechanical and Electrical Heads) category specialising in "Underground Pipeline for Telecommunication". Developers or owners may obtain a list of registered contractors from the BCA (http://www.bca.gov.sg).

5.1.3 The numbers of lead-in pipes specified herein are the minimum quantities required. Developers or owners are to check with TFCC on the need to provide additional number of lead-in pipes should the usage of telecommunications increase.

5.2 General Requirements for Lead-in Pipes

5.2.1 Only unplasticised polyvinyl chloride (uPVC) pipes, of nominal diameter of 110mm or 50mm (applicable for landed houses only) shall be used for lead-in pipes.

5.2.2 Lead-in pipes shall be provided by the developer or owner from the edge of the development boundary to a point 1m beyond the existing or proposed roadside drain (i.e. outside the development boundary). The pipes are to under-cross below the drain (refer to the guidelines of Drainage Department of the Public Utility Board). The gradient is 1:6 for uPVC pipe of nominal diameter of 110mm and 1:3 for uPVC pipe of nominal diameter of 50mm or smaller. Lead-in pipes shall be limited to a length of 30m. In situation where it is not possible for the pipes to undercross below the drain, developer or owner may install pipes to over-cross the drain, subject to the approval of the Drainage Department of the Public Utility Board.

5.2.3 Where a common services tunnel ("CST") or equivalent tunnel system is constructed for the purpose of facilitating the laying of telecommunication cables and other utility cables to building development sites (for example, in the Marina South new downtown area), the lead-in pipes to be provided by the developer or owner are to extend beyond the existing or proposed roadside drain (i.e. outside the development boundary line) and connect to the pipe-sleeves of the designated CST junction box that is adjacent to the development site. The number of lead-in pipes to be provided shall be the same as the number of pipe-sleeves of the

designated CST junction box. In this regard, the number of lead-in pipes specified in sub-sections 5.3 and 5.4 shall not apply.

5.2.4 Developers or owners are to consult the TFCC for guidance on the location and orientation of the lead-in pipes into building or building complex within the development boundary.

5.2.5 A factory-made bend shall be used when there is a 90° upturn, i.e., changing from the horizontal to vertical plane. The pipes 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 TFCC, see Figures 5.1 and 5.2. The specifications for bend pipes, of nominal diameter of 110mm and 50mm, are as shown in Figures 5.3 and 5.4 respectively. The straight pipe reducer, reducing the nominal diameter from 110mm to 50mm and reducing the nominal diameter from 50mm to 25mm, are as shown in Figures 5.5 and 5.6 respectively.

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

5.2.7 A nylon/polyethylene rope of 4-core or multi-strand type with overall diameter of 6mm shall be provided in each pipe to facilitate cable pulling.

5.2.8 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 telecommunication system licensee's networks shall be capped or plugged and indicated by a marker on the final ground level.

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

(a) 50mm of concrete (1:2:4 mix), or

(b) 300mm in well tamped earth.

5.2.10 If lead-in pipes enter a building in a horizontal position, a cable duct sealing module system such as MCT, SVT or ROX types shall be installed to prevent the ingress of water. Information related to the duct sealing system can be found in **Annex B.2**. However, as there may be instances of water seepage, no plant or equipment should be installed below the duct sealing module system. As an added precaution, a drain shall be constructed below the module system to allow for proper drainage of water.

5.2.11 For MDF room located in the basement, developers or owners shall ensure that lead-in pipes do not enter directly into the MDF room located in the basement. In such cases, developers or owners are to install lead-in pipes directly into the basement and then connect, via cable trays, into the MDF room.

5.2.12 Lead-in pipes to a multi-storey building shall end inside the telecommunication risers, flush against the wall and rise up to a minimum height of 1m.

5.3 Lead-in Pipes for Non-Residential Buildings

5.3.1 All lead-in pipes to non-residential buildings shall be uPVC type with a nominal diameter of 110mm.

5.3.2 The number of lead-in pipes to be provided shall depend on the usable floor area of the building as shown in Table 5.3.2.

Table 5.3.2 Number of Lead-in Pipes for Non-Residential Buildings

Usable floor area (per '000 m^2)	Total number of lead-in pipes (Minimum quantity)	Pipe formation (when entering the building)
Up to 20	8	2 x 4
20 to 40	12	2 x 6
40 to 60	20	2 x 10
60 to 80	24	2 sets of 2 x 6
80 to 120	32	2 sets of 2 x 8
120 to 160	40	2 sets of 2 x 10
160 to 200	48	2 sets of 2 x 12

5.3.3 Of the lead-in pipes provided, two lead-in pipes of nominal diameter of 110mm shall be allocated for services provided over BCS.

5.4 Lead-in Pipes for Residential Multi-Storey Buildings

5.4.1 All lead-in pipes to residential multi-storey buildings shall be uPVC type with a nominal diameter of 110mm. The number of lead-in pipes to be provided into the MDF room shall depend on the number of units in the development as shown in Table 5.4.1.

Table 5.4.1 Number of Lead-in Pipes for Residential Multi-Storey Buildings

Number of residential units in the residential development to be served by the MDF room	Total number of lead-in pipes (Minimum quantity)	Pipe Formation (when entering the building)
≤ 60	6	2 x 3
61 – 200	8	2 x 4
201 – 400	10	2 x 5
401 – 600	12	2 x 6
601 – 800	14	2 x 7
801 – 1000	16	2 x 8
1001 – 1500	18	2 x 9

5.4.2 Of the lead-in pipes provided, two lead-in pipes of nominal diameter of 110mm shall be allocated for services provided over BCS.

5.5 Lead-in Pipes for Cluster or Strata Landed Houses and Single-Unit Landed Houses

5.5.1 All lead-in pipes to cluster or strata landed houses and single-unit landed houses shall be uPVC with a nominal diameter of 50mm.

5.5.3 Lead-in pipes shall be buried at a minimum depth of 1m and maintained throughout in a straight run. They shall undercross the road-side drain. They should rise up 250mm inside the gate pillar as shown in Figure 5.7.

5.5.4 Two uPVC pipes of nominal diameter of 50mm (one shall be allocated for services provided over BCS) are required from the gate pillar to the building. The polyethylene cables and/or RG-11 (flooded) cables may be purchased from telecommunication system licensees.

5.5.5 Two uPVC lead-in pipes, of nominal diameter of 50mm, shall be provided to the gate pillar for each unit.

5.5.6 For development works such as alteration and addition, the following requirements shall apply:

(a) If no gatepost is constructed – An exposed uPVC lead-in pipe, of nominal diameter of 50mm, clipped along the house drain or dividing wall is required from the unit to the existing drain headwall and connected to the existing pipe used for cables installed in BCS facilities. In addition, the owner shall make arrangements with the relevant telecommunication system licensees for reconnection or relocation of existing underground plant related to Telecommunications (non-BCS) services; or

(b) If a new gatepost is constructed – sub-section 5.5.1 to 5.5.5 shall apply.

For the purposes of sub-section 5.5.6 (a) or (b) above, the developer or owner shall obtain the relevant authority's approval for the running of any exposed pipes on the drain headwall.

5.6 Lead-in Pipes for Single-Tenanted Non-Residential Buildings

5.6.1 All lead-in pipes to single-tenanted non-residential buildings with less than 2,000 m^2 of usable floor area for telecommunication services and whose demand for telephone lines does not exceed 50, shall be uPVC type with a nominal diameter of 110mm. A minimum of six lead-in pipes, of which two are allocated for services provided over BCS, shall be provided into the MDF room.

5.7 Pipeline System within Development Boundary

5.7.1 Developers or owners shall ensure that all pipeline systems provided are of good workmanship and free of obstructing materials/substance such that they can be used by telecommunication system licensees for the deployment of their telecommunication cables. Developers or owners may refer to **Annex B.3(A)** and **Annex B.3(B)** for the testing procedure of their pipelines.

5.7.2 Pipes are either single or multi-way. They shall be of nominal diameter of either 50mm (Class C complying with Singapore Standard (SS) 141) or 110mm (complying with Singapore Standard (SS) 272). Please refer to **Annex B.4**.

5.7.3 All underground pipelines including joints, bend pipes and manholes shall be water-tight.

5.7.4 Pipes shall be laid at a minimum depth of 1m below the final ground level.

5.7.5 Multi-way pipes shall be installed with spacers according to the diagrams in **Annex B.5**.

5.7.6 Pipes shall be in straight run throughout the whole pipe length. If there is any change in direction, a manhole shall be provided. There shall not be any 'S' bend. In the event of obstruction posed by other services or under-crossing of 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.

5.7.7 In the case of cluster landed housing, manhole(s) and underground pipelines of nominal diameter of 110mm and/or cable trays (for cable laying through basement car park) shall also be provided. The number of pipes, constituting the underground pipelines, shall correspond to the number of lead-in pipes provided into the MDF room. There is to be a minimum number of 6 pipes connected to the manhole within the development furthest away from the MDF room. Furthermore, a space for the pedestal (to be constructed by telecommunication system licensees) shall be set aside for every manhole that is used to serve the houses. Developers or owners shall provide 2 pipes of nominal diameter of 110mm from the manhole to the space set aside for the pedestal. The pipes shall protrude at least 300mm from the ground level at the space set aside for pedestal.

5.7.8 In the case of non-residential buildings, developers or owners are to provide pipes linking the main building to all other buildings (e.g. guard house) within the same compound for installation of telecommunication services.

5.8 Manholes within Development Boundary

5.8.1 Manholes within the development boundaries of the buildings shall be provided by developers or owners in accordance with the following requirements.

5.8.2 Drawings of various standard manhole sizes of type JX2, MX1, MX2 and MX3 are as shown in Figures 5.8 to 5.29. Details of bigger size manholes from MX4

onwards and non-standard or irregular manholes may be obtained from the TFCC or telecommunication system licensees.

5.8.3 The following describes the method and specifications pertaining to the construction of manholes:

(a) Before any concrete is placed:

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

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

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

(c) Pipes shall enter manhole as shown in Figures 5.8 to 5.17 and 5.22 to 5.25. The pipes shall enter the manholes at such depths as to ensure a minimum clearance of 450mm above the floor level and/or 350mm 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 5.18 to 5.21 and 5.24 to 5.29. 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 20mm rendering of cement mortar with fall towards the sump-hole from all directions.

(g) To prevent flooding or overflowing of water from the manholes (situated at lower level) into the surrounding, one uPVC pipe of nominal diameter of 50mm shall be constructed at the neck of these manholes and connected to the nearest drains situated lower than the manholes.

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

5.8.4 Precast manholes meeting the above requirements are also acceptable.

5.8.5 Manhole frames, covers and channel brackets shall be purchased directly from suppliers. Developers or owners may consult the TFCC for information on the suppliers.

5.8.6 For manholes constructed under the carriageway/vehicular access area, heavy duty manhole covers (complied with Singapore Standard (SS) 30 Grade A1) shall be used. For manhole constructed under the turfed areas/pedestrian footway, medium duty manhole covers (complied with Singapore Standard (SS) 30 Grade B) shall be used.

5.8.7 All manhole covers provided by developers or building owners, shall not bear the name of any telecommunication system licensee.

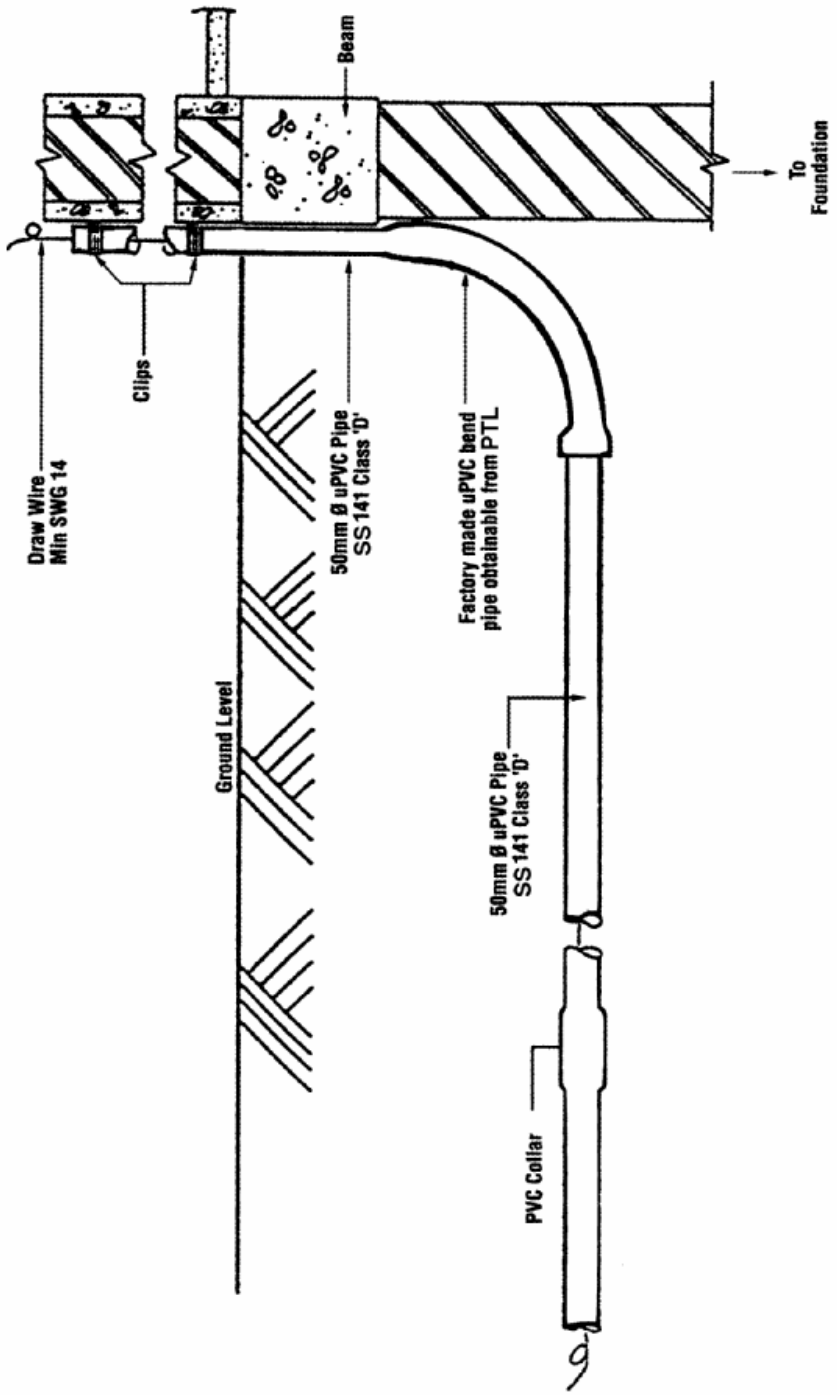


Figure 5.1: Details of Lead-in Pipes with Bend Pipes

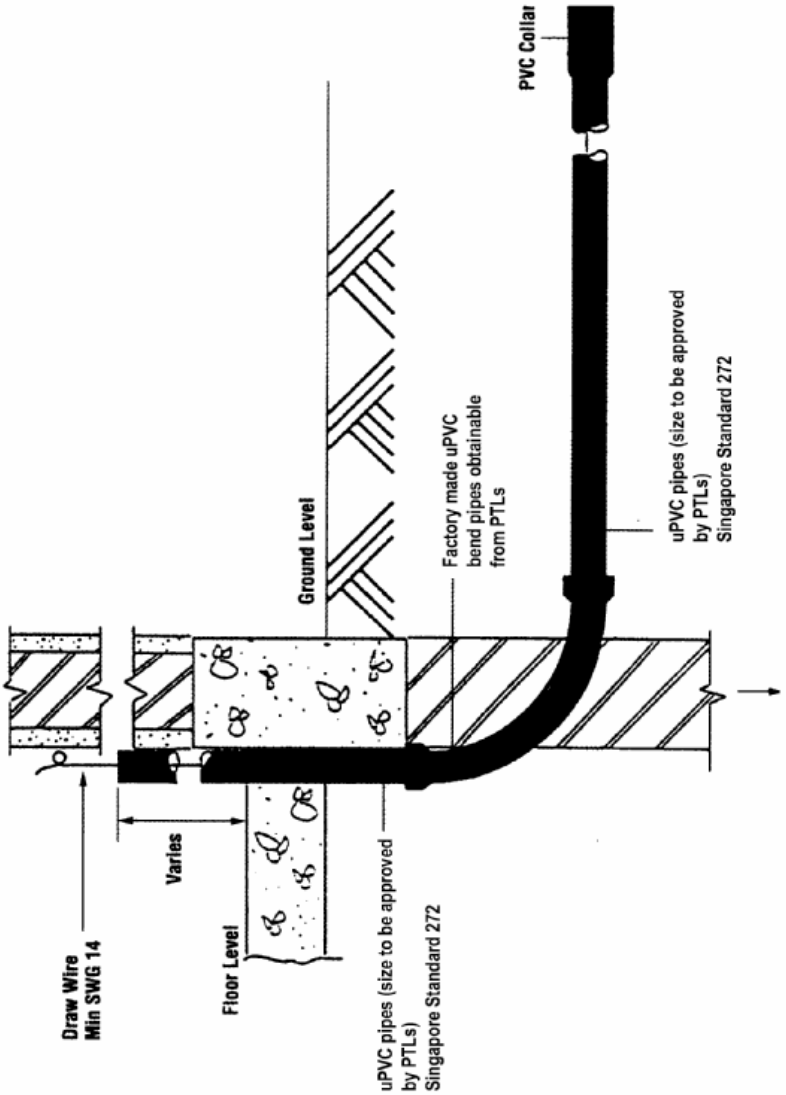


Figure 5.2: Details of Lead-in Pipes

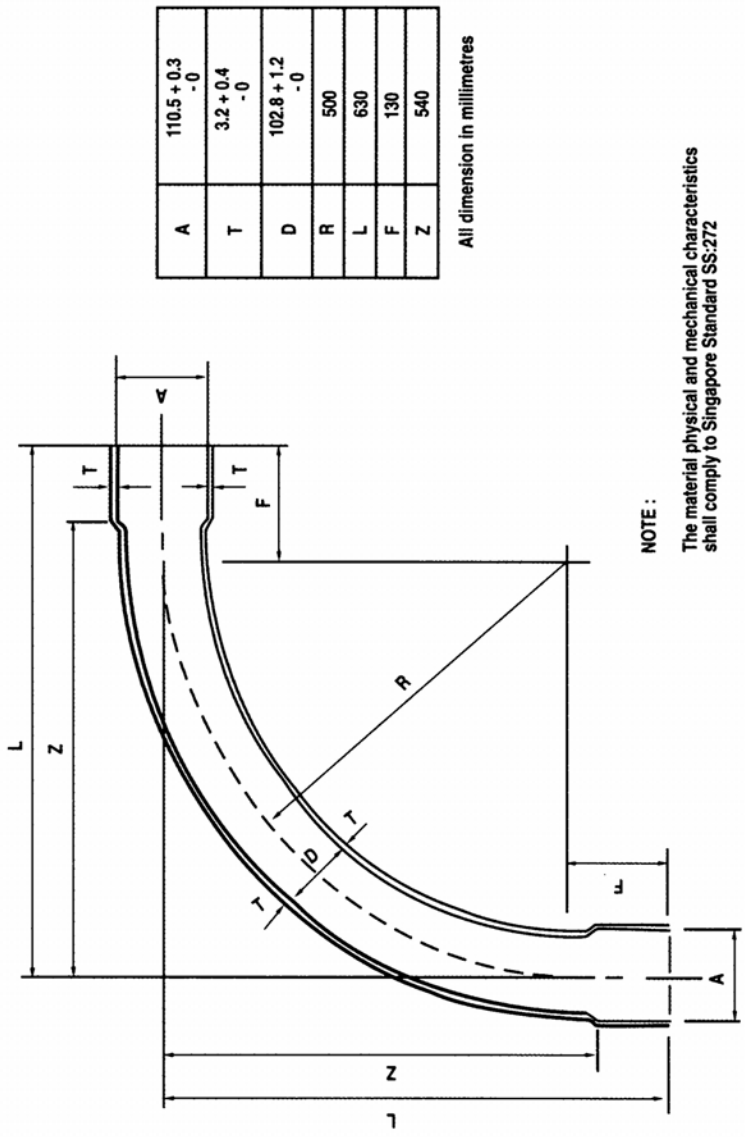


Figure 5.3: 110mm Diameter uPVC bend pipe

Figure 5.4: 50mm Diameter uPVC bend pipe

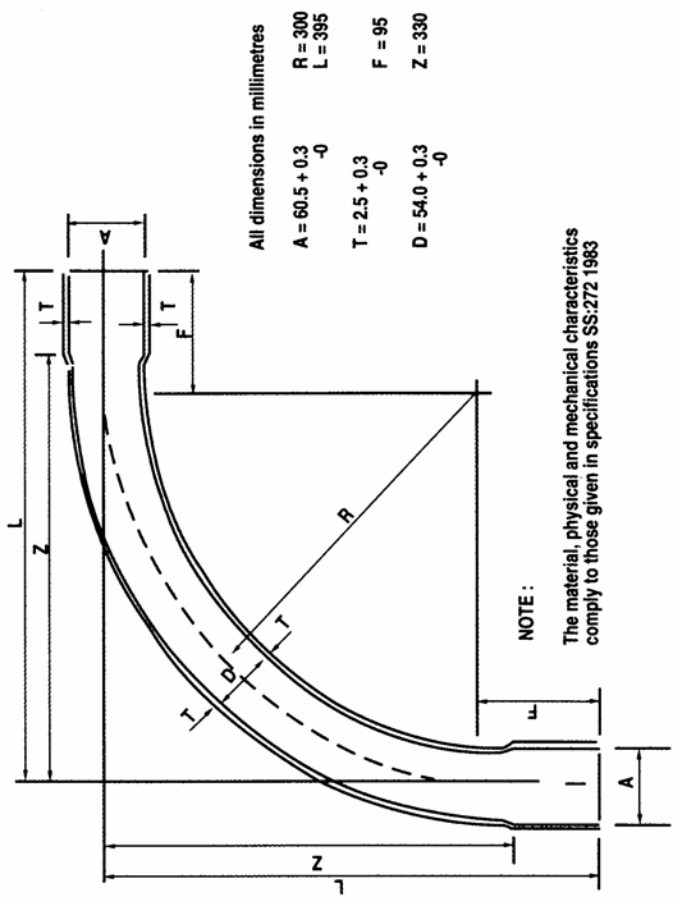
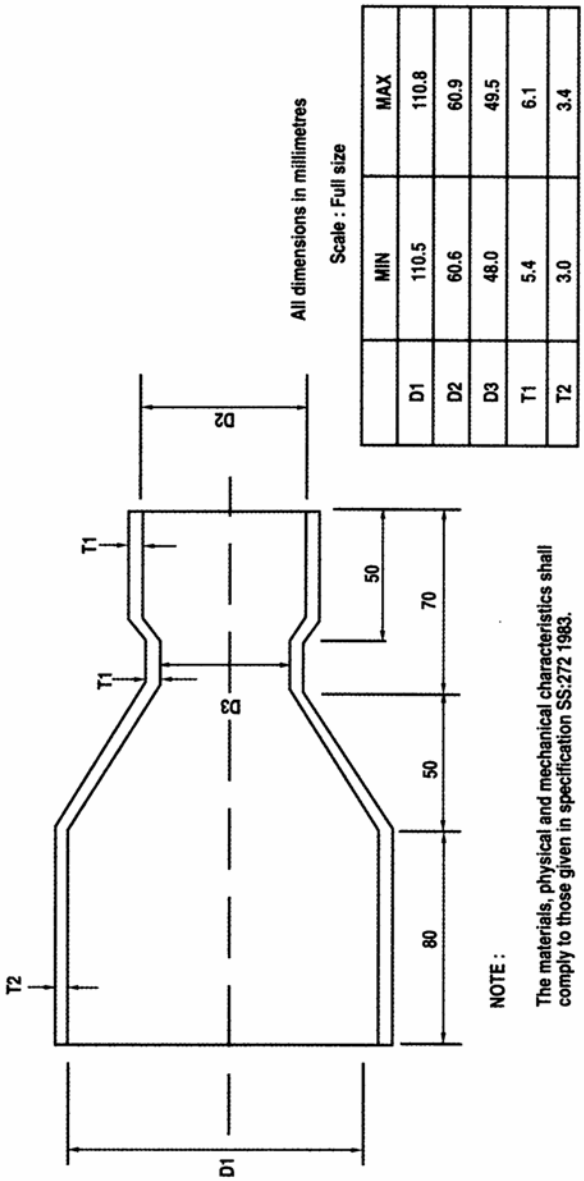
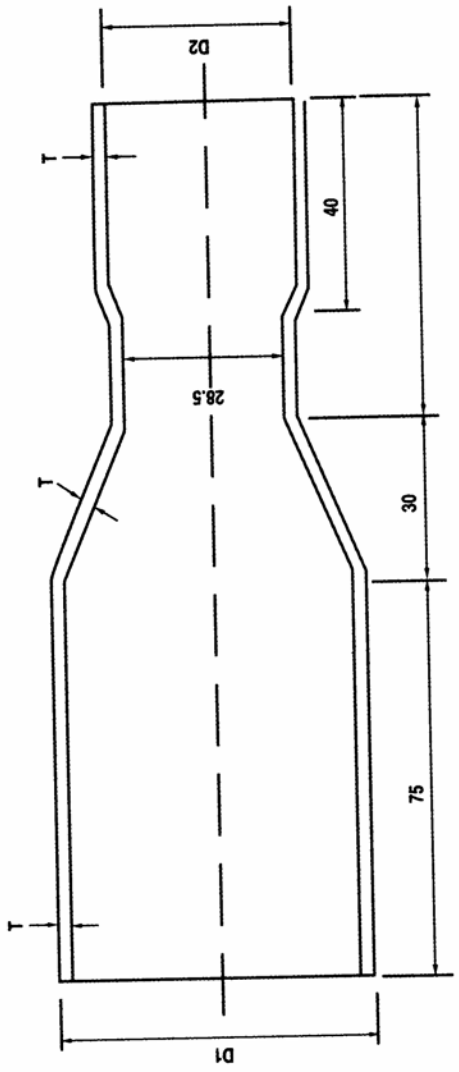


Figure 5.5: Reducer for 110mm to 50mm Diameter Nominal Size UPVC bend pipe



	MIN	MAX
D1	110.5	110.8
D2	60.6	60.9
D3	48.0	49.5
T1	5.4	6.1
T2	3.0	3.4

Figure 5.6: Reducer for 110mm to 50mm Diameter Nominal Size UPVC bend pipe (Stock 134837Z)



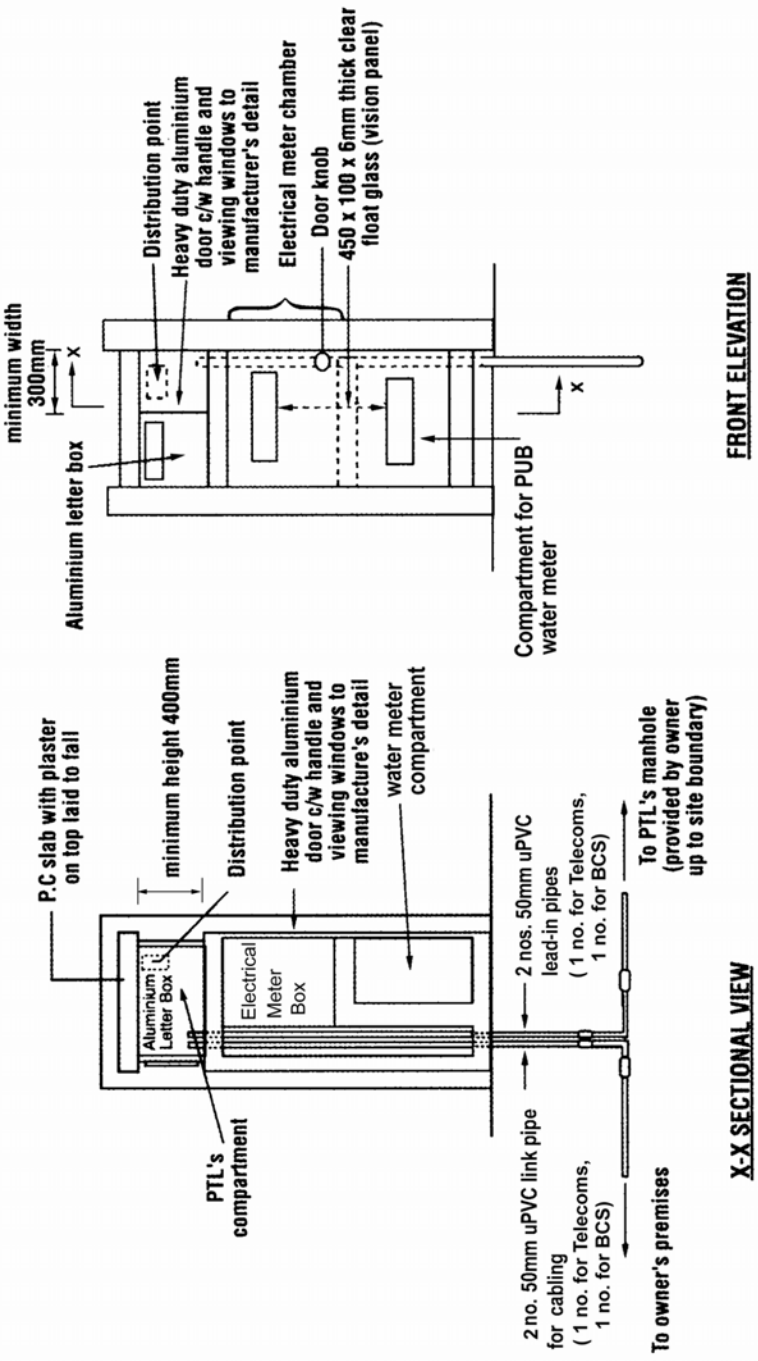
	MIN	MAX
D1	60.2	60.5
D2	33.7	34.0
T	2.7	3.0

NOTE :

The materials, physical and mechanical characteristics shall comply to those given for 110mm Ø nominal size uPVC pipe in accordance to Singapore Standard SS:272 1983.

All dimensions in millimetres

Figure 5.7: Location of Lead-in Pipes in Gate Pillar



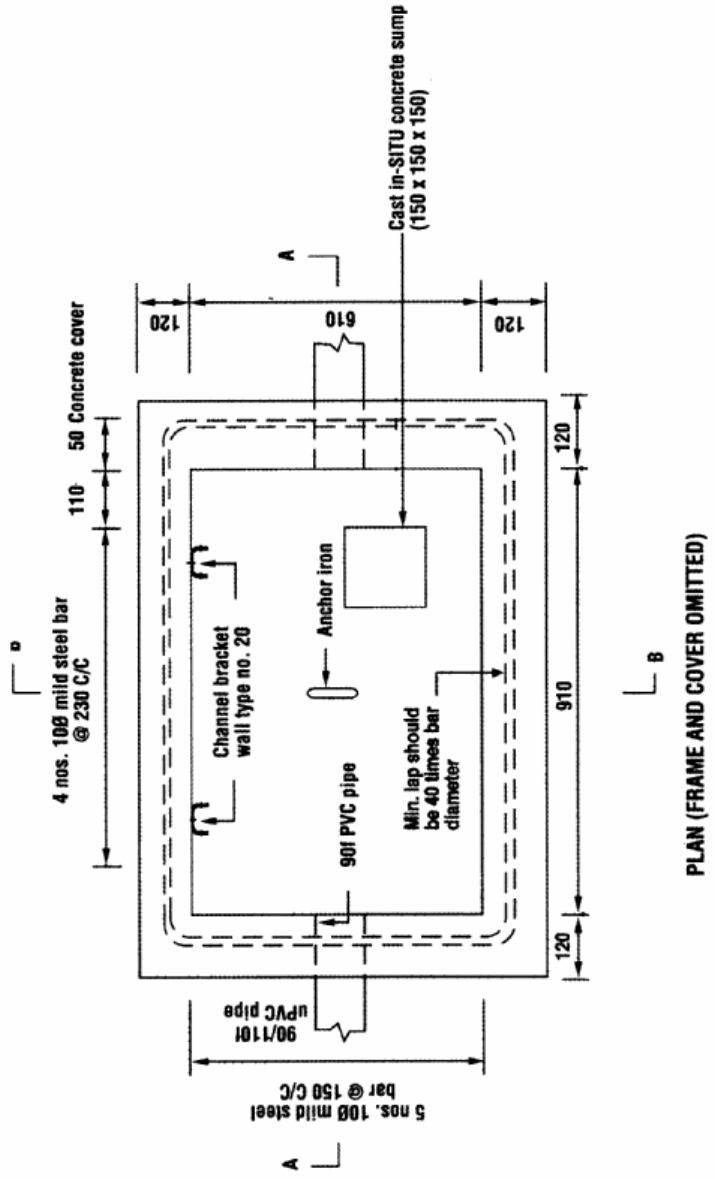


Figure 5.8: Manhole Drawings – Type JX2

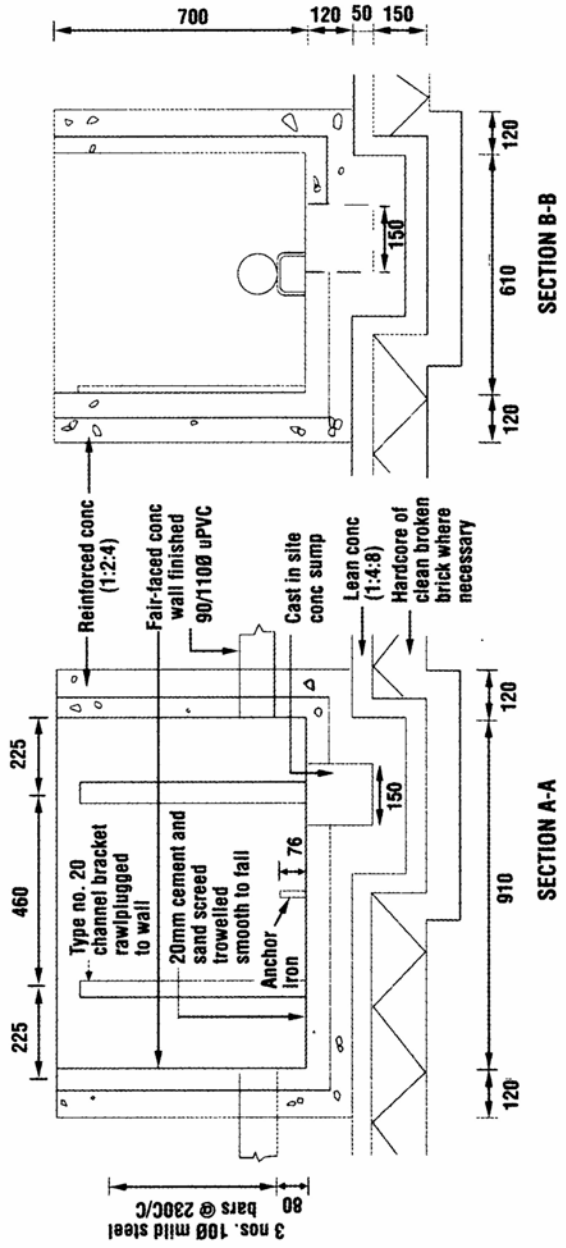


Figure 5.9: Manhole Drawings – Type JX2

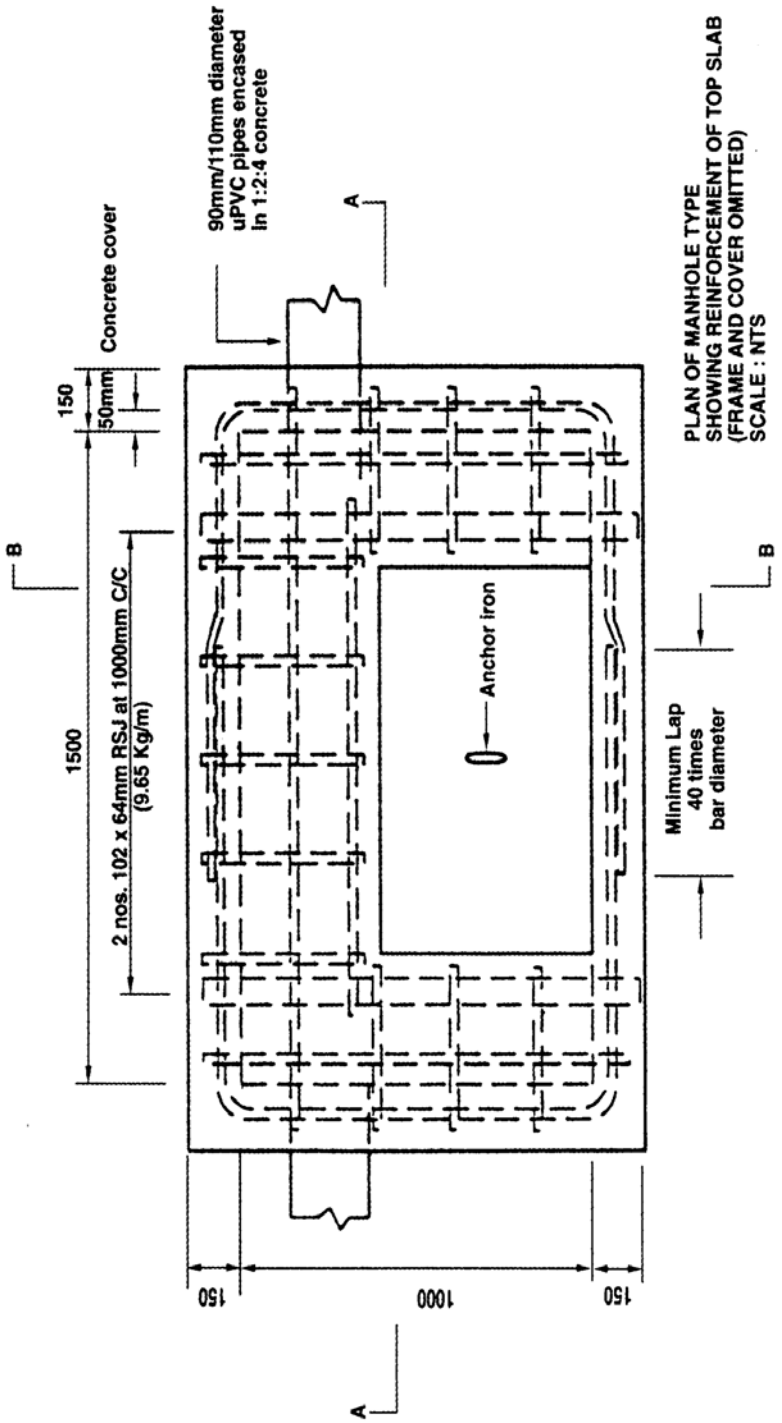


Figure 5.10: Manhole Drawings – Type MX1

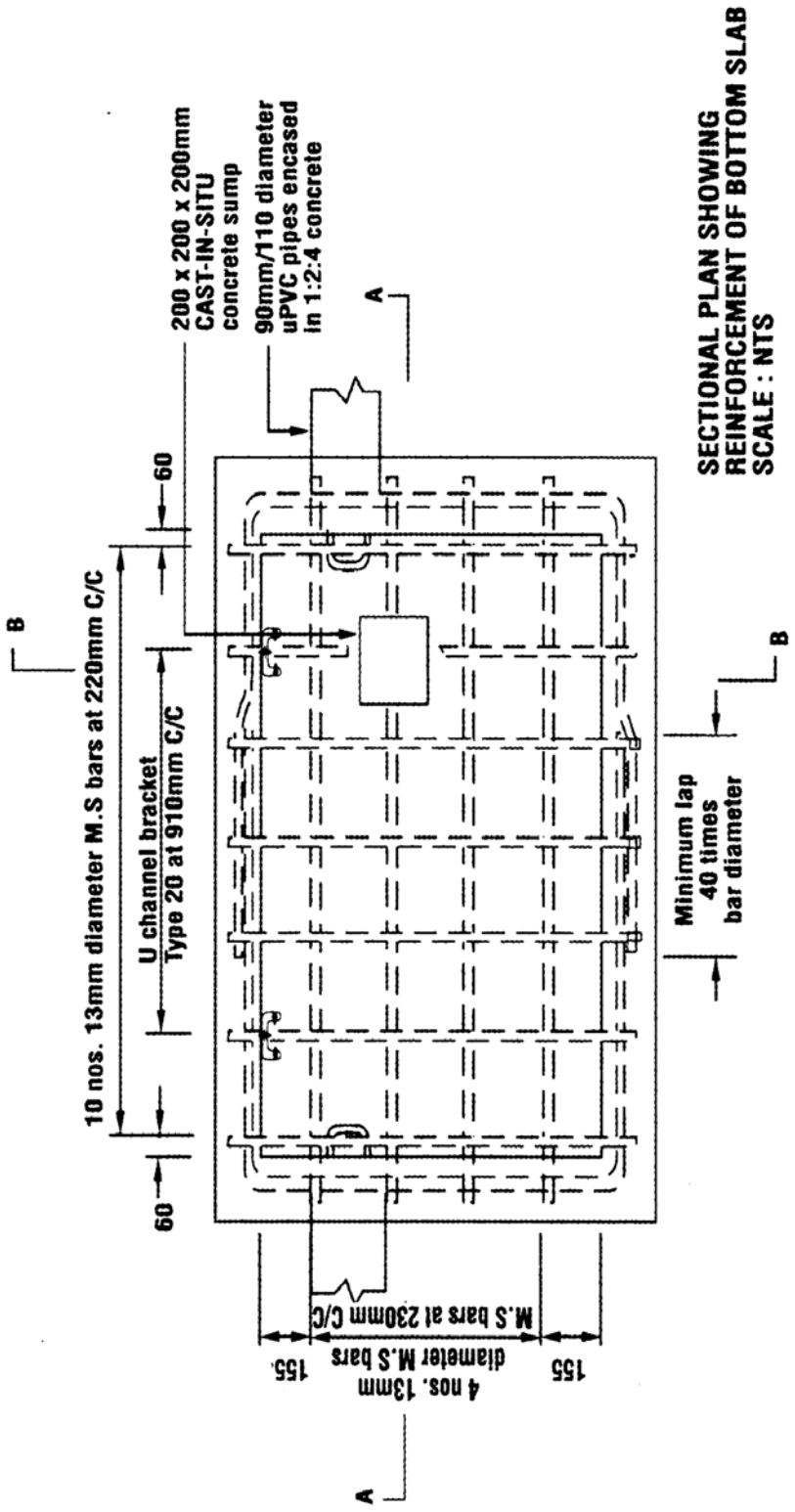


Figure 5.11: Manhole Drawings – Type MX1

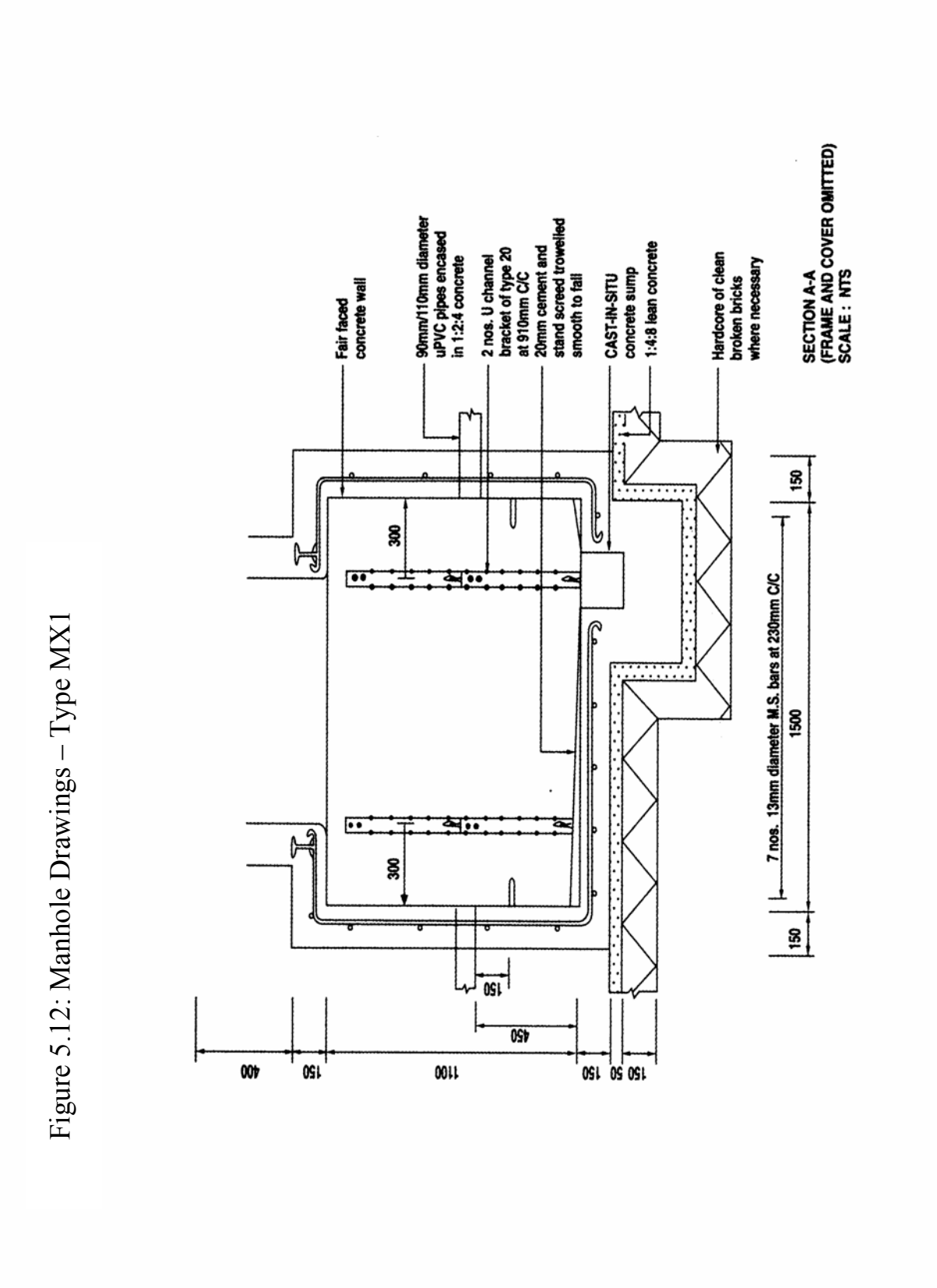


Figure 5.12: Manhole Drawings – Type MX1

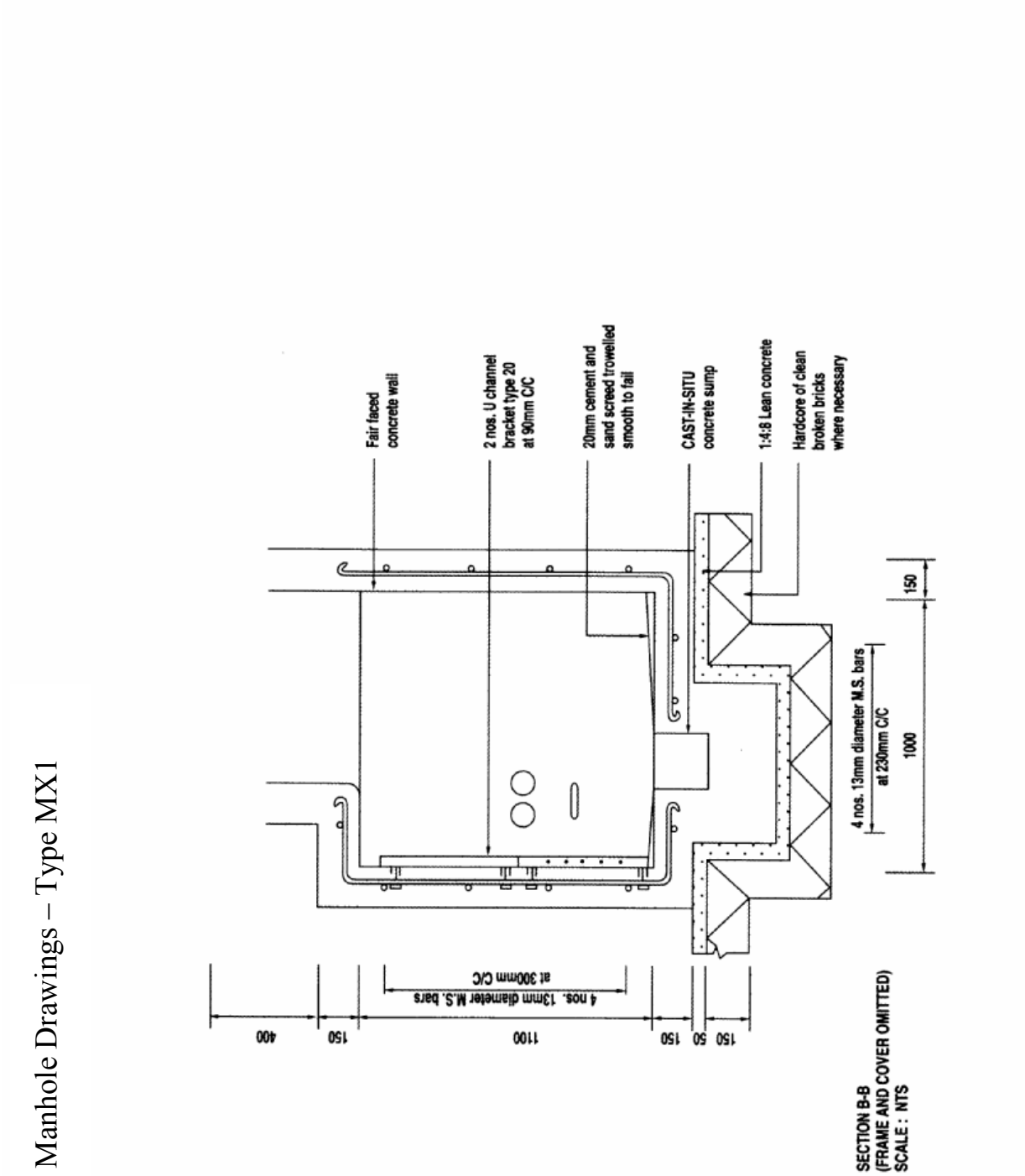


Figure 5.13: Manhole Drawings – Type MX1

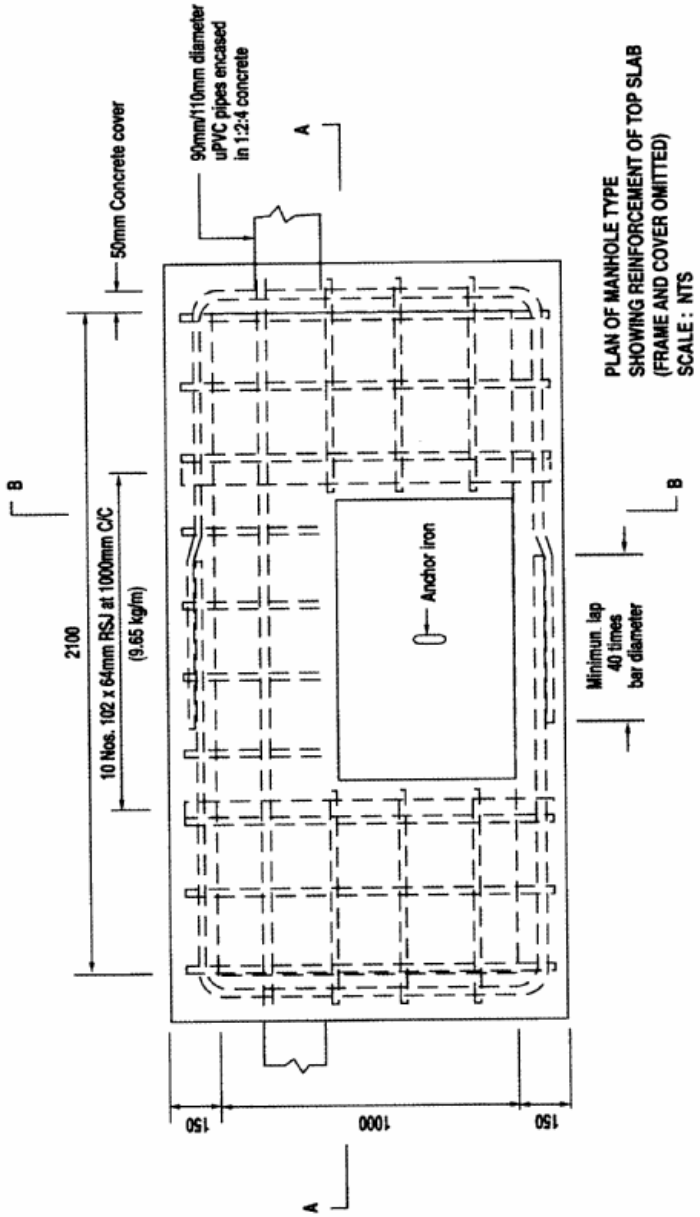


Figure 5.14: Manhole Drawings – Type MX2

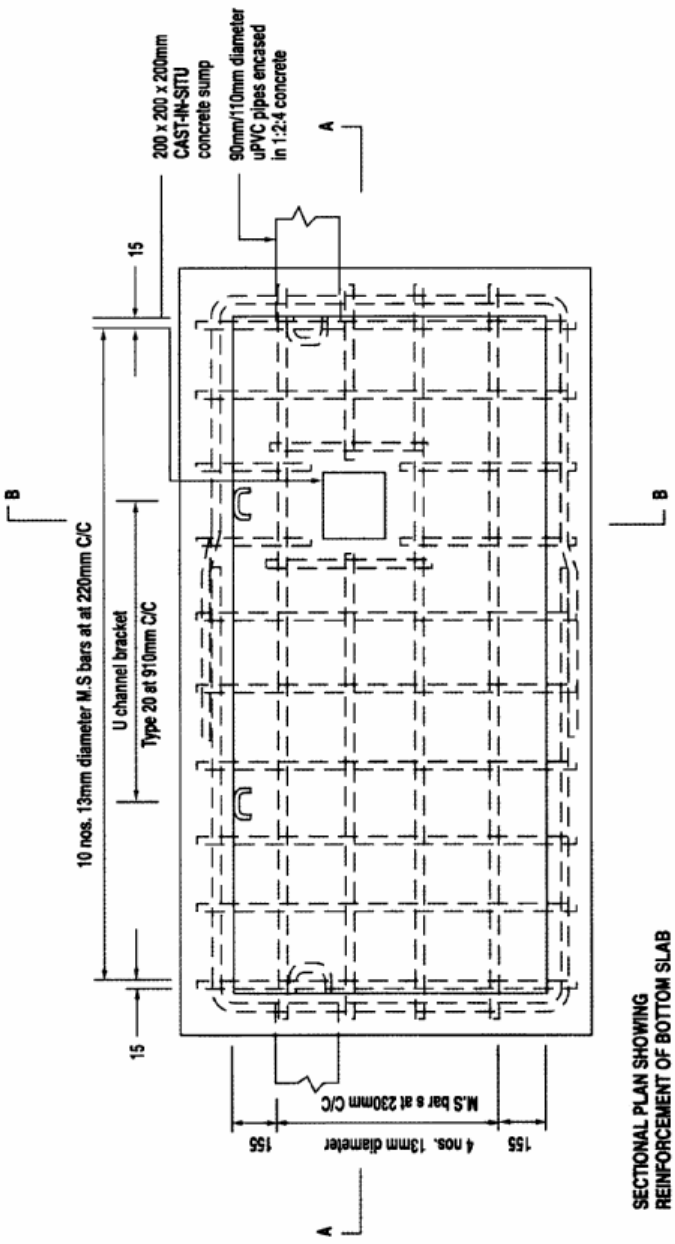


Figure 5.15: Manhole Drawings – Type MX2

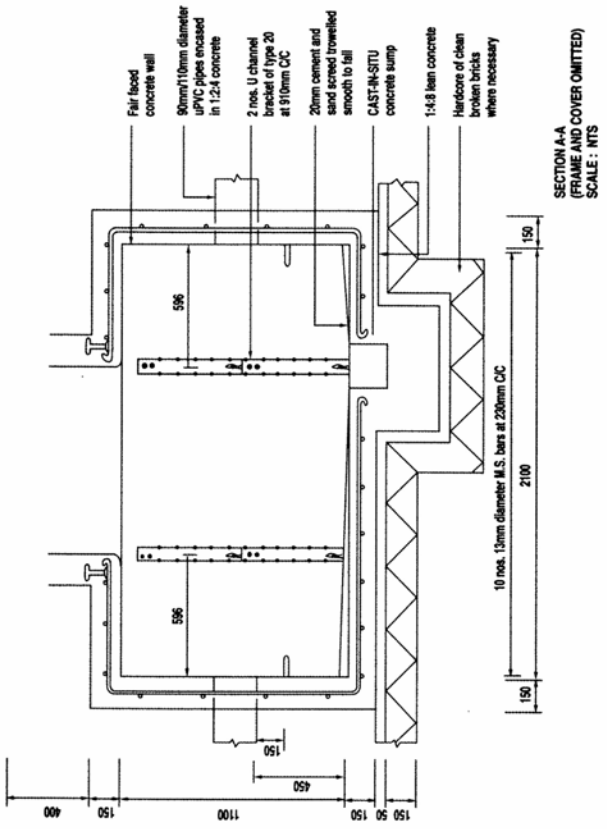


Figure 5.16: Manhole Drawings – Type MX2

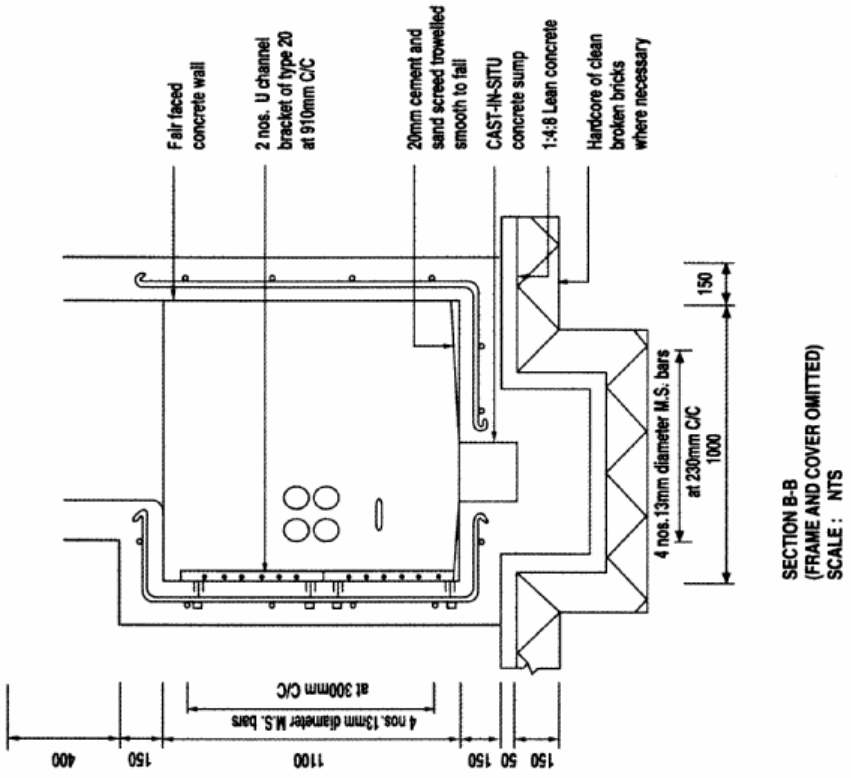


Figure 5.17: Manhole Drawings – Type MX2

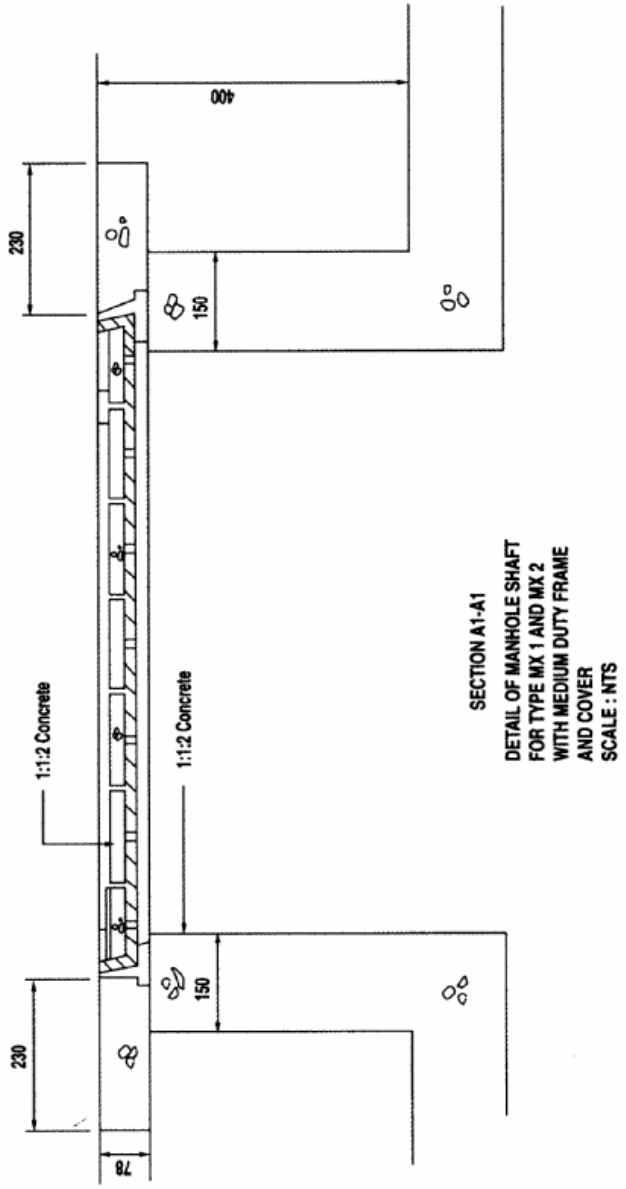


Figure 5.18: Manhole Drawings – Type MX1 & MX2

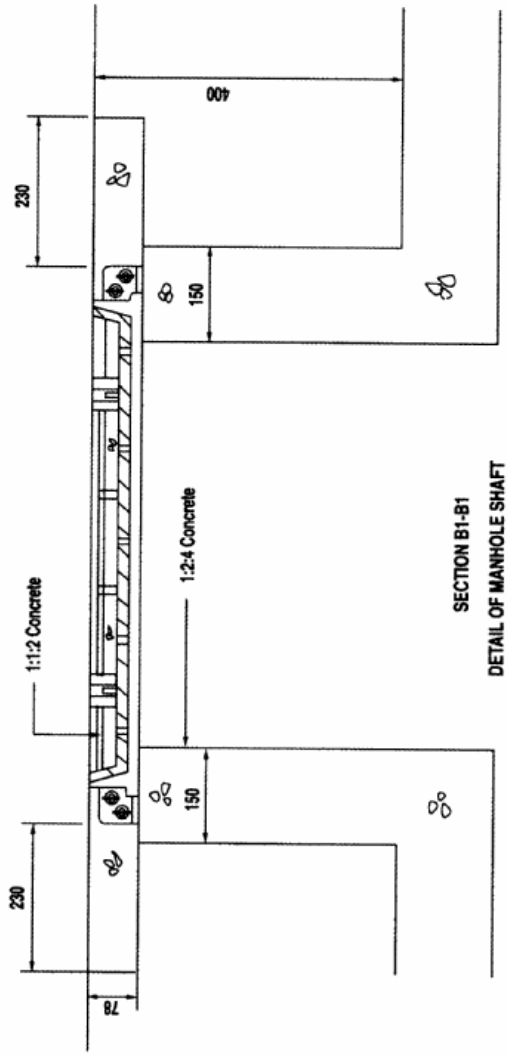


Figure 5.19: Manhole Drawings – Type MX1 & MX2

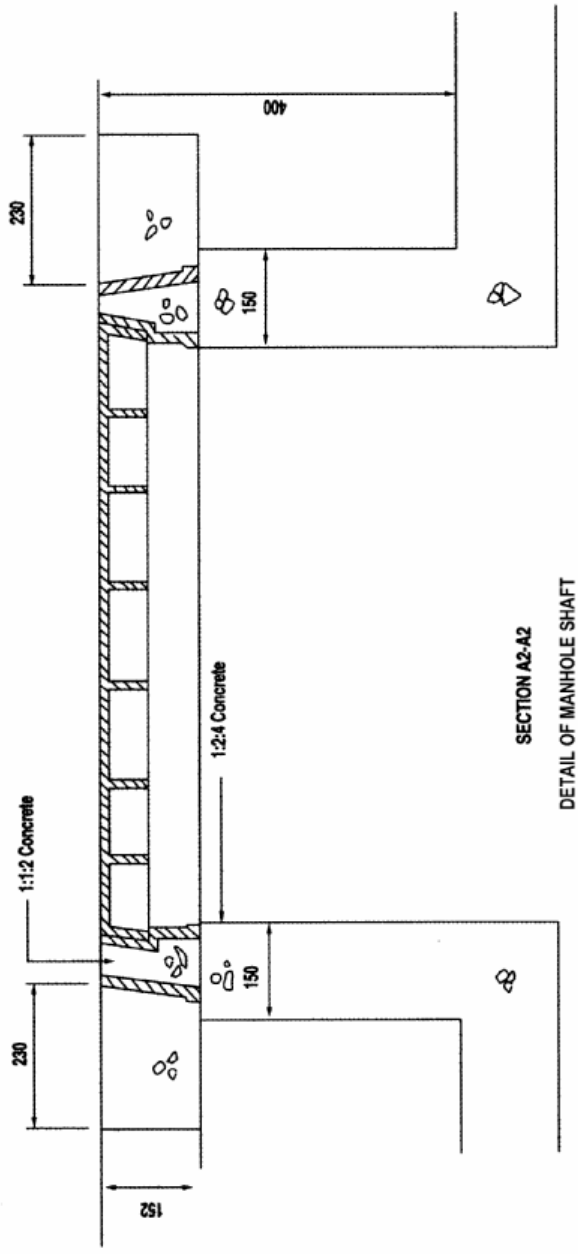


Figure 5.20: Manhole Drawings – Type MX1 & MX2

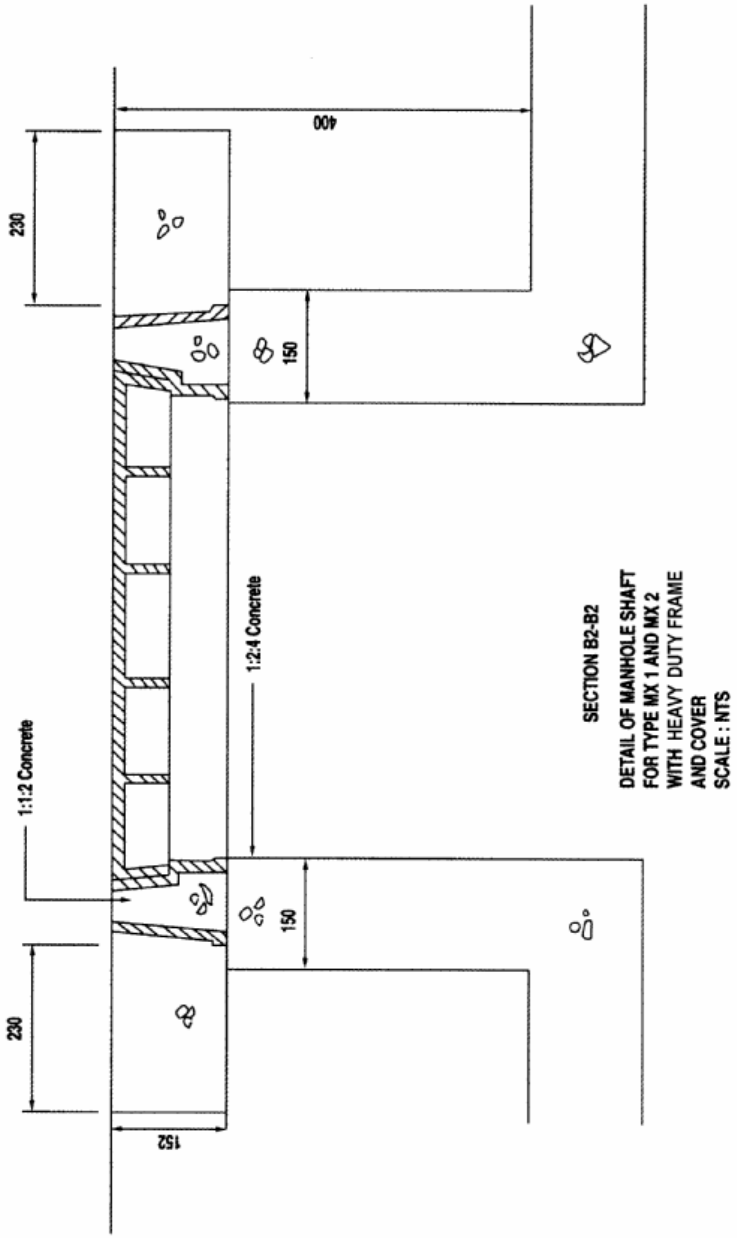


Figure 5.21: Manhole Drawings – Type MX1 & MX2

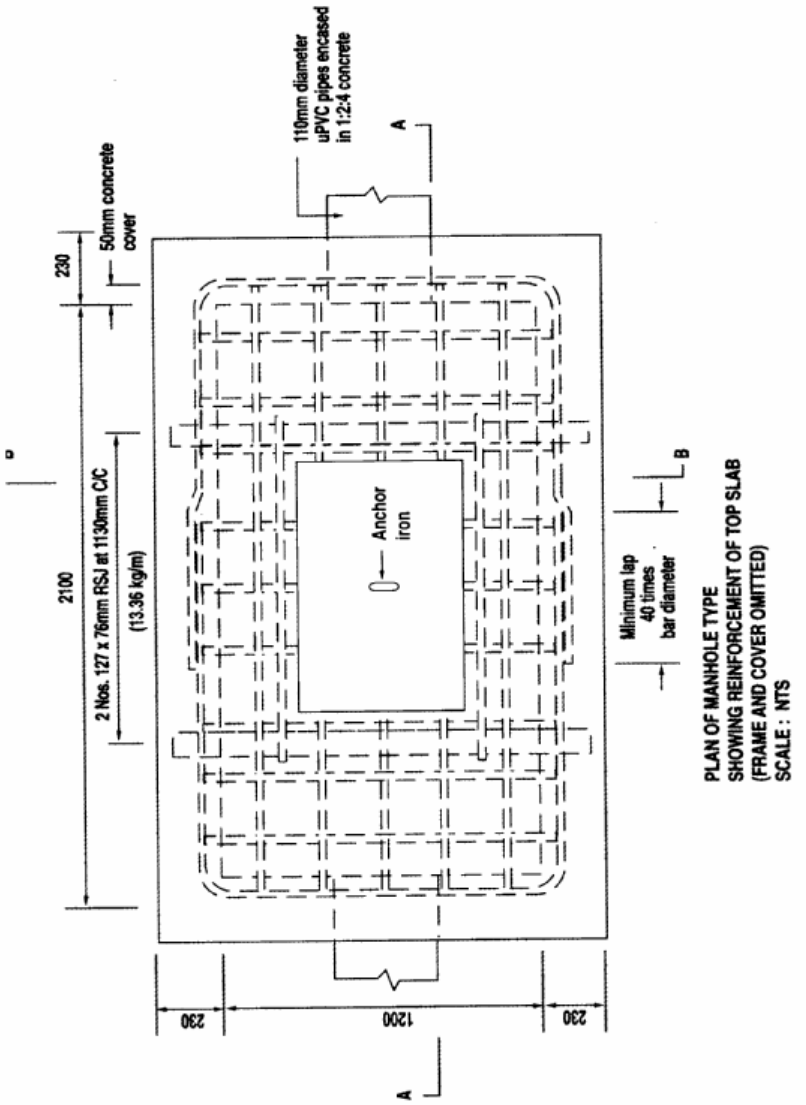


Figure 5.22: Manhole Drawings – Type MX3

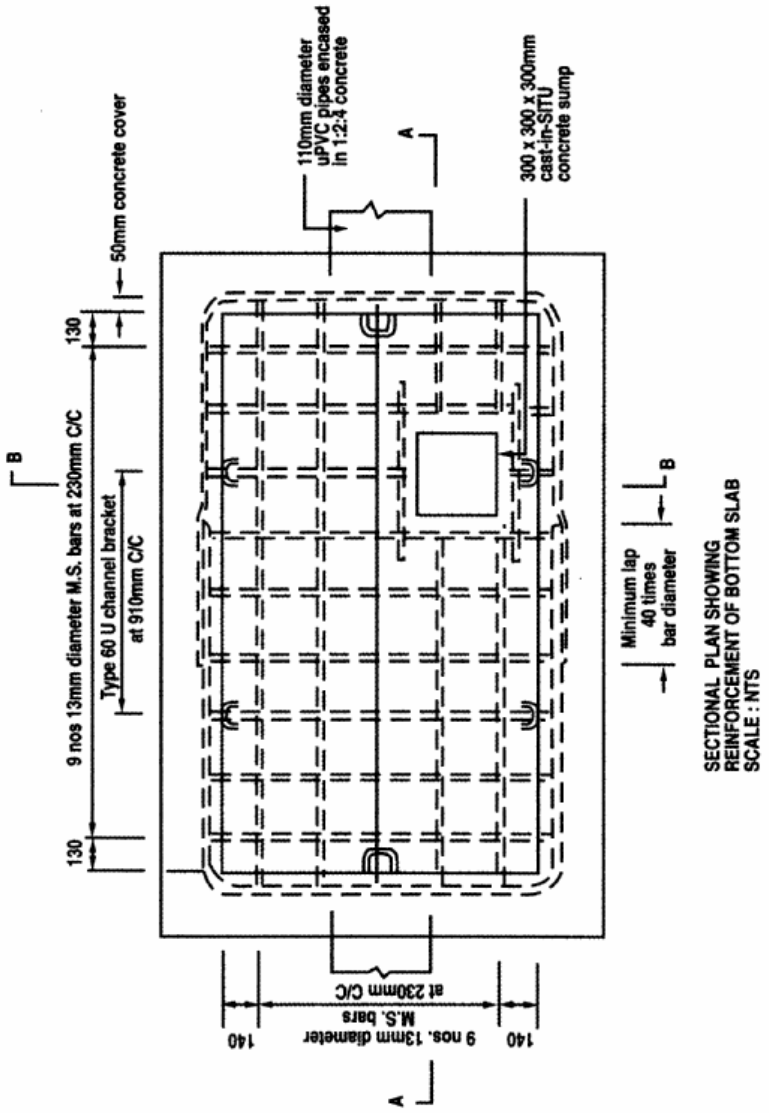


Figure 5.23: Manhole Drawings – Type MX3

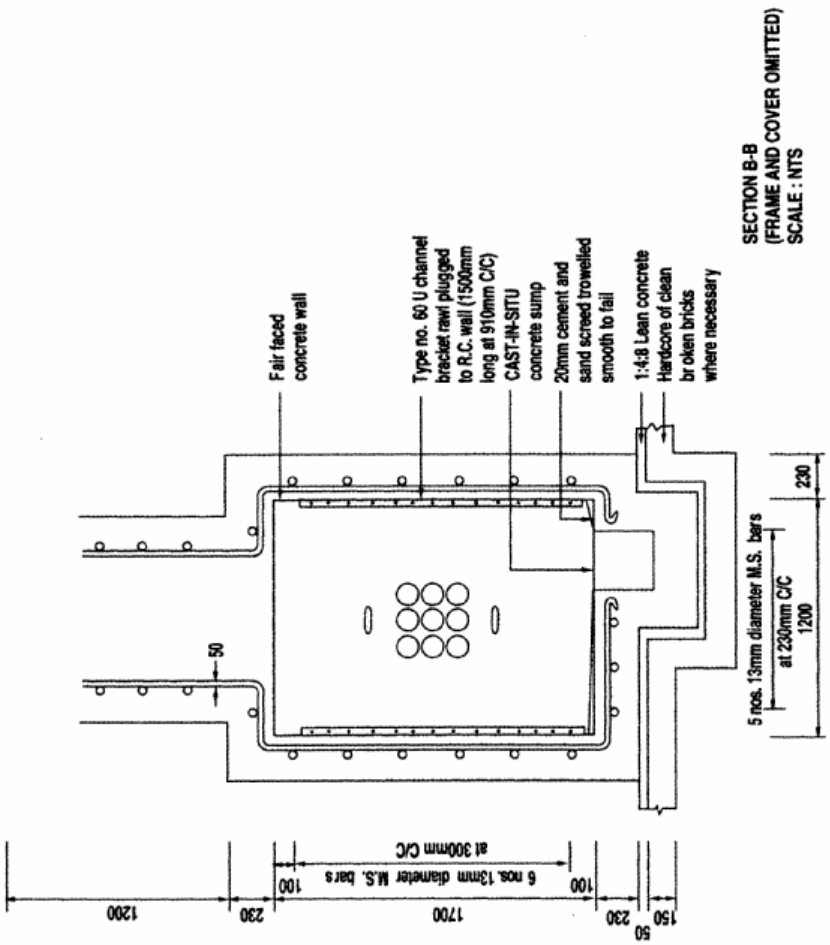
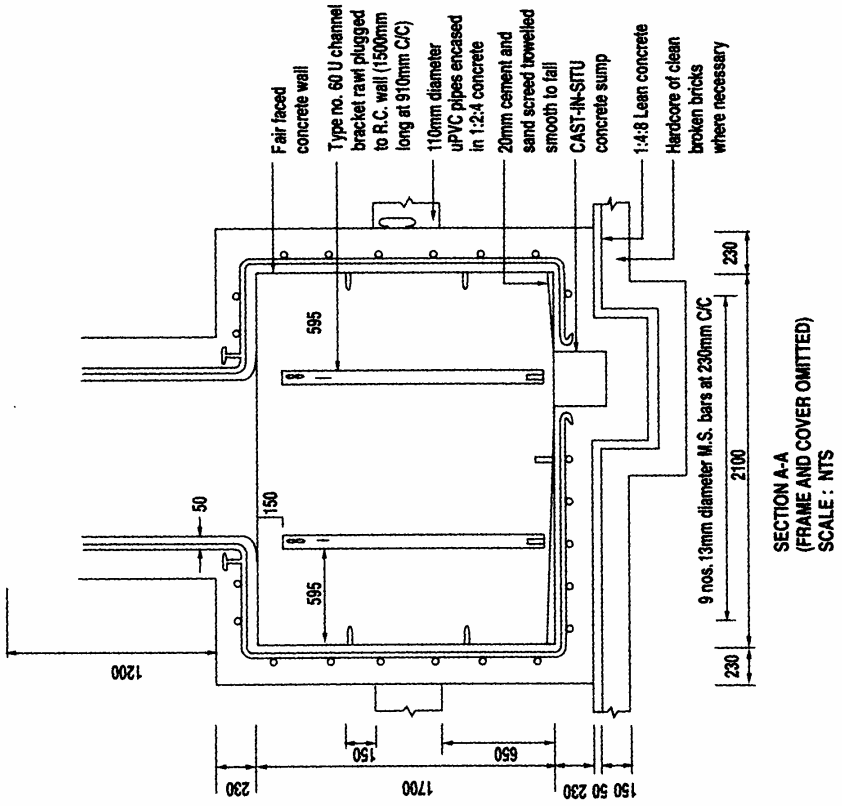


Figure 5.24: Manhole Drawings – Type MX3

Figure 5.25: Manhole Drawings – Type MX3



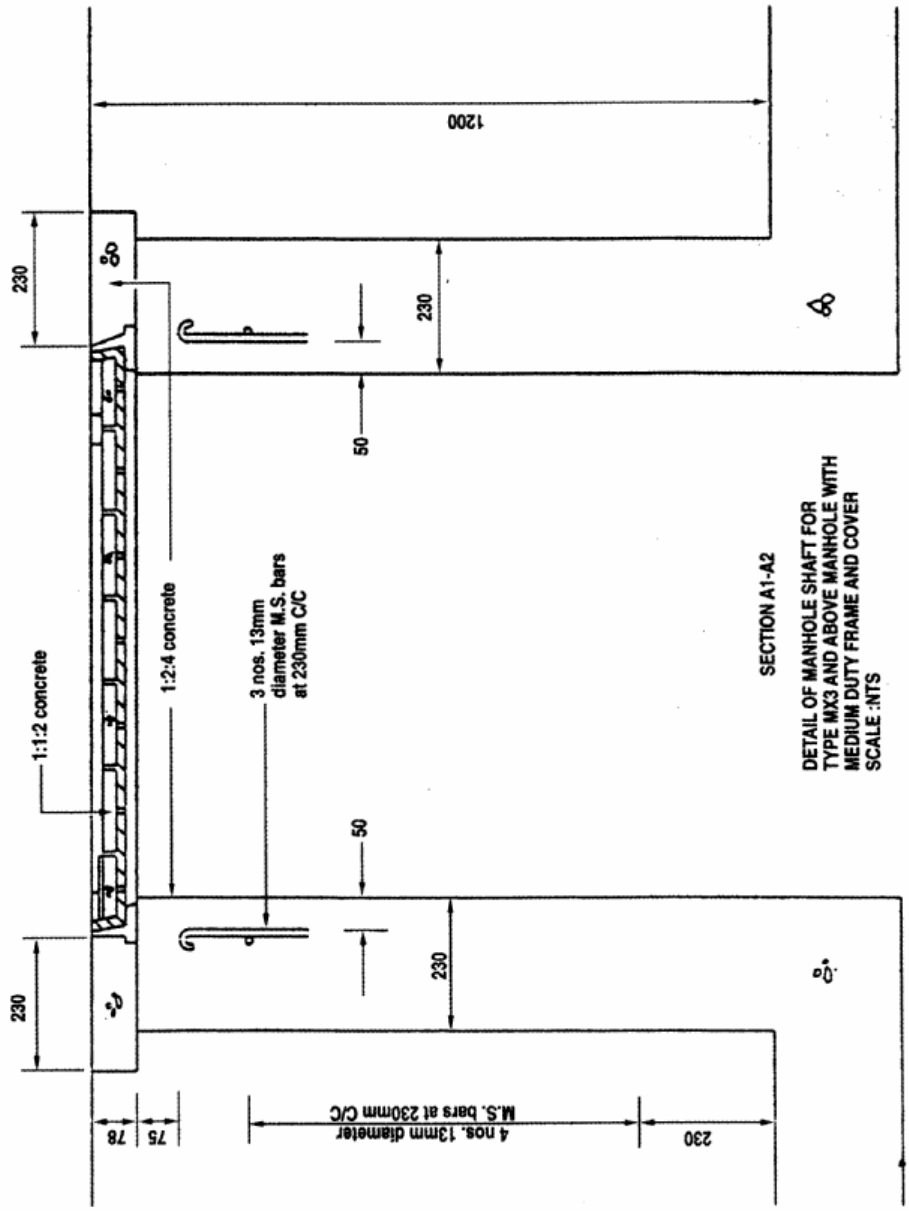


Figure 5.26: Manhole Drawings – Type MX3 & Above

Figure 5.27: Manhole Drawings – Type MX3 & Above

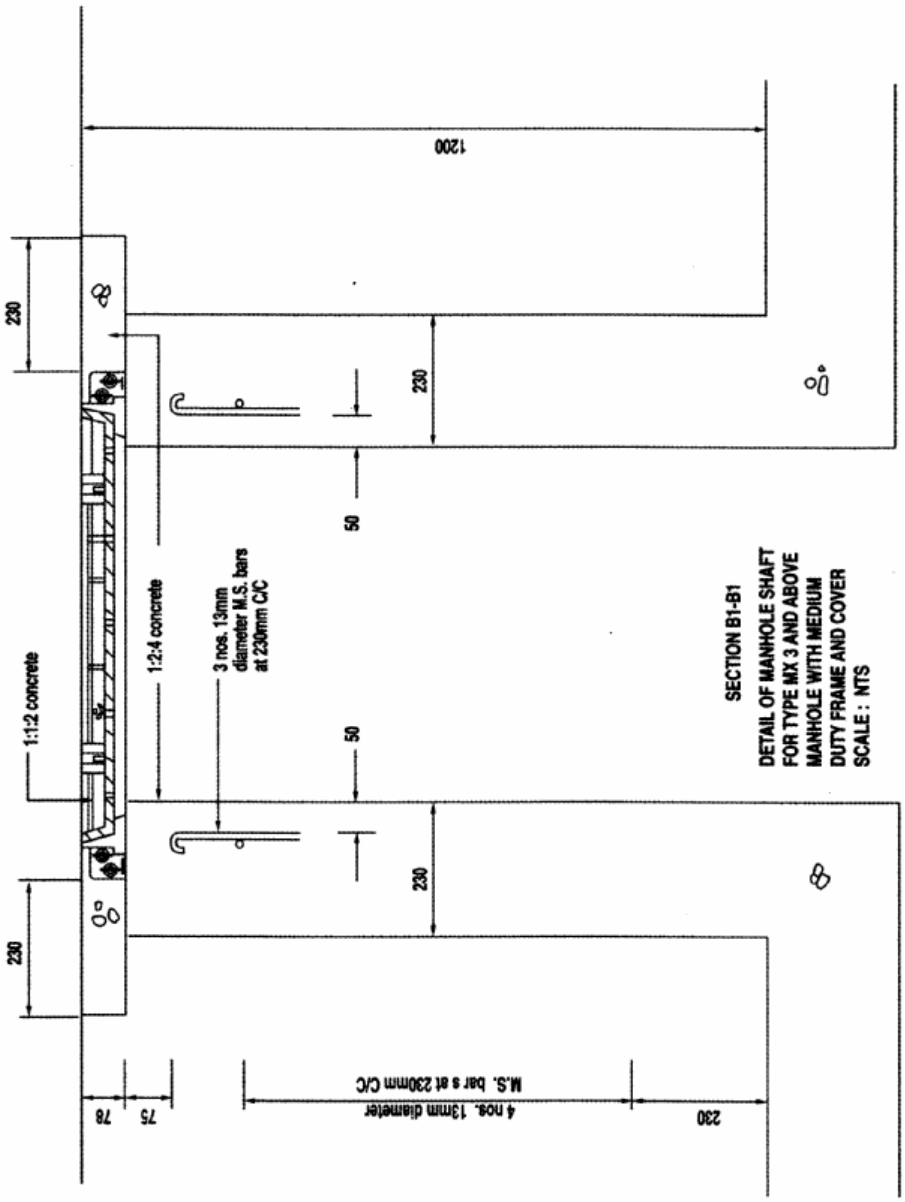
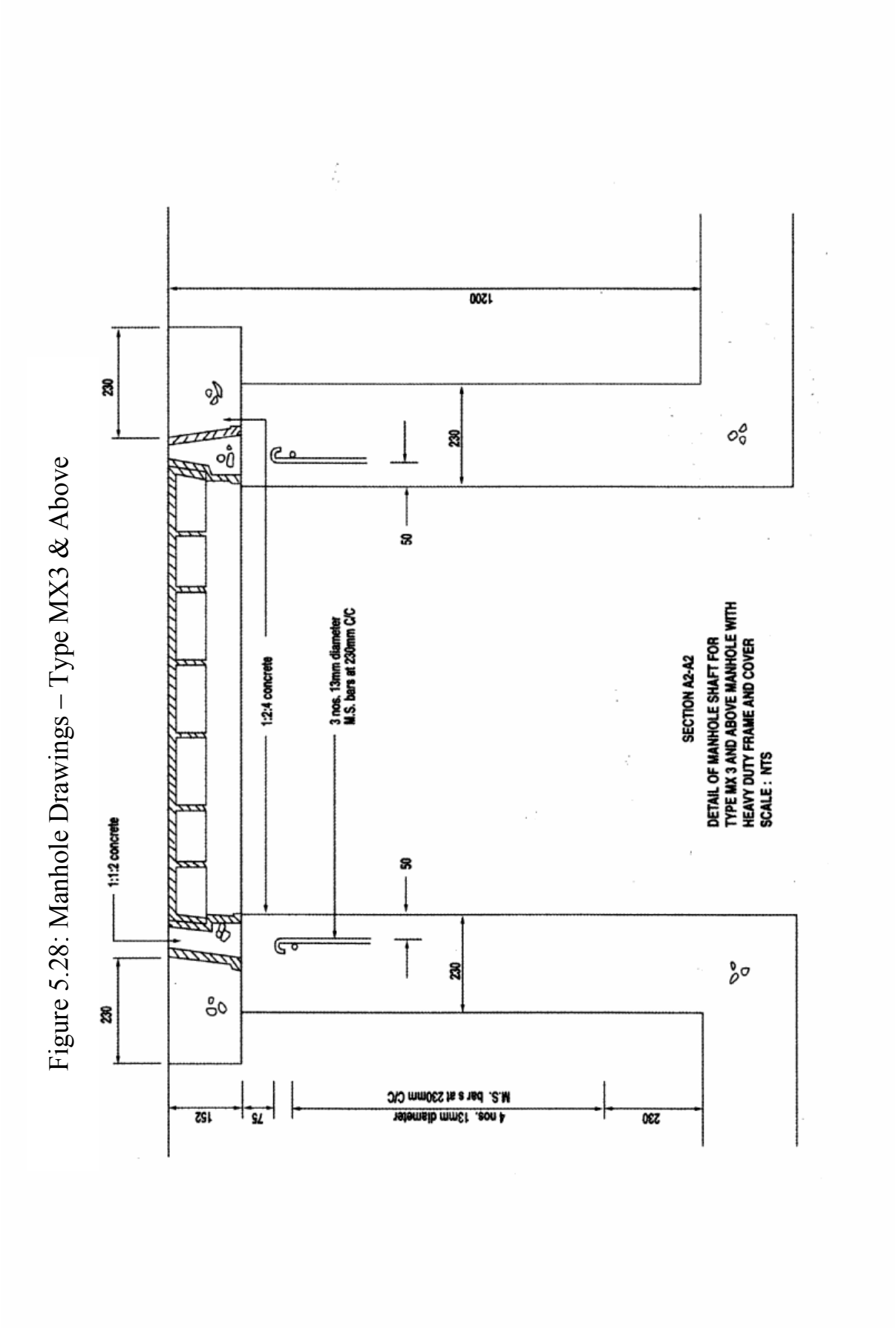


Figure 5.28: Manhole Drawings – Type MX3 & Above



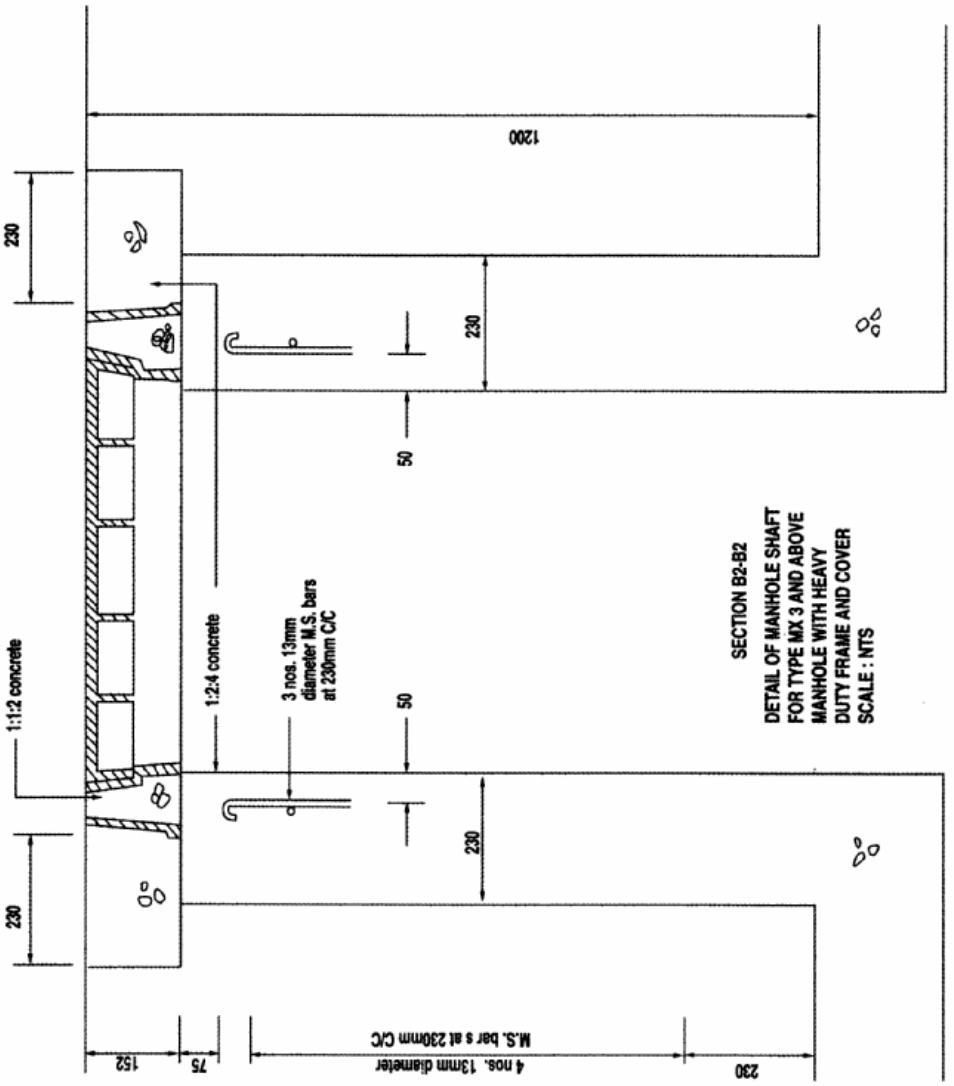


Figure 5.29: Manhole Drawings – Type MX3 & Above

6. REQUIREMENTS FOR MAIN DISTRIBUTION FRAME ROOM

6.1 Overview

6.1.1 This section deals with the requirements relating to the provision of the Main Distribution Frame room ("MDF room"). The MDF room is used to accommodate the main distribution frame and telecommunication equipment of telecommunication system licensees who provide services to the building and to serve as the interconnecting point between the main incoming cables and the local distribution cables.

6.1.2 In the case of residential developments, the size of the MDF room to be provided shall depend on the total number of dwelling units to be served from the MDF room as specified in sub-section 6.3. Where a condominium, apartment or public housing project consists of multiple blocks of residential buildings, developers or owners shall, in addition to a MDF room for the development, provide a TER in each block of residential building (except for the block where the MDF room is located) to facilitate the provision of telecommunication services. The requirements for TER are specified in section 7 of this Code.

6.1.3 The size of the MDF room specified herein is the minimum size required. Developers or owners are to check with TFCC on the need to increase the size of the MDF room should the usage of telecommunications increase.

6.2 Exclusive Use by Telecommunication System Licensees

6.2.1 The MDF room is designated for the shared use of telecommunication system licensees only. No developer or owner shall install his own main distribution frame, local distribution cables or any other equipment, whether telecommunication related or otherwise, in the MDF room.

6.3 Room Size Requirements

6.3.1 The required size of the MDF room for a non-residential building is set out in Table 6.3.1.

Table 6.3.1 Size of MDF room in Non-Residential building

Usable floor area (' 000 m^2)	MDF room (m^2) (Minimum size)
Under 2	12
2 – 12	20
12 – 25	30
25 – 50	40
50 – 75	60
75 – 100	80

6.3.2 For a non-residential development project with usable floor area exceeding 60,000 m^2 or a building exceeding 30 storeys in height, an additional MDF room shall be provided at mid-height.

6.3.3 The floor space required for the MDF room in a single-tenanted non-residential building with less than 2,000 m^2 usable floor area for telecommunication services and whose demand for telephone lines does not exceed 50, shall be a minimum size of $6m^2$ (i.e. 2 m by 3 m).

6.3.4 The required size of the MDF room in a residential building is set out in Table 6.3.4.

Table 6.3.4 Size of MDF room in a residential building

Number of residential units in the residential development to be served by the MDF room	MDF room size (m^2) (Minimum size)
2 – 10	4
11 – 20	6
21 – 60	9
61 – 120	12
121 – 200	16
201 – 400	20
401 – 600	30
601 – 800	42
801 – 1000	49
1001 – 1500	56

6.3.5 For residential development of more than 1500 residential units, two MDF rooms shall be provided. Developer or owner shall consult IDA on the dimensions of the two MDF rooms and TFCC on the locations of the two MDF rooms.

6.3.6 The shape of the MDF room shall be either square or rectangular (the maximum ratio of the length to the width is 2:1). The minimum length or width for smaller MDF room (e.g. 4 m^2 and 6 m^2), shall have at least 2m.

6.4 Location Requirements

6.4.1 The MDF room shall be located so that it is readily accessible to authorised personnel at all times. The MDF room should be accessible directly from the outside of the building to comply with the Fire Safety and Shelter Department's ("FSSD") condition of waiver for water sprinkler installation in the MDF room.

6.4.2 The MDF room shall be situated at the street or first floor level. However, in buildings with more than one basement, the MDF room may be located at the top-most basement floor. MDF rooms should not be situated in basements (other than the top most basement floor) which are susceptible to flooding, dampness and dirt, unless the developer or owner satisfies IDA that adequate protection against such eventualities is implemented.

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

(a) under a vehicle washing bay, swimming pool and washroom/toilet where it is susceptible to dampness or moisture;

(b) where it is subject to perceptible vibration such as the movement of vehicles or operation of mechanical equipment. The vibrant to the installed telecommunication equipment in MDF room shall be less than 0.05G, where G is the acceleration due to gravity ($G=9.81\ m/s^2$), or

(c) where it is subject to discharge of steam, fumes, gases or dust. If the MDF room is sited near to such discharge, the opening to the MDF room shall be sealed to protect the telecommunication equipment in the room. In this case, appropriate ventilation shall be provided in the MDF room.

6.4.4 No facilities or installation for any other services (e.g. water pipe, chilled water pipe, gas pipe and electrical trunkings) shall pass through the MDF room.

6.4.5 When planning the MDF room location, due consideration should also be given to the feasibility of linking it to telecommunication risers via cable trays.

6.4.6 The MDF room should be located close to the telecommunication riser(s).

6.5 Building Requirements

6.5.1 The MDF room shall be constructed of reinforced concrete or brick wall and the surface shall be finished with cement plaster such that there shall be no cracks, blister or other defects. The wall shall be painted with light colour durable paint.

6.5.2 A clear head-room of minimum 3.5m is required to accommodate both the equipment racks and overhead cable trays. In the event that the clear headroom is less than 3.5m, a cable ladder shall be provided from the lead-in pipes vertically upwards to a height of approximately 2.5m with a vertical clearance of at least 300mm from any obstruction. The cable ladder shall run horizontally to at least 3 sides of the walls of the MDF room for shared use by the telecommunication system licensees. The width of the vertical cable ladder as well as horizontal cable ladder provided shall be the full length of the lead-in pipes occupied.

6.5.3 The floor of the MDF room must be structurally designed to withstand a loading of 480 kg/m^2. Vinyl tile finishes for the floor shall be provided. Alternatively, the floor shall be properly screeded.

6.5.4 Door(s) which can be fully opened outwards is required for easy access to MDF room. Furthermore, there must be a 100mm high concrete skirting/kerb at the frame of the door(s) of the MDF room to prevent the ingress of water.

6.5.5 If the MDF room is in an independent (standalone) building, the following additional requirements shall apply:

(a) The floor shall be at least 150mm above the immediate external final road or driveway level and shall be waterproofed.

(b) The wall shall be waterproofed and the emulsion painting system used for the outside wall suitable for external application.

(c) The ceiling shall be of smooth finishes and emulsion painted.

(d) The roof shall be of flat reinforced concrete and suitably waterproofed and constructed to a fall of 1:80 minimum away from the door direction.

(e) Proper drainage around the building shall be provided (e.g. with hinged hot-dipped galvanized m.s. gratings).

(f) The gate and perimeter fencing (where required) shall be 1.8m high.

(g) The driveway shall be 4 m wide and designed to withstand vehicular load.

(h) Other vacant space (from the building structure to the perimeter fencing) shall be paved using tarmac or weld-mesh reinforced concrete with fall designed for quick dispersion of water to surrounding drains.

6.6 Ventilation and Air-Conditioning Requirements

6.6.1 For non-residential developments:

(a) In the MDF room where telecommunication equipment is installed, air-conditioning from a central system shall be provided and the environmental condition inside the room should be as follows: -

(i) Temperature: 22°C ± 2°C; and

(ii) Relative Humidity: < 70%;

(b) The heat load of the telecommunication equipment is estimated at 300 W/m^2.

(c) If air-conditioning is not provided in smaller non-residential buildings, specifically religious building, school, factory/warehouse, community centre/club and market/food centre, mechanical ventilation like exhaust fan(s) and natural ventilation like lourve shall be provided as stated in sub-sections 6.6.2 (b) and (c).

6.6.2 For residential developments:

(a) The MDF room must be adequately ventilated.

(b) Natural ventilation like lourve shall be provided on the side of the wall where the door is located and must be located above the door.

(c) Mechanical ventilation like exhaust fan(s) shall also be installed and positioned at the corner(s) of the MDF room.

6.7 Electrical Requirements

6.7.1 230V, 50Hz AC single-phase 13A power points and 30A isolators are to be provided in the MDF room to power the telecommunication equipment of telecommunication system licensees. The number of power points and isolators to be provided for a residential building is as shown in Table 6.7.1

Table 6.7.1 Power points and isolators requirement for MDF room residential building

Number of residential units in the residential development	Minimum number of power points to be provided in MDF room	Number of isolators to be provided in MDF room
20 or below	2 x single-15A 3 x twin-13A	Not applicable
21 – 200	4 x twin-13A	2 x 30A
201 and above	4 x twin-13A	4 x 30A

6.7.2 For non-residential buildings, at least four twin-13A power points and at least four 30A isolators shall be provided in the MDF room. For single-tenanted non-residential buildings (applicable to buildings with less than 2,000 m^2 usable floor area) where demand for telephone lines does not exceed 50, three twin-13A and two single-15A power points shall be provided in the MDF room.

6.7.3 The TFCC may request for more isolators and/or power points if the layout of the MDF room is of irregular shape. For buildings without standby generators, the 30A 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.

6.7.4 Earth Leakage Circuit Breakers ("ELCBs") (earth leakage current of 30mA) and Miniature Circuit Breakers ("MCBs") shall be provided. Each twin-13A power point and each isolator shall be connected to its own MCB (20A) and protect by the ELCB (30mA). The lighting shall also be connected to its own MCB (20A). In addition, there must be at least two spare MCBs (20A).

6.7.5 Batteries will be used by telecommunication system licensees to backup the equipment against power failure of short duration. However, the power supply to

the MDF room shall be connected to the standby generator in the building. For buildings without standby generators, the 30A 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.

6.7.6 The illumination level within MDF room shall be at least 450 lux on the vertical plane of all rack and frame surfaces. Fluorescent tube lighting, with on/off switch, shall be provided.

6.7.7 Circuit breaker(s) shall be located within the MDF room with separate Distribution Board (DB) provided.

6.7.8 In a cluster landed housing development where a stand-alone MDF room is provided, a minimum of two separate electrical power meters and two separate DB with circuit breakers, isolators and power points in the MDF room shall be provided.

6.8 Earthing Requirements

6.8.1 The developer or owner should provide a building ground grid (clean earth) of 1Ω or less without the use of salts for earthing of the MDF room. This earthing point shall not be tapped from the electrical system and is to be used for telecommunication equipment only.

6.8.2 The earthing point shall be connected to the earth electrode system via earth cable with a cross section area of not less than $50mm^2$, as recommended by ITU-T handbook on earthing of telecommunication installations. The copper earth bar shall be at least 600mm long with screw holes of diameter of 6mm. The screw holes shall be 50mm apart (measured from centre to centre).

6.8.3 The developer or owner shall submit the certified test result of the earth system together with actual layout diagrams showing the earth system arrangement to the TFCC during the inspection of the MDF room.

6.8.4 The developer or owner shall maintain the earth system throughout the lifetime of the building.

7. REQUIREMENTS FOR TELECOMMUNICATION EQUIPMENT ROOM FOR RESIDENTIAL BUILDINGS

7.1 Overview

7.1.1 This section deals with the requirements relating to the provision of the Telecommunication Equipment Room ("TER") in residential buildings. To cater for the provision of telecommunication services (e.g. broadband services provided over fibre-based equipment or BCS), one TER shall be provided in every block of residential apartments, condominiums and public housing other than the block where the MDF room is located.

7.2 Exclusive Use by Telecommunication System Licensees

7.2.1 The TER is designated for the shared use of telecommunication system licensees only. No developer or owner shall install his own equipment, whether telecommunication related or otherwise, in the TER.

7.3 Room Size Requirements

7.3.1 The size of the TER to be provided shall depend on the number of residential units to be served from the TER as specified in the Table 7.1 below.

Table 7.1 Size of TER

Number of residential units to be served	TER size (m^2) (Minimum size)
2 – 10	2 x 2
11 – 20	2 x 3
21 – 60	3 x 3
61 – 120	3 x 4
121 – 200	4 x 4

7.4 Location Requirements

7.4.1 The location requirements for the TER shall be the same as that for MDF rooms as specified in sub-section 6.4

7.5 Building Requirements

7.5.1 The building requirements for the TER shall be the same as that for MDF rooms as specified in sub-section 6.5.

7.6 Ventilation and Air-Conditioning Requirements

7.6.1 The ventilation and air-conditioning requirements for the TER shall be the same as that for MDF rooms as specified in sub-section 6.6.2 (b) and (c).

7.7 Electrical Requirements

7.7.1 The specifications for electrical requirements for the TER are as follows:

(a) The number of power points and isolators to be provided in the TER is as shown in Table 7.7.1.

Table 7.7.1 Power points and isolators requirement for TER

Number of residential units to be served	Minimum number of power points to be provided in TER	Number of isolators to be provided in TER
20 or below	2 x 15A 3 x twin-13A	Not applicable
21 – 200	4 x twin-13A	2 x 30A

(b) TFCC may request for more isolators and/or power points, if the layout of the TER is of irregular shape. For buildings without standby generators, the 30A 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 affect the changeover.

(c) ELCBs (earth leakage current of 30mA) and MCBs shall be provided. Each twin-13A power point and each isolator shall be connected to its own MCB (20A) and protect by the ELCB (30mA). The lighting shall also be connected to its own MCB (20A). In addition, there must be at least two spare MCBs (20A).

(d) Batteries will be used by telecommunication system licensees to backup the equipment against power failure of short duration. However, the power supply to the TER shall be connected to the standby generator in the building. For buildings without standby generators, the 30A 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.

(e) The illumination level shall be at least 450 lux on the vertical plane of all rack and frame surfaces. Fluorescent tube lighting, with on/off switch, shall be provided.

(f) Circuit breaker(s) shall be located within the TER with separate DB provided.

7.8 Earthing Requirements

7.8.1 The earthing requirements for the TER shall be the same as that for MDF rooms as specified in sub-section 6.8.

7.9 Lead-in Pipes Requirements

7.9.1 The number of uPVC lead-in pipes, of nominal diameter of 110mm, to be provided for each TER is as shown in Table 7.9.1.

Table 7.9.1 Number of lead-in pipes

Number of residential units to be served	Number of lead-in pipes (Minimum quantity)	Pipe formation
≤ 60	6 (2 lead-in pipes shall be allocated for BCS)	2 x 3
61 – 200	8 (2 lead-in pipes shall be allocated for BCS)	2 x 4

8. REQUIREMENTS FOR TELECOMMUNICATION RISER

8.1 Overview

8.1.1 This section deals with requirements relating to the provision of telecommunication risers in buildings. The telecommunication riser is a compartment vertically aligned and usually beginning from the first storey or basement and extending through to the topmost level of a multi-storey building. It is used to accommodate telecommunication cables from the MDF room or TER to various floors of the building.

8.2 Exclusive Use by Telecommunication System Licensees

8.2.1 The telecommunication risers are designated for the shared use of telecommunication system licensees only. No developer or owner shall use the telecommunication risers for the purpose of accommodating public address systems, computer networking cables or for any other purpose.

8.3 Specific Requirements

8.3.1 Telecommunication riser shafts must be installed in a direct vertical line throughout the building.

8.3.2 A door which can be fully opened outwards at least 90° is required for easy access to the telecommunication risers at each floor level. The height of the door shall be at least 2.1m. Where the width of the door exceeds 1.8m, it shall be of double leaves. In all cases, the fire-rating of the doors and compartment walls are to comply with the FSSD's requirements.

8.3.4 For residential buildings, two cable trays/cable ladders or metal trunking are required in the telecommunication riser to facilitate the installation of cables. The dimensions of the cable trays/cable ladders/metal trunking are shown in Table 8.3.3.

Table 8.3.3 Dimension of cable trays/cable ladders or metal trunkings in telecommunication riser of residential building

	Residential buildings	
	Up to 25 Storeys	**Up to 50 Storeys**
Cable trays/cable ladders		
Telecommunications (Non-BCS)	200mm (width)	300mm (width)
BCS [See note]	100mm (width)	150mm (width)
Metal trunking		
Telecommunications (Non-BCS)	300mm by 100mm	
BCS	200mm by 100mm	

Note: The width of the BCS cable tray/cable ladder shall be increased by an additional 50mm if cables used for MATV system is installed concurrently with cables used for BCS.

8.3.4 For non-residential buildings, two cable trays/cable ladders are required in the telecommunication riser to facilitate the installation of cables. The dimensions of the cable trays/cable ladders are shown in Table 8.3.4.

Table 8.3.4 Dimension of cable trays/cable ladders in telecommunication riser for non-residential buildings

	Non- residential buildings	
	Up to 25 storeys	**Above 25 storeys**
Cable trays/cable ladders		
Telecommunications (Non-BCS)	450mm (Width)	600mm (Width)
BCS See note	100mm (Width)	150 mm (Width)

Note: The BCS cable tray/cable ladder's width shall be increased by an additional 50mm if cables used for MATV system is installed concurrently with cables used for BCS.

8.3.5 There shall be a 100mm high concrete skirting/kerb round the telecommunication riser opening/slot or at the door(s) of the telecommunication riser to prevent the ingress of water.

8.3.6 All doors of the telecommunication riser(s) shall be locked. In the case of residential buildings, if developers or owners are unable to provide locks to telecommunication riser(s), two vertical metal trunkings (one for Telecommunications (Non-BCS) and the other for BCS) shall be provided instead of cable trays for installation of telecommunication distribution cables. The dimension of the metal trunkings shall be as stated in Table 8.3.3.

8.3.7 Adequate lighting shall be provided to ensure that telecommunication system licensees are able to carry their installation and maintenance work in the telecommunication riser.

8.3.8 The inter-floor openings in the telecommunication riser shall be able to accommodate the cables in the cable trays, metal trunkings or ladders. The openings shall be 1.25 times the width of the cable trays, metal trunkings or ladders. For residential buildings the minimum depth of the opening shall be 150mm. For non-residential buildings the minimum depth of the opening shall be 250mm.

8.3.9 The wall of the telecommunication riser shall be smoothly plastered and painted with a light colour.

8.3.10 The telecommunication riser openings/slots on floors shall be sealed, in accordance with the FSSD's requirement, with a fire-resistant material approved by the FSSD and having the fire rating of at least half-an-hour. The developer or

owner shall provide openings through the fire resistant material if additional cables are required to be installed by telecommunication system licensees. The developer or owner shall seal the openings after the cables have been installed.

8.3.11 The telephone cables from telecommunication system licensees and the internal wirings of occupants shall terminate onto the IDFs/DP located in the telecommunication riser. The BCS cables, if required, shall terminate onto an amplifier (where applicable) and tap/splitter located in the telecommunication riser.

8.3.12 Horizontal cable trays and/or underground pipeline system shall be provided to link up all telecommunication risers to the MDF rooms and/or TERs within the Development Boundary Line.

8.4 Design Requirements

8.4.1 The number of telecommunication risers to be provided will depend on the floor area to be served. Generally, the serving radius of each telecommunication riser shall not exceed 40m. Each telecommunication riser shall 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 telecommunication riser as shown in Table 8.4.1 below should be forwarded to the telecommunication system licensees no later than three months prior to building completion.

Table 8.4.1 Address of users against telecommunication riser number

Telecom riser number	Address of units

8.4.2 The developer or owner shall ensure that the pre-cabling to all units by their licensed telecommunication wiring contractors is done strictly in accordance with the pre-cabling schedule.

8.4.3 It is the responsibility of the developer or owner to provide IDFs (non-residential), DPs (residential) and Tee/Tap Box (BCS) inside the telecommunication riser for termination of both cables and internal wiring.

8.4.4 For non-residential buildings, the size of telecommunication riser shall depend on usable floor area as shown in Table 8.4.4.

Table 8.4.4 Size of telecommunication riser for non-residential buildings

Usable Floor Area (per '000 m^2)	Size of telecommunication riser (mm^2)
Less than or equal to 60	1100 (width) x 600 (depth)
More than 60	1600 (width) x 800 (depth)

8.4.5 For residential buildings, the size of telecommunication riser is as shown in Table 8.4.5.

Table 8.4.5 Size of telecommunication riser for residential buildings

Number of residential units	Size of telecommunication riser (mm^2)
Less than or equal to 20 units	600 (width) x 450 (depth)
More than 20 units	800 (width) x 600 (depth)

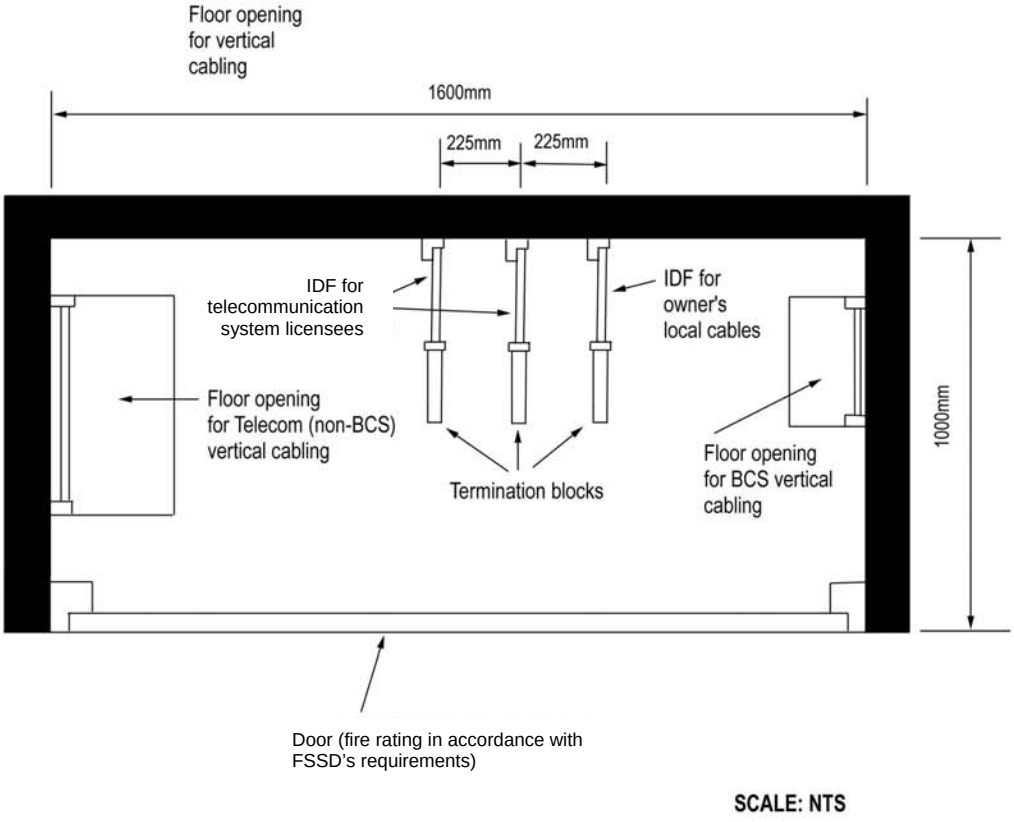
8.4.6 The door to the telecommunication riser shall be located on the width's side.

8.4.7 The telecommunication riser space required in a single-tenanted building of less than 2,000 m^2 usable floor area for telecommunication services and whose demand for telephone lines does not exceed 50), shall be of a minimum size of 600mm (width) by 450mm (depth).

8.5 Placement of Telecommunication Systems in Telecommunication Risers

8.5.1 Cables and associated cabling facilities for Telecommunications (Non-BCS) and BCS shall be placed as far apart as possible. Details of the placement configuration are set out in Figure 8.1.

Figure 8.1: Typical Layout in Riser Duct



9. INTERNAL WIRING AND ASSOCIATED CABLING DISTRIBUTION SYSTEM

9.1 Overview

9.1.1 This section deals with the requirements relating to the provision of internal wiring and associated cabling distribution system for basic telephone services in residential and non-residential developments.

9.2 Requirements for Residential Developments

9.2.1 For residential developments, developers or owners are required to provide internal wiring (i.e. cables) and cable distribution system from the telecommunication riser(s) to the telephone points in individual residential unit.

9.2.2 The quantity of cables as well as the type of cables and horizontal cable distribution system will be left to the developers or owners to determine. Developers or owners are encouraged to follow the relevant parts (e.g. Cable Distribution Systems, Customer Premises Cabling & Interface Points and Specifications of Cables and Sockets) of the Guidelines Relating to Info-communications Facilities in Buildings.

9.2.3 Developers or owners are strongly recommended to provide UTP Category 5e (or better) cables when pre-wiring from the telecommunication risers to all telephone points to cater for newer and faster technology in the future. Please refer to the part on Ethernet-To-The-Home/Office of the Guidelines Relating to Info-communications Facilities in Buildings for more information.

9.2.4 For single-unit landed housing, if the owner does not wish to subscribe to basic telephone services and hence does not wish to provide the necessary space and facilities, a self-declaration letter from the owner shall be submitted to IDA. The letter should state that the owner understands the implications if the required space and facilities are not provided during the construction stage. A sample self-declaration letter is attached in **Annex A.1** for reference.

9.3 Requirements for Non-residential Developments

9.3.1 For non-residential developments, developers or owners are required to provide cable distribution system from telecommunication riser(s) to the entrance of the individual's non-residential unit.

9.3.2 The method of horizontal cable distribution system will be left to the developers or owners. Developers or owners are encouraged to refer to the relevant parts (e.g. Cable Distribution Systems, Customer Premises Cabling & Interface Points and Specifications of Cables and Sockets) of the Guidelines Relating to Info-communications Facilities in Buildings.

10. REQUIREMENTS FOR INSTALLATION OF BROADBAND COAXIAL CABLE SYSTEM

10.1 Overview

10.1.1 This section deals with the requirements relating to the erection, cabling, safety and performance of the Broadband Coaxial Cable System ("BCS") for the transmission of signal operating between 5MHz and 824MHz.

10.1.2 The requirements in this section are intended to enable buildings to be made cable-ready for connection to the operator's network and to ensure that the system performance limits are well optimised for the transmission of both the upstream and downstream signals.

10.1.3 When a BCS is made cable-ready in accordance with the said requirements, no major wiring change is anticipated. However, the installation of additional passive and active devices such as filters, decoders, reverse signal path amplifiers and interdiction equipment may be necessary in order to keep abreast of technological changes and new technical requirements.

10.1.4 Correct provisioning is critical for the proper transmission of two-way broadband interactive applications on the BCS, especially on the reverse path. The entire BCS radio frequencies ("RF") resources can be classified into the following two distinct categories:

(a) Downstream Bandwidth (50-824MHz); and

(b) Upstream Bandwidth (5-42MHz)

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 in the reverse directions.

10.1.5 An owner of a single-unit landed house who does not require broadband coaxial cable services (e.g. cable television and broadband cable modem services) shall not have to provide the BCS if he submits to IDA a declaration in the form attached at **Annex A.1** (Declaration of Services not Required). By this declaration, the owner is deemed to have fully understood the consequences of his decision not to provide for the BCS.

10.1.6 The terminology of the technical terms used in this section can be found at **Annex C.1**.

10.2 Performance Requirements for Systems Operating between 5MHz and 824MHz

10.2.1 General Requirements

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

10.2.2 Impedance

The nominal impedance of the system shall be 75Ω. 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.

10.2.3 Carrier Levels at System Outlets

(a) 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 10.2.3(a).

Table 10.2.3(a) Carrier signal levels at system outlets

Frequency Range and Service	Max. Level (dBμV)	Min. Level (dBμV)	Definitions
54-824MHz television	80	60	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 75Ω termination or relative to 75Ω.
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 75Ω termination or relative to 75Ω.
FM sound VHF Band (stereo)	75	50	

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

(b) Carrier Level Differences

The differences in carrier levels shall not exceed the values given in Table 10.2.3(b).

Table 10.2.3(b) Maximum level difference at each system outlet between distributed television channels

Frequency Range	Maximum Level Differences (dB)
54MHz to 824MHz	16
Adjacent Channel	3
Any 60MHz range	6

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

10.2.4 Random Noise

The carrier-to-noise ratio for systems from the head-end input to the system outlets (see sub-section 10.2.1) shall not be less than the value shown in Table 10.2.4. 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 10.2.3(a), in which case the minimum levels given in that table should be used.

Table 10.2.4 Minimum carrier-to-noise ratio for TV and FM (if any) systems outlets

System	Minimum carrier-to-noise ratio (dB)	Noise bandwidth (MHz)
625-lines System B, G	47	5
FM sound (mono)	41	0.20
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 10.2.3(a).

10.2.5 Interference to Television Channels

(a) Single-frequency interference to television channels

This portion 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 60dB, 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.

(b) Multiple-frequency inter-modulation interference

At any system outlet, the level of the multiple frequency inter-modulation interference, in any wanted television channel, shall be such that the carrier to interference ratio shall be not less than 65dB for 30 channels loading.

10.2.6 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 60dB below the peak-to-peak amplitude of the wanted modulation for 30 channels loading.

10.2.7 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 10.2.7.

Table 10.2.7 Differential gain and phase in Television Channels

System	Maximum differential gain	Maximum differential phase
PAL	10 %	5°

10.2.8 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 visual signal level to hum modulation ratio does not exceed 3%.

10.2.9 Immunity to External Fields

(a) Immunity of complete system

The immunity of the system shall be such that at any system outlet (see sub-section 10.2.1) 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 sub-section 10.2.5(a).

(b) Immunity of individual system components

The immunity of individual system components shall be such that, the RF wanted-to-unwanted signal ratio is better than 64dB for vision programmes and 50dB for sound programmes.

10.2.10 Chrominance/Luminance Delay Inequality

At any system outlet (see sub-section 10.2.1) on any television channel, the difference in transmission delay between luminance and chrominance information shall not exceed 170 ns.

10.3 Network Topology

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

(a) At 54MHz to 824 MHz – Between 15 and 25dBmV; and

(b) Channel loading – 60 PAL TV Channels.

10.3.2 Routing To Subscriber's Premises

(a) 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.

(b) Subscriber feeder cables shall be installed in conduit (for concealed) throughout its entire length so that they cannot be accessed by

unauthorised person(s). Where multiple feeder cables are bunched together, cable trunking with cover may be used in lieu of conduit.

(c) No splices/joints or termination between the passive device and the system outlet shall be made in the subscriber feeder cable.

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

10.3.3 Distribution Panels and Boxes

(a) The distribution panel/boxes shall be lockable and securely mounted to the building wall or in telecommunication riser.

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

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

10.4 Cables

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

10.4.2 Subscriber Feeder (Drop) Cables (Above Ground)

General Requirements:

(a) Characteristic impedance shall be 75Ω ± 2Ω.

(b) Velocity of propagation shall be 83%.

(c) Structural return loss shall exceed 20dB (5-1000MHz).

(d) The centre conductor shall be copper-clad steel, Beryllium copper alloy or hard drawn copper. It shall have a solid single core.

(e) The dielectric shall be gas injected 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 (indoor) and polyethylene (PE) for damp environment (outdoor/underground).

(h) The screening effectiveness shall be either:

(i) greater than 90dB at 200MHz when measured using the Dipole Antennae Procedure, or

(ii) greater than 80dB at 200MHz when measured using the Absorbing Clamp method;

(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 shall be incorporated to reduce corrosion or oxidation of the centre conductor's copper surface.

10.4.3 Main Cables (Above Ground)

General Requirements:

(a) All main cables shall be hard-line (solid outer conductor) cables.

(b) The characteristics impedance shall be $75\Omega \pm 2\Omega$.

(c) Velocity of propagation shall be more than 87%.

(d) Structural return loss (measured with the cable under test terminated in its conjugate impedance) shall exceed 20dB at any frequency in the band 5-1000MHz.

(e) The dielectric shall be gas injected foam polyethylene or other dielectric of similar electrical properties. The cable with equivalent dielectric shall be in every aspect, no less effective than that with gas injected 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, 0.412" or greater size cable with full bonding of jacket to outer conductor and outer conductor to dielectric is recommended.

10.4.4 Underground Cables

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 shall be more than 87%.

(d) Structural return loss (measured with the cable under test terminated in its conjugate impedance) shall exceed 30dB at any frequency in the band 5-1000MHz.

(e) The dielectric shall be gas injected foam polyethylene.

(f) The underground cables shall be water-proof and weather resistant.

10.5 Safety

10.5.1 Safety Requirement

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

(a) Personal protection against electric shock;

(b) Personal protection against physical injury, and

(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.

10.5.2 Main-supplied Apparatus

(a) The devices used in a cabled distribution system shall meet the requirements of SS 143 and the requirements of the EMA. In addition, the special requirements of sub-section 10.5.2(b) and (c) 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.

10.5.3 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: Devices like taps and splitters shall also be fitted with bonding terminals.

10.5.4 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 EMA.

(b) In the absence of any specific requirements by EMA, 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.

10.5.5 Feeders Bonding

(a) Metal enclosures especially those containing live equipment shall be bonded in accordance with the requirements of EMA. 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 30A 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 $4mm^2$.

(f) The maximum value of earth-loop impedance shall comply with the EMA'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.

10.5.6 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) EMA'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 aspect and at all times.

10.5.7 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 V.

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

10.5.8 Environmental Protection

All apparatus and cables which are exposed to weather, corrosive atmosphere or other adverse conditions, shall be constructed or protected to prevent damage arising from such exposure.

10.6 Installation Practices and Procedures

10.6.1 To protect against moisture, the entire network shall be tightly sealed mechanically to prevent moisture from entering the electronic devices and coaxial cables.

10.6.2 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) Galvanised protection;

(c) Protective coating such as painting with rust-inhibiting paints, and/or

(d) Other suitable corrosion prevention measures.

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

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

10.7 Workmanship

10.7.1 All materials used shall be securely attached to permanent building walls or other structures.

10.7.2 All F-type connectors must be installed properly.

10.7.3 Adequate measures shall be undertaken to ensure protection against moisture and corrosion (see sub-sections 10.6.1 and 10.6.2).

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

10.8 Other Details

Other relevant technical details and specifications are set out at:

Annex C.1: Definitions of terms

Annex C.2: Equipment Specifications

Annex C.3: Commissioning Test Procedures

Annex C.4: Methods of Measurements

11. USE OF THE SPACE AND FACILITIES BY TELECOMMUNICATION SYSTEM LICENSEES

11.1 Overview

11.1.1 This section sets out the practices which must be observed by all telecommunication system licensees, including public telecommunication licensees, when deploying and operating their installation, plant or system within the space and facilities provided by a developer or owner, regardless of whether such space and facilities are provided pursuant to this Code or previous codes of practices, guidelines or specifications.

11.1.2 The section is aimed at ensuring that the space and facilities for telecommunication services in buildings are efficiently utilised by telecommunication system licensees within the context of a multi-operator, multi-network environment so as to facilitate increased network rollout and deployment of telecommunication infrastructure. Telecommunication system licensees should not use the space and facilities in a manner which prevents other telecommunication system licensees from installing their own installation, plant or system within the same space and facilities

11.1.3 For the avoidance of doubt, nothing in this section shall be construed as authorising or granting any telecommunication system licensee the right to access and use the space and facilities in the absence of approval from the developer or owner. In all cases, a telecommunication system licensee must first obtain the informed consent of the developer or owner in relation to every aspect of its proposed use of the space and facilities before it can proceed to install its installation, plant or system within the same.

11.2 Eligibility for Use

11.2.1 Unless otherwise permitted by IDA, only telecommunication system licensees who offer fixed telecommunication services to the public are allowed to use the space and facilities to install their installation, plant or system for the purpose of providing telecommunication services. This excludes licensees that are issued limited licences by IDA to operate telecommunication systems to provide services for their own use.

11.3 General Principles relating to the Use of Space and Facilities

11.3.1 <u>MDF room and associated facilities</u>

11.3.1.1 A telecommunication system licensee must ensure that it maximises the use of space and facilities in the most efficient manner possible when installing its installation, plant or system within the space and facilities.

11.3.1.2 A telecommunication system licensee shall not reserve any space and facilities which it will not be using within the next three (3) months.

11.3.1.3 A telecommunication system licensee shall only install such installation, plant or system that is able to meet both its current demand and its expected demand for up to a maximum of three (3) months.

11.3.1.4 A telecommunication system licensee shall pay for the utilities which it requires to operate the installation, plant or system that it installs within the space and facilities specified in this Code. This shall include electricity charges incurred for the operation of such installation, plant or system.

11.3.1.5 A telecommunication system licensee shall not make or permit to be made any structural alteration in the construction or arrangement of the space and facilities.

11.3.1.6 Whenever it accesses the property of a developer or owner in connection with its use of the space and facilities, a telecommunication system licensee must ensure that it takes due and proper care to maintain the cleanliness and condition of the space and facilities and those parts of the property which it accesses. A telecommunication licensee shall be responsible for making good any damage to the space and facilities or property that is caused by its act, omission or default. Any damage so caused must be immediately reported to the developer or owner.

11.3.1.7 When doing anything on the property of a developer or owner in connection with its use of the space and facilities, a telecommunication system licensee shall not do or permit or suffer to be done upon the said property anything which may be or may become a nuisance, annoyance, disturbance, inconvenience, injury or damage to or in any way interfere in the quiet and comfort of its occupants and shall not use the same for any illegal or immoral purpose.

11.3.2 Sharing Arrangements

11.3.2.1 Where there is insufficient capacity in the space and facilities of a particular building to accommodate all the installation, plant or system sought to be installed by multiple telecommunication system licensees, the relevant telecommunication system licensees should first attempt to reach a voluntary sharing agreement.

11.3.2.2 In the event that the telecommunication system licensees are unable to reach agreement, IDA may determine the sharing arrangement to be complied with by the telecommunication system licensees. IDA will generally grant priority to use the space and facilities in the following order:

1st priority – Telecommunication system licensees who are designated as public telecommunication licensees and who are rolling out services to the buildings in accordance with the basic obligations in their licences.

2nd priority – Telecommunication system licensees that are rolling out telecommunication services to the building

3rd priority – Other uses

11.3.3 Lead-in Pipes and associated facilities

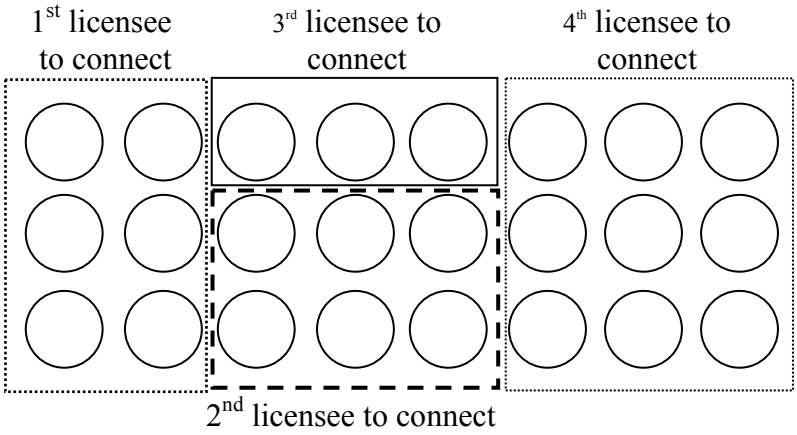
11.3.3.1 Telecommunication system licensees are to ensure the efficient use of lead-in pipes and associated facilities provided by developers or owners. In situations where telecommunication system licensees intend to install multiple fibre or copper cables to the same building to provide telecommunication services, telecommunication system licensees should, subject to feasibility, install sub-ducts in the lead-in pipes such that each lead-in pipe can accommodate multiple fibre and/or copper cables.

11.3.3.2 Telecommunication system licensees may connect lead-in pipes to their own underground pipeline systems based on their immediate and expected duct requirements for laying of telecommunication cables into buildings. However, telecommunication system licensees are required to give up and disconnect the unused or inefficiently used lead-in pipes(s) at their own expense if other telecommunication system licensees (new or existing) require the use of lead-in pipes to provide services to the building. Telecommunication system licensees that are designated as public telecommunication licensees are allowed to reserve one connected spare lead-in pipes for operational and maintenance purposes.

11.3.3.3 Each telecommunication system licensee is to ensure that its connections to the lead-in pipes are grouped together and are not obstructing other telecommunication system licensees' connections to the lead-in pipes. Furthermore, connection to lead-in pipes should proceed in a left-to-right (or right-to-left manner depending on where the previous connection has occurred) and/or in a bottom-up manner (see illustration in Figure 11.1). If a new manhole is to be constructed by a telecommunication system licensee to connect to particular lead-in pipes of a building, the position of the manhole shall be appropriately sited so that it will not block other telecommunication system licensees from connecting their own pipelines to the remaining lead-in pipes.

11.3.3.4 If telecommunication system licensee connects lead-in pipes inappropriately and/or uses them inefficiently (i.e. not in accordance with the general principles set up above), IDA will require that telecommunication system licensee to remove its connections to the lead-in pipes and/or reposition its manhole(s) at its own expense.

Figure 11.1 An example of four telecommunication system licensees connecting their own pipes to building lead-in pipes from left-to-right



11.3.4 Sharing Arrangements

11.3.4.1 In situations where the lead-in pipes are insufficient to accommodate the requirements of all telecommunication system licensees, the relevant telecommunication system licensees should first attempt to reach a sharing agreement amongst themselves. Failing such agreement, IDA may determine the sharing arrangement which the telecommunication system licensees are to comply with. Where IDA decides on the sharing arrangement, the priority in usage of lead-in pipes will generally be given in the following order:

1st priority – Telecommunication system licensees who are designated as public telecommunication licensees and who are rolling out services to the buildings in accordance with the basic obligations in their licences

2nd priority– Telecommunication system licensees that are rolling out fixed telecommunication services to the building

3rd priority – Other uses

11.4 IDA's Right to Require Removal

11.4.1 Without prejudice to any other action that IDA may take, IDA may require any telecommunication system licensee who contravenes any requirement in this section to remove, relocate or alter its installation, plant or system, or such part or portion thereof, installed within any space and facilities at its own expense.

ANNEX A.1 DECLARATION OF SERVICES NOT REQUIRED (ONLY FOR OWNERS OF SINGLE-UNIT LANDED HOUSE)

[SAMPLE]

Date: dd-mm-yyyy

Infocomm Development Authority of Singapore
8 Temasek Boulevard
#14-00 Suntec Tower Three
Singapore 038988
Fax No:

Attn: Director
Interconnection & Access Division

Dear Sir,

DECLARATION OF SERVICES NOT REQUIRED FOR SINGLE-UNIT LANDED HOUSE - [*STATE ADDRESS OF PROPERTY*]
PROJECT REFERENCE NO:
PROJECT TITLE:

I refer to my single-unit landed property above.

I hereby declare and confirm that I do not require the following services for the property:

☐ Telephone services (which includes broadband services)

☐ Cable services (which includes cable television and broadband cable modem services)

[Tick as applicable]

In this regard, I will not provide the relevant space and facilities specified in IDA's Code of Practice for the Provision of Info-communication Facilities in Buildings (the "COPIF") for the services that I do not require[*].

I understand that by not providing the space and facilities, I may not be able to obtain info-communication services expediently if I require them subsequently due to the lack of ready infrastructure for deployment of the services. I am also aware that it may be more costly and inconvenient for me to provide the space and facilities at a later date after construction works are completed.

Yours faithfully

(Owner's full name as in NRIC)

ANNEX A.2 INSPECTION CHECKLIST FOR SPACE AND FACILITIES

[*] The space and facilities which need not be provided are as follows:
(i) If telephone services are not required, the internal wiring specified in the COPIF need not be provided.
(ii) If cable services are not required, the Broadband Coaxial Cable System ("BCS") specified in the COPIF need not be provided.
(iii) If both telephone and cable services are not required, in addition to the facilities referred to in (i) and (ii), the 50mm diameter lead-in pipes to the property specified in the COPIF also need not be provided.

[SAMPLE]

Date: dd-mmm-yyyy

Infocomm Development Authority of Singapore
8 Temasek Boulevard
#14-00 Suntec Tower Three
Singapore 038988
Fax No:

Attn: Director
Interconnection & Access Division

Dear Sir,

JOINT INSPECTION OF SPACE AND FACILITIES REQUIRED TO BE PROVIDED UNDER THE CODE OF PRACTICE FOR INFO-COMMUNICATIONS FACILITIES IN BUILDINGS

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

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

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

Yours faithfully

Xxx Xxxxx Xxxxxx (*Developer's/Owner's name*)

Encl

[SAMPLE]

JOINT INSPECTION CHECKLIST FOR TELECOMMUNICATION SPACE AND FACILITIES REQUIRED TO BE PROVIDED UNDER THE CODE OF PRACTICE FOR INFO-COMMUNICATIONS FACILITIES IN BUILDINGS

PROJECT TITLE: _____
TFCC REFERENCE NO.: _____

1. I understand that the dimension and quantities of space and facilities that I am to provide for my building(s) as specified in the COPIF are as follows:

a) MDF room

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

b) TER

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

c) Telecom riser

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

2. During the joint inspection carried out on _____(dd-mmm-yyyy), the as-built dimensions and quantities, or actual dimensions and quantities, are recorded as follows:

a) MDF room

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

b) TER

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

c) Telecom riser

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

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

a) Developer/Owner – _____ (*developer's/owner's name*)

Representative's Name – _____

Signature/Date – _____

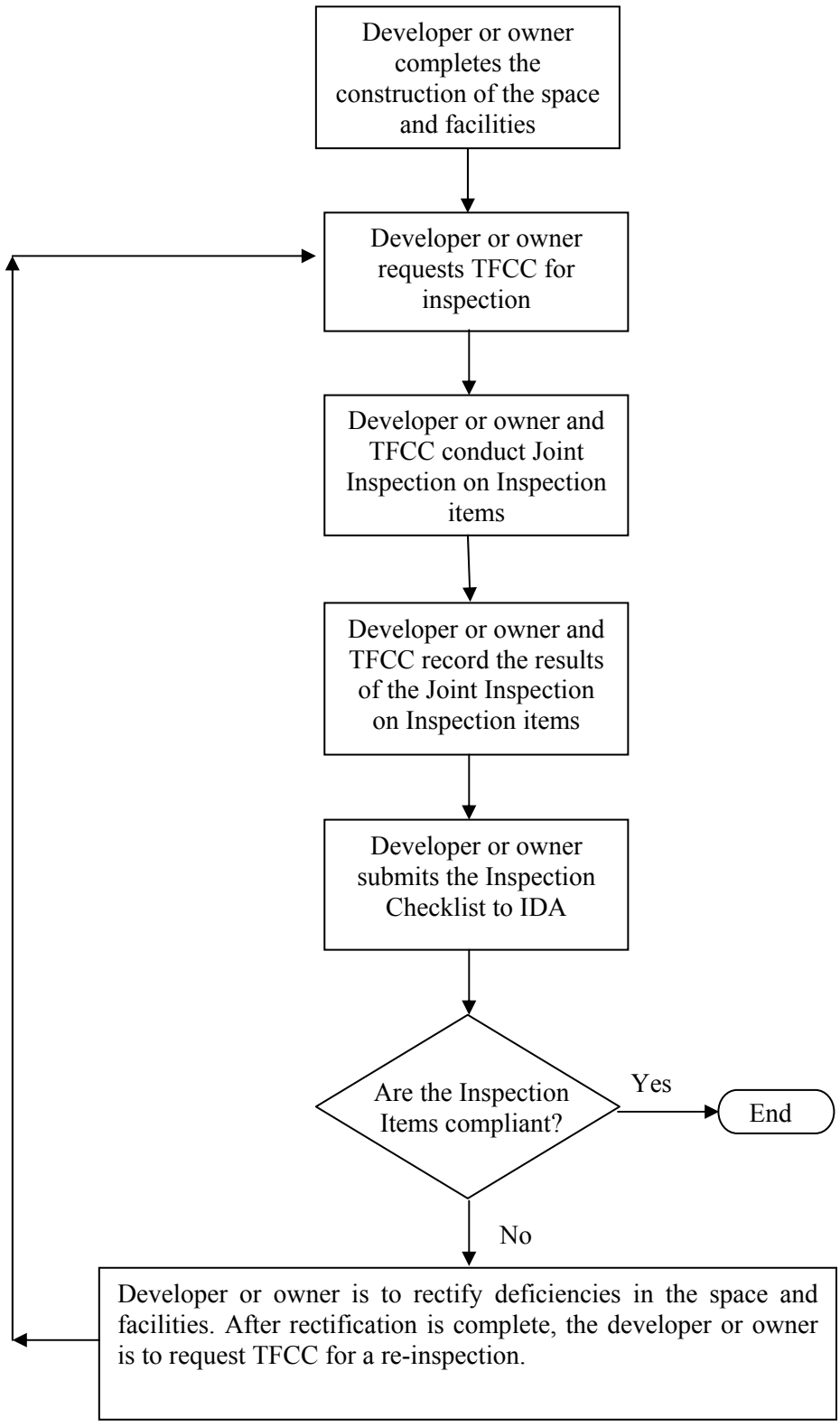
b) TFCC Member (1) – _____ (*name*)

Signature/Date – _____

c) TFCC Member (2) – _____ (*name*)

Signature/Date – _____

ANNEX A.3 INSPECTION PROCESS FLOWCHART



ANNEX B.1 TERMINOLOGY USED IN TELECOMMUNICATION FACILITIES (EXCLUDING BCS FACILITIES)

1 Block Terminal (BT)

An object consisting of a series of electrically separated metallic points on which cables and wires are terminated, the capacity and shape of which vary.

2 Cable Tray/Cable Ladder

A flat metallic surface for horizontal or vertical anchoring of cables.

3 Conduit

uPVC pipe used for accommodation of telecommunication cables and wires to protect against physical damage.

4 Distribution Case (Discase)

A rectangular wooden, PVC or metallic box or case in which a series of termination strips are fixed for cable termination and cross-connection purposes.

5 Distribution Plan

A drawing showing the distribution cable network and routing within a building or between a related group of buildings.

6 Distribution Point

The point where local cables from the MDF are terminated.

7 Duct/Trunking

An enclosed space of metallic or non-metallic construction provided for the installation and concealment of telecommunication cables and wires. This expression includes the space provided in the wall and in the skirting of walls and partitions.

8 Final Distribution Point

The final point where the local cable terminates.

9 Intermediate Distribution Frame (IDF)

A metallic frame used for the termination of local cables within the building.

10 Internal Wires

Wiring which is run from interface point to the actual terminal equipment e.g. telephone.

11 Junction Box/Outlet

An opening with a removable cover to provide access to the concealed ducts/conduits.

12 KTS

Key Telephone System.

13 Lead-in Pipe

Ducts linking telecommunication system licensees existing/proposed underground pipes to the building.

14 Local Cables

Cabling run between the MDF and distribution point (DP), IDF or FDP.

15 Main Cables

Cables provided by telecommunication system licensees which link the building to a telephone exchange and terminate onto the MDF.

16 Main Distribution Frame (MDF)

The metallic frame on which the incoming main cables and the local cables are terminated and cross-connected. It is the main distribution point for all cables within the building or related group of buildings.

17 MDF room

The room housing the main distribution frame and related telecommunication equipment.

18 Manhole

An underground chamber for facilitating cable pulling and jointing purposes.

19 PABX

Private Automatic Branch Exchange.

20 Telecommunication Riser

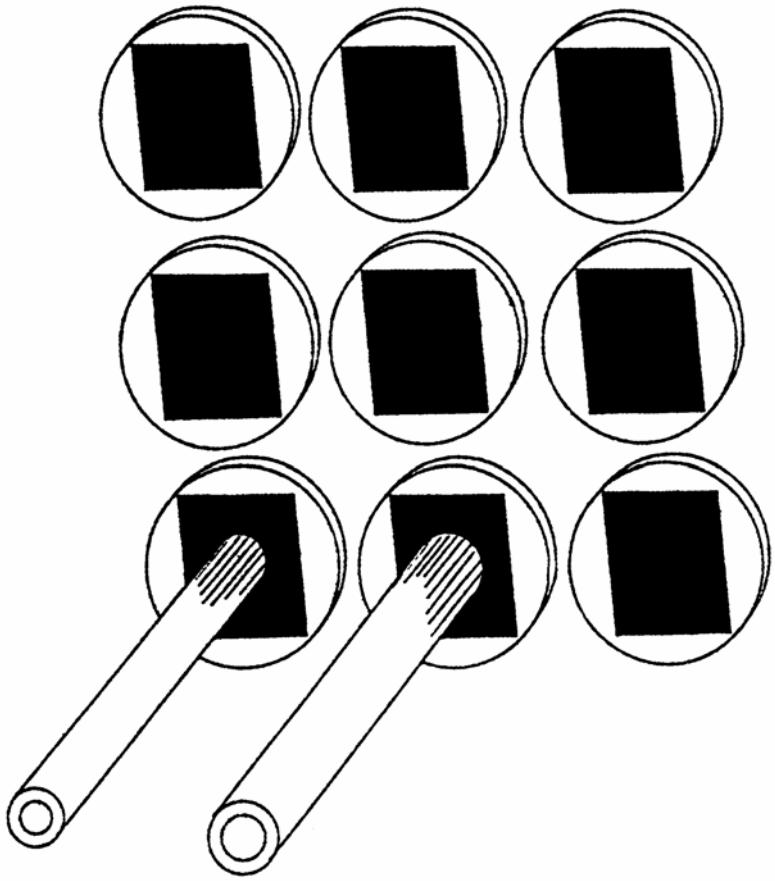
Compartment for running local cables vertically to individual floor of the building.

21 TER

The room housing telecommunication equipment.

ANNEX B.2 DUCT SEALING SYSTEM

Annex B.2(A): Pictorial View of Cable Duct Sealing System



ANNEX B.2 (B) DUCT SEALING SYSTEM FOR BUILDINGS

1 Systems Used

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

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

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

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

2 Suppliers

(a) For MCT System: Czeta Pte Ltd
50 Kian Teck Road
Singapore 628788.
Tel: 6264 0225.

(b) For ROX System: Finessco Engineering Pte Ltd
75A Joo Koon Circle
Singapore 629095.
Tel: 6862 3200.

(c) For BST System: Best Technology Pte Ltd
627A Aljunied Road #08-10
Singapore 389842.
Tel: 6747 5688.

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

3 Developer or Owner's Responsibility

The developer or owner shall ensure that no water leaks through the duct seal.

ANNEX B.3 TESTING PROCEDURE FOR PIPELINES

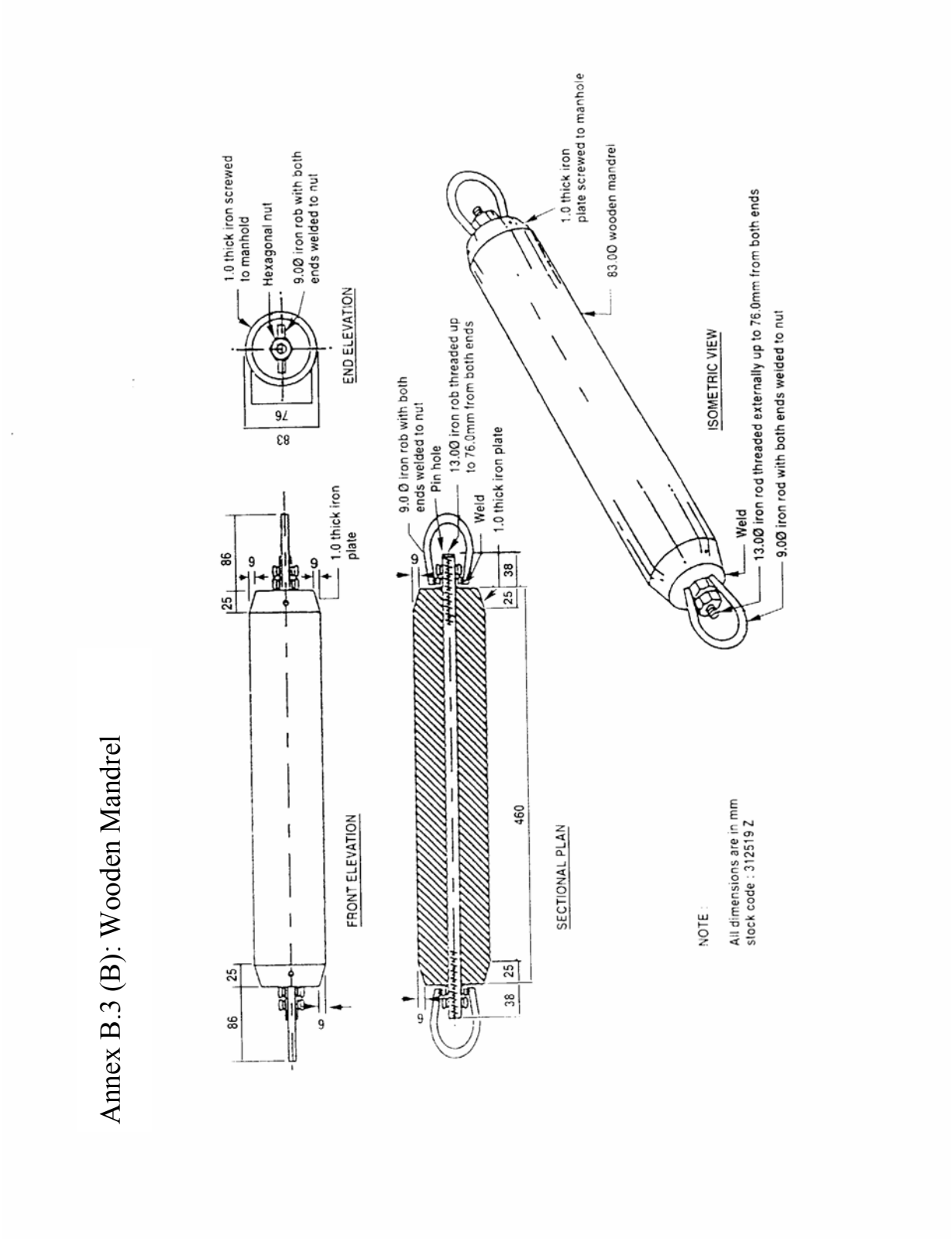
B.3(A) Testing Procedure for Pipelines provided by Development or Building Owner

1 Upon completion of pipe-laying works, the developer or owner may have the pipe tested in accordance with the following procedures:

2 For uPVC Pipe of nominal diameter of 110mm, a brush of appropriate size shall be drawn through each pipe to remove any dirt which may have entered. A standard wooden test mandrel as shown in Annex B.3(B) shall then be drawn through each pipe from both ends of the pipe.

3 For uPVC Pipes of nominal diameter of 25mm and 50mm, a 2m length of cable with diameter 15mm smaller than the internal diameter of the pipe shall be drawn through each pipe from both ends.

Annex B.3 (B): Wooden Mandrel



ANNEX B.4 SPECIFICATIONS FOR UNPLASTICISED PVC PIPE OF NOMINAL DIAMETER OF 110MM IN ACCORDANCE TO SINGAPORE STANDARD

1 Scope

1.1 This specification applies to unplasticised polyvinyl chloride (uPVC) pipe of nominal diameter of 110mm use as underground conduit for containing telecommunication cables.

1.2 Pipes shall comply with all requirements as specified in SS:272 or equivalent.

2 Material

2.1 The material from which the pipes and couplings are produced shall comply with Clause 3 of SS:272 or equivalent.

3 Colour

3.1 Pipes and couplings shall be no darker than the grey colour.

4 Manufacturing Requirements

4.1 Pipe

4.1.1 General

The pipes shall be supplied in straight length of 6.0m within the tolerance of +50mm and -0mm as specified in Clause 7 of SS:272 or equivalent.

The pipe shall be supplied complete with one pipe one coupling.

4.1.2 Dimensions

Pipes shall conform to dimension given in Table 1 of SS:272 for nominal size 110mm.

4.2 Coupling

4.2.1 General

The coupling shall be manufactured by injection moulding method. Details for coupling are shown on Figure 1.

4.2.2 Dimensions

The dimensions of the coupling shall conform to the tolerance as follows:

Coupling Length : 180.0mm ± 2.0mm

Internal Diameter	:	At the edges:	110.5mm + 0.2mm – 0.0mm
		At the centre:	110.0mm + 0.0mm – 0.2mm
Wall Thickness	:	Average Value:	3.2mm + 0.4mm – 0.0mm
		Individual Value:	3.0mm (min)

The wall thickness for a length of 15mm from both ends of the coupling shall increase to:

Average Value	:	4.7mm + 0.3mm
Individual Value	:	4.2mm (min)

5 Properties

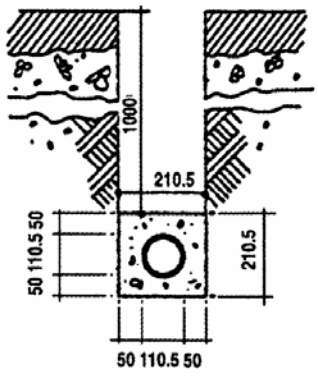
5.1 Pipes and couplings shall comply with all tests as specified in Clause 8.1 and 8.2 of SS:272 or equivalent .

6 Marking

6.1 Each length of pipe shall be clearly, indelibly and continuously marked at intervals of not more that 1.0m using a distinctive colour. The marking shall read as follows:

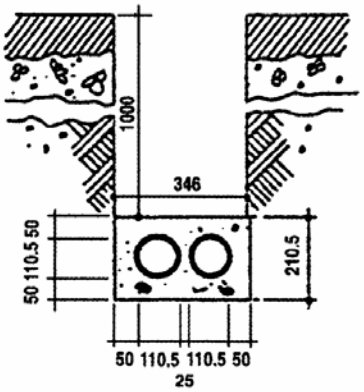
Manufacturer’s identification/110mm uPVC pipe/Day/Month/Year/SS272.

ANNEX B.5 DRAWINGS OF MULTIWAY PIPELINES



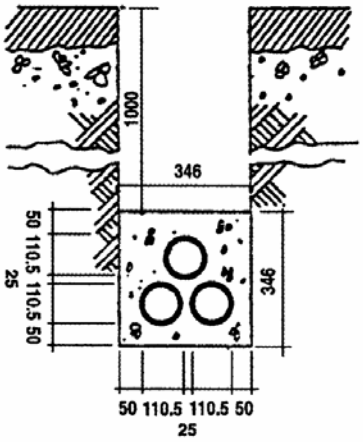
SECTION

1 way pipe formation
DRAWING NO 1



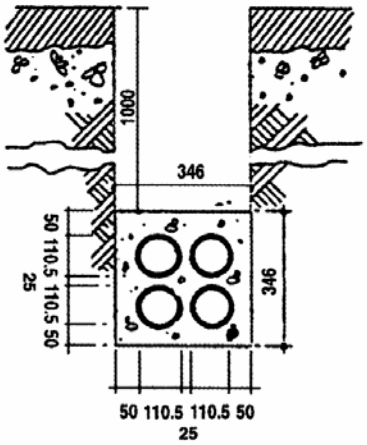
SECTION

2 way pipe formation
DRAWING NO 1a



SECTION

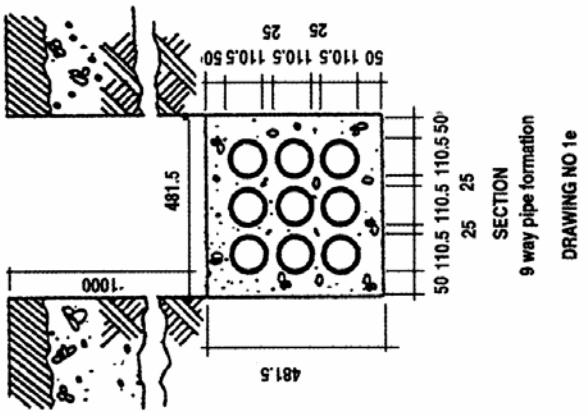
3 way pipe formation
DRAWING NO 1b



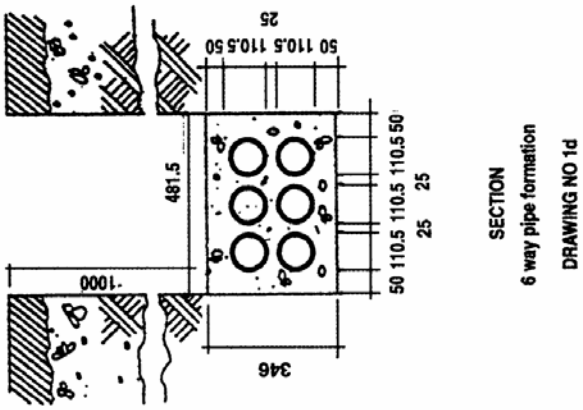
SECTION

4 way pipe formation
DRAWING NO 1c

ANNEX B.5 (CONT'D)

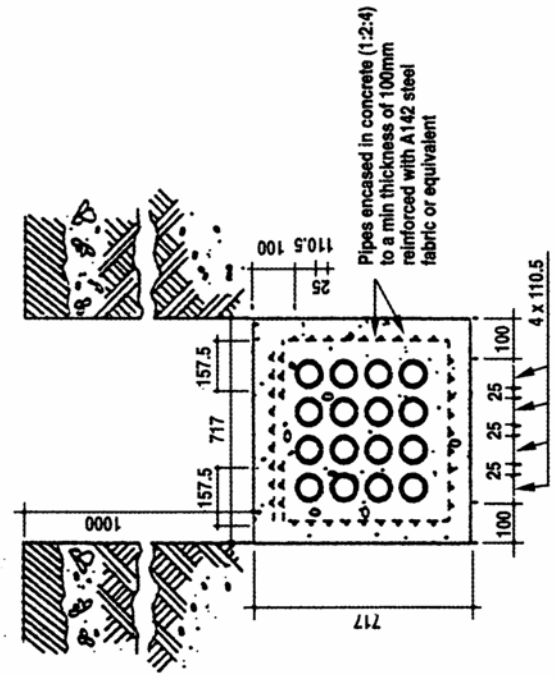


SECTION
9 way pipe formation
DRAWING NO 1e



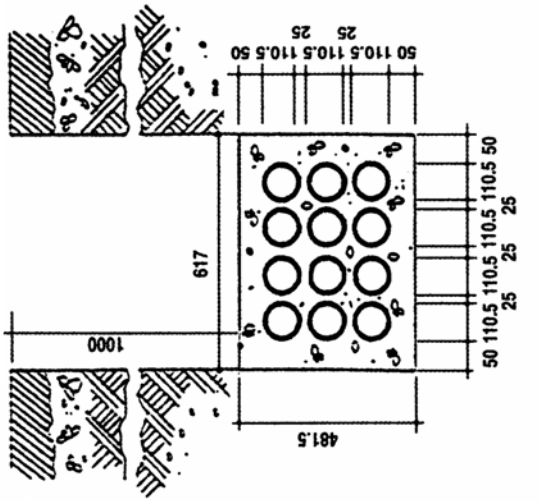
SECTION
6 way pipe formation
DRAWING NO 1d

ANNEX B.5 (CONT'D)



SECTION
16 Wat pipe formation

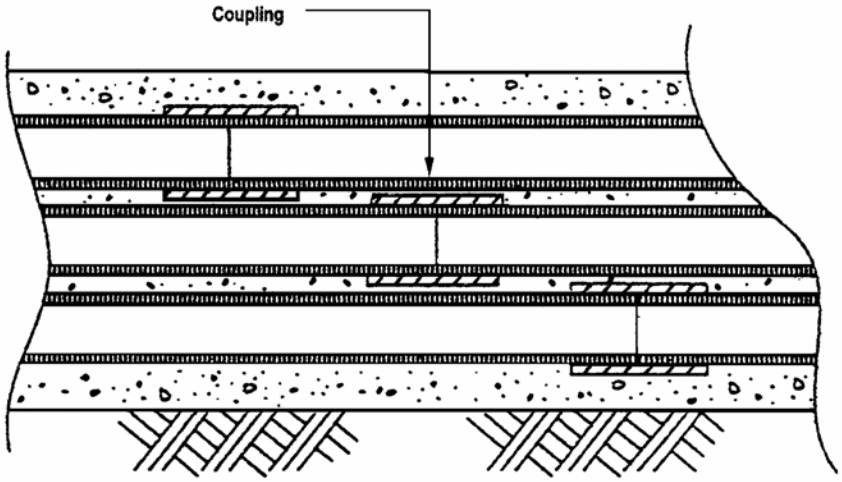
DRAWING NO 1g



SECTION
12 Way pipe formation

DRAWING NO 11

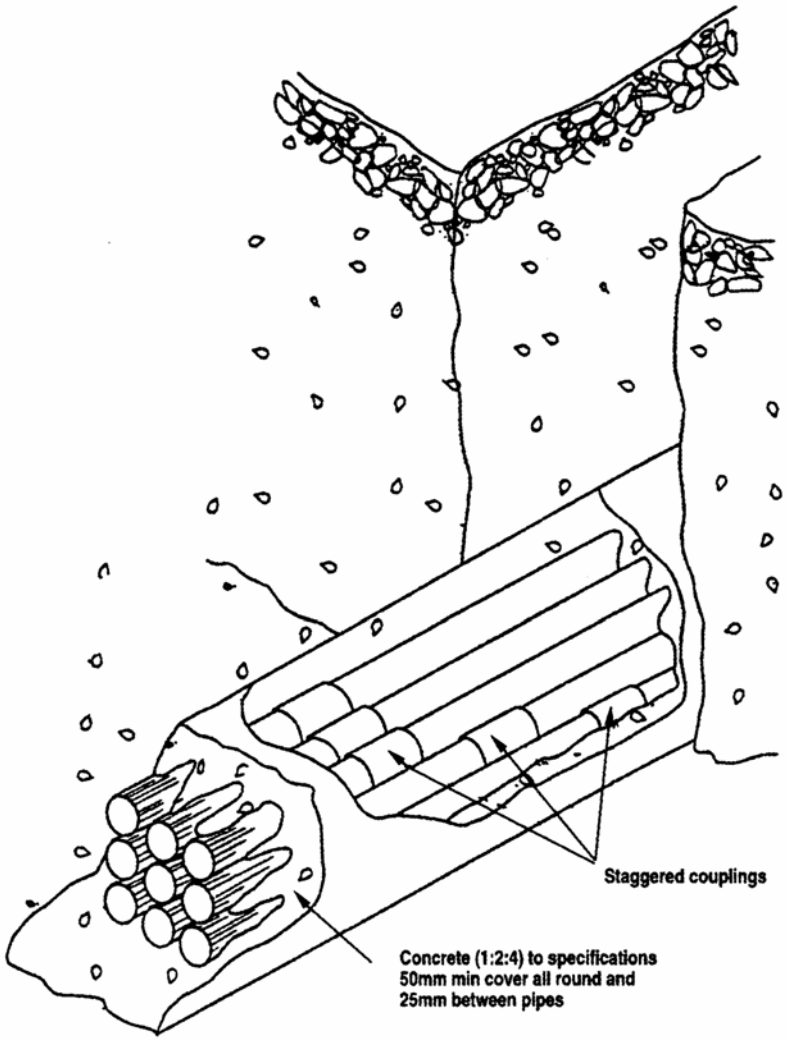
ANNEX B.5 (CONT'D)



Detail showing staggered joints of PVC applicable to all multiple ways

DRAWING NO 2

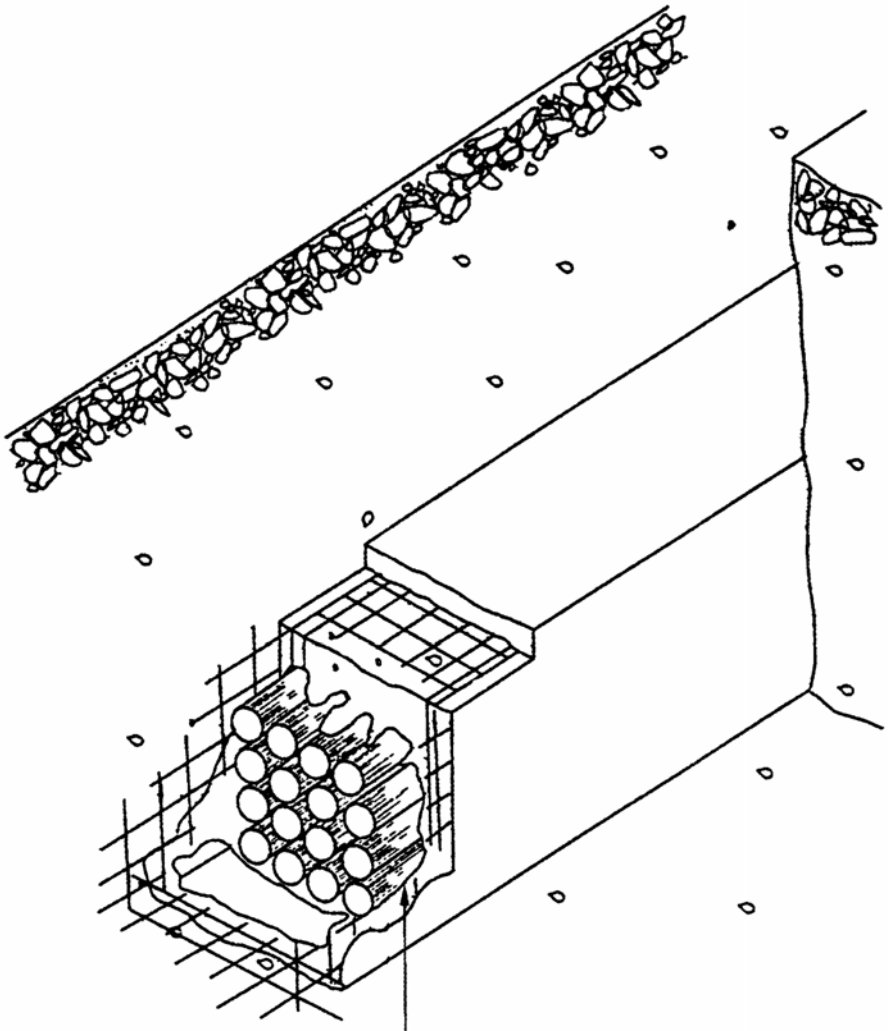
ANNEX B.5 (CONT'D)



9 way pipe formation

DRAWING NO 3

ANNEX B.5 (CONT'D)



NOTES :

1) 16 Way pipe formation

2) All pipe formation exceeding 16 ways

DRAWING NO 4

ANNEX C.1 DEFINITION OF TERMS

Note: The terms are made reference to Figure 1.

1 Broadband Coaxial Cable System (BCS)

A wide-area, wired (cabled) system of coaxial, interconnecting a large number of outlets installed in the buildings. The system include upstream bandwidth for broadband interactive services such as cable-modem high-speed Internet access service, in addition to conventional CATV network for subscriber CATV services.

2 Head End

Facility with equipment that are connected between receiving antennae or other signal sources and the remainder of the cabled distribution system to process the signals to be distributed.

Note: The head end may, for example, comprise antennae amplifiers, frequency converters, combiners, separators and generators.

3 Local Head End

The transmission facility that is directly connected to the trunk feeders or to a short haul "trunk feeder replacement" link.

4 Hub Head End

A subsidiary head end usually located at the centre of its service area, with inputs from a local head end, and possibly other sources.

5 Remote Head End

A head end from which signals are delivered to a local head end via a long-distance terrestrial or satellite link.

6 Distribution Point

The point where signal from the trunk feeder that energises the branches and/or spur feeders.
Note: In some cases a distribution point may be directly connected to the head end.

7 Feeder

A transmission path forming part of a cabled distribution system. Such a path may consist of a metallic cable, optic fibre, wave-guide, or any combination of them. By extension, the term is also applied to paths containing one or more radio links.

8 Supertrunk feeder

A feeder which only connects between head ends or between a head end and the first distribution point.

9 Trunk feeder

A feeder used for the transmission of signals between a head end and a distribution point or between distribution points.

10 Branch feeder

A feeder used for connecting a distribution point to spur feeders.

11 Spur feeder

A feeder to which subscribers' taps are connected.

12 Subscriber's feeder

A feeder connecting a subscriber's tap to a system outlet or where the latter is not used, directly to the subscriber's apparatus, in which case it may include filters and transformers.

Distribution System Equipment

13 Antenna Amplifier

An amplifier (often a low noise type) associated with an antenna.

14 Trunk Amplifier

An amplifier to compensate for attenuation in a trunk feeder.

15 Bridger Amplifier

An amplifier for connection in a trunk feeder to provide a distribution point. An amplifier for connection in a branch feeder, to energise one or more branch or spur feeders.

16 Trunk Bridger Amplifier

An amplifier to compensate for attenuation in a trunk feeder and also to provide a distribution point.

17 Distribution Amplifier

An amplifier designed to feed one or more branch or a spur feeders.

18 Branch Amplifier

An amplifier to compensate for attenuation in a branch feeder.

19 Automatic Level Controlled Amplifier

An amplifier that includes means to control automatically the level of the signal(s) at its output.

Note: This may be achieved using variation of gain or slope or both by means of:

(a) one or more pilot carriers;

(b) a temperature sensing device; or

(c) remote control.

20 Frequency Converter

A device for changing the carrier frequency of one or more signals prior to transmission on a feeder.

21 Combiner

A device in which the signals arriving at two or more input ports are fed to a single output port.

Note: Some forms of this device may be used in the reverse direction as a splitter.

22 Separator (multiplexer)

A device in which the signal energy at one (input) port which covers a frequency band is divided between two or more (output) ports each of which covers a part of that frequency band.

Note: (a) For example, a diplexer is a two-output separator.

(b) Some forms of this device may be used in the reverse direction for combining signal energy.

23 Splitter (Spur Unit)

A device in which the signal energy at the (input) port is divided equally or unequally between two or more (output) ports.

Note: Some forms of this device may be used in the reverse direction for combining signal energy.

24 Directional Coupler

A splitter in which the attenuation between any two output ports exceeds the sum of all the attenuation between the input port and each of these output ports.

25 Equaliser

A device designed to compensate over a certain frequency range the amplitude/frequency distortion or the phase/frequency distortion introduced by feeders or equipment.

Note: This device is for the compensation of linear distortions only.

26 Subscriber's Tap

A device for connecting a subscriber's feeder to a spur feeder.

Subscriber-Related Equipment

27 Channel Selector

A device incorporated in the system for selecting the desired channel, often at the subscriber's premises.

28 System Outlet

A device for interconnecting a subscriber's feeder and a receiver lead.

29 Distribution Panel

A device through which the spur feeder passes and which contains one or more passive electrical devices (taps/tee or splitters) used to distribute MATV or CATV signals to system outlets.

30 Receiver Lead

A lead which connects the system outlet to the subscriber's apparatus.
Note: It may include filters and 'ba-lun' transformers in addition to the cable.

31 Signal Adaptor

In a cabled distribution system which distributes television signals not conforming to any CCIR system (only in respect of r.f. structure) a device which modifies the signal to achieve conformity with the appropriate CCIR system, without changing the baseband characteristics.

32 Cabled System Receiver

A television or sound receiver specifically designed to operate from a cabled distribution system.

33 Set Top Converter

A device connected in a receiver lead, to change the system carrier frequencies to those for which the receiver was designed.

Characteristics of the Signal

34 Decibel Ratio

The decibel ratio of two quantities of power P_1 and P_2 is defined by :

$$10\log_{10}\frac{P_1}{P_2}(dB)$$

35 Standard Reference Power (P_0).

In cabled systems the standard reference power is 1/75 pW.

Note: This is the power dissipated in a 75 ohm resistor with a voltage drop of 1uV r.m.s across it.

36 Level

The level of any power (P_1) is the decibels ratio of that power to the standard reference power (P_0) i.e.

$$10\log_{10}\frac{P_1}{P_0}(dB)$$

This may be expressed in decibels (relative to 1uV in 75Ω) or more simply in dB(μV) if there is no risk of ambiguity.
Note: By "power" in relation to a vision-modulated carrier is meant power at the peak of the modulation envelope (i.e. the maximum r.m.s. voltage squared and divided by the resistance).

37 Attenuation

The attenuation of any system is the decibel ratio of the input power of the output power.

38 Gain

Gain of any system is the decibel ratio of the output power to the input power.

39 Automatic Gain Control

The automatic control of a device to maintain constant the level of the signal at its output, without using the amplitude of the sync pulse of the signal to be controlled as the control stimulus.

40 Automatic Level Controlled Amplifier

An amplifier which includes means to control automatically the level of the signal(s) at its output but excludes the use of the amplitude of the synchronising pulses of the received television signals for such control purpose.

41 Frequency Response

The gain or loss of a system plotted against frequency.

42 Slope

Between any two points in a system, the difference in gain or attenuation at two specified frequencies.

43 Signal Tilt

The difference in level deliberately established between specified signals or groups of signals at any point in a system.

Performance Characteristics

44 Crossview

In a multi-pair system, the effect on a wanted television signal of the undesired transfer of one or more television signal(s) from other circuit(s).

45 Cross-modulation

The undesired modulation of the carrier of a desired signal by the modulation of another signal as a result of system non-linearities.

46 Inter-modulation

The process whereby non-linearity in equipment in a system produced spurious output signals (called inter-modulation products) at frequencies which are linear combinations of those of the input signals.

47 Carrier to inter-modulation ratio

The difference in decibels between the carrier level at a specified point in a system and the level of a specified inter-modulation product or combination of products.

48 Carrier to noise ratio

The difference in decibels between the vision or sound carrier level at a given point in the system and the noise level at that point (measured within a bandwidth appropriate to the television or radio system in use).

49 Mutual Isolation

The attenuation between one system outlet to that of another at any frequency within the range of the system under investigation. It is always specified, for any particular installation, as the minimum value obtained within specified frequency limits.

50 Reflections or echoes

These are visible as multiple images to the right of the displayed picture. They become more visible the more they are separated from the picture and no single figure can be given for the admissible maximum level of the unwanted reflected signal.

51 Echo rating

The "echo rating", E, is defined as the result of a system test with a 2T sine-squared pulse (as determined in CCIR Recommendations 473 and 567) by the boundary line on a specified graticule within which all parts of the received pulse fall.

Note: The object of the gratitude design is to ensure that the subjective effect of an echo of rating E% is the same as that of a single echo, with displacement greater than 12T, of E/2 %, relative to the peak amplitude of the test pulse.

52 VSWR

Voltage Standing Wave Ratio is the ratio of the maximum voltage along the transmission line to the minimum voltage along the transmission line. It is also the ratio of the impedance of the load to the characteristic impedance of the transmission line. It is a measure of mismatch between the transmission line and the load and is equal to one when perfectly matched.

53 Front-to-back ratio

The ratio of the original strength received by the antenna when it is pointing to the signal source against that received when the antenna is reversed (rotated) by 180^{o}.

Miscellaneous

54 Well-matched

A test set up is said to be "well-matched" when the port or ports facing the equipment under test have a return loss ratio of at least 20dB relative to the system impedance.

55 Bonding

Bonding is the safety connection of circuits to the main supply earth (ground) or to other electrically grounded metallic installations, or in the case of outdoor equipment, the connection to the surrounding earth (ground).

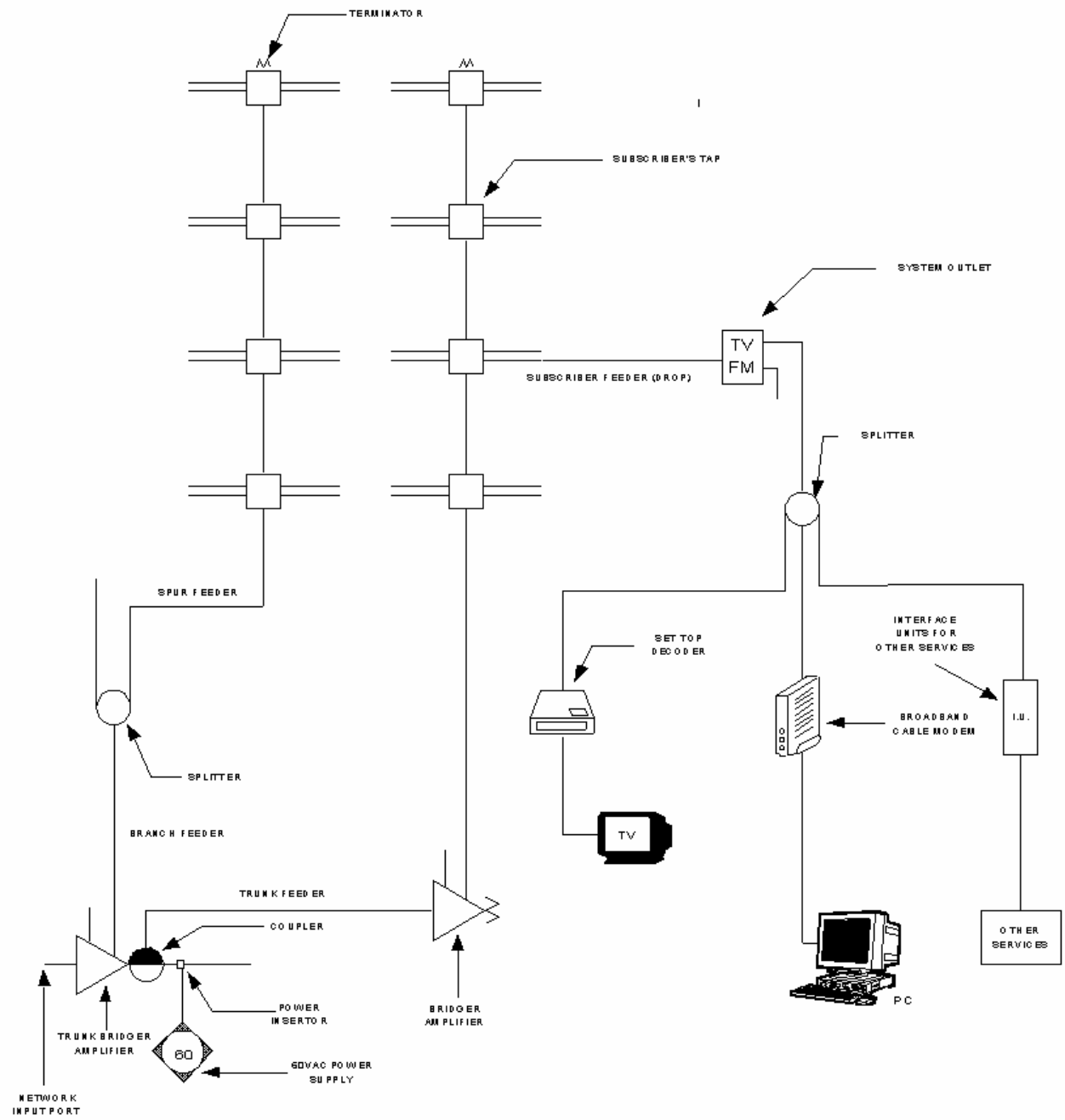


Figure 1: Principal items of equipment employed in a BCS system

ANNEX C.2 EQUIPMENT SPECIFICATIONS

1. General

1.1 The detailed performance specification of each component part to be installed in a BCS shall be selected to attain the overall system performance specification and requirements.

2 Minimum Requirement of Amplifiers

2.1 The amplifiers shall meet the minimum specifications set out hereunder:

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

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

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

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

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

(i) Noise figure with equaliser; less or equal to 10dB

(ii) Flatness in unity gain configuration: ± 1dB

(iii) Forward bandwidth (downstream): (54–824)MHz

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

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

(h) Amplifiers shall require AGC. This would compensate for any level variation that may be introduced from the BCS.

3 Minimum Requirements of Passive Devices: Taps/Tees, Splitters and Wall Outlets

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

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

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

3.4 To minimise signal reflections, devices that do not present a constant impedance match to the distribution cables should not be used. The return loss over the total frequency band shall be better than 15dB.

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

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

4 Minimum Requirements of Connectors and Splices

4.1 Connectors for subscriber feeder cables shall be ‘F’ type, with long (12-19mm) attached ferrule. The connectors will utilise a compression sealed plastic ferrule bushing within the ferrule and a neoprene rubber gasket within the rotational joint in order to keep out moisture. In addition, it is recommended to seal the front end of the F type connectors with neoprene rubber boots which fit over the female ‘F’ port and are compressed by the front face of the ‘F’ type connector.

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

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

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

4.5 Adapters between ‘F’ connectors and housings or other devices shall be designed for use with each other and the coaxial cables used.

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

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

ANNEX C.3 COMMISSIONING TEST PROCEDURES

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

2. For a multi-storey building, a sample test shall be conducted for every storey and telecommunication riser in the building. Tests shall be completed by making measurements on all telecommunication vertical cable risers on all storeys. Signals shall be measured at the distribution panels. Test will be for continuity and proper levels. Not less than three visual carriers, spread across the band, should be tested.

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

ANNEX C.4 METHODS OF MEASUREMENTS

1 General

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

1.2 The following measurements are considered:

(a) Measurement of Hum;

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

(c) Measurement of Visual, Aural Carrier Centre Frequency;

(d) Measurement of inter-modulation;

(e) Measurement of Visual Carrier to Noise Ratio;

(f) Measurement of Chrominance – Luminance delay Inequality

(g) Measurement of differential gain and phase;

(h) Measurement of Signal Leakage.

2 Measurement of Hum

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

2.2 Equipment required for the test set-up shall be provided and the measurement shall be conducted in accordance with the recommendations of FCC 76.605(a)(10) and NCTA

2.3 Recommended Practices – Second Edition 1993.

3 Measurement of Frequency Response within A Channel

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

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

4 Measurement of Visual, Aural Carrier Centre Frequency

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

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

5 Measurement of Inter-modulation

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

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

6 Measurement of Visual Carrier to Noise Ratio

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

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

7 Measurement of Chrominance – Luminance Delay Inequality

7.1 The Chrominance – Luminance delay inequality caused by a headend system or component is defined as the change in delay time of the chrominance component of the signal relative to the luminance component after passing through the system. The parameter is also called Chroma Delay.

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

8 Measurement of Differential Gain and Phase

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

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

9 Measurement of Signal Leakage

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

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