

CODE OF PRACTICE FOR INFO-COMMUNICATIONS FACILITIES IN BUILDINGS



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**TELECOMMUNICATIONS ACT
(CHAPTER 323)**

**CODE OF PRACTICE FOR INFO-COMMUNICATION
FACILITIES IN BUILDINGS**

In exercise of the powers conferred by section 19 of the Telecommunications Act (Cap. 323), the Info-communications Development Authority of Singapore hereby issues the following Code of Practice:

CHAPTER 1. PRELIMINARY

1.1 Citation and commencement

This Code may be cited as the Code of Practice for Info-communication Facilities in Buildings 2008 and shall come into operation on 15 September 2008.

1.2 Definitions

In this Code, unless the context otherwise requires –

“block terminal” means an object consisting of a series of electrically separated metallic points on which cables and wires are terminated;

“broadband coaxial cable system” means a wide-area wired system of coaxial cables which connect to television outlets installed within a building for the transmission of cable services;

“building” excludes any temporary building or structure;

“cable” means a cable, wire or line used or intended to be used for telecommunications;

“cable distribution system” means a network of cable trays, cable ladders, trunkings, conduits, and underfloor ducts, which enable cables to be laid from one point to another point within a building or a development;

“cable service” means any telecommunication service which is provided over a broadband coaxial cable system;

“certificate of statutory completion” has the same meaning as in the Building Control Act (Cap. 29);

“construction” in relation to a building, means the erection, extension of, alteration and/or addition to the building, and “construct” and “constructed” shall be construed accordingly;

“development” means a single project consisting of 1 or more buildings;

“distribution point” means the point at which local cables from either the main distribution frame room or a licensee’s installation or plant terminate;

“duct” or “trunking” means an enclosed space of metallic or non-metallic construction which is used to house and conceal cables and includes spaces provided in a wall and in the skirting of walls and partitions;

“Effective Date” means the date this Code comes into operation;

“IDA” means the Info-communications Development Authority of Singapore constituted under the Info-communications Development Authority of Singapore Act (Cap. 137A);

“installation or plant” includes all structures, machinery, equipment, cables, poles and lines used or intended for use in connection with telecommunications;

“intermediate distribution frame” means a metallic frame used for the termination of telecommunication cables within a building;

“internal telecommunication wiring” has the same meaning as in regulation 2 of the Telecommunication (Internal Wiring) Regulations 2005 (G.N. No. S 479/2005);

“landed dwelling-house” means any of the following types of houses used wholly or mainly for the purpose of human habitation –

- (a) detached house;
- (c) semi-detached house; or
- (d) terrace house

but does not include a strata landed dwelling-house;

“lead-in pipes” in relation to –

- (a) a landed dwelling-house, means the pipes which extend outwards from the boundary of the house to enable the laying of cables from outside the property into the property; and
- (b) a development consisting of buildings other than landed dwelling-houses, means the pipes which extend outwards from the boundary of the development to enable the laying of cables from outside the development into the development;

“licensee” means a telecommunication system licensee as defined in section 2 of the Telecommunications Act;

“main distribution frame” means the frame on which incoming main cables and the local distribution cables within a building or development are terminated and cross-connected;

“main distribution frame room” means a room within a building or development that is used to house a main distribution frame and licensees’ installation or plant;

“mixed-use building” means a building used for both residential and non-residential purposes;

“multi-storey residential building” means a residential building, other than a landed dwelling-house (including strata landed dwelling-houses), consisting of two or more storeys used wholly or mainly for the purpose of human habitation;

“Next Generation National Broadband Network” means the nationwide info-communications broadband network to be designed, built and deployed in Singapore by the licensees that are awarded the contracts for the Network Company and Operating Company pursuant to IDA’s Next Generation National Broadband Network project;

“non-residential building” means a building used for any non-residential purpose and includes –

- (a) office towers;
- (b) shophouses and shopping complexes;
- (c) convention and exhibition complexes;
- (d) markets and food centres;
- (e) hotels, boarding houses, guest houses, service apartments, student hostels and workers’ dormitories;
- (f) resort developments;
- (g) factories and warehouses;
- (h) utilities and telecommunication installations,
- (i) business or technology park developments;
- (j) airport or sea port terminals;
- (k) bus terminals, bus interchanges, train stations, Mass Rapid Transit System (MRT) stations or Light Rail Transit System (LRT) stations;
- (l) fire stations, police stations, civil defence buildings, military camps, prison buildings, hospitals, government offices or embassies;
- (m) places of worship;
- (n) libraries, museums, community clubs or centres, association buildings, sports and recreational complexes, homes for the aged and hospices; and
- (o) primary schools, secondary schools, junior colleges, universities, polytechnics, foreign and specialist schools;

“previous codes” means any previously issued codes of practice or guidelines which specified the space and facilities to be provided by owners or developers of buildings for the purpose of enabling the deployment and operation of installation and plant to provide telecommunication service to the buildings, including –

- (a) the Code of Practice for Info-communications Facilities in Buildings issued by IDA on 15 September 2000 including its addendums dated 15 March 2001 and 15 September 2006;
- (b) the Code of Practice for Telecommunication Facilities in Buildings issued by the Telecommunication Authority of Singapore on March 1997;
- (c) the Revised Guidelines for the Provision of Telecommunication Facilities by Developers issued by Singapore Telecommunications Ltd in 1994; and
- (d) the Guidelines for the Provision of Telecommunication Facilities by Developers issued by the Telecommunication Authority of Singapore in 1988;

“public road” means any road over which the public has a right of way;

“relevant space and facilities” means the space and facilities provided by the developer or owner of a building pursuant to this Code or any previous codes;

“strata landed dwelling-house” means a landed dwelling-house comprised in a development the strata subdivision of which is permitted under a written permission granted by the competent authority under section 14 (4) of the Planning Act (Cap. 232) or authorised by the Minister under section 21 (6) of the Planning Act;

“telecommunication equipment room” means a room within a building or a development that is used to house a licensee’s installation or plant;

“telecommunication (non-broadband coaxial cable) system” means any telecommunication system other than a broadband coaxial cable system;

“telecommunication riser” means a compartment that is used to house and distribute local cables vertically from the main distribution frame room or telecommunication equipment room to the individual storeys of a building;

“underground pipes” –

- (a) in relation to a landed dwelling-house, means the pipes which extend from the boundary of the house into the house;
- (b) in relation to a development consisting of strata landed dwelling-houses, means the pipes which extend from the boundary of the development to the main distribution frame room or to the retaining wall of the development (as the case may be) and which

extend from the main distribution room or retaining wall to each strata landed dwelling-house within the development; and

- (c) in relation to a development consisting of buildings other than landed dwelling-houses or strata landed dwelling-houses, means the pipes which extend from the boundary of the development to the main distribution frame room or retaining wall of the development (as the case may be) and which extend from the main distribution frame room to the telecommunication equipment room(s) or telecommunication riser(s) within the development; and

“usable floor area” refers to any floor space within a development which is to be served by any telecommunication system.

1.3 Purpose of this Code

This Code specifies –

- (a) the space and facilities that the developer or owner of a building shall provide at his expense to enable the deployment and operation of installation and plant to be used in providing telecommunication service to the building;
- (b) the duties that shall be observed by the developer or owner of a building in relation to the space and facilities provided in the building pursuant to this Code or previous codes; and
- (c) the duties that shall be observed by a licensee who deploys and operates its installation or plant within the relevant space and facilities.

1.4 Application of this Code

1.4.1 Where a development has been granted provisional or written permission for its construction by the competent authority under the Planning Act (Cap. 232) on or after the Effective Date, the developer or owner of the development shall, unless he obtains a waiver from IDA in accordance with paragraph 1.5, provide at his expense the space and facilities described in chapters 4 to 9 as may be applicable.

1.4.2 Chapters 4 to 9 specify the space and facilities to be provided for the following types of developments –

- (a) development consisting of 1 or more landed dwelling-houses abutting an existing road (Chapter 4);
- (b) development consisting of 2 or more landed dwelling-houses abutting a new road to be constructed by the developer or owner (Chapter 5);
- (c) development consisting of 2 or more strata landed dwelling-houses (Chapter 6);
- (d) development consisting of 1 or more multi-storey residential buildings (Chapter 7);

- (e) development consisting of 1 or more non-residential buildings of up to 200,000 m² usable floor area or with more than 50 telephone lines (Chapter 8); and
- (f) development consisting of 1 or more non-residential buildings of up to 2,000 m² usable floor area and with up to 50 telephone lines (Chapter 9).

1.4.3 Where a development consists of –

- (a) 1 or more mixed-use buildings; or
- (b) a mix of landed dwelling-houses, strata landed dwelling-houses, multi-storey residential buildings, non-residential buildings, mixed-use buildings or any combination thereof,

the developer or owner shall refer to and provide at his expense the relevant space and facilities specified in chapters 4 to 9 corresponding to the use or type of building(s) in the development. For example, in the case of a development consisting of a multi-storey mixed-use building, the developer or owner shall provide the space and facilities specified in chapter 7 in respect of the residential portion of the building and provide the space and facilities specified in chapter 8 or 9 (as the case may be) in respect of the non-residential portion of the building. In the event of any uncertainty as to the space and facilities to be provided, the developer or owner shall consult IDA for clarification.

1.4.4 Where the space and facilities to be provided for a particular development are not specified in this Code, the developer or owner shall consult IDA on the space and facilities to be provided at his expense for such development and comply with such requirements as may be imposed by IDA.

1.4.5 Where space and facilities have been provided within a development pursuant to this Code or any previous codes regardless of when the development was constructed, the developer or owner shall comply with chapter 2 unless he obtains a waiver from IDA in accordance with paragraph 1.5.

1.4.6 Every developer or owner who is required to provide -

- (a) lead-in pipes, underground pipes and manholes;
- (b) main distribution frame room(s);
- (c) telecommunication equipment room(s);
- (d) telecommunication riser(s); and/or
- (e) a broadband coaxial cable or broadband coaxial cable system

pursuant to chapters 4 to 9 of this Code shall comply with the additional requirements set out in chapters 10, 11, 12 and/or 13 of this Code (as the case may be).

- 1.4.7 Every licensee who uses the space and facilities provided by the developer or owner of a development pursuant to this Code or any previous codes shall comply with chapter 14 of this Code.
- 1.4.8 Nothing in this Code shall limit IDA's power to issue a direction under section 21 of the Telecommunications Act.
- 1.4.9 For the avoidance of doubt, the developer or owner of a development shall not be excused from any failure to observe the requirements of this Code arising from acts or omission of any consultant or contractor whom he engages to design and construct the development.

1.5 Exemption and waiver

- 1.5.1 IDA may on receipt of an application in relation to the space and facilities to be provided in accordance with this Code, exempt or waive, upon and subject to such terms and conditions as it thinks fit, any of the requirements specified in this Code.
- 1.5.2 Any such application shall be made in writing to IDA by or on behalf of the developer or owner of the development to which such application relates and shall state the nature and extent of and reasons for the proposed exemption or waiver of such requirements and shall be accompanied by such plans and particulars as may be required to support his application.
- 1.5.3 An exemption or waiver may be permanent, temporary (either for a fixed period or effective until the occurrence of a specific event) or on a one-time basis.

1.6 Cancellation and transitional provisions

- 1.6.1 The Code of Practice for Info-communications Facilities in Buildings issued by IDA in September 2000 including its addendums dated 15 March 2001 and 15 September 2006 (hereinafter referred to as the cancelled Code) is cancelled.
- 1.6.2 Notwithstanding paragraph 1.6.1, the cancelled Code shall continue to apply to buildings which are under construction on the Effective Date as if that Code had not been cancelled. For the purposes of this paragraph, a building shall be under construction if either provisional or written permission for its construction had been granted under the Planning Act (Cap. 232) but no certificate of statutory completion had been issued in respect of the building.
- 1.6.3 Nothing in paragraph 1.6.2 shall require any developer or owner to comply with the cancelled Code if he was not already required to do so before the Effective Date.

1.7 Guidelines

- 1.7.1 The guidelines entitled "Guidelines For Info-communications Facilities in Buildings" shall be read in conjunction with this Code. Developers and owners should refer to the guidelines for the technical specifications of the space and facilities to be provided under this Code and the recommended practices in relation to the construction thereof.

CHAPTER 2. CHARGES & CONTINUING OBLIGATION TO PROVIDE SPACE AND FACILITIES

2.1 Charges for use of and access to relevant space and facilities

- 2.1.1 The provision and maintenance of the space and facilities required to be provided under this Code or any previous codes shall, unless otherwise specified in this Code, be at the expense of the developer or owner of the development.
- 2.1.2 Without prejudice to the generality of paragraph 2.1.1 and subject to paragraph 2.1.4, no charges or rent shall be imposed on or collected from a licensee for its use of or access to the relevant space and facilities, including but not limited to –
- (a) main distribution frame rooms;
 - (b) telecommunication equipment rooms and coaxial distribution rooms;
 - (c) telecommunication risers;
 - (d) lead-in pipes, underground pipes and manholes; and
 - (e) cable distribution systems.
- 2.1.3 The developer or owner of a development shall provide lighting and ventilation to the relevant space and facilities at his own expense where this is necessary to enable a licensee to deploy and operate its installation or plant in such space and facilities.
- 2.1.4 The developer or owner of a building shall not be required to bear the utility charges for the operation of any installation and plant deployed by any licensee in the relevant space and facilities.

2.2 Space and facilities for exclusive use of licensees

- 2.2.1 All space and facilities required to be provided under this Code or any previous codes shall be for the exclusive use of licensees.
- 2.2.2 The developer or owner of a building shall not use the relevant space and facilities for any purpose. In particular, the developer or owner shall not –
- (a) install main distribution frames, local distribution cables or any other equipment in the main distribution frame room, telecommunication equipment room or coaxial distribution room of the building for his own use whether for telecommunication purposes or otherwise;
 - (b) install cables in the lead-in pipes, underground pipes, manholes or cable distribution system of the building for his own use whether for telecommunication purposes or otherwise;
 - (c) use the telecommunication risers in the building for the deployment of public address systems or computer networking cables; or

- (d) use the relevant space and facilities for the storage of any items whatsoever.

2.3 Continuing obligation to provide relevant space and facilities

2.3.1 The developer or owner of a development shall, in relation to the space and facilities provided pursuant to this Code or any previous codes, at his own expense –

- (a) maintain the relevant space and facilities in a condition that is fit for the purpose of its use;
- (b) repair any part of the relevant space and facilities that falls into disrepair or is damaged unless such damage is caused by a licensee in which case the developer or owner may require the licensee to carry out the necessary repairs; and
- (c) implement reasonable measures to safeguard the security of the relevant space and facilities.

CHAPTER 3. SUBMISSION OF INFORMATION BY THE DEVELOPER OR OWNER

3.1 Application of this chapter

- 3.1.1 This chapter specifies the requirements to be observed by the developer or owner of a development who is required to provide space and facilities under this Code.
- 3.1.2 Where a development has been granted provisional or written permission for its construction by the competent authority under the Planning Act (Cap. 232) on or after the Effective Date, the developer or owner shall ensure that their building plans fully and accurately incorporate the requirements of this Code before construction commences.

3.2 Submission of building plans to the Telecommunication Facility Co-ordination Committee (TFCC)

- 3.2.1 The developer or owner shall submit the building plans to the Telecommunication Facility Co-ordination Committee ("TFCC") during the planning stage of the development together with the following information –
- (a) the name and address of the developer or owner;
 - (b) the names and addresses of the consultants and contractors engaged for the building works, including the architect, the M&E consultant and building contractors;
 - (c) the location of the development;
 - (d) the proposed number of units and the usable floor area;
 - (e) the intended use of the development;
 - (f) the estimated commencement and completion dates of the building works; and
 - (g) the house or unit numbering plan.
- 3.2.2 In addition to the information required in paragraph 3.2.1, the developer or owner shall submit –
- (a) the site plan indicating the location of the proposed development;
 - (b) building plans indicating the space and facilities provided for the development as specified in chapters 4 to 9 (as the case may be); and
 - (c) where a broadband coaxial cable system is required to be provided, the relevant design of such broadband coaxial cable system as specified in chapter 13.
- 3.2.3 The building plans, including the softcopy of drawings and cover letter detailing the information required under paragraphs 3.2.1 and 3.2.2, shall be submitted electronically to the TFCC via the Building Construction Authority's CORENET e-Submission system.

CHAPTER 4. DEVELOPMENT CONSISTING OF 1 OR MORE LANDED DWELLING-HOUSES ABUTTING AN EXISTING ROAD

4.1 Application of this chapter

4.1.1 This chapter specifies the space and facilities to be provided for a development consisting of 1 or more landed dwelling-houses abutting an existing road.

4.2 Provision of lead-in pipes and underground pipes

4.2.1 Every landed dwelling-house shall be provided, at the minimum, with –

- (a) 1 lead-in pipe for a telecommunication (non-broadband coaxial cable) system which shall extend from the gate pillar of the house to the abutting road, to a point 1 m beyond the roadside drain located immediately outside the house;
- (b) 1 lead-in pipe for a broadband coaxial cable system which shall extend from the gate pillar of the house to the abutting road, to a point 1 m beyond the roadside drain located immediately outside the house;
- (c) 1 underground pipe for a telecommunication (non-broadband coaxial cable) system which shall run from the gate pillar of the house into the house, and terminating at the block terminal referred to in paragraph 4.3.1(a);
- (d) 1 underground pipe for a broadband coaxial cable system which shall run from the gate pillar of the house into the house, and terminating at the multi-way splitter or tap referred to in paragraph 4.3.1(b); and
- (e) 1 continuous lead-in pipe and underground pipe for the Next Generation National Broadband Network which shall extend to the abutting road, to a point 1 m beyond the roadside drain located immediately outside the house and run into the house, and terminating at an empty 2-gang box (which shall be provided by the developer or owner) with minimum internal dimensions of 160 mm (length), 80 mm (breadth) and 25 mm (depth) and a blank face plate (which may be located in the utility room or closet).

4.2.2 For the purposes of paragraph 4.2.1, all lead-in pipes and underground pipes shall be made of unplasticised polyvinyl chloride (uPVC) material with a nominal diameter of 50 mm and which are compliant with the Singapore Standard SS:141 Class C.

4.2.3 In addition to the requirements set out in paragraphs 4.2.1 to 4.2.2, all lead-in pipes and underground pipes shall be provided in accordance with the requirements set out in chapter 10.

4.3 Provision of cables in underground pipes

4.3.1 With regard to the pipes referred to in paragraph 4.2.1 –

- (a) a minimum of 2 twisted copper 4-pair cables (Category 3 or better) shall be provided in the underground pipe designated for a telecommunication (non-broadband coaxial cable) system, which shall terminate into a block terminal (which may be located in the utility room or closet) in each house;
- (b) a minimum of 1 underground coaxial cable shall be provided in the underground pipe designated for a broadband coaxial cable system, which shall terminate into a multi-way splitter or tap at one end (which may be located in the utility room or closet) and into a gate pillar at the other end. The underground coaxial cable shall be provided in accordance with the requirements set out in chapter 13; and
- (c) 1 draw rope shall be provided in the continuous lead-in pipe and underground pipe designated for the Next Generation National Broadband Network.

4.4 Provision of internal telecommunication wiring and broadband coaxial cable

4.4.1 Every landed dwelling-house shall be provided with internal telecommunication wiring and a broadband coaxial cable from the gate pillar of the house to all telephone and television outlets in the house.

4.4.2 In relation to the internal telecommunication wiring and broadband coaxial cable, every landed dwelling-house shall be provided, at the minimum, with –

- (a) 1 twisted copper 4-pair cable (Category 3 or better) from the living room and each bedroom of the house, which shall terminate into a block terminal (which may be located in the utility room or closet) at one end and into RJ11 outlets in the living room and bedrooms at the other end;
- (b) 1 RG6 coaxial cable from the living room and each bedroom of the house, which shall terminate into a multi-way splitter (which may be located in the utility room or closet) at one end and into F-type TV outlets in the living room and bedrooms at the other end. The RG6 coaxial cable shall be provided in accordance with the requirements set out in chapter 13; and
- (c) 1 unshielded twisted pair cable (Category 6 or better) complying with TIA/EIA 568-B specifications from the living room or any bedroom of the house, which shall terminate into an RJ45 outlet (which may be located in the utility room or closet) at one end and into an RJ45 outlet in the living room or bedroom at the other end. The length of the unshielded twisted pair cable shall not exceed 90 m.

4.5 Provision of electrical switch socket outlet

4.5.1 Every landed dwelling-house shall be provided with a minimum of one 13 A electrical switch socket outlet which shall be placed adjacent to the empty 2-gang box referred to in paragraph 4.2.1(e).

CHAPTER 5. DEVELOPMENT CONSISTING OF 2 OR MORE LANDED DWELLING-HOUSES ABUTTING A NEW ROAD TO BE CONSTRUCTED BY THE DEVELOPER OR OWNER

5.1 Application of this chapter

- 5.1.1 This chapter specifies the space and facilities to be provided for a development consisting of 2 or more landed dwelling-houses abutting a new road to be constructed by the developer or owner. All references to landed dwelling-houses in this chapter shall refer only to such type of houses.
- 5.1.2 If the relevant development consists of more than 1500 landed dwelling-houses, the developer or owner shall consult IDA on the additional space and facilities to be provided and comply with such requirements as may be imposed by IDA.

5.2 Provision of main distribution frame room

- 5.2.1 A minimum of 1 main distribution frame room shall be provided in every relevant development, which shall be constructed at such location within the relevant development as the developer or owner considers appropriate.
- 5.2.2 The size of the main distribution frame room to be provided under paragraph 5.2.1 shall be based on the total number of landed dwelling-houses in the relevant development as specified in Table 5.2.2.

Table 5.2.2 Size of main distribution frame room to be provided in each relevant development

Total number of landed dwelling-houses in the development	Minimum floor area of main distribution frame room (m²)	Minimum height of main distribution frame room (m)
2 – 10	4	3.5
11 – 20	5	
21 – 30	6	
31 – 60	8	
61 – 120	12	
121 – 200	16	
201 – 400	20	
401 – 600	30	
601 – 800	42	
801 – 1000	49	
1001 – 1500	56	

- 5.2.3 Where the floor area to be provided for the main distribution frame room is less than 6 m², the minimum width of the room shall be 2 m. The ratio of the length and width to be provided for a main distribution frame room with a floor area of 8 m² or greater shall be between 1:1 and 2:1.
- 5.2.4 Louvres or exhaust fans (or both) shall be provided in the main distribution frame room for ventilation.

- 5.2.5 Where a relevant development consists of a total of up to 30 landed dwelling-houses, 3 sets of electrical distribution panels operating on 230 V, single phase, 50 Hz power supply connecting to the switch socket outlets shall be provided in every main distribution frame room in accordance with paragraphs 5.2.7 and 5.2.8.
- 5.2.6 Where a relevant development consists of a total of more than 30 but up to 1500 landed dwelling-houses –
- (a) 3 sets of electrical distribution panels operating on 230V, single phase, 50 Hz power supply connecting to the switch socket outlets; and
 - (b) 30 A isolators
- shall be provided in every main distribution frame room in accordance with paragraphs 5.2.7 and 5.2.8.
- 5.2.7 Every electrical distribution panel shall contain –
- (a) a 30 mA earth leakage circuit breaker of appropriate electrical current rating and miniature circuit breakers for final circuit connections and to facilitate the installation of electrical meters;
 - (b) 2 spare 20 A miniature circuit breakers; and
 - (c) a single-line diagram in each panel.
- 5.2.8 Switch socket outlets and isolators shall be provided in the main distribution frame room in accordance with the quantities specified in Table 5.2.8 which are to be distributed evenly between the 3 sets of electrical distribution panels.

Table 5.2.8 Requirements of switch socket outlets and isolators to be provided in the main distribution frame room of each relevant development

Total number of landed dwelling-houses in development	Minimum number of switch socket outlets to be provided in main distribution frame room	Minimum number of isolators to be provided in main distribution frame room
30 or below	3 x single-15 A 3 x twin-13 A	Not applicable
31 – 200	3 x twin-13 A	3 x 30 A
201 – 1500	3 x twin-13 A	6 x 30 A

- 5.2.9 Natural or electrical lighting (or both) shall be provided in the main distribution frame room.
- 5.2.10 A clean earth of 1 Ω or less (without the use of salt) shall be provided for the exclusive use of licensee's installation or plant in the main distribution frame room. The clean earth shall be connected directly to an independent earth electrode system.

- 5.2.11 Where a relevant development consists of a total of up to 120 landed dwelling-houses, the clean earth that is provided pursuant to paragraph 5.2.10 shall be in the form of a copper earth bar of at least 300 mm in length with screw holes that are 6 mm in diameter.
- 5.2.12 Where a relevant development consists of a total of more than 120 but up to 1500 landed dwelling-houses, the clean earth that is provided pursuant to paragraph 5.2.10 shall be in the form of a copper earth bar of at least 600 mm in length with screw holes that are 6 mm in diameter.
- 5.2.13 In addition to the requirements set out in paragraphs 5.2.1 to 5.2.12, the main distribution frame room(s) shall be provided in accordance with the requirements set out in chapter 11.

5.3 Provision of underground pipes and manholes to serve the development

- 5.3.1 The developer or owner shall provide underground pipes within the development to –
- (a) enable licensees to link their cables from outside the development to the main distribution frame room; and
 - (b) enable the landed dwelling-houses within the development to be served by the main distribution frame.
- 5.3.2 The underground pipes shall extend from the main distribution frame room to the nearest new road to be constructed by the developer or owner and shall run along the new road(s) to the boundary of the development and to all houses that are to be served by the main distribution frame room.
- 5.3.3 The number of underground pipes to be provided shall be in accordance with the quantities specified in Table 5.3.3. With the exception of the underground pipes terminating at the boundary of the development, the number of underground pipes provided to other areas within the development may be gradually reduced based on the houses served subject to consultation with IDA.

Table 5.3.3 Number of underground pipes to be provided from the main distribution frame room to serve the development

Total number of landed dwelling-houses in the development	Total number of underground pipes to be provided
< 200	8
201 – 400	10
401 – 600	12
601 – 800	14
801 – 1000	16
1001 – 1500	18

- 5.3.4 When entering the main distribution frame room, the underground pipes shall be configured in accordance with the formation specified in Table 5.3.4.

Table 5.3.4 Underground pipe formation in main distribution frame room

Total number of landed dwelling-houses in the development	Pipe formation in the main distribution frame room
< 200	2 x 4
201 – 400	2 x 5
401 – 600	2 x 6
601 – 800	2 x 7
801 – 1000	2 x 8
1001 – 1500	2 x 9

- 5.3.5 All underground pipes shall be made of unplasticised polyvinyl chloride (uPVC) material with a nominal diameter of 110 mm and which are compliant with the Singapore Standard SS:272.
- 5.3.6 In addition to the requirements set out in paragraphs 5.3.1 to 5.3.5, all underground pipes shall be provided in accordance with the requirements set out in chapter 10.
- 5.3.7 Manholes shall be provided for the undergrounds pipes within each relevant development as follows –
- (a) a manhole shall be constructed at every location where there is effectively a 90° bend in the direction of the underground pipes; and
 - (b) a minimum of 1 manhole must be provided for every 150 m segment of underground pipes laid.
- 5.3.8 The type of manholes to be provided under paragraph 5.3.7 shall be in accordance with Table 5.3.8 based on the highest number of underground pipes entering any one side of the manhole.

Table 5.3.8 Type of manholes to be provided

Highest number of underground pipes entering any one side of the manhole	Type of manhole to be provided
≤ 2	JX2
3 to 6	MX1
7 to 9	MX2
10 to 12	MX3
13 to 16	MX4
17 to 24	MX5

- 5.3.9 Where a manhole is constructed under carriageways or vehicle access areas, a heavy duty manhole cover which complies with Singapore Standard SS:30 Grade A1 shall be used for such manhole.
- 5.3.10 A minimum space of –
- (a) 1500 mm x 650 mm in dimension; or

- (b) 500 mm x 500 mm in dimension

shall be set aside in close proximity to every manhole to facilitate the construction of a pedestal used for the deployment of broadband coaxial cable systems. The developer or owner shall consult the relevant licensee on the appropriate minimum space to be set aside. 2 additional underground pipes of 110 mm nominal diameter shall be provided from the manhole to the allocated space, which shall protrude at least 300 mm above the ground level at the allocated space.

- 5.3.11 In addition to the requirements set out in paragraphs 5.3.7 to 5.3.10, all manholes shall be provided in accordance with the requirements set out in chapter 10.

5.4 Provision of lead-in pipes and underground pipes for individual landed dwelling-houses

- 5.4.1 Every landed dwelling-house shall be provided, at the minimum, with –

- (a) 1 lead-in pipe for a telecommunication (non-broadband coaxial cable) system which shall extend from the gate pillar of the house to the new abutting road to be constructed by the developer, and connect from there to the nearest manhole provided in accordance with paragraph 5.3;
- (b) 1 lead-in pipe for a broadband coaxial cable system which shall extend from the gate pillar of the house to the new abutting road to be constructed by the developer, and connect from there to the nearest manhole provided in accordance with paragraph 5.3;
- (c) 1 underground pipe for a telecommunication (non-broadband coaxial cable) system which shall run from the gate pillar of the house into the house, and terminating at the block terminal referred to in paragraph 5.5.1(a);
- (d) 1 underground pipe for a broadband coaxial cable system which shall run from the gate pillar of the house into the house, and terminating at the multi-way splitter or tap referred to in paragraph 5.5.1(b); and
- (e) 1 continuous lead-in pipe and underground pipe for the Next Generation National Broadband Network. The lead-in pipe shall extend to the new abutting road to be constructed by the developer, and connect from there to the nearest manhole provided in accordance with paragraph 5.3. The underground pipe shall run into the house, terminating at an empty 2-gang box (which shall be provided by the developer or owner) with minimum internal dimensions of 160 mm (length), 80 mm (breadth) and 25 mm (depth) and a blank face plate (which may be located in the utility room or closet).

- 5.4.2 For the purposes of paragraph 5.4.1, all lead-in pipes and underground pipes shall be made of unplasticised polyvinyl chloride (uPVC) material with a

nominal diameter of 50mm and which are compliant with the Singapore Standard SS:141 Class C.

- 5.4.3 In addition to the requirements set out in paragraphs 5.4.1 and 5.4.2, all lead-in pipes and underground pipes shall be provided in accordance with the requirements set out in chapter 10.

5.5 Provision of cables in the underground pipes

- 5.5.1 With regard to the pipes referred to in paragraph 5.4.1 –
- (a) a minimum of 2 twisted copper 4-pair cables (Category 3 or better) shall be provided in the underground pipe designated for a telecommunication (non-broadband coaxial cable) system, which shall terminate into a block terminal (which may be located in the utility room or closet) in each house;
 - (b) a minimum of 1 underground coaxial cable shall be provided in the underground pipe designated for a broadband coaxial cable system, which shall terminate into a multi-way splitter at one end (which may be located in the utility room or closet) and into a gate pillar at the other end. The underground coaxial cable shall be provided in accordance with the requirements set out in chapter 13; and
 - (c) 1 draw rope shall be provided in the continuous lead-in pipe and underground pipe designated for the Next Generation National Broadband Network.

5.6 Provision of internal telecommunication wiring and broadband coaxial cable

- 5.6.1 Every landed dwelling-house shall be provided with internal telecommunication wiring and a broadband coaxial cable from the gate pillar of the house, to all telephone and television outlets in the house.
- 5.6.2 In relation to the internal telecommunication wiring and broadband coaxial cable, every landed dwelling-house shall be provided, at the minimum, with –
- (a) 1 twisted copper 4-pair cable (Category 3 or better) from the living room and each bedroom of the house, which shall terminate into a block terminal (which may be located in the utility room or closet) at one end and into RJ11 outlets in the living room and bedrooms at the other end;
 - (b) 1 RG6 coaxial cable from the living room and each bedroom of the house, which shall terminate into a multi-way splitter (which may be located in the utility room or closet) at one end and into F-type TV outlets in the living room and bedrooms at the other end. The RG6 coaxial cable shall be provided in accordance with the requirements set out in chapter 13; and
 - (c) 1 unshielded twisted pair cable (Category 6 or better) complying with TIA/EIA 568-B specifications from the living room or any bedroom of the house, which shall terminate into an RJ45 outlet (which may be located in the utility room or closet) at one end and into an RJ45 outlet in the

living room or bedroom at the other end. The length of the unshielded twisted pair cable shall not exceed 90 m.

5.7 Provision of electrical switch socket outlet

- 5.7.1 Every landed dwelling-house shall be provided with a minimum of one 13 A electrical switch socket outlet which shall be placed adjacent to the empty 2-gang box referred to in paragraph 5.4.1(e).

CHAPTER 6. DEVELOPMENT CONSISTING OF 2 OR MORE STRATA LANDED DWELLING-HOUSES

6.1 Application of this chapter

- 6.1.1 This chapter specifies the space and facilities to be provided for a development consisting of 2 or more strata landed dwelling-houses.
- 6.1.2 If the relevant development consists of more than 200 strata landed dwelling-houses, the developer or owner shall consult IDA on the additional space and facilities to be provided and comply with such requirements as may be imposed by IDA.

6.2 Provision of main distribution frame room

- 6.2.1 A main distribution frame room shall be provided in every relevant development. The main distribution frame room shall be located on the first storey of the relevant development or if in the basement, on the uppermost floor of the basement.
- 6.2.2 The size of the main distribution frame room to be provided shall be based on the total number of strata landed dwelling-houses in the relevant development as specified in Table 6.2.2.

Table 6.2.2 Size of main distribution frame room to be provided in each relevant development

Total number of strata landed dwelling-houses in the development	Minimum floor area of main distribution frame room (m ²)	Minimum height of main distribution frame room (m)
2 – 10	4	3.5
11 – 20	5	
21 – 30	6	
31 – 60	8	
61 – 120	12	
121 – 200	16	

- 6.2.3 Where the floor area to be provided for the main distribution frame room is less than 6 m², the minimum width of the main distribution frame room shall be 2 m. The ratio of the length and width to be provided for a main distribution frame room with a floor area of 8 m² or greater shall be between 1:1 and 2:1.
- 6.2.4 Louvres or exhaust fans (or both) shall be provided in the main distribution frame room for ventilation.
- 6.2.5 Where a relevant development consists of a total of up to 30 strata landed dwelling-houses, 3 sets of electrical distribution panels operating on 230 V, single phase, 50 Hz power supply connecting to the switch socket outlets shall be provided in the main distribution frame room in accordance with paragraphs 6.2.7 and 6.2.8.

- 6.2.6 Where a relevant development consists of a total of more than 30 but up to 200 strata landed dwelling-houses:-
- (a) 3 sets of electrical distribution panels operating on 230 V, single phase, 50 Hz power supply connecting to the switch socket outlets; and
 - (b) 30 A isolators
- shall be provided in the main distribution frame room in accordance with paragraphs 6.2.7 and 6.2.8.
- 6.2.7 Every electrical distribution panel shall contain –
- (a) a 30 mA earth leakage circuit breaker of appropriate electrical current rating and miniature circuit breakers for final circuit connections and to facilitate the installation of electrical meters;
 - (b) 2 spare 20 A miniature circuit breakers; and
 - (c) a single-line diagram in each panel.
- 6.2.8 Switch socket outlets and isolators shall be provided in the main distribution frame room in accordance with the quantities specified in Table 6.2.8 which are to be distributed evenly between the 3 sets of electrical distribution panels.

Table 6.2.8 Requirements of switch socket outlets and isolators to be provided in the main distribution frame room of each relevant development

Total number of strata landed dwelling-houses in the development	Minimum number of switch socket outlets to be provided in main distribution frame room	Minimum number of isolators to be provided in the main distribution frame room
30 or below	3 x single-15A 3 x twin-13A	Not applicable
31 – 200	3 x twin-13A	3 x 30A

- 6.2.9 Where a standby power generator is provided in the relevant development, the power supply to the main distribution frame room shall be connected to such standby power generator.
- 6.2.10 Where a standby power generator is not provided in the relevant development, the 30 A isolators in the main distribution frame room shall be connected to power sockets for connection to portable power generators and equipped with a manually activated switch to effect the changeover.
- 6.2.11 Natural or electrical lighting (or both) shall be provided in the main distribution frame room.
- 6.2.12 A clean earth of 1 Ω or less (without the use of salt) shall be provided for the exclusive use of licensees' installation or plant in the main distribution frame

room. The clean earth shall be connected directly to an independent earth electrode system.

- 6.2.13 Where a relevant development consists of a total of up to 120 strata landed dwelling-houses, the clean earth that is provided pursuant to paragraph 6.2.12 shall be in the form of a copper earth bar of at least 300 mm in length with screw holes that are 6mm in diameter.
- 6.2.14 Where a relevant development consists of a total of more than 120 but up to 200 strata landed dwelling-houses, the clean earth that is provided pursuant to paragraph 6.2.12 shall be in the form of a copper earth bar of at least 600 mm in length with screw holes that are 6 mm in diameter.
- 6.2.15 In addition to the requirements set out in paragraphs 6.2.1 to 6.2.14, the main distribution frame room(s) shall be provided in accordance with the requirements set out in chapter 11.

6.3 Provision of lead-in pipes, underground pipes and manholes

- 6.3.1 8 continuous lead-in pipes and underground pipes shall be provided for the relevant development as follows –
- (a) the lead-in pipes shall extend from the boundary of the development to the abutting road, to a point 1 m beyond the roadside drain located immediately outside the development; and
 - (b) the underground pipes shall connect from the lead-in pipes at the boundary of the development and run to the retaining wall of the development, or to the main distribution frame room if there is no basement level in the development.
- 6.3.2 Where underground pipes are provided to the main distribution frame room, such pipes shall enter the room in a formation of 2 rows x 4 pipes.
- 6.3.3 For the purposes of paragraph 6.3.1, all lead-in pipes and underground pipes shall be made of unplasticised polyvinyl chloride (uPVC) material with a nominal diameter of 110 mm and which are compliant with the Singapore Standard SS:272.
- 6.3.4 A cable duct sealing module system shall be installed at the retaining wall of the relevant development to prevent any ingress of water flowing from the underground pipes into the basement.
- 6.3.5 In addition to the requirements set out in paragraphs 6.3.1 to 6.3.4, all lead-in pipes and underground pipes shall be provided in accordance with the requirements set out in chapter 10.
- 6.3.6 Manholes shall be provided in each relevant development as follows –
- (a) a manhole shall be constructed at every location where there is effectively a 90° bend in the direction of the underground pipes; and
 - (b) a minimum of 1 manhole must be provided for every 150 m segment of underground pipes laid.

6.3.7 The type of manholes to be provided under paragraph 6.3.6 shall be type MX2.

6.3.8 Where a manhole is constructed under carriageways or vehicle access areas, a heavy duty manhole cover which complies with Singapore Standard SS:30 Grade A1 shall be used for such manhole.

6.3.9 In addition to the requirements set out in paragraphs 6.3.6 to 6.3.8, all manholes shall be provided in accordance with the requirements set out in chapter 10.

6.4 Provision of cable trays from the retaining wall to the main distribution frame room where there is basement level in the relevant development

6.4.1 Cable trays for a telecommunication (non-broadband coaxial cable) system and a broadband coaxial cable system shall be provided from the retaining wall of the relevant development to the main distribution frame room, of which

(a) 1 cable tray shall be used for a telecommunication (non-broadband coaxial cable) system; and

(b) 1 cable tray shall be used for a broadband coaxial cable system.

6.4.2 The size of these cable trays shall cover the total cross-sectional width of the underground pipes terminating at the retaining wall.

6.4.3 Where cable trays are provided in accordance with paragraph 6.4.1 in relation to a building in which both a master antenna television system (MATV) and a broadband coaxial cable system are installed, the width of the cable tray to be used for a broadband coaxial cable system shall be increased by an additional 50 mm.

6.4.4 As an alternative to providing the cable trays specified in paragraph 6.4.1, 2 metal trunkings of equivalent size may be provided, of which –

(a) 1 metal trunking shall be used for a telecommunication (non-broadband coaxial cable) system; and

(b) 1 metal trunking shall be used for a broadband coaxial cable system.

6.5 Provision of cable trays from the main distribution frame room to each house

6.5.1 A cable tray with a minimum width of 200 mm shall be provided from the main distribution frame room to each strata landed dwelling-house for a telecommunication (non-broadband coaxial cable) system.

6.5.2 A cable tray with a minimum width of 100 mm shall be provided from the main distribution frame room to each strata landed dwelling-house for a broadband coaxial cable system.

6.6 Provision of broadband coaxial cable system

- 6.6.1 A broadband coaxial cable system shall be provided from the main distribution room to each strata landed dwelling-house. The broadband coaxial cable system shall be provided in accordance with chapter 13.

6.7 Provision of conduits to each house

- 6.7.1 Every strata landed dwelling-house in the relevant development shall be provided, at the minimum, with –
- (a) 1 conduit of a minimum size of 20 mm in diameter for a telecommunication (non-broadband coaxial cable) system which shall run from the location where the cable trays referred to in paragraph 6.5 terminate, into each house, and terminating at the block terminal referred to in paragraph 6.8.2(a);
 - (b) 1 conduit of a minimum size of 20 mm in diameter for a broadband coaxial cable system which shall run from the location where the cable trays referred to in paragraph 6.5 terminate, into each house, and terminating at the multi-way splitter referred to in paragraph 6.8.2(b); and
 - (c) 1 empty conduit of a minimum size of 20 mm in diameter which shall run from the location where the cable trays referred to in paragraph 6.5 terminate, into each house, and terminating at an empty 2-gang box (which shall be provided by the developer or owner) with minimum internal dimensions of 160 mm (length), 80 mm (breadth) and 25 mm (depth) and a blank face plate (which may be located in the utility room or closet). The bending radius of the central line of the conduit shall not be less than 100 mm. The empty conduit shall be designated for the Next Generation National Broadband Network.

6.8 Provision of internal telecommunication wiring and broadband coaxial cable

- 6.8.1 Every strata landed dwelling-house shall be provided with internal telecommunication wiring and a broadband coaxial cable from the telephone distribution point and splitter box located outside the house to all telephone and television outlets in each house.
- 6.8.2 With regard to the conduits referred to in paragraph 6.7.1 –
- (a) a minimum of 2 twisted copper 4-pair cables (Category 3 or better) shall be provided in the conduit designated for a telecommunication (non-broadband coaxial cable) system, which shall terminate into a block terminal (which may be located in the utility room or closet) in each house; and
 - (b) a minimum of 1 coaxial cable shall be provided in the conduit designated for a broadband coaxial cable system, which shall terminate into a multi-way splitter at one end (which may be located in the utility room or closet) and into a splitter box located outside the house at the

other end. The coaxial cable shall be provided in accordance with the requirements set out in chapter 13.

6.8.3 In relation to the internal telecommunication wiring and broadband coaxial cable, every strata landed dwelling-house shall be provided, at the minimum, with –

- (a) 1 twisted copper 4-pair cable (Category 3 or better) from the living room and each bedroom of the house, which shall terminate into a block terminal (which may be located in the utility room or closet) at one end and into RJ11 outlets in the living room and bedrooms at the other end;
- (b) 1 RG6 coaxial cable from the living room and each bedroom of the house, which shall terminate into a multi-way splitter (which may be located in the utility room or closet) at one end and into F-type TV outlets in the living room and bedrooms at the other end. The RG6 coaxial cable shall be provided in accordance with the requirements set out in chapter 13; and
- (c) 1 unshielded twisted pair cable (Category 6 or better) complying with TIA/EIA 568-B specifications from the living room or any bedroom of the house, which shall terminate into an RJ45 outlet (which may be located in the utility room or closet) at one end and into an RJ45 outlet in the living room or bedroom at the other end. The length of the unshielded twisted pair cable shall not exceed 90 m.

6.9 Provision of electrical switch socket outlet

6.9.1 Every strata landed dwelling-house shall be provided with a minimum of one 13 A electrical switch socket outlet which shall be placed adjacent to the empty 2-gang box referred to in paragraph 6.7.1 (c).

CHAPTER 7. DEVELOPMENT CONSISTING OF 1 OR MORE MULTI-STOREY RESIDENTIAL BUILDINGS

7.1 Application of this chapter

- 7.1.1 This chapter specifies the space and facilities to be provided for a development consisting of 1 or more multi-storey residential buildings.
- 7.1.2 If the relevant development consists of more than 1500 residential units, the developer or owner shall consult IDA on the additional space and facilities to be provided and comply with such requirements as may be imposed by IDA.

7.2 Provision of main distribution frame room

- 7.2.1 A minimum of 1 main distribution frame room shall be provided in every relevant development. The main distribution frame room shall be located on the first storey of the relevant development or, if in the basement, on the uppermost floor of the basement.
- 7.2.2 The size of the main distribution frame room to be provided under paragraph 7.2.1 shall be based on the total number of residential units in the relevant development, as specified in Table 7.2.2.

Table 7.2.2 Size of main distribution frame room to be provided in each relevant development

Total number of residential units in the development	Minimum floor area of main distribution frame room (m ²)	Minimum height of main distribution frame room (m)
2 – 10	4	3.5
11 – 20	5	
21 – 30	6	
31 – 60	8	
61 – 120	12	
121 – 200	16	
201 – 400	20	
401 – 600	30	
601 – 800	42	
801 – 1000	49	
1001 – 1500	56	

- 7.2.3 Where the floor area to be provided for the main distribution frame room is less than 6 m², the minimum width of the main distribution frame room shall be 2 m. The ratio of the length and width to be provided for a main distribution frame room with a floor area of 8 m² or greater shall be between 1:1 and 2:1.
- 7.2.4 Louvres or exhaust fans (or both) shall be provided in the main distribution frame room for ventilation.
- 7.2.5 Where a relevant development consists of a total of up to 30 residential units, 3 sets of electrical distribution panels operating on 230 V, single phase, 50 Hz power supply connecting to the switch socket outlets shall be provided in

every main distribution frame room in accordance with paragraphs 7.2.7 and 7.2.8.

7.2.6 Where a relevant development consists of a total of more than 30 but up to 1500 residential units –

- (a) 3 sets of electrical distribution panels operating on 230 V, single phase, 50 Hz power supply connecting to switch socket outlets; and
- (b) 30 A isolators

shall be provided in the main distribution frame room in accordance with paragraphs 7.2.7 and 7.2.8.

7.2.7 Every electrical distribution panel shall contain –

- (a) a 30 mA earth leakage circuit breaker of appropriate electrical current rating and miniature circuit breakers for final circuit connections and to facilitate the installation of electrical meters;
- (b) 2 spare 20 A miniature circuit breakers; and
- (c) a single-line diagram in each panel.

7.2.8 Switch socket outlets and isolators shall be provided in every main distribution frame room in accordance with the quantities specified in Table 7.2.8 which are to be distributed evenly between the 3 sets of electrical distribution panels.

Table 7.2.8 Requirements of switch socket outlets and isolators to be provided in the main distribution frame room of each relevant development

Total number of residential units in the development	Minimum number of switch socket outlets to be provided in the main distribution frame room	Minimum number of isolators to be provided in the main distribution frame room
30 or below	3 x single-15A 3 x twin-13A	Not applicable
31 – 200	3 x twin-13A	3 x 30A
201 – 1500	3 x twin-13A	6 x 30A

7.2.9 Where a standby power generator is provided in the relevant development, the power supply to the main distribution frame room shall be connected to such standby power generator.

7.2.10 Where a standby power generator is not provided in the relevant development, the 30 A isolators in the main distribution frame room shall be connected to power sockets for connection to portable power generators and equipped with a manually activated switch to effect the changeover.

7.2.11 Natural or electrical lighting (or both) shall be provided in the main distribution frame room.

- 7.2.12 A clean earth of 1 Ω or less (without the use of salt) shall be provided for the exclusive use of licensees' installation or plant in the main distribution frame room. The clean earth shall be connected directly to an independent earth electrode system.
- 7.2.13 Where a relevant development consists a total of up to 120 residential units, the clean earth that is provided pursuant to paragraph 7.2.12 shall be in the form of a copper earth bar of at least 300 mm in length with screw holes that are 6 mm in diameter.
- 7.2.14 Where a relevant development consists a total of more than 120 but up to 1500 residential units, the clean earth that is provided pursuant to paragraph 7.2.12 shall be in the form of a copper earth bar of at least 600 mm in length with screw holes that are 6 mm in diameter.
- 7.2.15 In addition to the requirements set out in paragraphs 7.2.1 to 7.2.14, the main distribution frame room(s) shall be provided in accordance with the requirements set out in chapter 11.

7.3 Provision of lead-in pipes, underground pipes and manholes where there is no basement in the relevant development

- 7.3.1 Continuous lead-in pipes and underground pipes shall be provided for the relevant development as follows –
- (a) the lead-in pipes shall extend from the boundary of the development to the abutting road, to a point 1 m beyond the roadside drain located immediately outside the development; and
 - (b) the underground pipes shall connect from the lead-in pipes at the boundary of the development and run to the main distribution frame room.
- 7.3.2 The number of lead-in pipes and underground pipes to be provided under paragraph 7.3.1 shall be in accordance with the quantities specified in Table 7.3.2.

Table 7.3.2 Number of lead-in pipes and underground pipes to be provided for relevant development with no basement

Total number of residential units in the development	Minimum number of lead-in & underground pipes to be provided
≤ 60	6
61 – 200	8
201 – 400	10
401 – 600	12
601 – 800	14
801 – 1000	16
1001 – 1500	18

- 7.3.3 The underground pipes shall enter the main distribution frame room in accordance with the formation specified in the Table 7.3.3.

Table 7.3.3 Pipe formation in the main distribution frame room

Total number of residential units in the development	Pipe formation in the main distribution frame room
≤ 60	2 x 3
61 – 200	2 x 4
201 – 400	2 x 5
401 – 600	2 x 6
601 – 800	2 x 7
801 – 1000	2 x 8
1001 – 1500	2 x 9

- 7.3.4 For the purposes of paragraph 7.3.1, all lead-in pipes and underground pipes shall be made of unplasticised polyvinyl chloride (uPVC) material with a nominal diameter of 110 mm and which are compliant with the Singapore Standard SS:272.
- 7.3.5 Where a telecommunication equipment room is provided, the developer or owner shall consult IDA on the number of underground pipes to be provided between the main distribution frame room and the telecommunication equipment room, and comply with such requirements as may be imposed by IDA.
- 7.3.6 In addition to the requirements set out in paragraphs 7.3.1 to 7.3.5, all lead-in pipes and underground pipes shall be provided in accordance with the requirements set out in chapter 10.
- 7.3.7 Manholes shall be provided in each relevant development as follows –
- (a) a manhole shall be constructed at every location where there is effectively a 90° bend in the direction of the underground pipes; and
 - (b) a minimum of 1 manhole must be provided for every 150 m segment of underground pipes laid.
- 7.3.8 The type of manhole to be provided under paragraph 7.3.7 shall be in accordance with Table 7.3.8 below based on the highest number of underground pipes entering any one side of the manhole.

Table 7.3.8 Type of manhole to be provided

Highest number of underground pipes entering any one side of the manhole	Type of manhole to be provided
≤ 2	JX2
3 to 6	MX1
7 to 9	MX2
10 to 12	MX3

13 to 16	MX4
17 to 24	MX5

7.3.9 In addition to the requirements set out in paragraphs 7.3.7 to 7.3.8, all manholes shall be provided in accordance with the requirements set out in chapter 10.

7.4 Provision of lead-in pipes, underground pipes, manholes and cable trays where there is a basement in the development

7.4.1 Continuous lead-in pipes and underground pipes shall be provided for the relevant development as follows –

- (a) the lead-in pipes shall extend from the boundary of the development to the abutting road, to a point 1 m beyond the roadside drain located immediately outside the development; and
- (b) the underground pipe shall connect from the lead-in pipes at the boundary of the development and run to the retaining wall of the development.

7.4.2 The number of lead-in pipes and underground pipes to be provided under paragraph 7.4.2 shall be in accordance with the quantities specified in Table 7.4.2 below.

Table 7.4.2 Number of lead-in pipes and underground pipes to be provided for relevant development with basement

Total number of residential units in the development	Minimum number of lead-in & underground pipes to be provided
≤ 60	6
61 – 200	8
201 – 400	10
401 – 600	12
601 – 800	14
801 – 1000	16
1001 – 1500	18

7.4.3 For the purposes of paragraph 7.4.1, all lead-in pipes and underground pipes shall be made of unplasticised polyvinyl chloride (uPVC) material with a nominal diameter of 110 mm and which are compliant with the Singapore Standard SS:272.

7.4.4 A cable duct sealing module system shall be installed at the retaining wall of the relevant development to prevent any ingress of water flowing from the underground pipes into the basement

7.4.5 In addition to the requirements set out in paragraphs 7.4.1 to 7.4.4, all lead-in pipes and underground pipes shall be provided in accordance with the requirements set out in chapter 10.

7.4.6 Manholes shall be provided in each relevant development as follows –

- (a) a manhole shall be constructed at every location where there is effectively a 90° bend in the direction of the underground pipes regardless of whether such bend is constructed at a right angle or in a gradual curve; and
- (b) at the minimum, 1 manhole must be provided for every 150 m segment of underground pipes laid.

7.4.7 The type of manhole to be provided under paragraph 7.4.6 shall be in accordance with Table 7.4.7 below based on the highest number of underground pipes entering any one side of the manhole.

Table 7.4.7 Type of manhole to be provided

Highest number of underground pipes entering any one side of the manhole	Type of manhole to be provided
≤ 2	JX2
3 to 6	MX1
7 to 9	MX2
10 to 12	MX3
13 to 16	MX4
17 to 24	MX5

7.4.8 In addition to the requirements set out in paragraphs 7.4.6 to 7.4.7, all manholes shall be provided in accordance with the requirements set out in chapter 10.

7.4.9 Cable trays for a telecommunication (non-broadband coaxial cable) system and a broadband coaxial cable system shall be provided from the retaining wall of the relevant development to the main distribution frame room, of which

- (a) 1 cable tray shall be used for a telecommunication (non-broadband coaxial cable) system; and
- (b) 1 cable tray of shall be used for a broadband coaxial cable system.

7.4.10 The size of these cable trays shall cover the total cross-sectional width of the underground pipes terminating at the retaining wall.

7.4.11 Where cable trays are provided in accordance with paragraph 7.4.9 in relation to a building in which both a master antenna television system (MATV) and a broadband coaxial cable system are installed, the width of the cable tray to be used for a broadband coaxial cable system shall be increased by an additional 50 mm.

7.4.12 As an alternative to providing the cable trays specified in paragraph 7.4.9, 2 metal trunkings of equivalent size may be provided, of which –

- (a) 1 metal trunking shall be used for a telecommunication (non-broadband coaxial cable) system; and
- (b) 1 metal trunking shall be used for a broadband coaxial cable system.

7.4.13 Where a telecommunication equipment room is provided, the developer or owner shall consult IDA on the quantity and size of cable trays to be provided between the main distribution frame room and the telecommunication equipment room, and comply with such requirements as may be imposed by IDA.

7.5 Provision of telecommunication equipment rooms

7.5.1 In addition to the main distribution frame room specified in paragraph 7.2, a telecommunication equipment room shall be provided in every multi-storey residential building within a relevant development that has a total of more than 10 residential units, except where such building already houses a main distribution frame room. The telecommunication equipment room shall be located on the first storey of the relevant multi-storey residential building or, if in the basement, on the uppermost floor of the basement.

7.5.2 The size of the telecommunication equipment room to be provided under paragraph 7.5.1 shall be based on the total number of residential units in the multi-storey residential building, as specified in Table 7.5.2.

Table 7.5.2 Size of telecommunication equipment room to be provided in each multi-storey residential building

Total number of residential units in the multi-storey residential building	Minimum floor area of telecommunication equipment room (m ²)	Minimum height of main distribution frame room (m)
11 – 30	4	3.5
31 – 60	5	
61 – 120	6	
121 – 300	8	
301 – 600	10	

7.5.3 Where the floor area to be provided for the telecommunication equipment room is less than 6 m², the minimum width of the telecommunication equipment room shall be 2 m. The ratio of the length and width to be provided for a telecommunication equipment room with a floor area of 8 m² or greater shall be between 1:1 and 2:1.

7.5.4 The underground pipes to be provided for each telecommunication equipment room shall be in accordance with the quantities specified in Table 7.5.4 below.

Table 7.5.4 Number of underground pipes to be provided for the telecommunication equipment room

Total number of residential units in the multi-storey	Minimum number of underground pipes to be provided

building	
≤ 60	6
61 – 200	8
201 – 400	10

- 7.5.5 When entering the telecommunication equipment room, the underground pipes shall be configured in accordance with the formation specified in Table 7.5.5.

Table 7.5.5 Pipe formation in the telecommunication equipment room

Total number of residential units in the in the multi-storey residential building	Pipe formation in the telecommunication equipment room
≤ 30	2 x 3
31 – 300	2 x 4
301 – 600	2 x 5

- 7.5.6 Louvres or exhaust fans (or both) shall be provided in the telecommunication equipment rooms for ventilation.
- 7.5.7 3 sets of electrical distribution panels operating on 230 V, single phase, 50 Hz power supply connecting to the switch socket outlets shall be provided in the telecommunication equipment room in accordance with paragraphs 7.4.8 and 7.4.9.
- 7.5.8 Every electrical distribution panel shall contain –
- a 30 mA earth leakage circuit breaker of appropriate electrical current rating and miniature circuit breakers for final circuit connections and to facilitate the installation of electrical meters;
 - 2 spare 20 A miniature circuit breakers; and
 - a single-line diagram in each panel.
- 7.5.9 3 single-15 A and 3-twin 13 A switch socket outlets shall be provided in the each telecommunication equipment room which are to be distributed evenly between the 3 sets of electrical distribution panels.
- 7.5.10 Where a standby power generator is provided in the relevant development, the power supply to the telecommunication equipment room shall be connected to such standby power generator.
- 7.5.11 Where a standby power generator is not provided in the relevant development, the 30 A isolators in the main distribution frame room shall be connected to power sockets for connection to portable power generators and equipped with a manually activated switch to effect the changeover.

- 7.5.12 Natural or electrical lighting (or both) shall be provided in the telecommunication equipment room.
- 7.5.13 A clean earth of 1 Ω or less (without the use of salt) shall be provided for the exclusive use of licensees' installation or plant in the telecommunication equipment room. The clean earth shall be connected directly to an independent earth electrode system.
- 7.5.14 The clean earth that is provided pursuant to paragraph 7.5.13 shall be in the form of a copper earth bar of at least 300 mm in length with screw holes that are 6 mm in diameter.
- 7.5.15 In addition to the requirements set out in paragraphs 7.5.1 to 7.5.14, the telecommunication equipment room(s) shall be provided in accordance with the requirements set out in chapter 11.

7.6 Provision of telecommunication risers

- 7.6.1 Telecommunication risers shall be provided in every residential multi-storey building in the relevant development.
- 7.6.2 The serving radius of each telecommunication riser shall not exceed 40 m. Each telecommunication riser shall be labelled as "Telecom Riser" and numbered for easy reference and identification.
- 7.6.3 All telecommunication riser shafts must be constructed in a direct vertical line throughout the building.
- 7.6.4 The dimensions of each telecommunication riser to be provided under paragraph 7.6.1 shall be based on the total number of residential units in the multi-storey residential building to be served by the telecommunication riser, as specified in Table 7.6.4.

Table 7.6.4 Dimensions of telecommunication riser

Total number of residential units in the multi-storey residential building served by a telecommunication riser	Minimum dimensions of each telecommunication riser
≤ 30	600 mm (width) x 450 mm (depth)
> 30	800 mm (width) x 600 mm (depth)

- 7.6.5 Every telecommunication riser shall have a door which can be fully opened outwards throughout its entire width for easy access at each floor level. The height of the door shall be at least 2.1 m.
- 7.6.6 All doors of the telecommunication risers shall be locked. However, for those telecommunication risers that are not provided with locks, metal trunkings shall be provided in place of cable trays.
- 7.6.7 At the minimum, either 2 cable trays or 2 metal trunkings shall be installed in each telecommunication riser from the first storey or basement to the topmost level of every multi-storey residential building for a telecommunication (non-broadband coaxial cable) system and a broadband coaxial cable system.

7.6.8 The cable trays for a telecommunication (non-broadband coaxial cable) system and a broadband coaxial cable system shall be installed opposite each other on the side wall of the telecommunication riser.

7.6.9 For the purposes of paragraph 7.6.7, cable trays shall be provided in accordance with the requirements specified in Table 7.6.9.

Table 7.6.9 Width of cable trays in each telecommunication riser

	Minimum width of each cable tray where telecommunication riser has a side wall depth of 450 mm	Minimum width of each cable tray where telecommunication riser has a side wall depth of 600 mm
Cable tray for telecommunication (non-broadband coaxial cable) system (≤ 25 storeys)	200 mm	300 mm
Cable tray for telecommunication (non-broadband coaxial cable) system (between 25 to 50 storeys)	300 mm	400 mm
Cable tray for broadband coaxial cable system (≤ 25 storeys)	100 mm	200 mm
Cable tray for broadband coaxial cable system (between 25 to 50 storeys)	200 mm	300 mm

7.6.10 Where metal trunkings are provided in place of cable trays, such metal trunkings shall be provided in accordance with the requirements specified in Table 7.6.10.

Table 7.6.10 Dimensions of metal trunking in each telecommunication riser

	Minimum dimensions of each cable tray where telecommunication riser has a side wall depth of 450 mm	Minimum dimensions of each cable tray where telecommunication riser has a side wall depth of 600 mm
Metal trunking for a telecommunication (non-broadband coaxial cable) system (≤ 25 storeys)	300 mm x 100 mm	400 mm x 100 mm
Metal trunking for a telecommunication (non-broadband coaxial cable) system (between 25 to 50 storeys)	400 mm x 100 mm	500 mm x 100 mm
Metal trunking for a broadband coaxial cable	200 mm x 50 mm	200 mm x 100 mm

system (≤ 25 storeys)		
Metal trunking for a broadband coaxial cable system (between 25 to 50 storeys)	300 mm x 50 mm	400 mm x 100 mm

7.6.11 The telecommunication riser openings on every storey in each multi-storey residential building shall be sealed in accordance with the Code of Practice for Fire Precautions in Buildings.

7.6.12 All telecommunication (non-broadband coaxial) cables shall terminate in the distribution point boxes located in the telecommunication risers.

7.6.13 All broadband coaxial cables shall terminate in the tap or splitter boxes located in the telecommunication risers.

7.6.14 In addition to the requirements set out in paragraphs 7.6.1 to 7.6.13, all telecommunication risers shall be provided in accordance with the requirements set out in chapter 12.

7.7 Provision of cable trays from the main distribution frame room or telecommunication equipment room to each telecommunication riser

7.7.1 A minimum of 2 cable trays for a telecommunication (non-broadband coaxial cable) system and a broadband coaxial cable system shall be provided from the main distribution frame room or telecommunication equipment room of each building to each telecommunication riser in accordance with the requirements specified in Table 7.7.1.

Table 7.7.1 Width of cable trays to be provided between main distribution frame room or telecommunication equipment room to each telecommunication riser

	Minimum width of each cable tray where telecommunication riser has a side wall depth of 450 mm	Minimum width of each cable tray where telecommunication riser has a side wall depth of 600 mm
Cable tray for a telecommunication (non-broadband coaxial cable) system	300 mm	400 mm
Cable tray for a broadband coaxial cable system	100 mm	200 mm

7.8 Provision of broadband coaxial cable system

7.8.1 A broadband coaxial cable system shall be provided from the main distribution frame room to each residential unit in the development. The broadband coaxial cable system shall be provided in accordance with chapter 13.

7.9 Provision of conduits from the telecommunication risers to each residential unit

- 7.9.1 Every residential unit in the relevant development shall be provided, at the minimum, with –
- (a) 1 conduit of a minimum size of 20 mm in diameter for a telecommunication (non-broadband coaxial cable) system which shall run from the telecommunication riser into the residential unit, and terminating at the block terminal referred to in paragraph 7.10.1(a);
 - (b) 1 conduit of a minimum size of 20 mm in diameter for a broadband coaxial cable system which shall run from the telecommunication riser into the residential unit, and terminating at the multi-way splitter referred to in paragraph 7.10.1(b); and
 - (c) 1 empty conduit of a minimum size of 20 mm in diameter which shall run from the telecommunication riser into the residential unit, and terminating at an empty 2-gang box (which shall be provided by the developer or owner) with minimum internal dimensions of 160 mm (length), 80 mm (breadth) and 25 mm (depth) and a blank face plate (which may be located in the utility room or closet). The bending radius of the central line of the conduit shall not be less than 100 mm. The empty conduit shall be designated for the Next Generation National Broadband Network.

7.10 Provision of cables in the conduits

- 7.10.1 With regard to the conduits referred to in paragraph 7.9.1 –
- (a) a minimum of 2 twisted copper 4-pair cables (Category 3 or better) shall be provided in the conduit designated for a telecommunication (non-broadband coaxial cable) system, which shall terminate into a block terminal (which may be located in the utility room or closet) in each residential unit;
 - (b) a minimum of 1 coaxial cable shall be provided in the conduit designated for a broadband coaxial cable system, which shall terminate into a multi-way splitter at one end (which may be located in the utility room or closet) and into a splitter box of the main coaxial cable in the telecommunication riser at the other end. The coaxial cable shall be provided in accordance with the requirements set out in chapter 13; and
 - (c) 1 draw rope shall be provided in the empty conduit designated for the Next Generation National Broadband Network.

7.11 Provision of internal telecommunication wiring and broadband coaxial cable

- 7.11.1 Every residential unit in the relevant development shall be provided with internal telecommunication wiring and a broadband coaxial cable from the telecommunication riser to all telephone and television outlets in each residential unit.
- 7.11.2 In relation to the internal telecommunication wiring and broadband coaxial cable, every residential unit shall be provided, at the minimum, with –

- (a) 1 twisted copper 4-pair cable (Category 3 or better) from the living room and each bedroom of the house, which shall terminate into a block terminal (which may be located in the utility room or closet) at one end and into RJ11 outlets in the living room and bedrooms at the other end;
- (b) 1 RG6 coaxial cable from the living room and each bedroom of the house, which shall terminate into a multi-way splitter (which may be located in the utility room or closet) at one end and into F-type TV outlets in the living room and bedrooms at the other end. The RG6 coaxial cable shall be provided in accordance with the requirements set out in chapter 13; and
- (c) 1 unshielded twisted pair cable (Category 6 or better) complying with TIA/EIA 568-B specifications from the living room or any bedroom of the house, which shall terminate into an RJ45 outlet (which may be located in the utility room or closet) at one end and into an RJ45 outlet in the living room or bedroom at the other end. The length of the unshielded twisted pair cable shall not exceed 90 m.

7.12 Provision of electrical switch socket outlet

- 7.12.1 Every residential unit shall be provided with a minimum of one 13 A electrical switch socket outlet which shall be placed adjacent to the empty 2-gang box referred to in paragraph 7.9.1(c).

CHAPTER 8. DEVELOPMENT CONSISTING OF 1 OR MORE NON-RESIDENTIAL BUILDINGS OF UP TO 200,000 m² USABLE FLOOR AREA OR WITH MORE THAN 50 TELEPHONE LINES

8.1 Application of this chapter

8.1.1 This chapter specifies the space and facilities to be provided for a development consisting of 1 or more non-residential buildings with up to 200,000 m² usable floor area or more than 50 telephone lines.

8.1.2 If the relevant development consists of a usable floor area of more than 200,000 m², the developer or owner shall consult IDA on the additional space and facilities to be provided and comply with such requirements as may be imposed by IDA.

8.2 Provision of main distribution frame room

8.2.1 A minimum of 1 main distribution frame room shall be provided in every relevant development. The main distribution frame room shall be located on the first storey of the relevant development or, if in the basement, on the uppermost floor of the basement.

8.2.2 The size of the main distribution frame room to be provided under paragraph 8.2.1 shall be based on the total usable floor area of the non-residential building(s) in the relevant development, as specified in Table 8.2.2.

Table 8.2.2 Size of main distribution frame room to be provided in each relevant development

Total usable floor area in development ('000 m ²)	Minimum floor area of main distribution frame room (m ²)	Minimum height of main distribution frame room (m)
≤ 2	12	3.5
> 2 to 12	20	
> 12 to 25	30	
> 25 to 50	40	
> 50 to 75	60	
> 75 to 100	80	
> 100 to 125	100	
> 125 to 150	120	
> 150 to 175	140	
> 175 to 200	160	

8.2.3 Where the usable floor area of the relevant development exceeds 50,000 m², the main distribution frame room shall be divided into 2 or more separate rooms to facilitate cable distribution by licensees. The total combined size of the rooms shall be no less than the minimum size specified in Table 8.2.2 based on the relevant usable floor area.

8.2.4 Where central air-conditioning system is provided in the relevant development, air-conditioning from the central system shall be provided into every main distribution frame room. Where no air-conditioning is provided, louvres or exhaust fans (or both) shall be provided.

- 8.2.5 3 sets of electrical distribution panels operating on 230 V, single phase, 50 Hz power supply connecting to switch socket outlets and isolators shall be provided in the main distribution frame room in accordance with paragraphs 8.2.6 and 8.2.7.
- 8.2.6 Every electrical distribution panel shall contain –
- a 30 mA earth leakage circuit breaker of appropriate electrical current rating and miniature circuit breakers for final circuit connections and to facilitate the installation of electrical meters;
 - 2 spare 20 A miniature circuit breakers; and
 - a single-line diagram in each panel.
- 8.2.7 Switch socket outlets and isolators shall be provided in every main distribution frame room in accordance with the quantities specified in Table 8.2.7 which are to be distributed evenly between the 3 sets of electrical distribution panels.

Table 8.2.7 Requirements of switch socket outlets and isolators for every main distribution frame room in each relevant development

Total usable floor area ('000 m²)	Minimum number of switch socket outlets to be provided in main distribution frame room	Minimum number of isolators to be provided in main distribution frame room
≤ 25	3 x twin-13 A	6 x 30 A
> 25	3 x twin-13 A	9 x 30 A

- 8.2.8 Where a standby power generator is provided in the relevant development, the power supply to the main distribution frame room shall be connected to such standby power generator.
- 8.2.9 Where a standby power generator is not provided in the relevant development, the 30 A isolators in the main distribution frame room shall be connected to power sockets for connection to portable power generators and equipped with a manually activated switch to effect the changeover.
- 8.2.10 Natural or electrical lighting (or both) shall be provided in the main distribution frame room.
- 8.2.11 A clean earth of 1 Ω or less (without the use of salt) shall be provided for the exclusive use of licensees' installation or plant in the main distribution room. The clean earth shall be connected directly to an independent earth electrode system.
- 8.2.12 Where the usable floor area of the development is less than or equal to 25,000 m², the clean earth that is provided pursuant to paragraph 8.2.11 shall be in the form of a copper earth bar of at least 300 mm in length with screw holes that are 6 mm in diameter.

8.2.13 Where the usable floor area of the development is more than 25,000 m², the clean earth that is provided pursuant to paragraph 8.2.11 shall be in the form of a copper earth bar of at least 600 mm in length with screw holes that are 6 mm in diameter.

8.2.14 In addition to the requirements set out in paragraphs 8.2.1 to 8.2.13, the main distribution frame room(s) shall be provided in accordance with the requirements set out in chapter 11.

8.3 **Provision of lead-in pipes, underground pipes and manholes where there is no basement in the development**

8.3.1 Continuous lead-in pipes and underground pipes shall be provided for the relevant development as follows –

- (a) the lead-in pipes shall extend from the boundary of the development to the abutting road, to a point 1 m beyond the roadside drain located immediately outside the development; and
- (b) the underground pipes shall connect to the lead-in pipes at the boundary of the development and run to the main distribution frame room.

8.3.2 The number of lead-in pipes and underground pipes to be provided under paragraph 8.3.1 shall be in accordance with the quantities specified in Table 8.3.2.

Table 8.3.2 Number of lead-in pipes and underground pipes to be provided for relevant development with no basement

Total usable floor area (per '000 m ²) of the development	Minimum number of lead-in & underground pipes to be provided
≤ 12	8
>12 to 25	10
>25 to 50	14
>50 to 75	20
>75 to 100	24
>100 to 125	28
>125 to 150	32
>150 to 175	40
>175 to 200	48

8.3.3 The underground pipes shall enter the main distribution frame room in accordance with the formation specified in the Table 8.3.3.

Table 8.3.3 Pipe formation in the main distribution frame room

Total usable floor area (per '000 m ²)	Pipe formation in the main distribution frame room
--	--

of the development	
≤12	2 x 4
>12 to 25	2 x 5
>25 to 50	2 x 7
>50 to 75	2 sets of 2 x 5
>75 to 100	2 sets of 2 x 6
>100 to 125	2 sets of 2 x 7
>125 to 150	2 sets of 2 x 8
>150 to 175	2 sets of 2 x 10
>175 to 200	2 sets of 2 x 12

- 8.3.4 Where the usable floor area exceeds 50,000 m², the 2 sets of underground pipes to be provided in accordance with paragraph 8.3.3 shall enter the main distribution frame room in different directions.
- 8.3.5 For the purposes of paragraph 8.3.1, all lead-in pipes and underground pipes shall be made of unplasticised polyvinyl chloride (uPVC) material with a nominal diameter of 110 mm and which are compliant with the Singapore Standard SS:272.
- 8.3.6 In addition to the requirements set out in paragraphs 8.3.1 to 8.3.5, all lead-in pipes and underground pipes shall be provided in accordance with the requirements set out in chapter 10.
- 8.3.7 Manholes shall be provided in each relevant development as follows –
- a manhole shall be constructed at every location where there is effectively a 90° bend in the direction of the underground pipes; and
 - a minimum of 1 manhole must be provided for every 150 m segment of underground pipes laid.
- 8.3.8 The type of manholes to be provided under paragraph 8.3.7 shall be in accordance with Table 8.3.8 based on the highest number of underground pipes entering any one side of the manhole.

Table 8.3.8 Type of manhole to be provided

Highest number of underground pipes entering any one side of the manhole	Type of manhole to be provided
≤ 2	JX2
3 to 6	MX1
7 to 9	MX2
10 to 12	MX3
13 to 16	MX4
17 to 24	MX5

- 8.3.9 In addition to the requirements set out in paragraphs 8.3.7 to 8.3.8, all manholes shall be provided in accordance with the requirements set out in chapter 10.

8.4 Provision of lead-in pipes, underground pipes, manholes and cable trays where there is a basement in the development

8.4.1 Continuous lead-in pipes and underground pipes shall be provided for the relevant development as follows –

- (a) the lead-in pipes shall extend from the boundary of the development to the abutting road, to a point 1 m beyond the roadside drain located immediately outside the development; and
- (b) the underground pipes shall connect from the lead-in pipes at the boundary of the development and run to the retaining wall of the development.

8.4.2 The number of lead-in pipes and underground pipes to be provided under paragraph 8.4.1 shall be in accordance with the quantities specified in Table 8.4.2.

Table 8.4.2 Number of lead-in pipes and underground pipes to be provided for relevant development with basement

Total usable floor area (per '000 m ²) of the development	Minimum number of lead-in & underground pipes to be provided
< 12	8
12 to 25	10
25 to 50	14
50 to 75	20
75 to 100	24
100 to 125	28
125 to 150	32
150 to 175	40
175 to 200	48

8.4.3 Where the usable floor area exceeds 50,000 m², at least half of the underground pipes that run to the retaining wall of the development shall enter the basement in different directions.

8.4.4 For the purposes of paragraph 8.4.1, all lead-in pipes and underground pipes shall be made of unplasticised polyvinyl chloride (uPVC) material with a nominal diameter of 110 mm and which are compliant with the Singapore Standard SS:272.

8.4.5 A cable duct sealing module system shall be installed at the retaining wall of the development to prevent any ingress of water flowing from the underground pipes into the basement.

8.4.6 In addition to the requirements set out in paragraphs 8.4.1 to 8.4.5, all lead-in pipes and underground pipes shall be provided in accordance with the requirements set out in chapter 10.

8.4.7 Manholes shall be provided in each relevant development as follows –

- (a) a manhole shall be constructed at every location where there is effectively a 90° bend in the direction of the underground pipes; and
- (b) a minimum of 1 manhole must be provided for every 150 m segment of underground pipes laid.

8.4.8 The type of manholes to be provided under paragraph 8.4.7 shall be in accordance with Table 8.4.8 based on the highest number of underground pipes entering any one side of the manhole.

Table 8.4.8 Type of manhole to be provided

Highest number of underground pipes entering any one side of the manhole	Type of manhole to be provided
≤ 2	JX2
3 to 6	MX1
7 to 9	MX2
10 to 12	MX3
13 to 16	MX4
17 to 24	MX5

8.4.9 In addition to the requirements set out in paragraphs 8.4.7 to 8.4.8, all manholes shall be provided in accordance with the requirements set out in chapter 10.

8.4.10 Cable trays for a telecommunication (non-broadband coaxial cable) system and a broadband coaxial cable system shall be provided from the retaining wall of the development to the main distribution frame room, of which -

- (a) 1 cable tray shall be used for a telecommunication (non-broadband coaxial cable) system; and
- (b) 1 cable tray of shall be used for a broadband coaxial cable system.

8.4.11 The size of these cable trays shall cover the total cross-sectional width of the underground pipes terminating at the retaining wall.

8.4.12 Where cable trays are provided in accordance with paragraph 8.4.10 in relation to a building in which both a master antenna television system (MATV) and a broadband coaxial cable system are installed, the width of the cable tray to be used for a broadband coaxial cable system shall be increased by an additional 50 mm.

8.4.13 As an alternative to providing the cable trays specified in paragraph 8.4.10, 2 metal trunkings of equivalent size may be provided, of which –

- (a) 1 metal trunking shall be used for a telecommunication (non-broadband coaxial cable) system; and
- (b) 1 metal trunking shall be used for a broadband coaxial cable system.

- 8.4.14 Where additional main distribution frame rooms are provided, the developer or owner shall consult IDA on the quantity and size of cable trays to be provided between each main distribution frame room, and comply with such requirements as may be imposed by IDA.

8.5 Provision of telecommunication risers

- 8.5.1 Telecommunication risers shall be provided in every non-residential building in the relevant development.
- 8.5.2 The serving radius of each telecommunication riser shall not exceed 40 m. Each telecommunication riser shall be labelled as "Telecom Riser" and numbered for easy reference and identification.
- 8.5.3 All telecommunication riser shafts must be constructed in a direct vertical line throughout the building.
- 8.5.4 The dimensions of each telecommunication riser to be provided under paragraph 8.5.1 shall be based on the usable floor area of the non-residential building, as specified in Table 8.5.4.

Table 8.5.4 Dimensions of telecommunication riser

Total usable floor area of the building (per '000 m ²)	Minimum dimensions of telecommunication riser
≤ 75	1100 mm (width) x 800 mm (depth)
> 75	1600 mm (width) x 800 mm (depth)

- 8.5.5 Every telecommunication riser shall have a door which can be fully opened outwards throughout its entire width for easy access at each floor level. The height of the door shall be at least 2.1 m.
- 8.5.6 All doors of the telecommunication risers shall be locked.
- 8.5.7 At the minimum, 2 cable trays shall be installed in each telecommunication riser from the first storey or basement to the topmost level of every non-residential building for a telecommunication (non-broadband coaxial cable) system and a broadband coaxial cable system.
- 8.5.8 The cable trays for a telecommunication (non-broadband coaxial cable) system and a broadband coaxial cable system shall be installed opposite each other on the side wall of the telecommunication riser.
- 8.5.9 For the purposes of paragraph 8.5.7, cable trays shall be provided in accordance with the requirements specified in Table 8.5.9.

Table 8.5.9 Width of cable trays in each telecommunication riser

	Minimum width of each cable tray where the building has up to 25 storeys	Minimum width of cable trays where the building has more than 25 storeys
Cable tray for a		

telecommunication (non-broadband coaxial cable) system	450 mm	600 mm
Cable tray for a broadband coaxial cable system	100 mm	200 mm

- 8.5.10 The telecommunication riser openings on every storey in each non-residential building shall be sealed in accordance with the Code of Practice for Fire Precautions in Buildings.
- 8.5.11 All telecommunication (non-broadband coaxial) cables shall terminate in either the intermediate distribution frames or distribution point boxes located in the telecommunication risers.
- 8.5.12 All broadband coaxial cables shall terminate in the tap or splitter boxes located in the telecommunication risers.
- 8.5.13 In addition to the requirements set out in paragraphs 8.5.1 to 8.5.12, all telecommunication risers shall be provided in accordance with the requirements set out in chapter 12.

8.6 Provision of cable trays from the main distribution frame room to each telecommunication riser

- 8.6.1 A minimum of 1 cable tray with a width of 600 mm shall be provided from the main distribution frame room to each telecommunication riser for a telecommunication (non-broadband coaxial cable) system.
- 8.6.2 A minimum of 1 cable tray with a width of 200 mm shall be provided from the main distribution frame room to each telecommunication riser for a broadband coaxial cable system.
- 8.6.3 Slots of a minimum height of 300 mm shall be provided in the wall of each telecommunication riser for cable trays to pass through.

8.7 Provision of cable distribution system from the telecommunication riser to each non-residential unit

- 8.7.1 A cable distribution system shall be provided to facilitate the laying of telecommunication cables from the telecommunication riser to each non-residential unit. The developer or owner may select an appropriate cable distribution system as described in the Guidelines For Info-communications Facilities in Buildings for the development.

CHAPTER 9. DEVELOPMENT CONSISTING OF 1 OR MORE NON-RESIDENTIAL BUILDINGS OF UP TO 2,000 m² USABLE FLOOR AREA AND WITH UP TO 50 TELEPHONE LINES

9.1 Application of this section

9.1.1 This section specifies the space and facilities to be provided for a development consisting of 1 or more non-residential buildings of up to 2,000 m² total usable floor area and with up to 50 telephone lines.

9.2 Provision of main distribution frame room

9.2.1 A main distribution frame room shall be provided in the relevant development.

9.2.2 The minimum dimensions of the main distribution frame room shall be 2 m (length) by 3 m (breadth) by 3.5 m (height).

9.2.3 Louvres or exhaust fans (or both) shall be provided in the main distribution frame room for ventilation.

9.2.4 3 sets of electrical distribution panels operating on 230 V, single phase, 50 Hz power supply connecting to 3 twin-13 A switch socket outlets and 3 single-15A switch socket outlets shall be provided in the main distribution frame room.

9.2.5 Every electrical distribution panel shall contain –

- (a) a 30 mA earth leakage circuit breaker of appropriate electrical current rating and miniature circuit breakers for final circuit connections and to facilitate the installation of electrical meters;
- (b) 2 spare 20 A miniature circuit breakers; and
- (c) a single-line diagram in each panel.

9.2.6 Where a standby power generator is provided in the relevant development, the power supply to the main distribution frame room shall be connected to such standby power generator.

9.2.7 Natural or electrical lighting (or both) shall be provided in the main distribution frame room.

9.2.8 Electrical switch socket outlets shall be provided in the main distribution frame room in which are to be distributed evenly between the 3 sets of electrical distribution panels.

9.2.9 A clean earth of 1 Ω or less (without the use of salt) shall be provided for the exclusive use of telecommunication installation or plant in the main distribution frame room. The clean earth shall be connected directly to an independent earth electrode system.

9.2.10 The clean earth that is provided pursuant to paragraph 9.2.9 shall be in the form of a copper earth bar of at least 300 mm in length with screw holes that are 6 mm in diameter.

9.2.11 In addition to the requirements set out in paragraphs 9.2.1 to 9.2.10, the main distribution frame room(s) shall be provided in accordance with the requirements set out in chapter 11.

9.3 Provision of lead-in pipes, underground pipes and manholes

9.3.1 A minimum of 6 continuous lead-in pipes and underground pipes shall be provided for the relevant development as follows –

- (a) the lead-in pipes shall extend from the boundary of the development to the abutting road, to a point 1 m beyond the roadside drain located immediately outside the development; and
- (b) the underground pipes shall connect from the lead-in pipes at the boundary of the development and run to the main distribution frame room.

9.3.2 For the purpose of paragraph 9.3.1 all lead-in pipes and underground pipes shall be made of unplasticised polyvinyl chloride (uPVC) material with a nominal diameter of 110 mm and which are compliant with the Singapore Standard SS:272

9.3.3 In addition to the requirements set out in paragraphs 9.3.1 to 9.3.2, all lead-in pipes and underground pipes shall be provided in accordance with the requirements set out in chapter 10.

9.3.4 Manholes shall be provided in each relevant development as follows –

- (a) a manhole shall be constructed at every location where there is effectively a 90° bend in the direction of the underground pipes; and
- (b) a minimum of 1 manhole must be provided for every 150 m segment of underground pipes laid.

9.3.5 The type of manholes to be provided under paragraph 9.3.4 shall be type MX1.

9.3.6 Where a manhole is constructed under carriageways or vehicle access areas, a heavy duty manhole cover which complies with Singapore Standard SS:30 Grade A1 shall be used for such manhole.

9.3.7 In addition to the requirements set out in paragraphs 9.3.4 to 9.3.6, all manholes shall be provided in accordance with the requirements set out in chapter 10.

9.4 Provision of telecommunication risers

9.4.1 Telecommunication riser(s) shall be provided in every non-residential multi-storey building in the relevant development.

- 9.4.2 The serving radius of each telecommunication riser shall not exceed 40 m. Each telecommunication riser shall be labelled as “Telecom Riser” and numbered for easy reference and identification.
- 9.4.3 All telecommunication riser shafts shall be constructed in a direct vertical line throughout the building.
- 9.4.4 The internal dimensions of a telecommunication riser shall be 600 mm (width) x 450 mm (depth) at the minimum.
- 9.4.5 Every telecommunication riser shall have a door which can be fully opened outwards throughout its entire width for easy access at each floor level. The height of the door shall be at least 2.1 m.
- 9.4.6 All doors of the telecommunication risers shall be locked.
- 9.4.7 At the minimum, 2 cable trays shall be installed in each telecommunication riser from the first storey or basement to the topmost level of every building for a telecommunication (non-broadband coaxial cable) system and a broadband coaxial cable system.
- 9.4.8 The cable trays for a telecommunication (non-broadband coaxial cable) system and a broadband coaxial cable system shall be installed opposite each other on the side wall of the telecommunication riser.
- 9.4.9 A cable tray with a minimum width of 200 mm shall be provided in the telecommunication riser for telecommunication (non-broadband coaxial cable) system.
- 9.4.10 A cable tray with a minimum width of 100 mm shall be provided in the telecommunication riser for broadband coaxial cable system.
- 9.4.11 The telecommunication riser openings on every storey in each building shall be sealed in accordance with the Code of Practice for Fire Precautions in Buildings.
- 9.4.12 All telecommunication (non-broadband coaxial) cables shall terminate in either the intermediate distribution frames or distribution point boxes located in the telecommunication risers.
- 9.4.13 All broadband coaxial cables shall terminate in the tap or splitter boxes located in the telecommunication risers.
- 9.4.14 In addition to the requirements set out in paragraphs 9.4.1 to 9.4.13, all telecommunication risers shall be provided in accordance with the requirements set out in chapter 12.
- 9.5 Provision of horizontal cable trays from the main distribution frame room to each telecommunication riser**
- 9.5.1 Cable trays with a minimum width of 200 mm shall be provided from the main distribution frame room to each telecommunication riser for a telecommunication (non-broadband coaxial cable) system.

- 9.5.2 Cable trays with a minimum width of 100 mm shall be provided from the main distribution frame room to each telecommunication riser for a broadband coaxial cable system.
- 9.5.3 Slots of a minimum height of 300 mm shall be provided in the wall of each telecommunication riser for cable trays to pass through.
- 9.6 **Provision of cable distribution system from the telecommunication riser to each non-residential unit**
- 9.6.2 A cable distribution system shall be provided to facilitate the laying of telecommunication cables from the telecommunication riser to each non-residential unit. The developer or owner may select an appropriate cable distribution system as described in the Guidelines For Info-communications Facilities in Buildings.

CHAPTER 10. LEAD-IN PIPES, UNDERGROUND PIPES AND MANHOLES

10.1 Overview

- 10.1.1 This chapter sets out the additional requirements for the provision of –
- (a) lead-in pipes;
 - (b) underground pipes;
 - (c) manholes; and
 - (d) cable trays where such trays are provided in lieu of underground pipes.
- 10.1.2 The quantities of lead-in pipes and underground pipes specified in this section are the minimum required to be provided. IDA reserves the right to require any developer or owner to provide additional lead-in pipes and underground pipes to meet the demand for telecommunication services where necessary.

10.2 Qualified builders

Every developer or owner who is required to provide lead-in pipes or an underground pipeline system or both shall ensure that they are constructed by builders who are registered with the Building and Control Authority under the ME14 (Mechanical and Electrical Heads) category specialising in “Underground Pipeline for Telecommunication”. The list of registered contractors may be obtained from the Building and Control Authority website (<http://www.bca.gov.sg>).

10.3 General requirements for all pipes

- 10.3.1 Every developer or owner who is required to provide lead-in pipes or underground pipes or both shall for such purpose –
- (a) use only pipes and associated couplings that are made from unplasticised polyvinyl chloride (uPVC) material which are compliant with the Singapore Standard SS:141, Singapore Standard SS:272 or its equivalent;
 - (b) use only pipes and associated couplings that are no darker than the grey colour;
 - (c) provide all pipes in straight length of 6.0 m within the tolerance of +50 mm and -0 mm as specified the Singapore Standard SS:141 or Singapore Standard SS:272 or its equivalent;
 - (d) provide all pipes complete with 1 coupling per pipe;
 - (e) ensure that all pipes are clearly, indelibly and continuously marked at intervals of not more than 1.0 m along the length of the pipe using a distinctive colour with the following description –

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

- (f) ensure that all associated couplings are manufactured by injection moulding method. Details for coupling are shown in Figure 10.1. The coupling shall comply to all tests as specified in the Singapore Standard SS:272 or its equivalent;
- (g) ensure that all associated couplings are of the dimensions and tolerances specified in Table 10.3(g) below;

Table 10.3(g) Dimension and tolerance of couplings

Coupling Length	180.0mm \pm 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)
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)

- (h) lay all pipes throughout in a straight run as far as practicable;
- (i) join all pipes together using a coating of solvent cement to both coupler and pipes;
- (j) where a bend is required to any pipe, use a factory-made bend of nominal diameter of 110 mm and 50 mm as illustrated in Figure 10.2(a) & (b) for 90° upturns (i.e. changing from the horizontal to vertical plane) and, unless otherwise advised by the Telecommunication Facility Co-ordination Committee, ensure that the pipe is clipped and flushed against the wall and rises up to a height of 1 m above ground as illustrated in Figure 10.2(c) & (d);
- (k) where a straight pipe reducer is required to reduce the nominal diameter of the pipe from 110 mm to 50 mm, use a pipe reducer in accordance with the specifications shown in Figure 10.3(a) & (b);
- (l) construct all pipes located below carriageways to a minimum depth of 1 m;
- (m) construct all pipes located below side-tables or footpaths to a minimum depth of 1.2 m;
- (n) ensure that all pipes that are buried in the ground are encased in 50 mm concrete surround of Grade 20 except that pipes with nominal diameter of not more than 110 mm and which are not buried under vehicular access need not be encased with 50 mm concrete surround of Grade 20;
- (o) provide a nylon/polyethylene rope of 4-core or multi-strand type with overall diameter of 6 mm in every pipe to facilitate cable pulling;

- (p) cap the unconnected ends of all pipes with rubber caps to prevent entry of earth, debris or cement except those ends terminating in manholes;
- (q) separate all pipes from power cables by no less than –
 - (i) 50 mm of concrete surround of Grade 20; or
 - (ii) 300 mm in well tamped earth;
- (r) where the underground pipes enter a building in a horizontal position, install a cable duct sealing module system such as MCT, SVT or ROX types as described in Appendix 2 of the Guidelines For Information Communications Facilities in Buildings to prevent the ingress of water and construct a drain below the module system to allow for the drainage of water;
- (s) where the main distribution frame room is located in the basement of the building, ensure that the underground pipes do not lead directly into the room but connects to cable trays installed outside the main distribution frame room for entry via such cable trays into the room; and
- (t) ensure that all pipes terminating inside the telecommunication risers are flushed against the wall and rise up to a minimum height of 1 m.

10.4 Specific requirements for lead-in pipes

10.4.1 Every developer or owner who is required to provide lead-in pipes shall –

- (a) construct all lead-in pipes at a depth of no less than 1 m from the base of (i.e. to under-cross) the existing or proposed roadside drain in accordance with the requirements of the Drainage Department of the Public Utilities Board except that where it is not possible for the lead-in pipes to under-cross the roadside drain, the owner may install pipes to over-cross the drain subject to the approval of the Public Utilities Board;
- (b) orientate all lead-in pipes to face public roads and ensure that they are not constructed into State Land or oriented to face the direction of trees, lamp posts, traffic lights, road signs, over-ground boxes (OG boxes) or other permanent obstacles;
- (c) ensure that the number of lead-pipes provided is equivalent to and no less than the number of pipes in the underground pipeline system entering the main distribution frame room;
- (d) where a common services tunnel (CST) or an equivalent type of tunnel system is constructed for the laying of telecommunication cables to building developments (for example, the CST constructed in the Marina South new downtown area) –
 - (i) construct and connect the lead-in pipes to the pipe-sleeves of the designated CST junction box adjacent to the building or building development and obtain all necessary approvals from the relevant authorities for such connection works; and

- (ii) ensure that the number of lead-in pipes provided is equivalent to and corresponds with the number of pipe-sleeves of the designated CST junction box; and
 - (e) cap all lead-in pipes intended for connection to any licensee's network and indicate their position by a marker on the final ground level.
- 10.4.2 Developer or owner is advised to consult the Telecommunication Facility Co-ordination Committee for guidance on the most suitable location and orientation for their lead-in pipes.
- 10.4.3 Figure 10.4 shows a typical layout of lead-in pipes in a gate pillar of landed dwelling houses.

10.5 Specific requirements for the provision of underground pipes

- 10.5.1 Every developer or owner who is required to provide underground pipes shall –
- (a) where multi-way pipes are used, ensure that spacers are installed;
 - (b) lay the underground pipes in straight runs and in lengths of 6 m as far as practicable;
 - (c) join the underground pipes together using a coating of solvent cement to both coupler and pipes;
 - (d) where the laying of the underground pipes is obstructed by other services or deep culverts which require the under-crossing or over-crossing of such obstacles, lay the pipes in a gradual gradient of not less than 1:6 for pipes of nominal diameter of 110 mm and not less than 1:3 for pipes of nominal diameter of 50 mm;
 - (e) ensure that the number of underground pipes connecting from the lead-in pipes to the main distribution room is equivalent to and correspond with the number of underground pipes entering the room;
 - (f) provide a minimum of 8 underground pipes at the portion of the underground pipeline system located furthest away from the main distribution frame room; and
 - (g) ensure that the underground pipes are constructed with good workmanship and is free of obstructing materials and substances to facilitate the deployment of plant by licensees.
- 10.5.2 Developers or owners are advised to refer to the testing procedures specified in Appendix 3 of the Guidelines For Info-communications Facilities in Buildings for the testing of the underground pipes.
- 10.5.3 Where a developer or owner is required to provide underground pipes in accordance with this Code, the developer or owner may provide cable trays or metal trunking in lieu of such underground pipes within a building where it is

practicable to do so, subject to the developer's or owner's compliance with paragraphs 10.6.1 to 10.6.3.

10.6 Cable trays and metal trunking

10.6.1 Where the developer or owner provides cable trays in lieu of underground pipes pursuant to paragraph 10.5.3, that developer or owner shall provide 2 cable trays of which –

- (a) 1 cable tray shall be used for a telecommunication (non-broadband coaxial cable) system; and
- (b) 1 cable tray shall be used for a broadband coaxial cable system.

10.6.2 As an alternative to providing the cable trays specified in paragraph 10.6.1, the developer or owner may provide 2 metal trunkings of equivalent size between the telecommunication risers and the main distribution frame room or the telecommunication equipment room (as the case may be), of which –

- (a) 1 metal trunking shall be used for a telecommunication (non-broadband coaxial cable) system; and
- (b) 1 metal trunking shall be used for a broadband coaxial cable system.

10.6.3 Where the developer or owner provides cable trays in lieu of underground pipes pursuant to paragraph 10.5.3 and in relation to a building in which both a master antenna television system (MATV) and a broadband coaxial cable system are installed, the developer or owner shall increase the width of the cable tray to be used for a broadband coaxial cable system by an additional 50 mm.

10.7 Manholes

10.7.1 Where standard sized manholes of type JX2, MX1, MX2, MX3 and MX4 are constructed, the developer or owner shall comply with the specifications set out in Figures 10.5 to 10.30 in relation to such manholes.

10.7.2 Where it is necessary for larger sized manholes (type MX5 and above) or non-standard manholes or irregular manholes to be constructed, the developer or owner shall obtain the specifications for such manholes from the Telecommunication Facility Co-ordination Committee.

10.7.3 Before any concrete is laid for the construction of any manhole, the developer or owner shall ensure that –

- (a) the bottom of the excavation is properly levelled and consolidated;
- (b) the bottom of the excavation is kept dry by providing a sump-hole to accommodate water pump, and where necessary provide a layer of 150 mm thick hard-core materials;
- (c) pipes are cast on site and that manhole fittings are placed as the construction proceeds;

- (d) uPVC pipes with a flared mouth at one end and which comply with the Singapore Standard SS:272 are used for entry into the wall of the manhole;
- (e) the underground pipes enter each manhole in the manner shown in Figures 10.5 to 10.14, 10.19 to 10.22 & 10.27 to 10.30, and at such depths as to ensure a minimum clearance of 450 mm above the floor level and 350 mm below the roof unless otherwise specified;
- (f) the manhole is constructed at a depth which allows for a concrete (1:2:4) shaft wall of varying height to be constructed for the various manhole sizes shown in Figures 10.15 to 10.18 & 10.23 to 10.26;
- (g) the concrete used for filling the recess of the manhole frame and cover is of Grade 20 and that such filling is flushed with the top of the cover, and where heavy duty frame and cover is used, ensure that the concrete is filled up to the ribs without covering the ribs
- (h) manhole walls are fair faced and not rendered, and that all projections or cavities in the manhole walls are removed or filled with cement mortar respectively;
- (i) the manhole walls are not coated with cement or cement sand wash;
- (j) the floor of the manhole is given a 20 mm rendering of cement mortar with fall towards the sump-hole from all directions;
- (k) 1 uPVC pipe of nominal diameter of 50 mm with a 1-way trap is constructed at the neck of the manhole and connected to the nearest drain that is situated at a lower level than the manhole;
- (l) only approved formwork is used in the construction of manholes;
- (m) where the manhole is constructed under carriageways or vehicular access areas, that a heavy duty manhole cover which complies with the Singapore Standard SS 30 Grade A1 is used for such manhole; and
- (n) where the manhole is constructed under turfed areas or pedestrian footways, that a medium duty manhole cover which complies with the Singapore Standard SS 30 Grade B is used for such manhole.

10.7.4 The developer or owner may choose to install pre-cast manholes as an alternative to constructing the manholes.

10.7.5 The developer or owner may purchase manhole frames, covers and channel brackets directly from suppliers or from licensees. Every developer or owner shall ensure that the manhole covers which he provides does not bear the name of any licensee.

FIGURE 10.1: INJECTION MOULDED UPVC COUPLING FOR 110MM NOMINAL SIZE UPVC PIPE

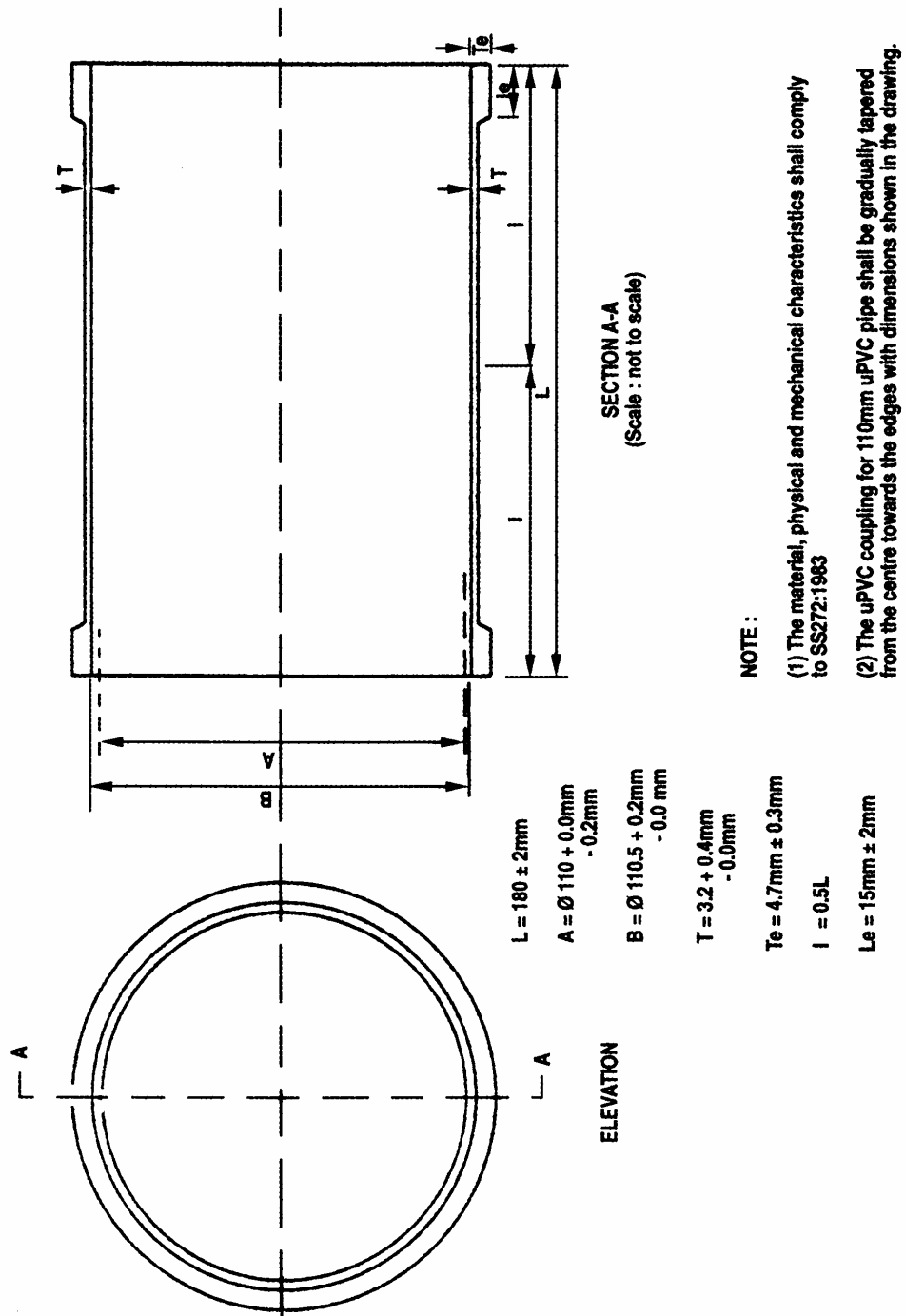


FIGURE 10.2(a): 110MM DIAMETER UPVC BEND PIPE

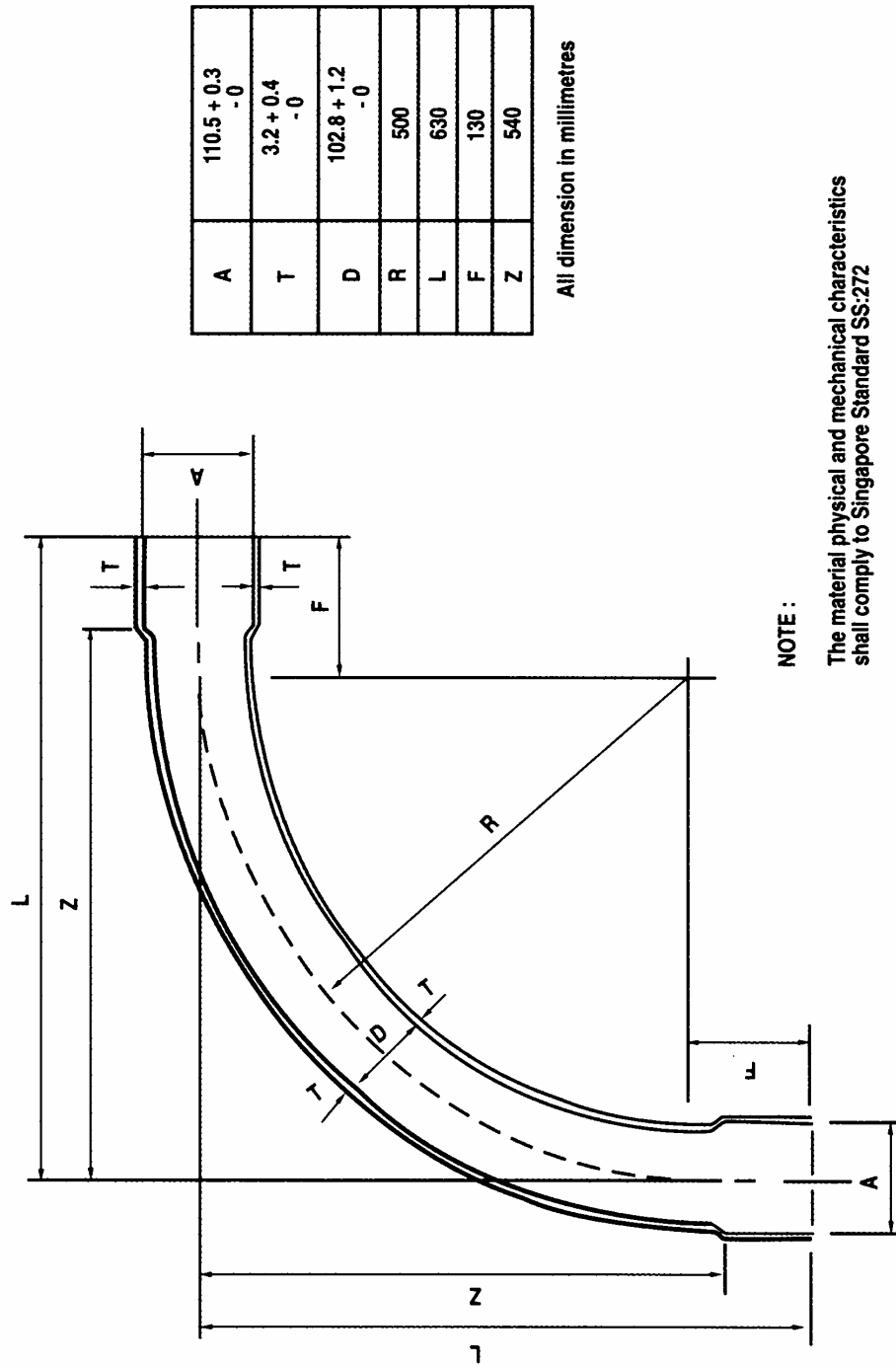


FIGURE 10.2(b): 50MM DIAMETER UPVC BEND PIPE

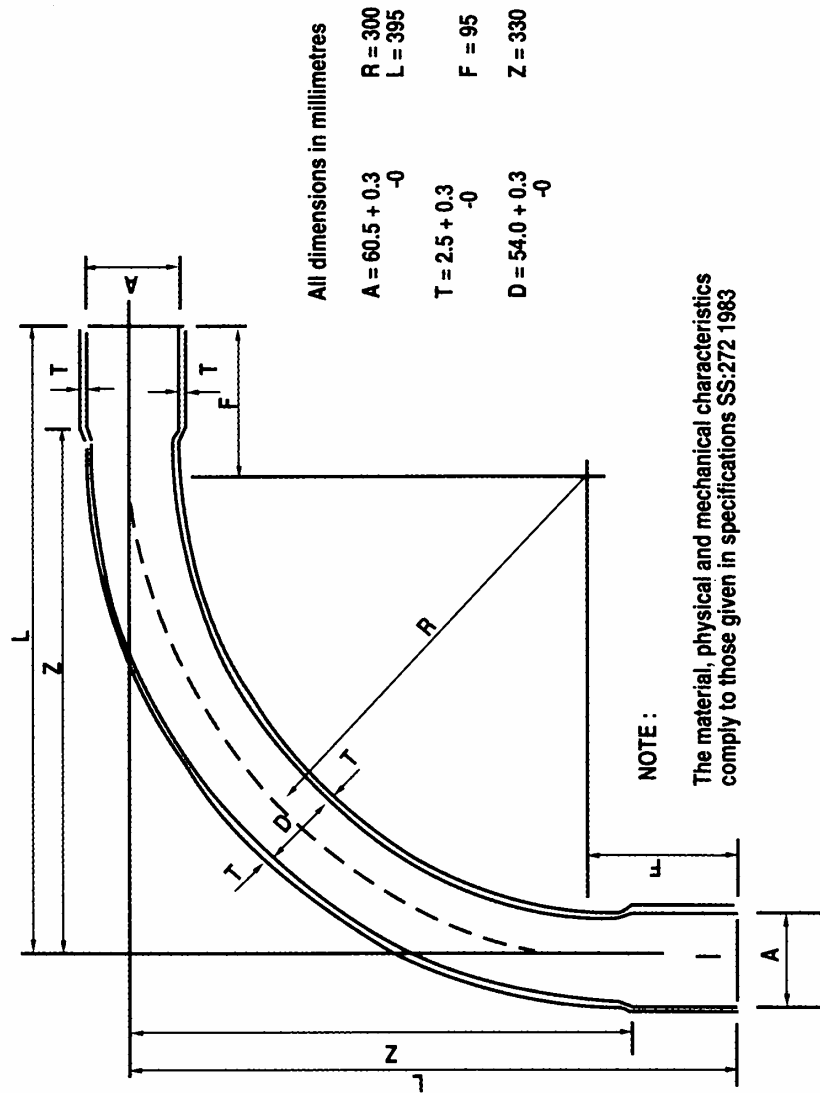


FIGURE 10.2(c): DETAILS OF LEAD-IN PIPES WITH BEND PIPES

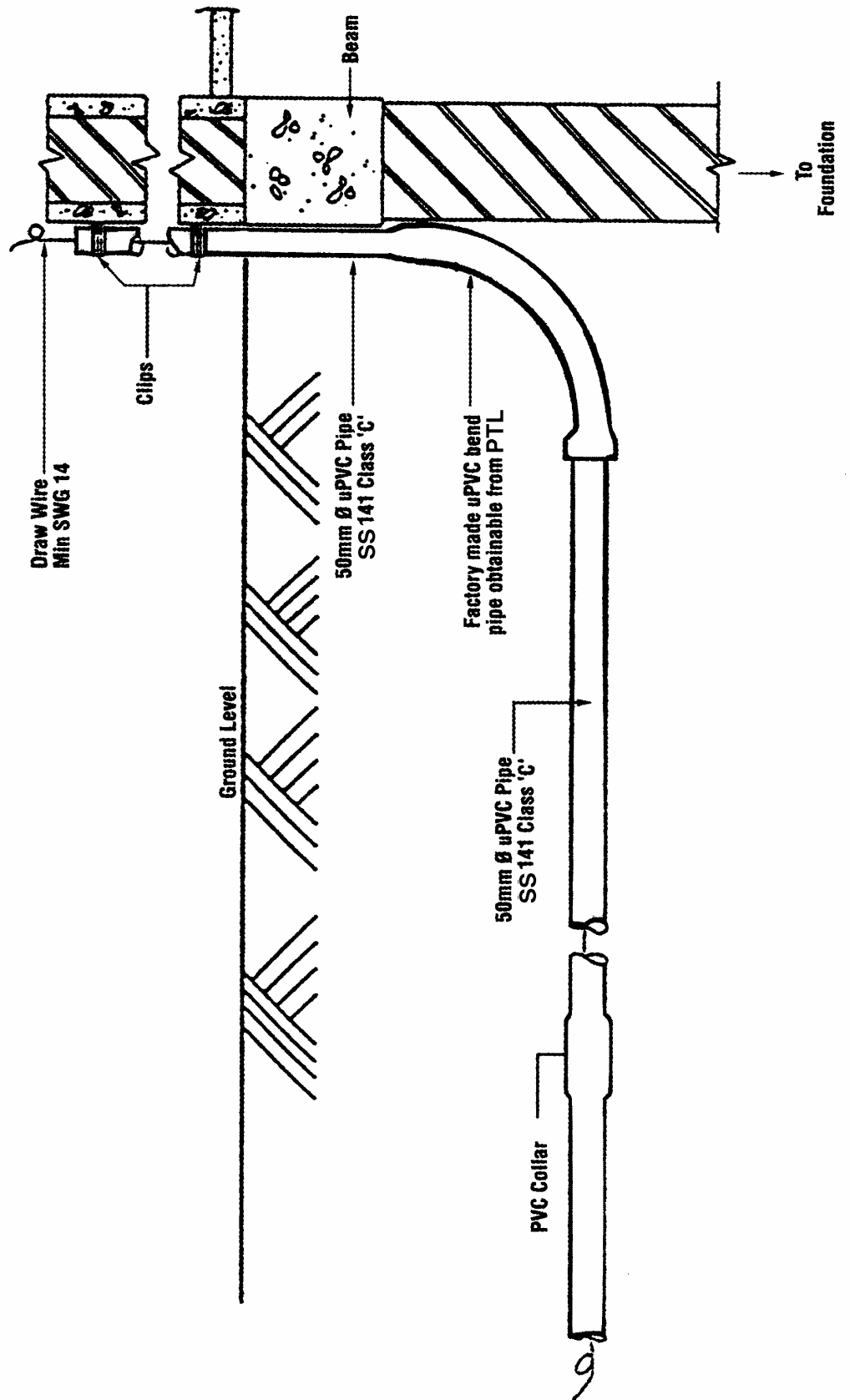


FIGURE 10.2(d): DETAILS OF LEAD-IN PIPES WITH BEND PIPES

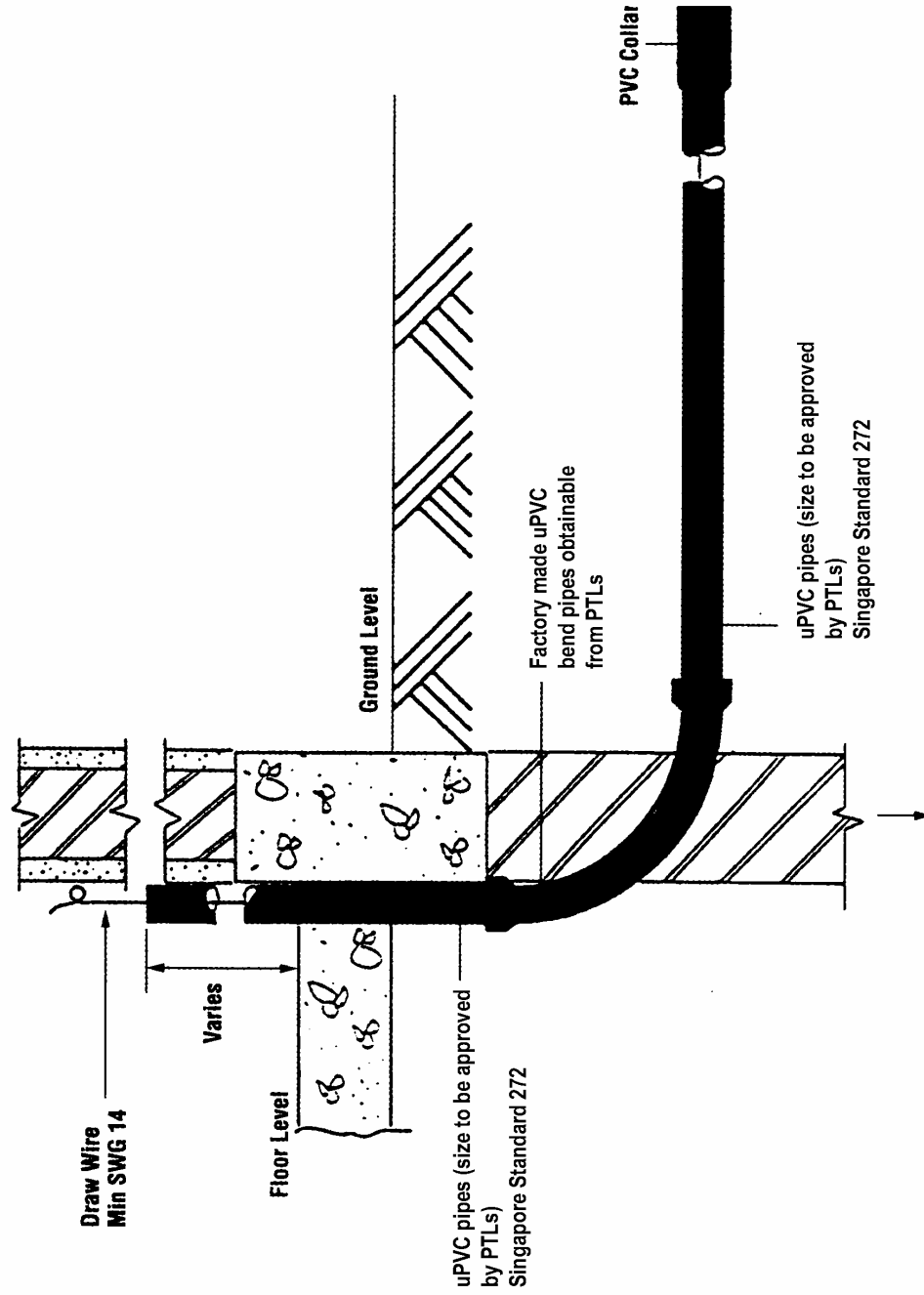


FIGURE 10.3(a): REDUCER FOR 110MM TO 50MM DIAMETER NOMINAL SIZE UPVC PIPE

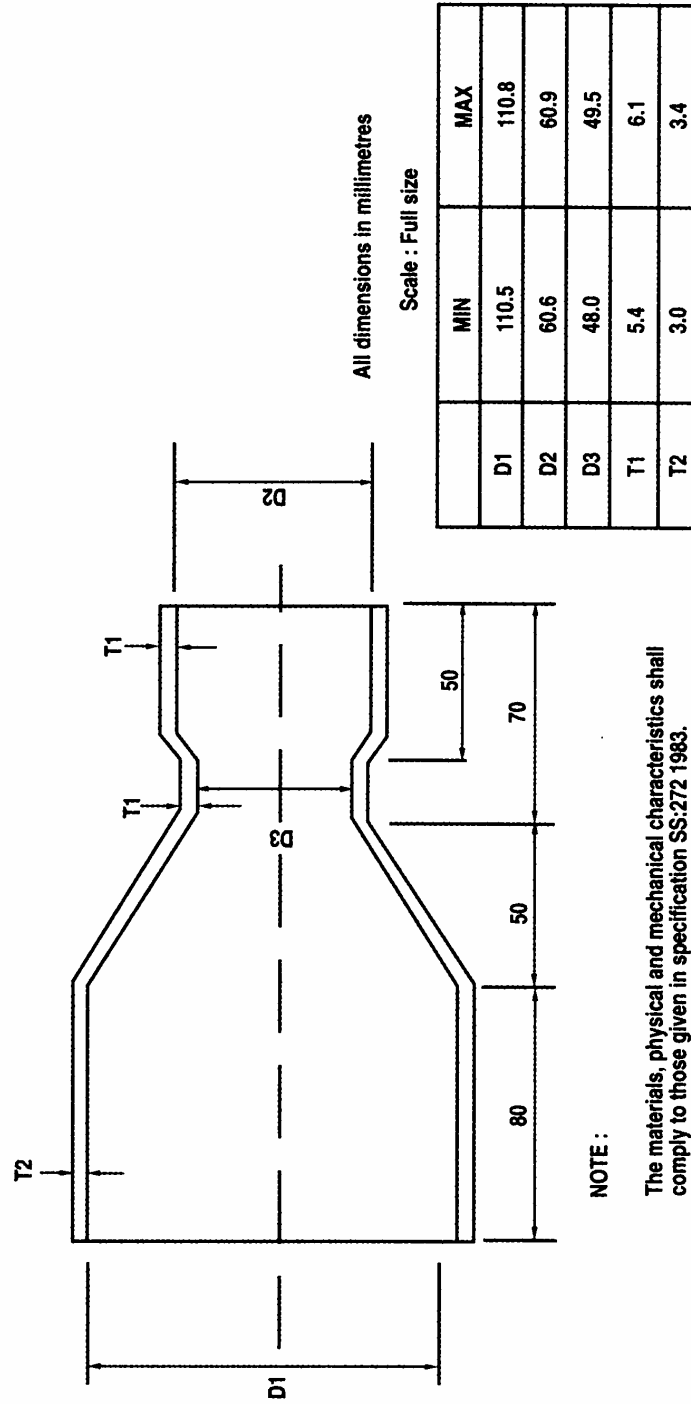
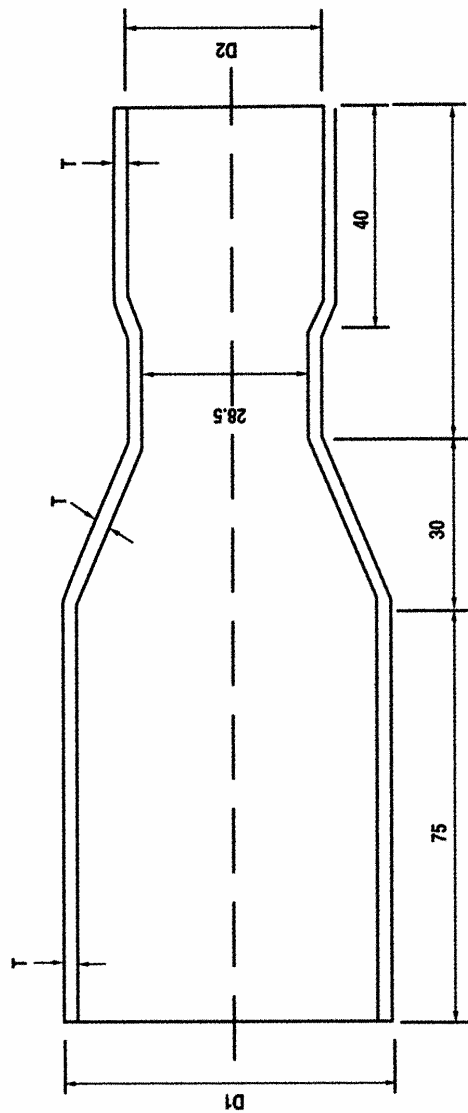


FIGURE 10.3(b): REDUCER FOR 50MM TO 25MM NOMINAL SIZE UPVC PIPE



NOTE :

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

All dimensions in millimetres

	MIN	MAX
D1	60.2	60.5
D2	33.7	34.0
T	2.7	3.0

FIGURE 10.4: LOCATION OF LEAD-IN PIPES IN GATE PILLAR

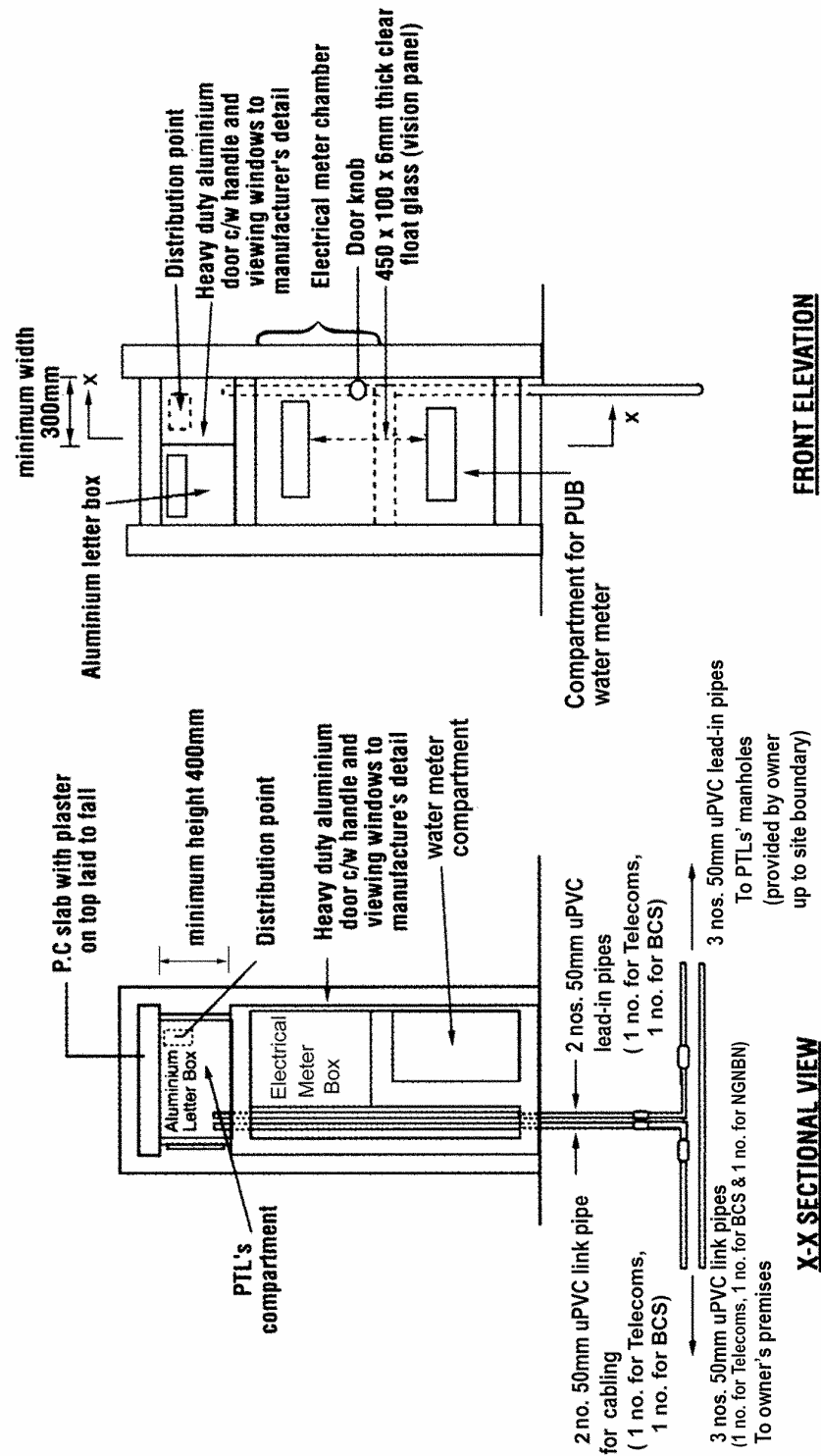


FIGURE 10.5: MANHOLE DRAWINGS - TYPE JX2

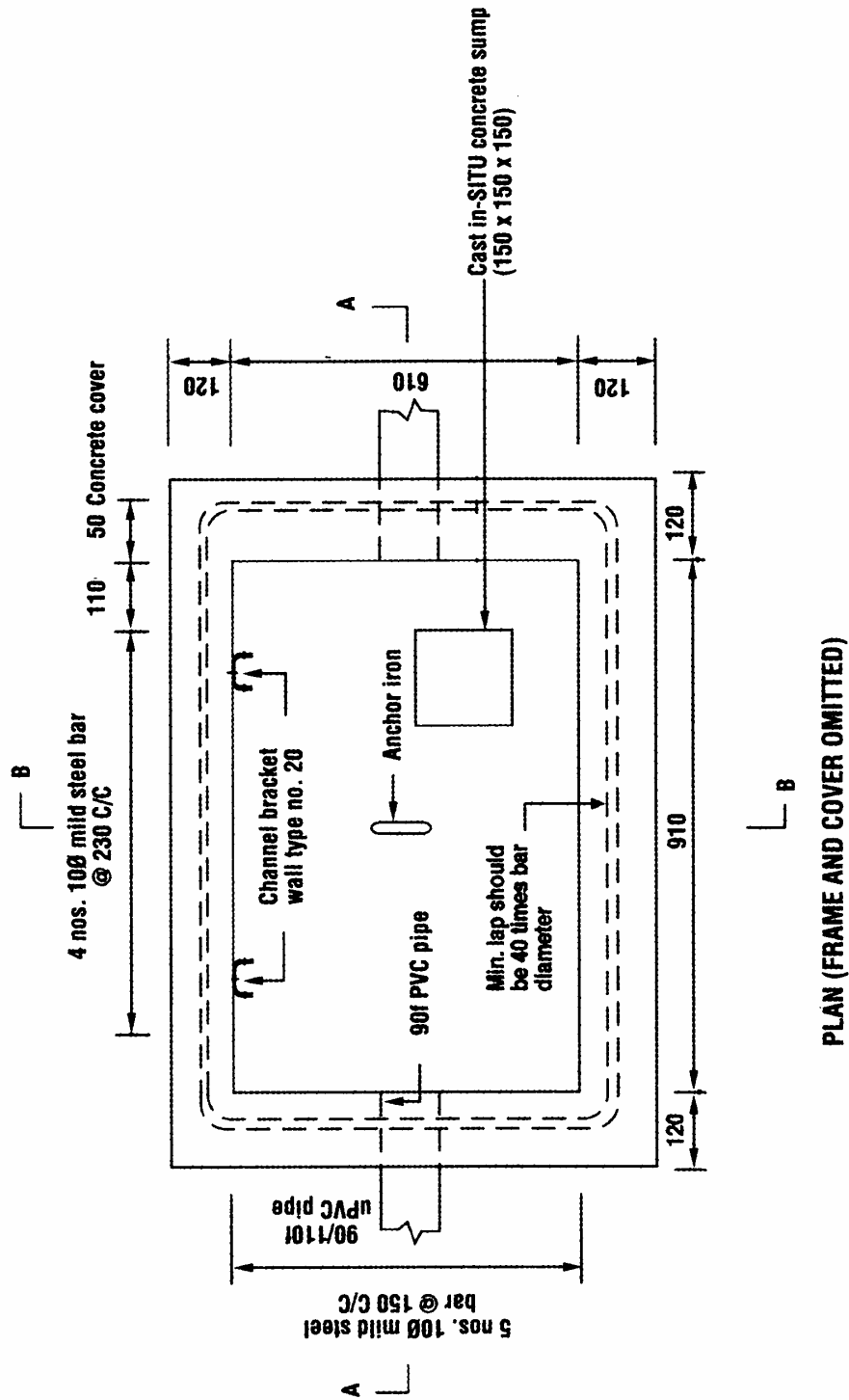


FIGURE 10.6: MANHOLE DRAWINGS - TYPE JX2

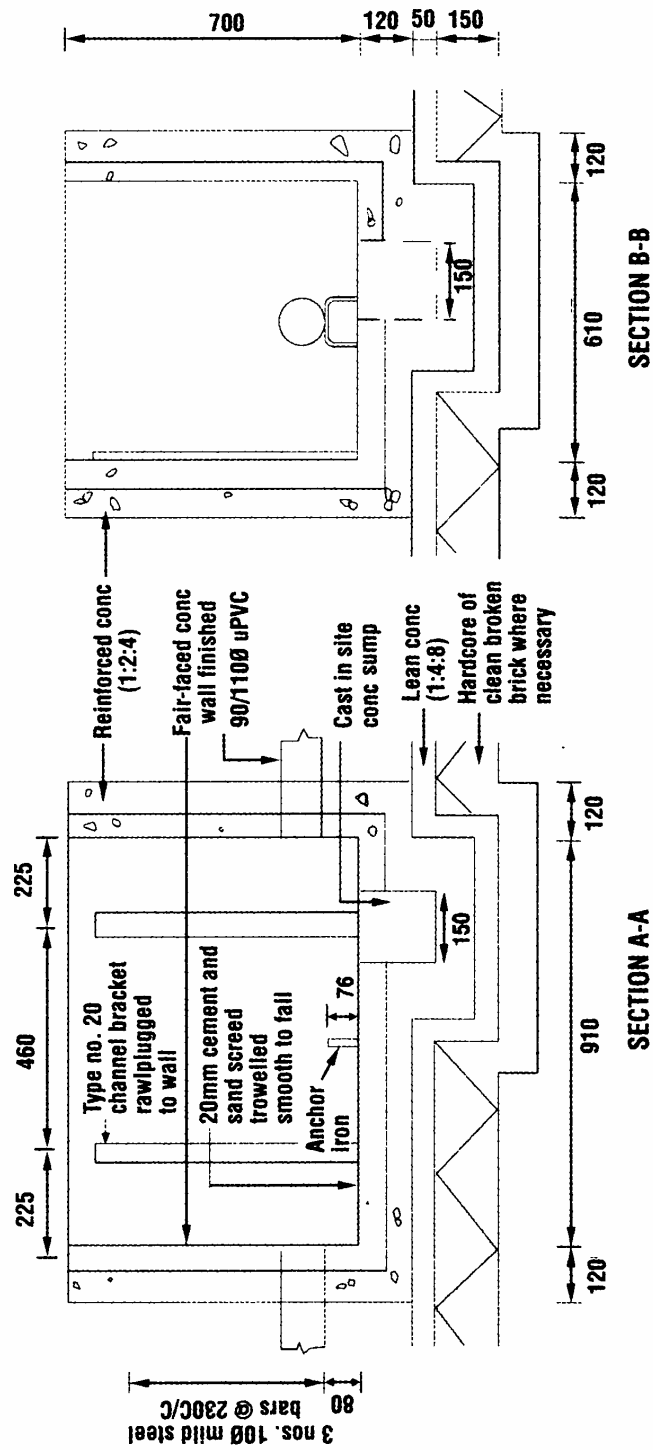


FIGURE 10.7: MANHOLE DRAWINGS - TYPE MX1

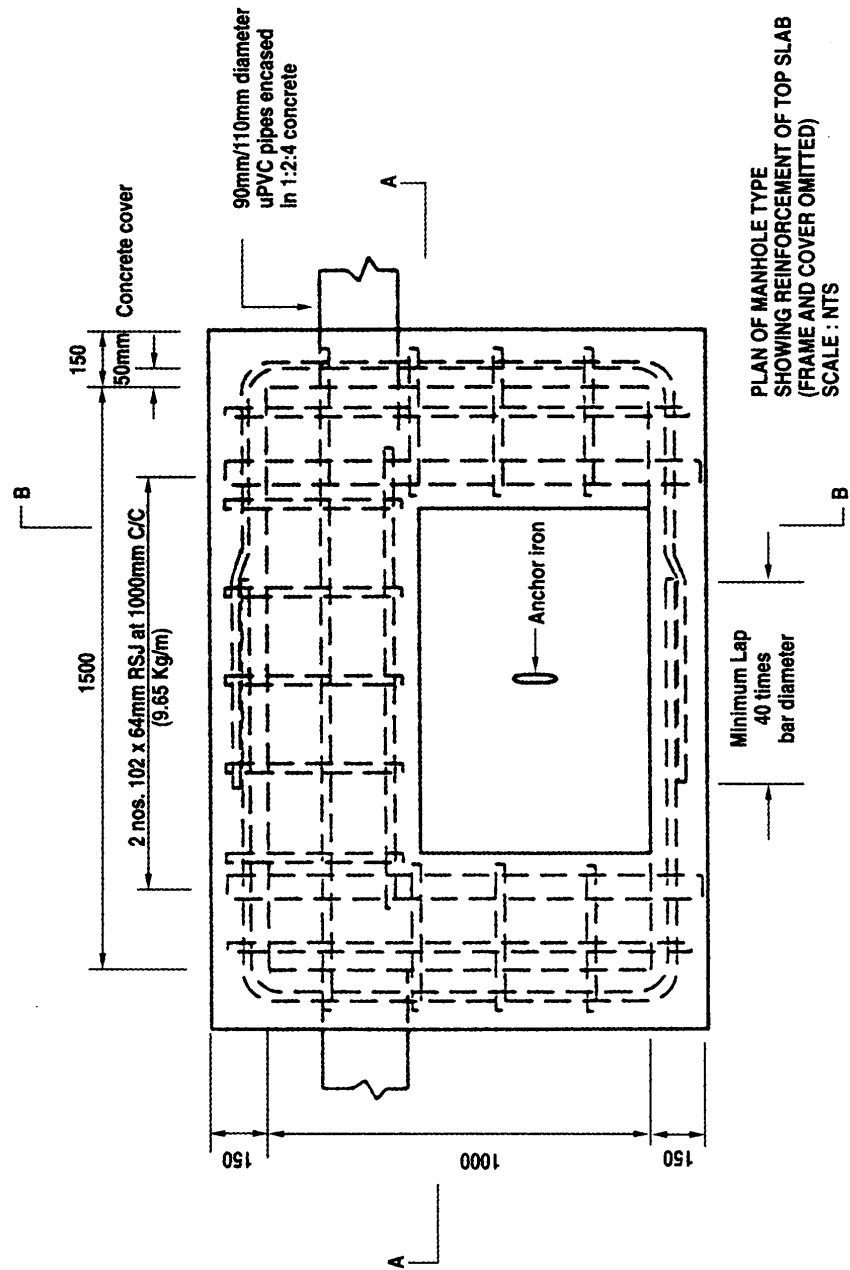


FIGURE 10.8: MANHOLE DRAWINGS - TYPE MX1

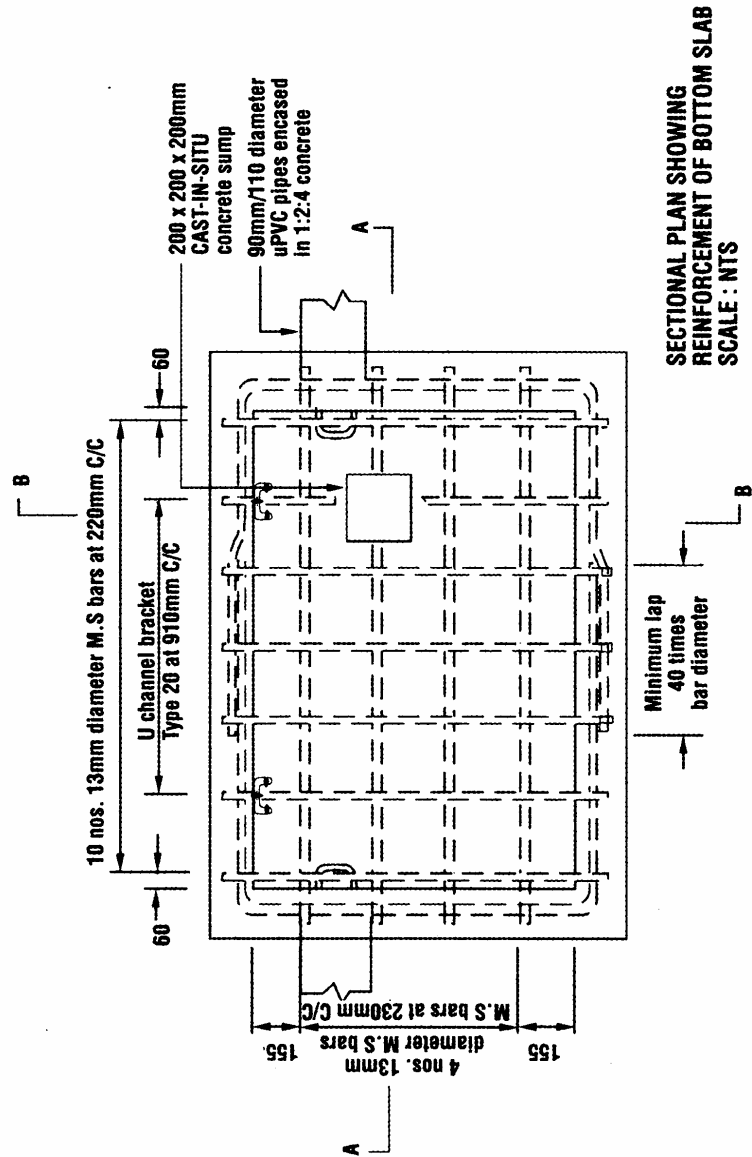


FIGURE 10.9: MANHOLE DRAWINGS - TYPE MX1

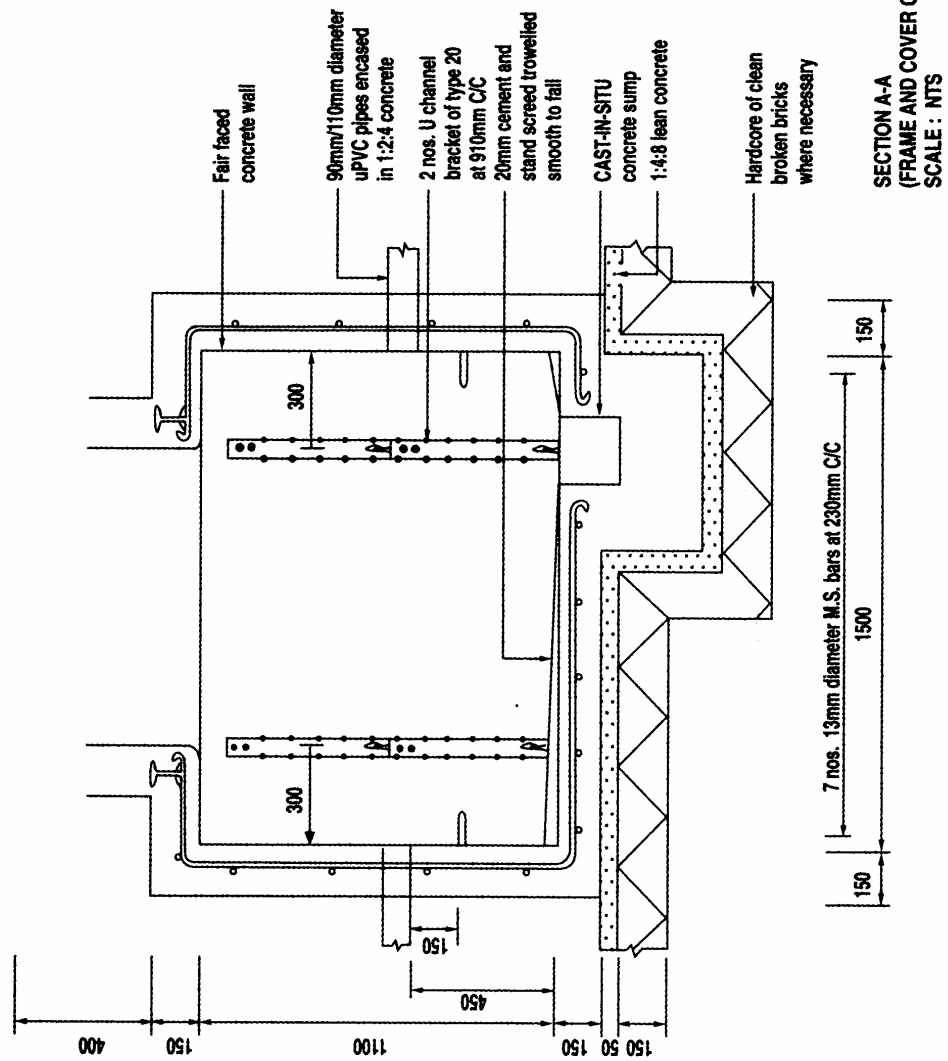
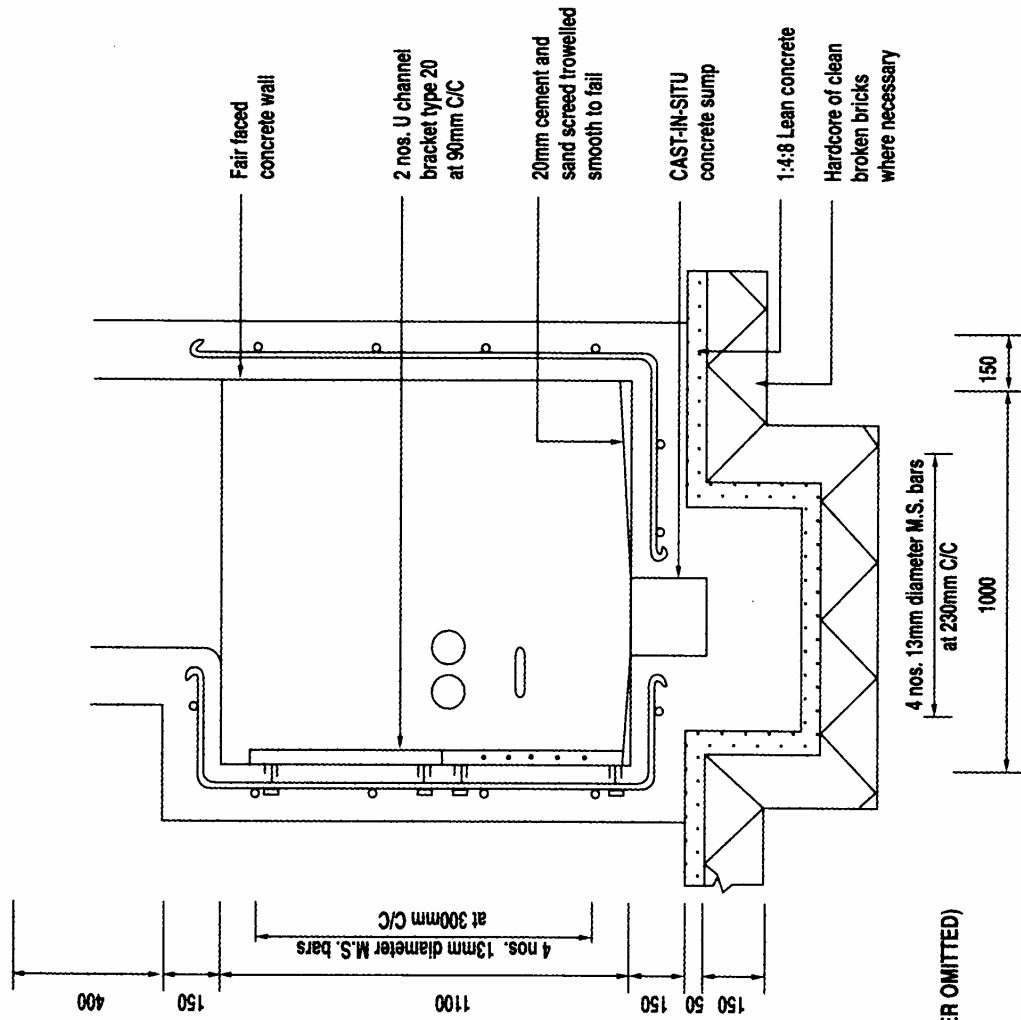


FIGURE 10.10: MANHOLE DRAWINGS - TYPE MX1



**SECTION B-B
(FRAME AND COVER OMITTED)
SCALE : NTS**

FIGURE 10.11: MANHOLE DRAWINGS - TYPE MX2

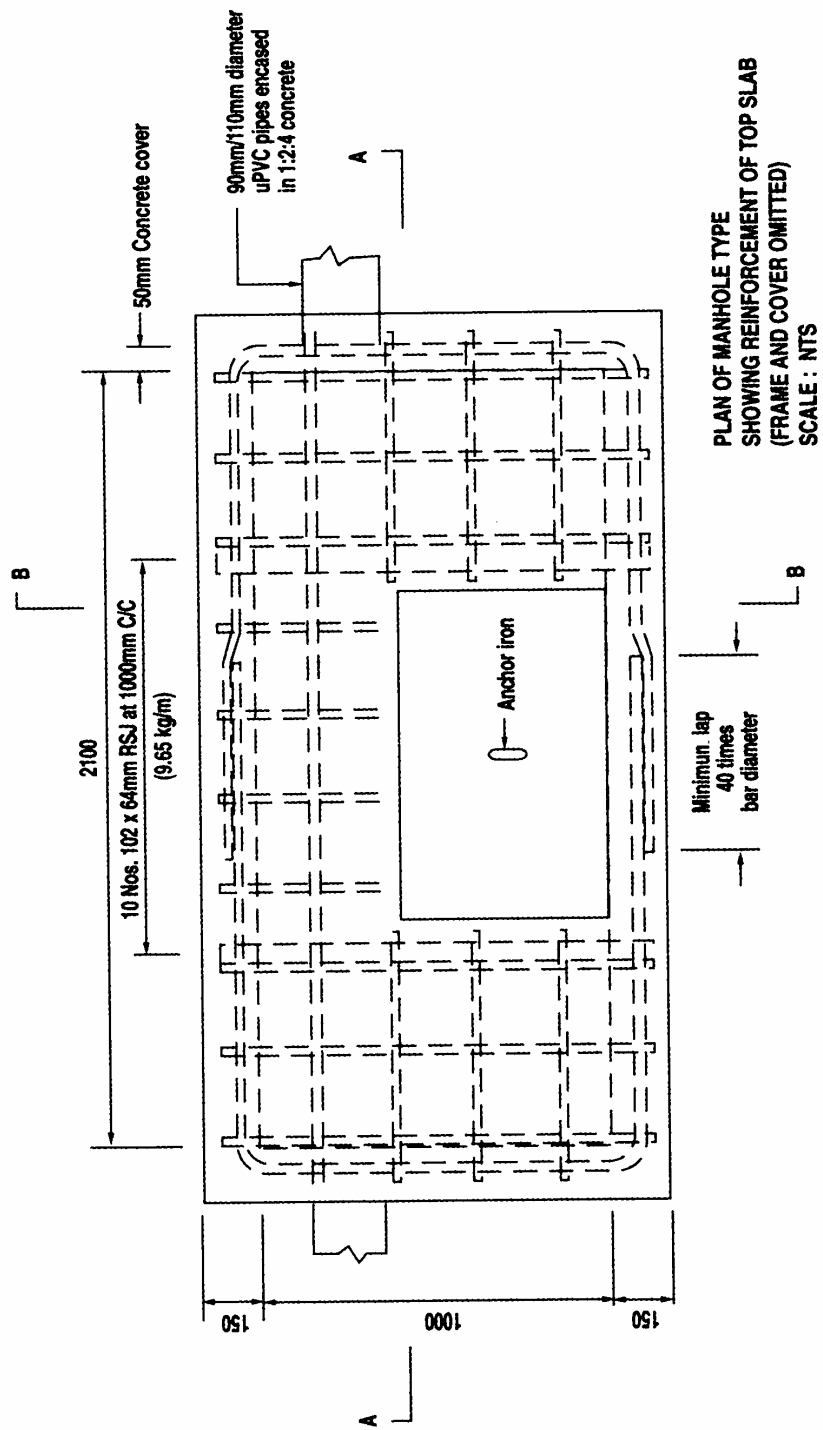


FIGURE 10.12: MANHOLE DRAWINGS - TYPE MX2

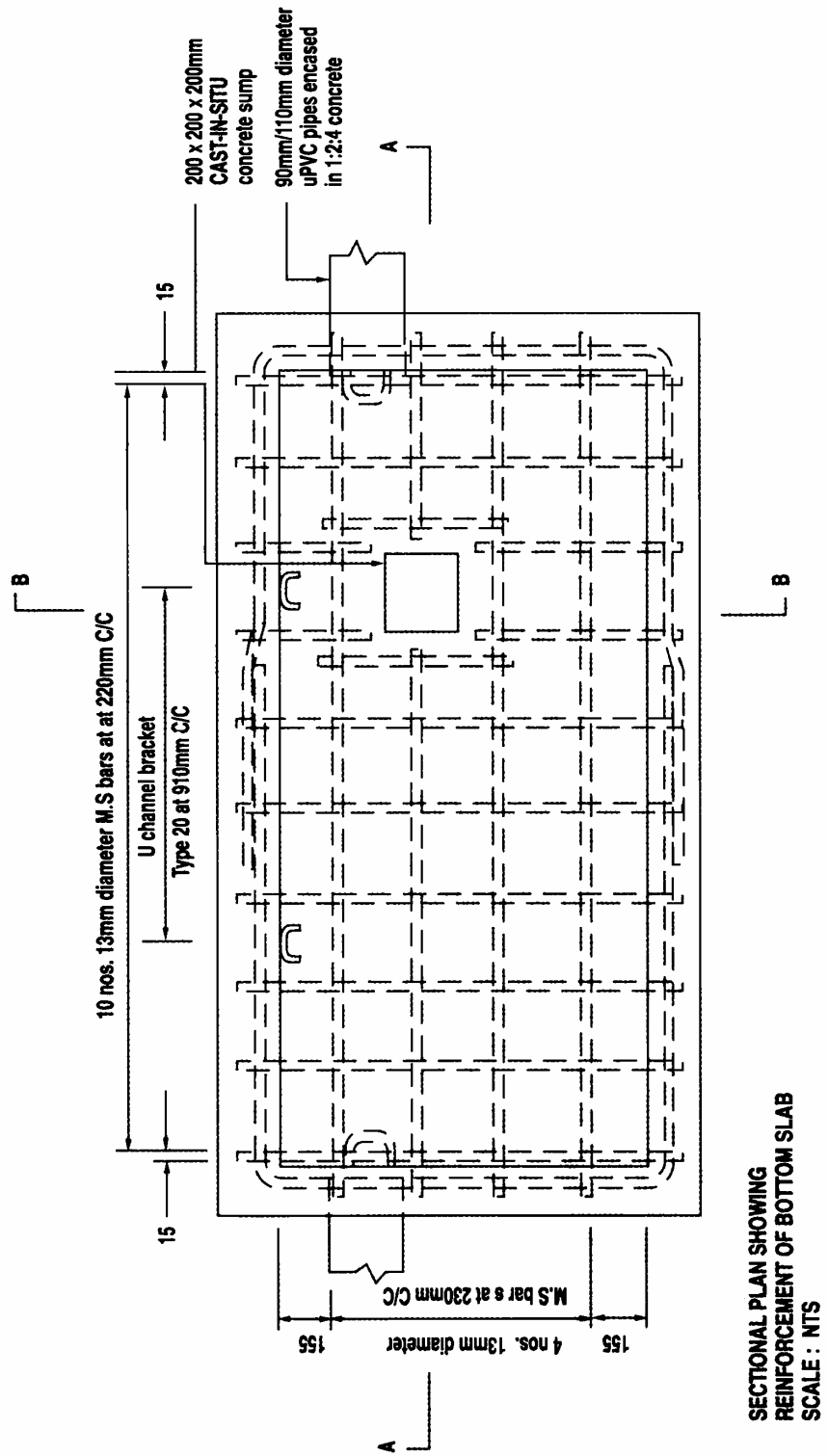


FIGURE 10.13: MANHOLE DRAWINGS - TYPE MX2

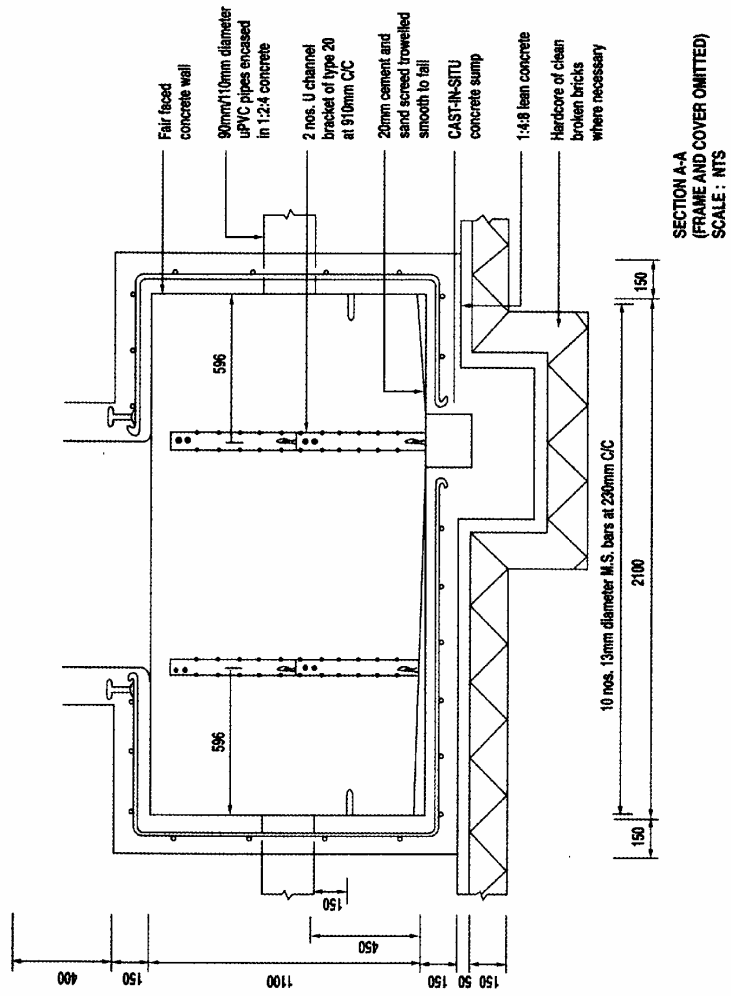
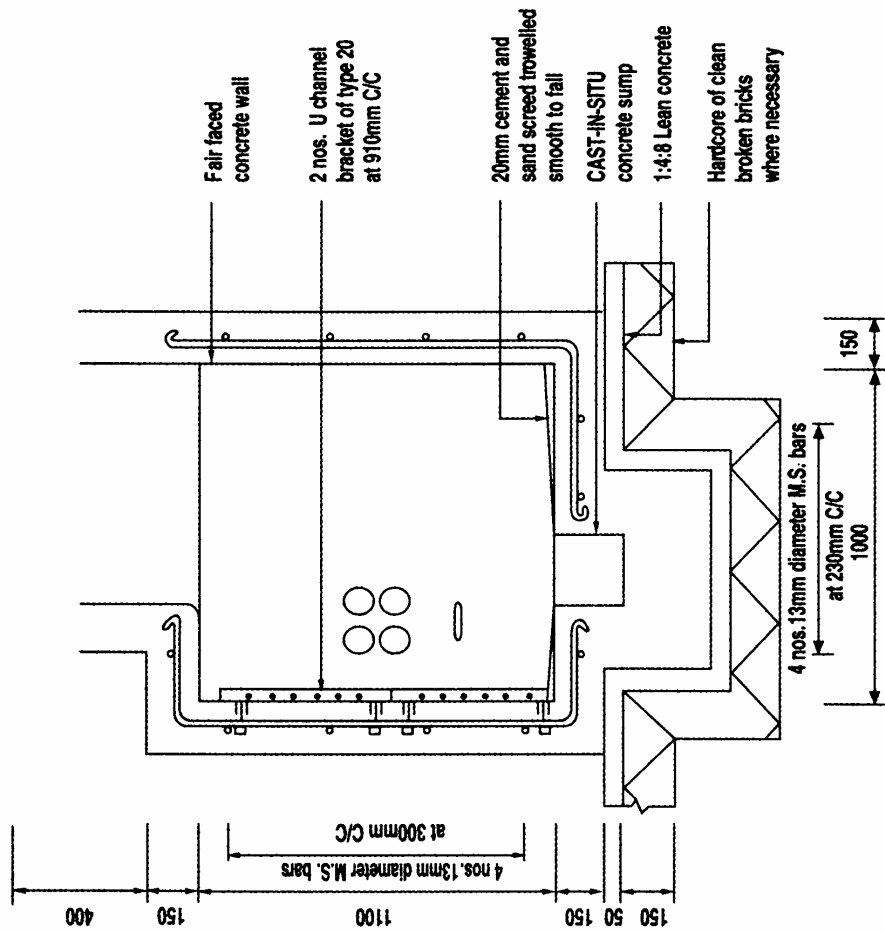
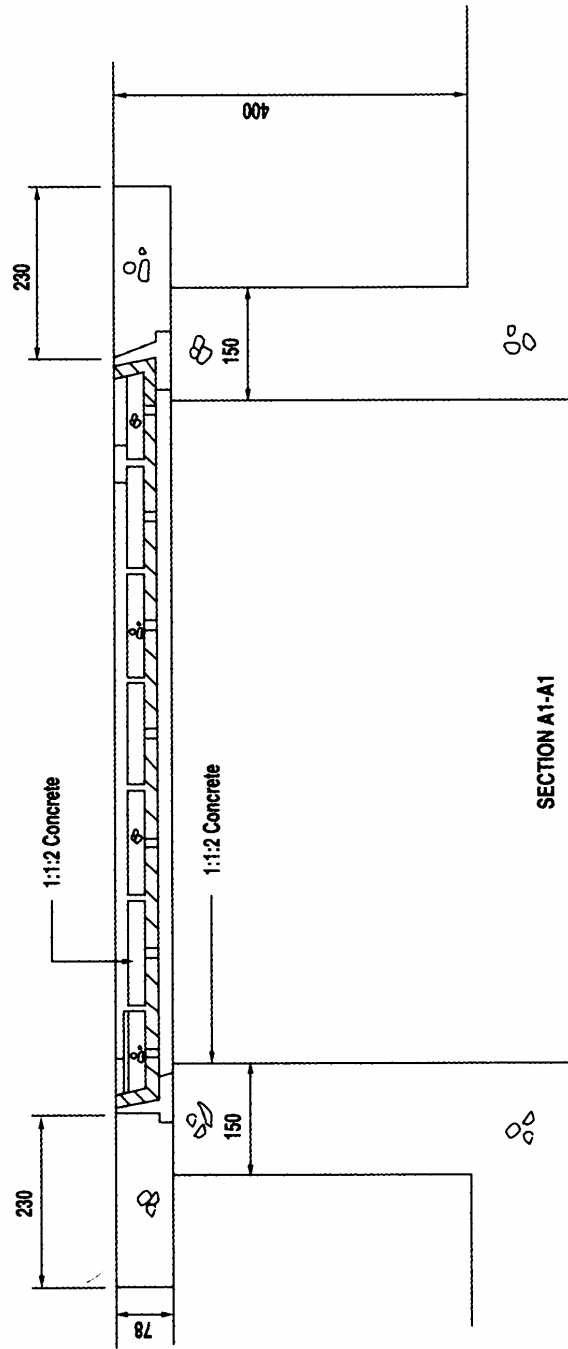


FIGURE 10.14: MANHOLE DRAWINGS - TYPE MX2



SECTION B-B
(FRAME AND COVER OMITTED)
SCALE: NTS

FIGURE 10.15: MANHOLE DRAWINGS - TYPE MX1 & MX2



SECTION A1-A1
DETAIL OF MANHOLE SHAFT
FOR TYPE MX 1 AND MX 2
WITH MEDIUM DUTY FRAME
AND COVER
SCALE : NTS

FIGURE 10.16: MANHOLE DRAWINGS - TYPE MX1 & MX2

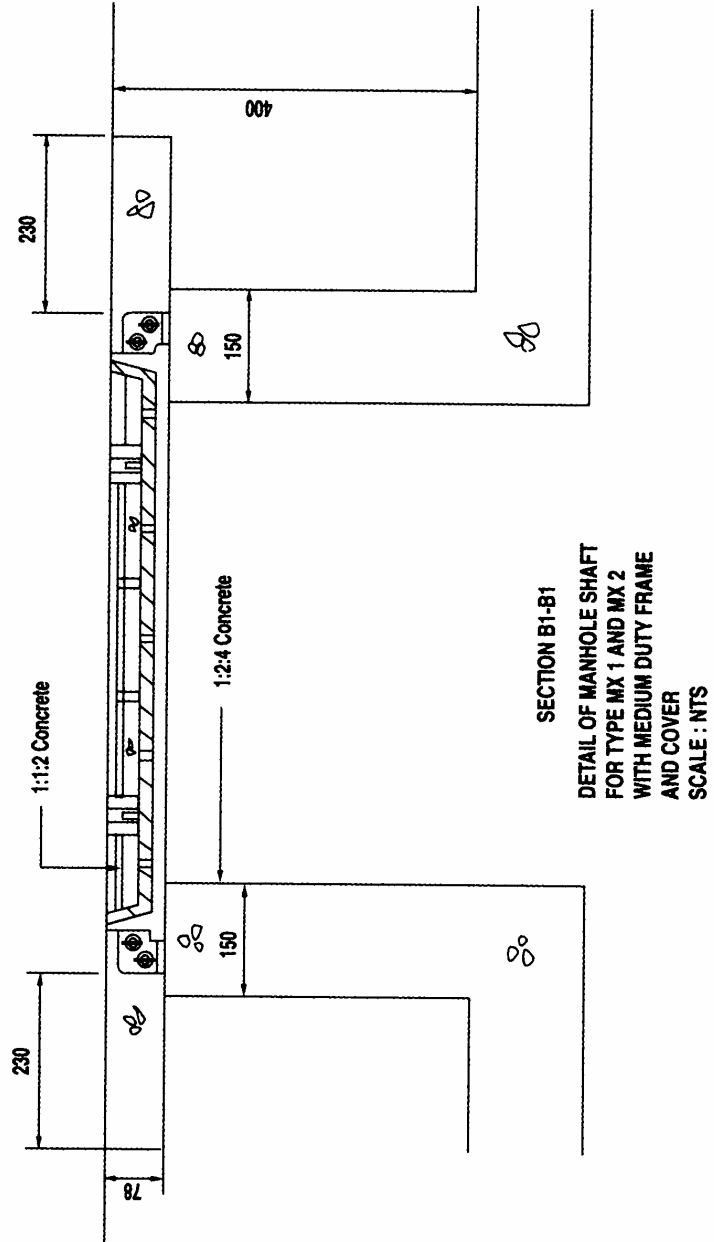
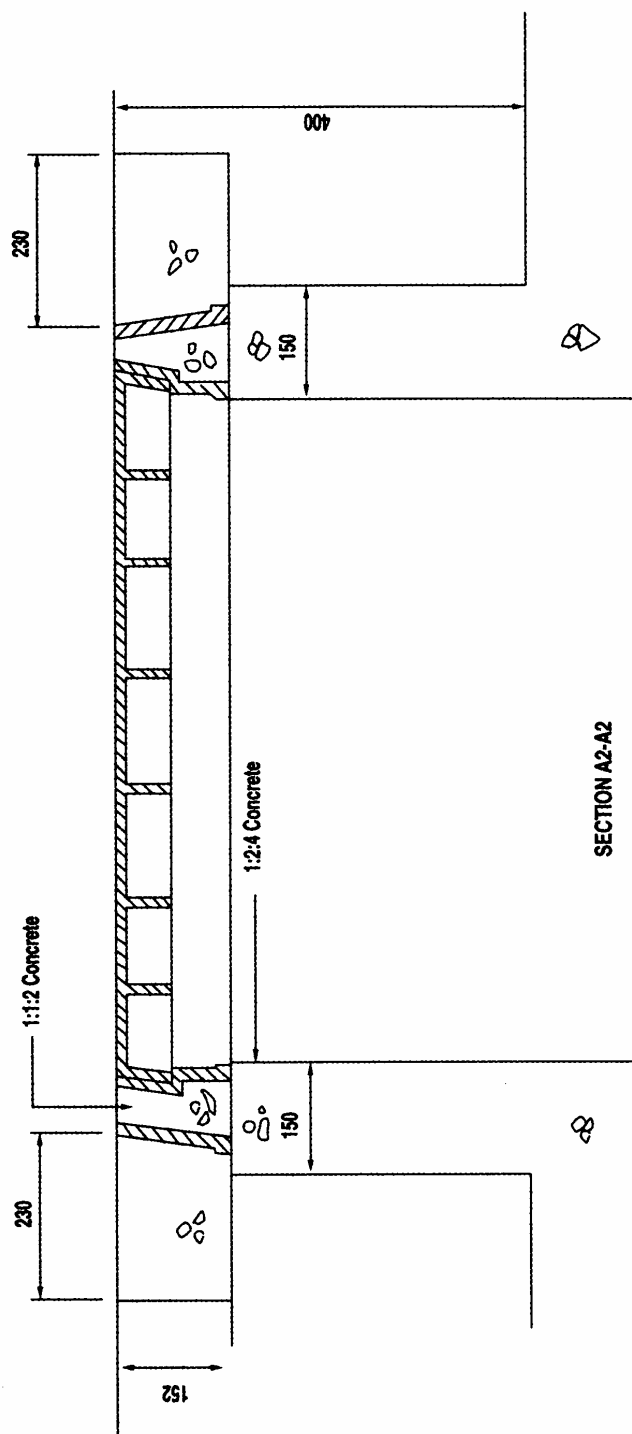


FIGURE 10.17: MANHOLE DRAWINGS - TYPE MX1 & MX2



SECTION A2-A2

DETAIL OF MANHOLE SHAFT
FOR TYPE MX 1 AND MX 2
WITH HEAVY DUTY FRAME
AND COVER COMPLIED WITH SS:30
SCALE: NTS

FIGURE 10.18: MANHOLE DRAWINGS - MX1 & MX2

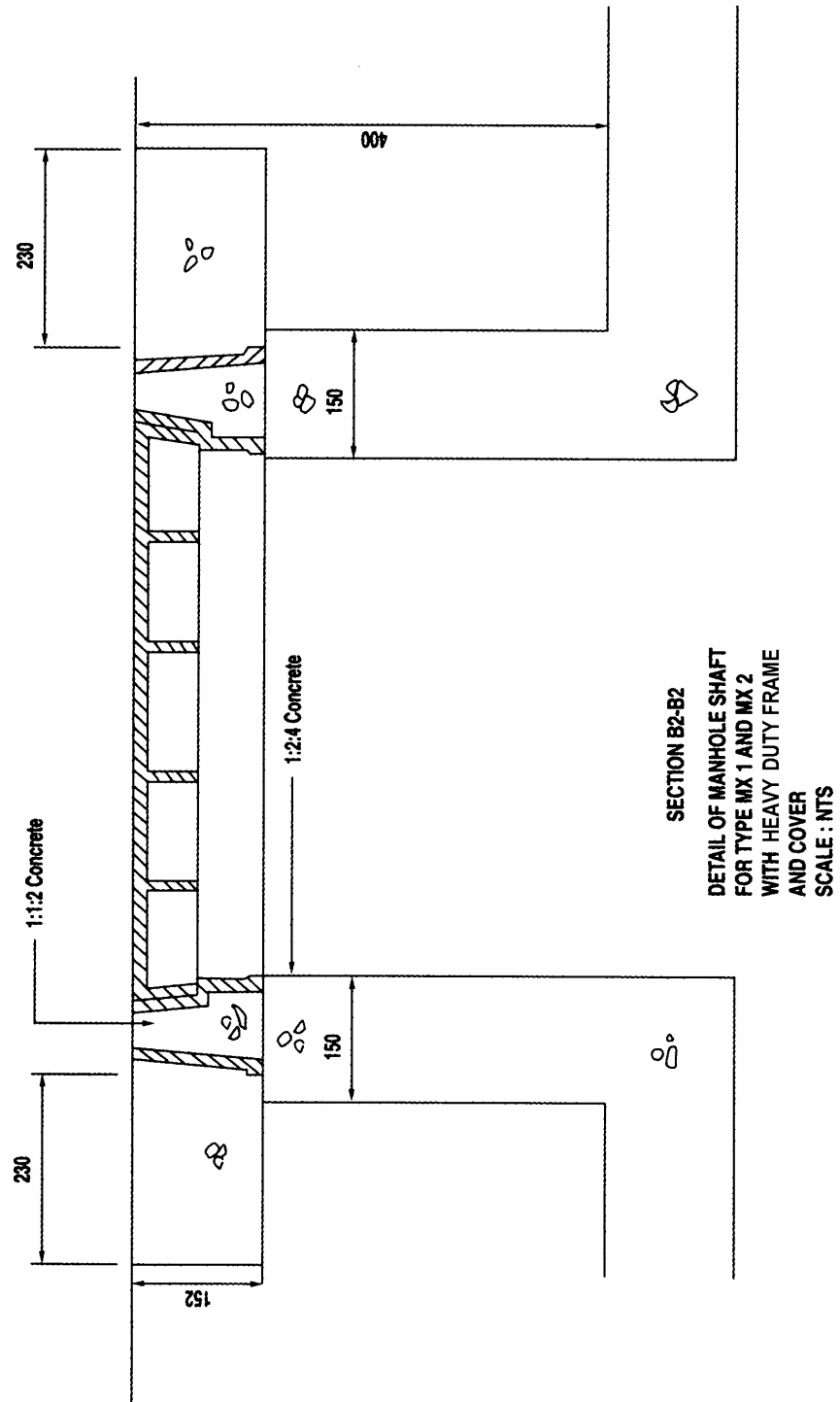
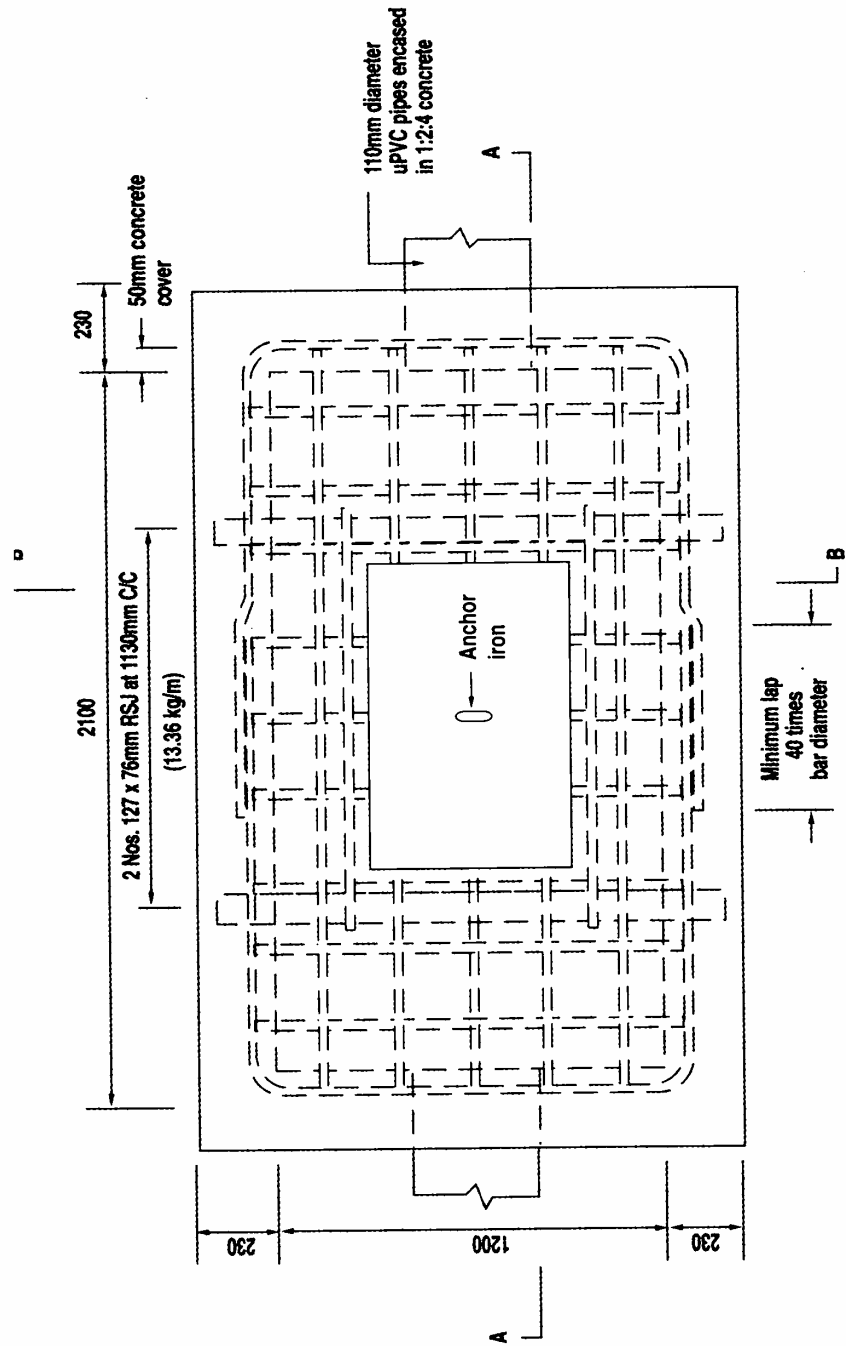


FIGURE 10.19: MANHOLE DRAWING - TYPE MX3



**PLAN OF MANHOLE TYPE
SHOWING REINFORCEMENT OF TOP SLAB
(FRAME AND COVER OMITTED)
SCALE : NTS**

FIGURE 10.20: MANHOLE DRAWINGS - TYPE MX3

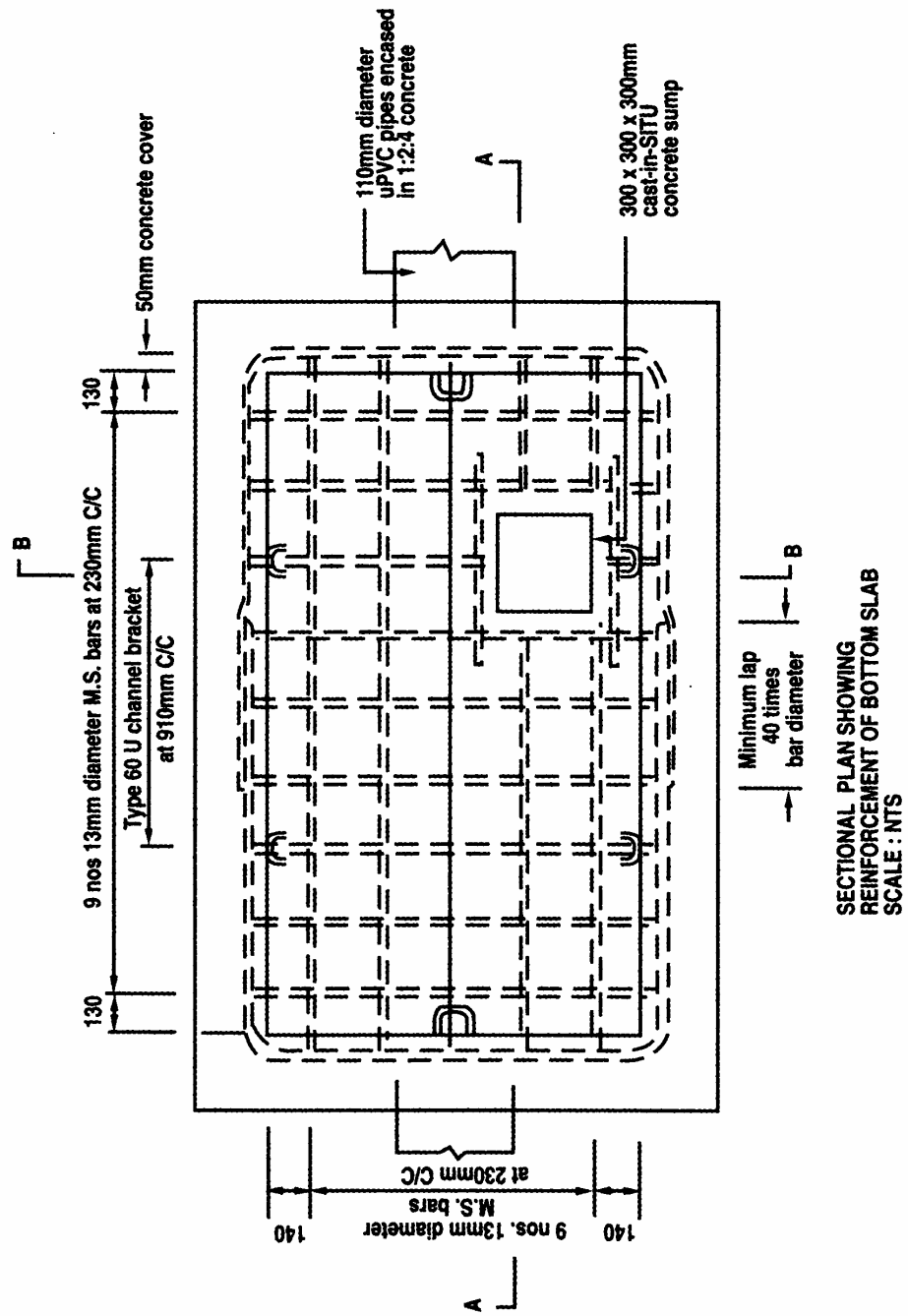


FIGURE 10.21: MANHOLE DRAWINGS - TYPE MX3

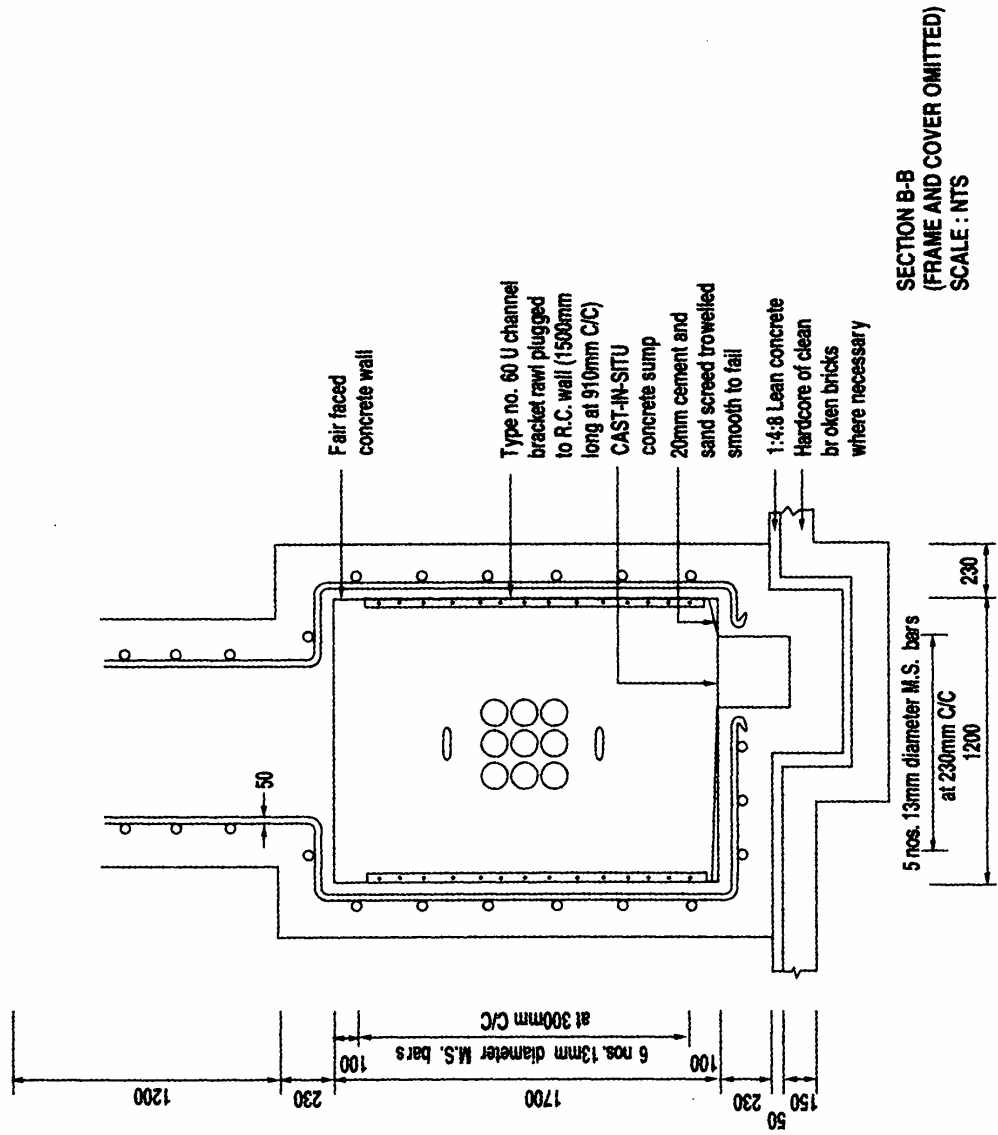
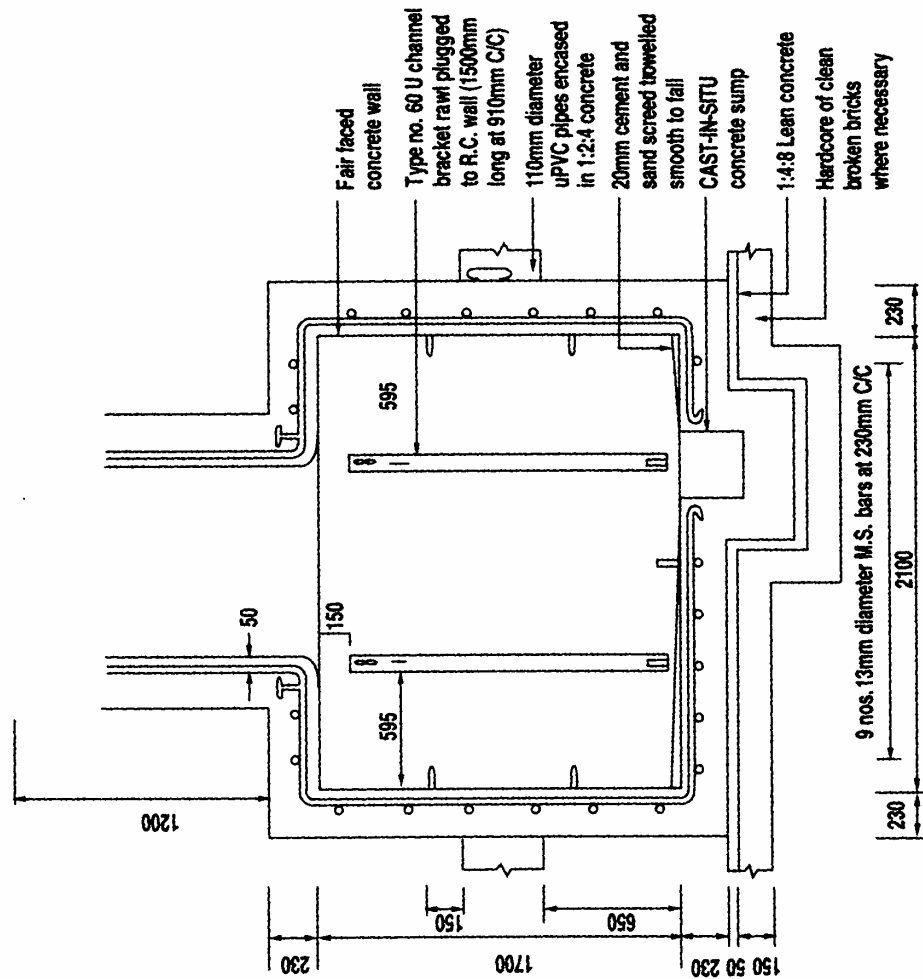


FIGURE 10.22: MANHOLE DRAWINGS - MX3



SECTION A-A
 (FRAME AND COVER OMITTED)
 SCALE : NTS

FIGURE 10.23: MANHOLE DRAWINGS - TYPE MX3 & ABOVE

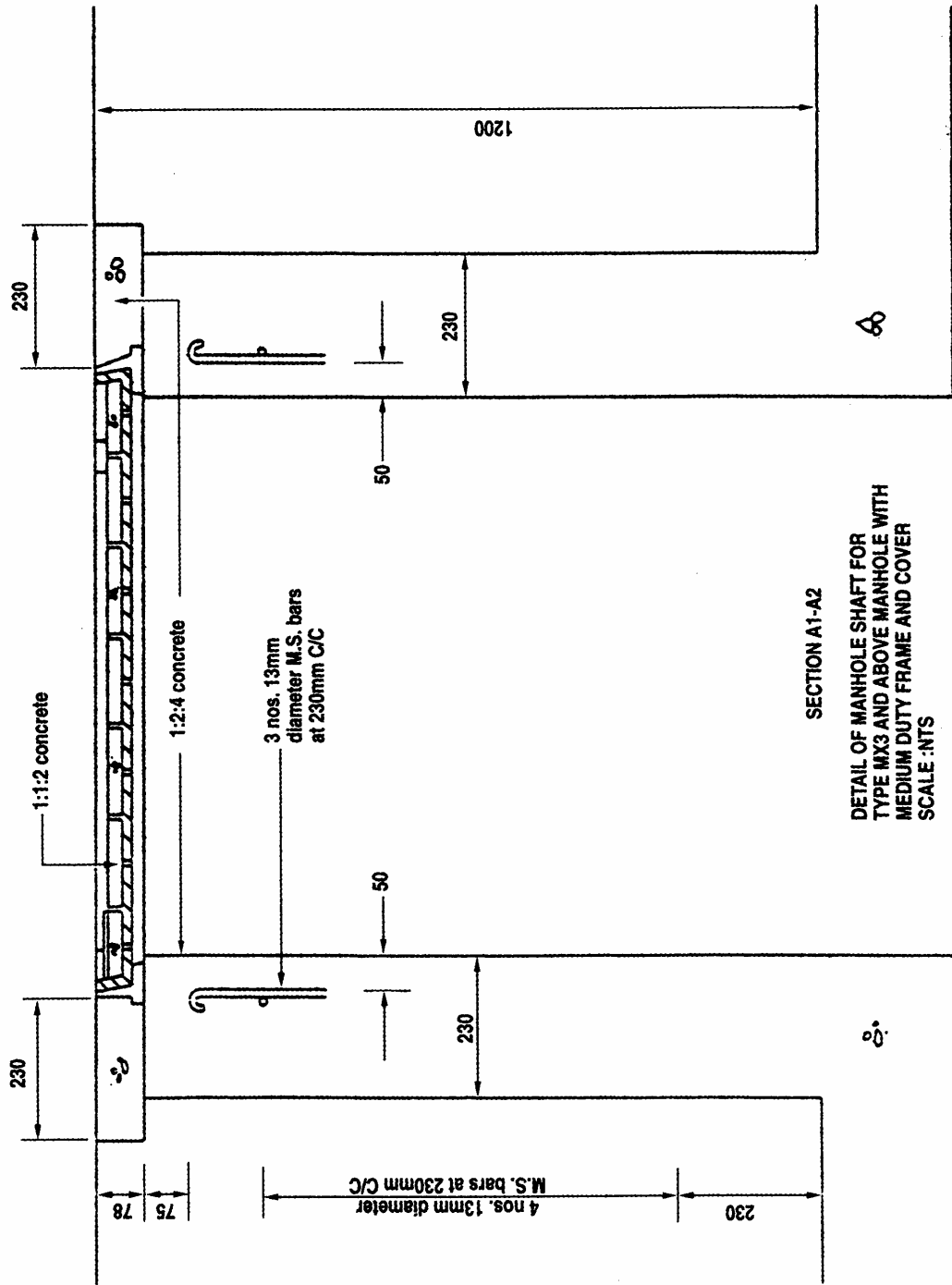


FIGURE 10.24: MANHOLE DRAWINGS - TYPE MX3 & ABOVE

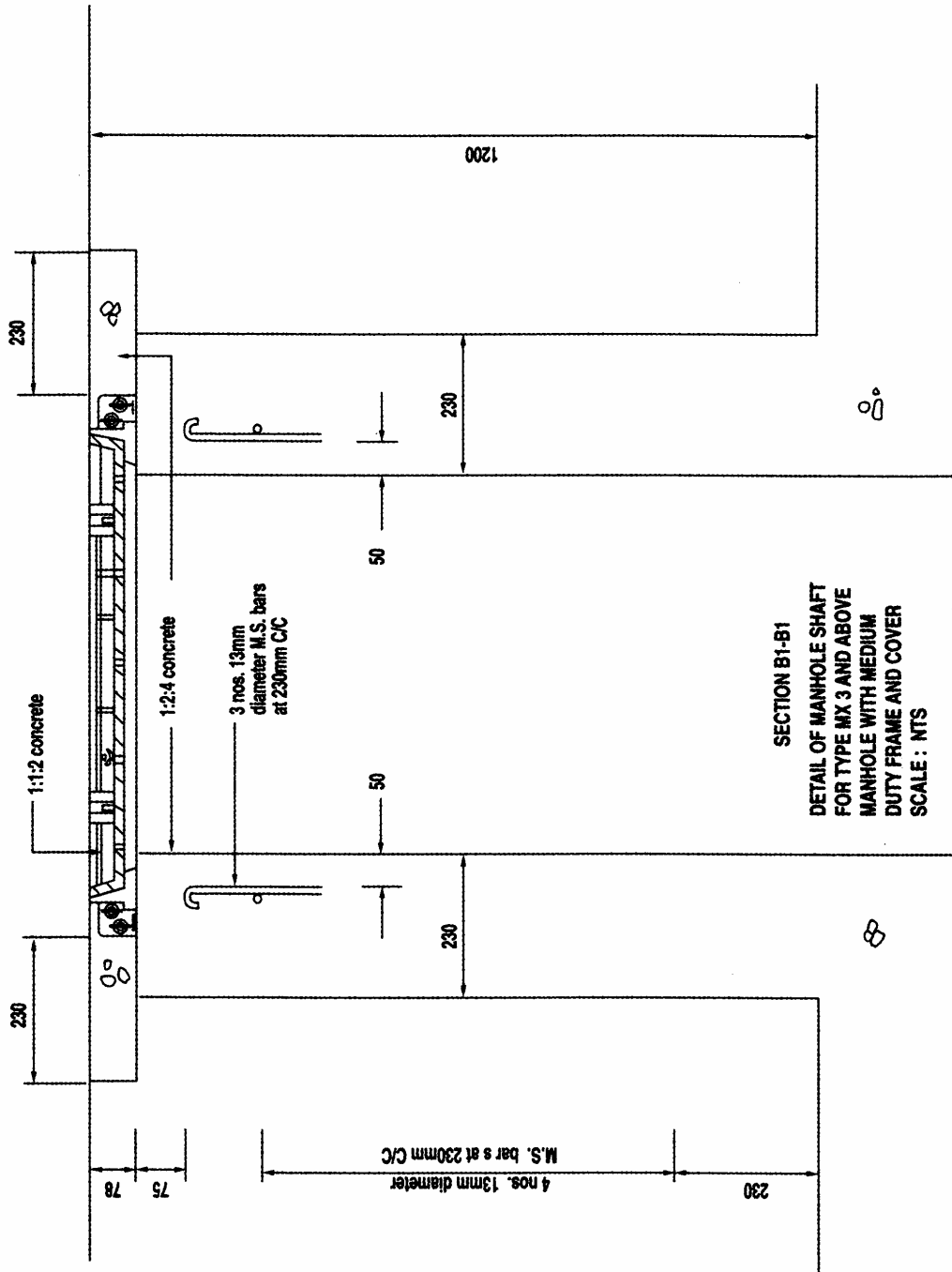


FIGURE 10.25: MANHOLE DRAWINGS - TYPE MX3 & ABOVE

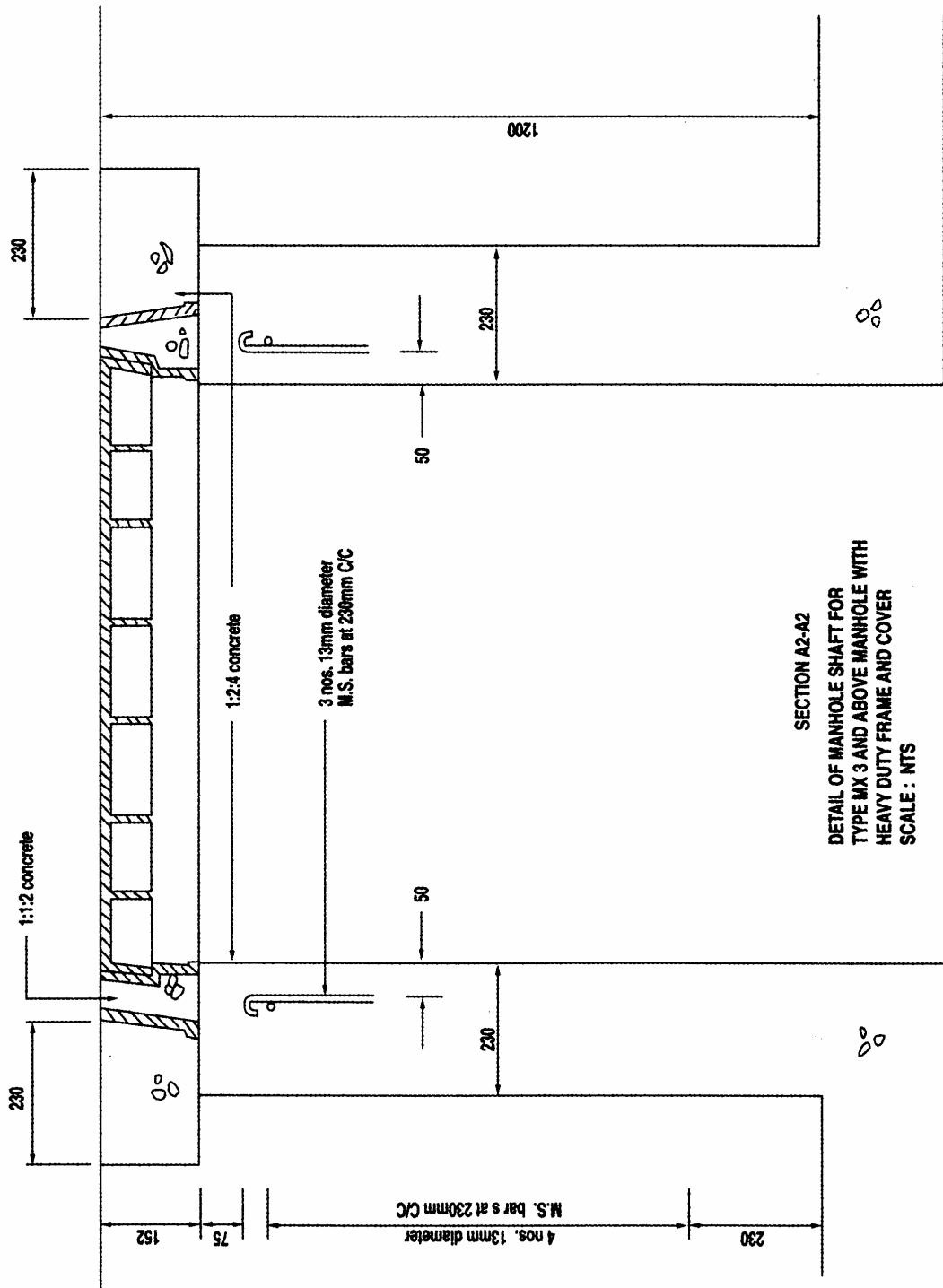


FIGURE 10.26: MANHOLE DRAWINGS - TYPE MX3 & ABOVE

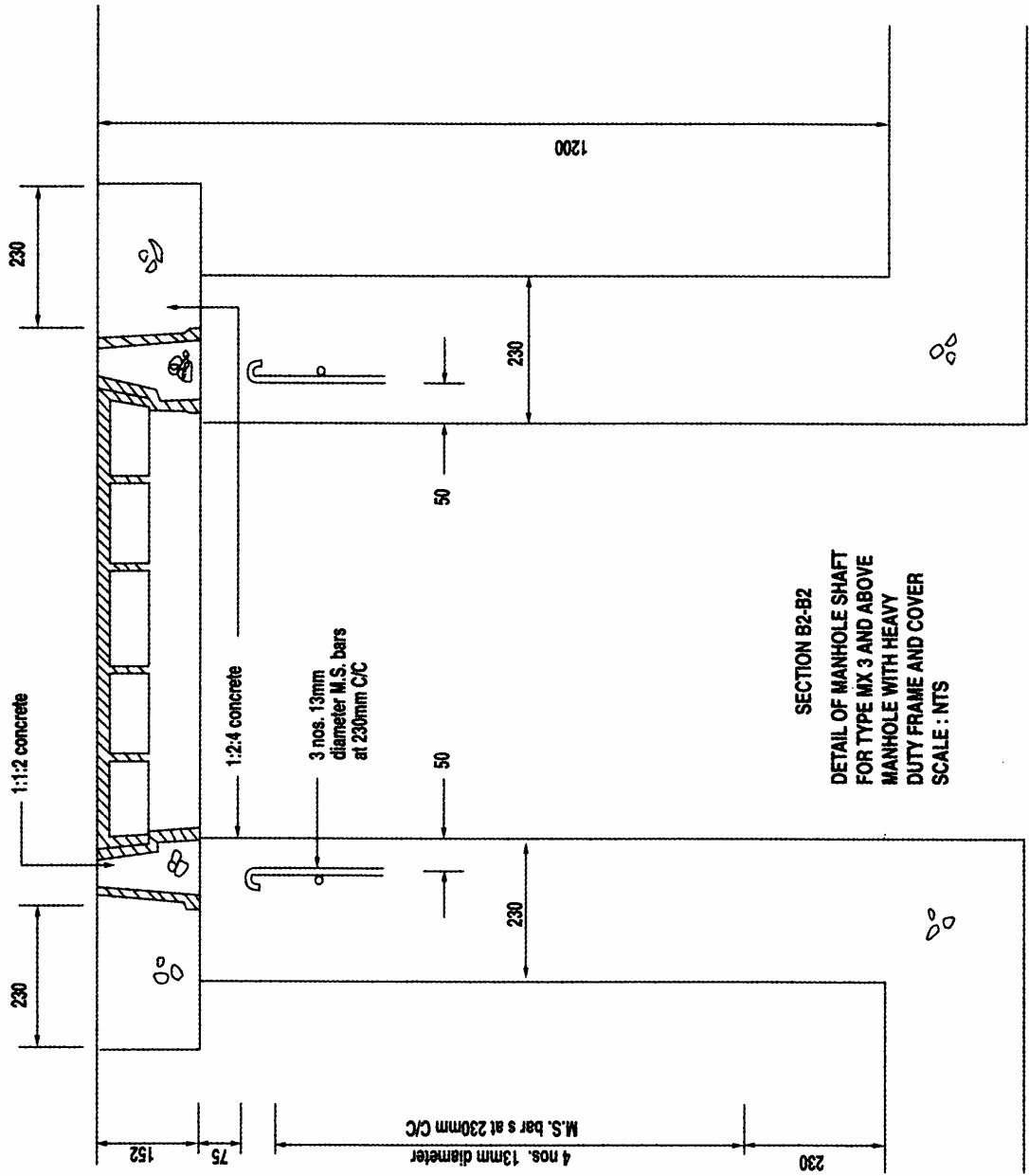
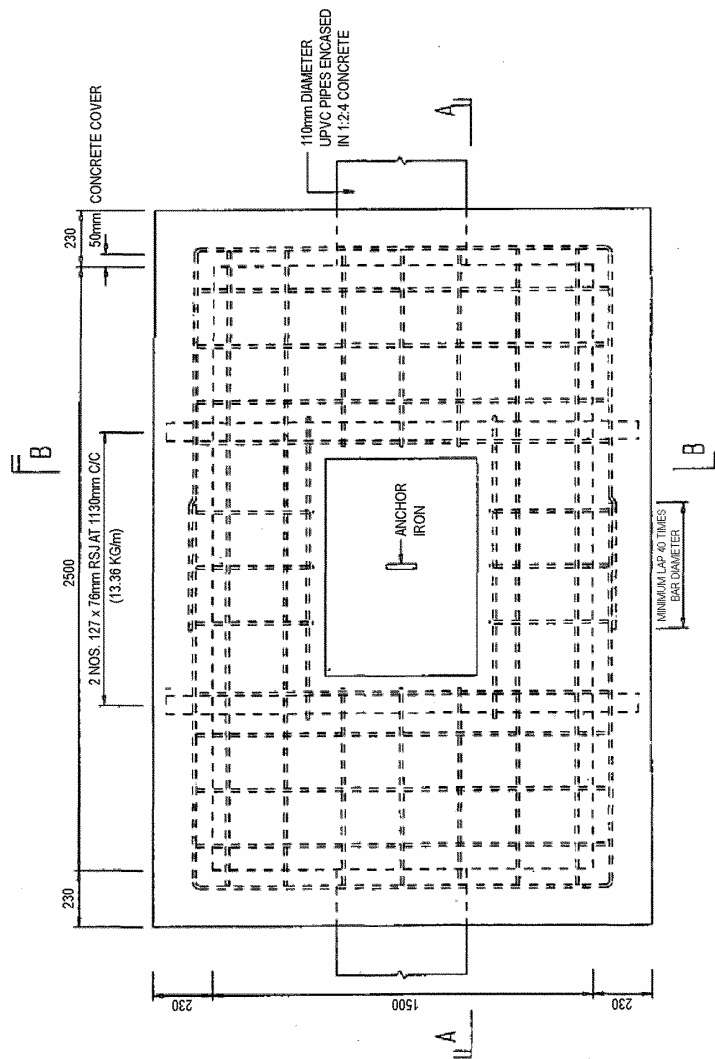
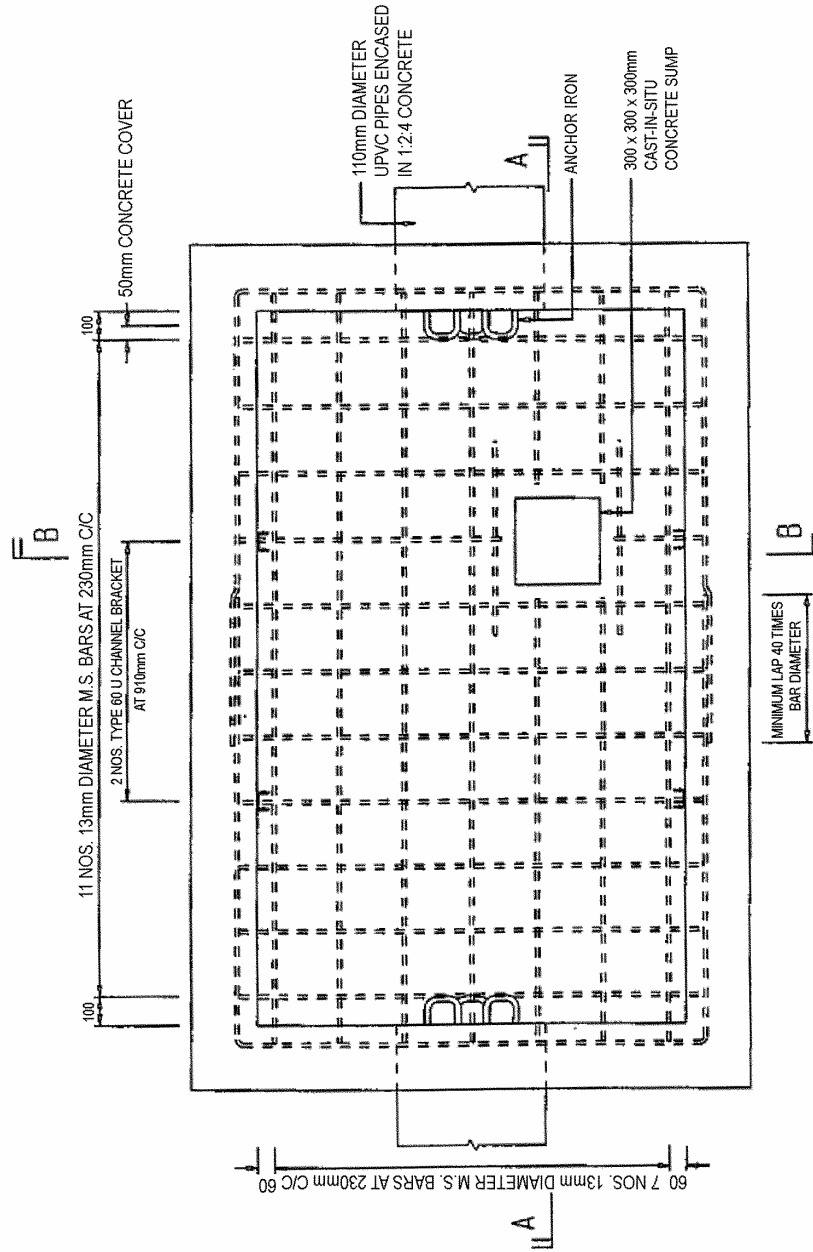


FIGURE 10.27: MANHOLE DRAWINGS - TYPE MX4



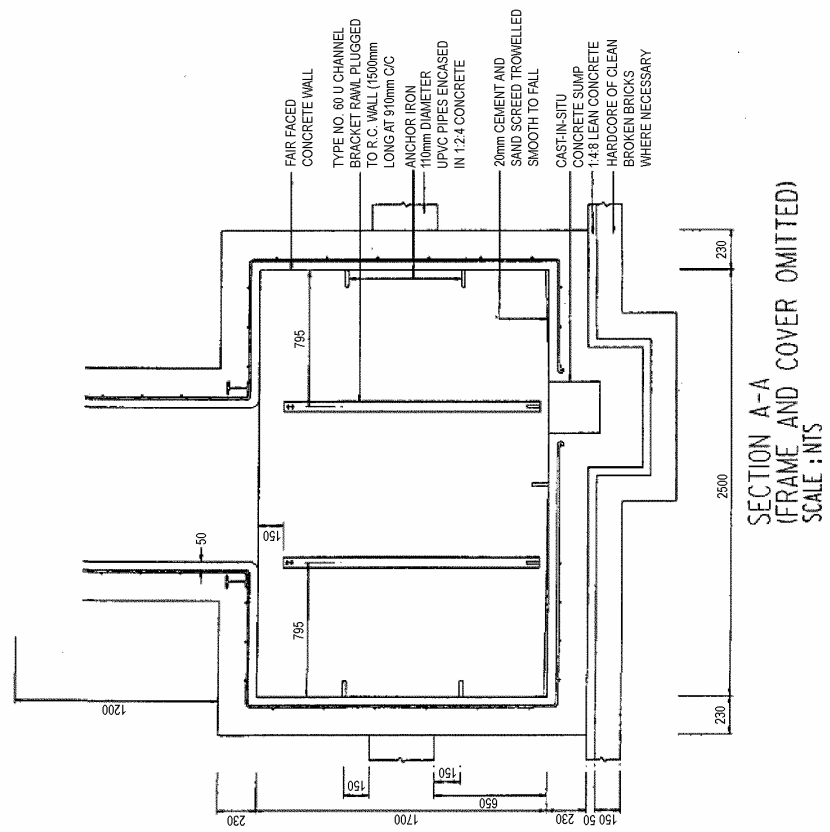
PLAN OF MANHOLE
 SHOWING REINFORCEMENT OF TOP SLAB
 (FRAME AND COVER OMITTED)
 SCALE: NTS

FIGURE 10.28: MANHOLE DRAWINGS - TYPE MX4



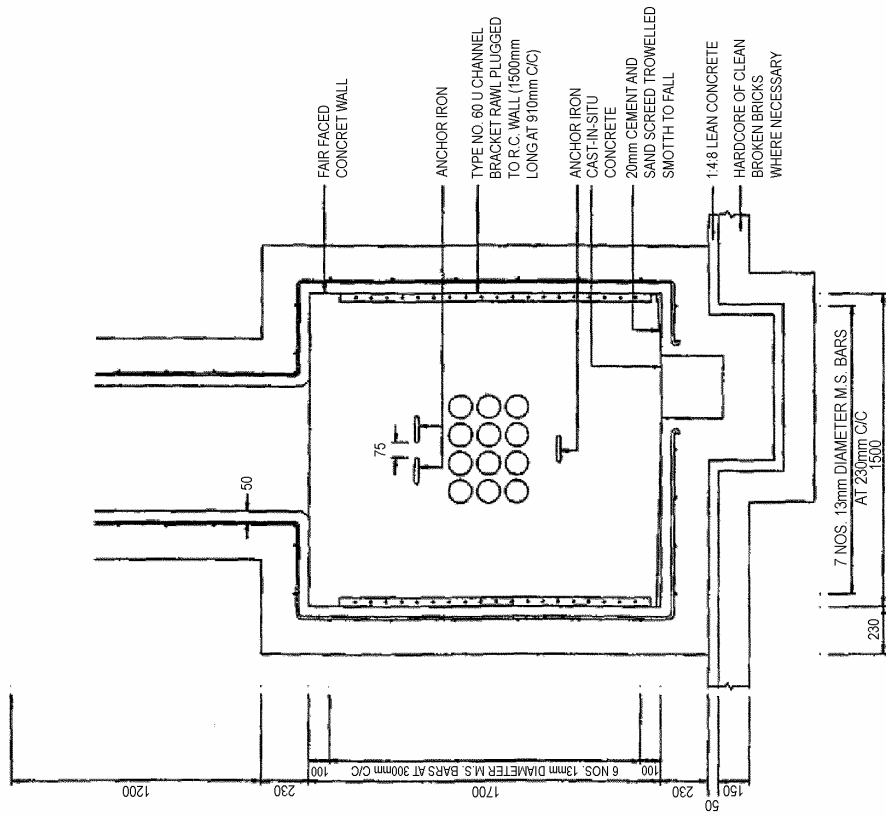
SECTIONAL PLAN OF MANHOLE
SHOWING REINFORCEMENT OF BOTTOM SLAB
SCALE: NTS

FIGURE 10.29: MANHOLE DRAWINGS - TYPE MX4



SECTION A-A
(FRAME AND COVER OMITTED)
SCALE : NTS

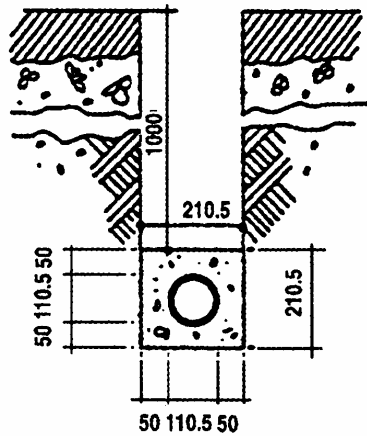
FIGURE 10.30: MANHOLE DRAWINGS - TYPE MX4



**SECTION B-B
(FRAME AND COVER OMITTED)**

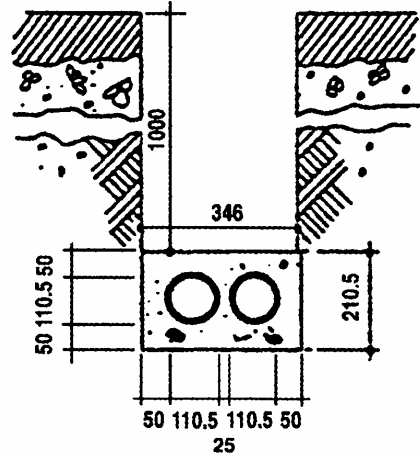
SCALE : NTS

FIGURE 10.31: DRAWINGS OF MULTI-WAY PIPELINES



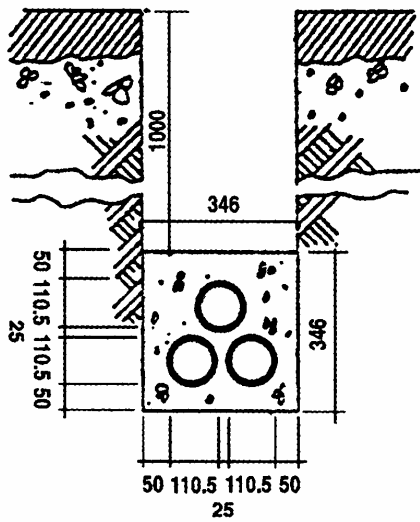
SECTION

**1 way pipe formation
DRAWING NO 1**



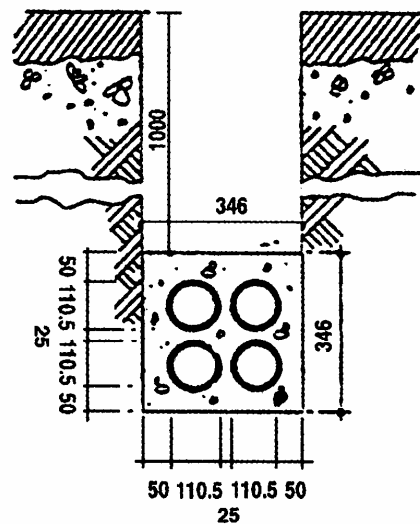
SECTION

**2 way pipe formation
DRAWING NO 1a**



SECTION

**3 way pipe formation
DRAWING NO 1b**



SECTION

**4 way pipe formation
DRAWING NO 1c**

FIGURE 10.31: DRAWINGS OF MULTI-WAY PIPELINES (CONT'D)

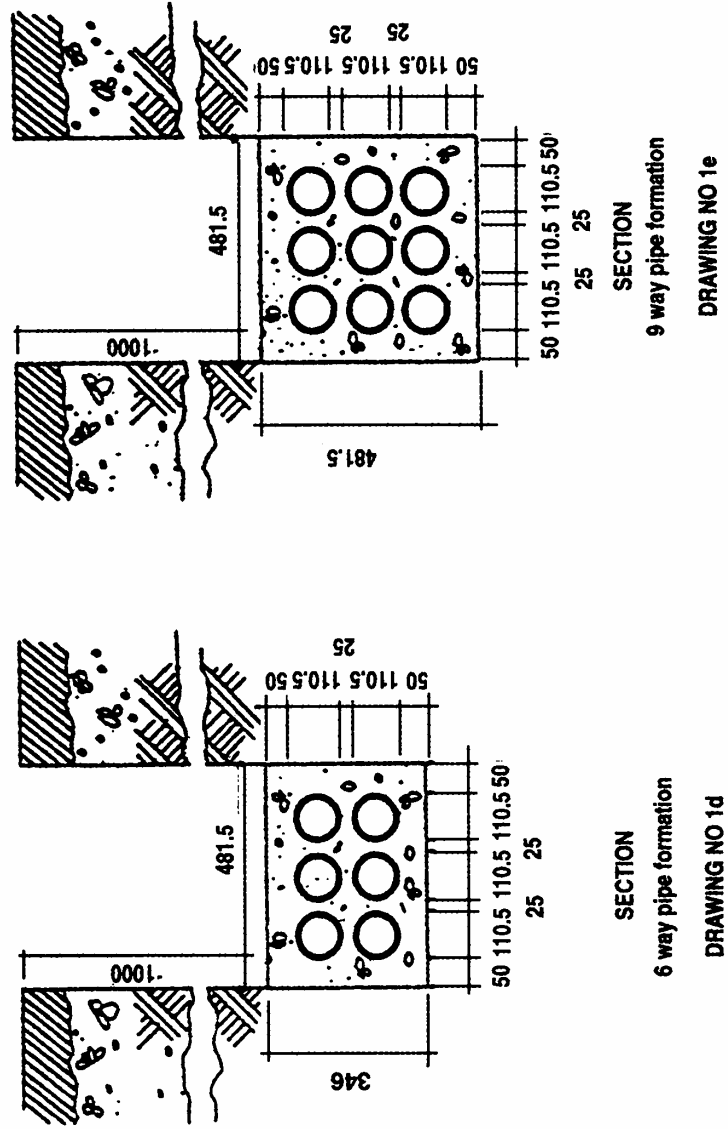
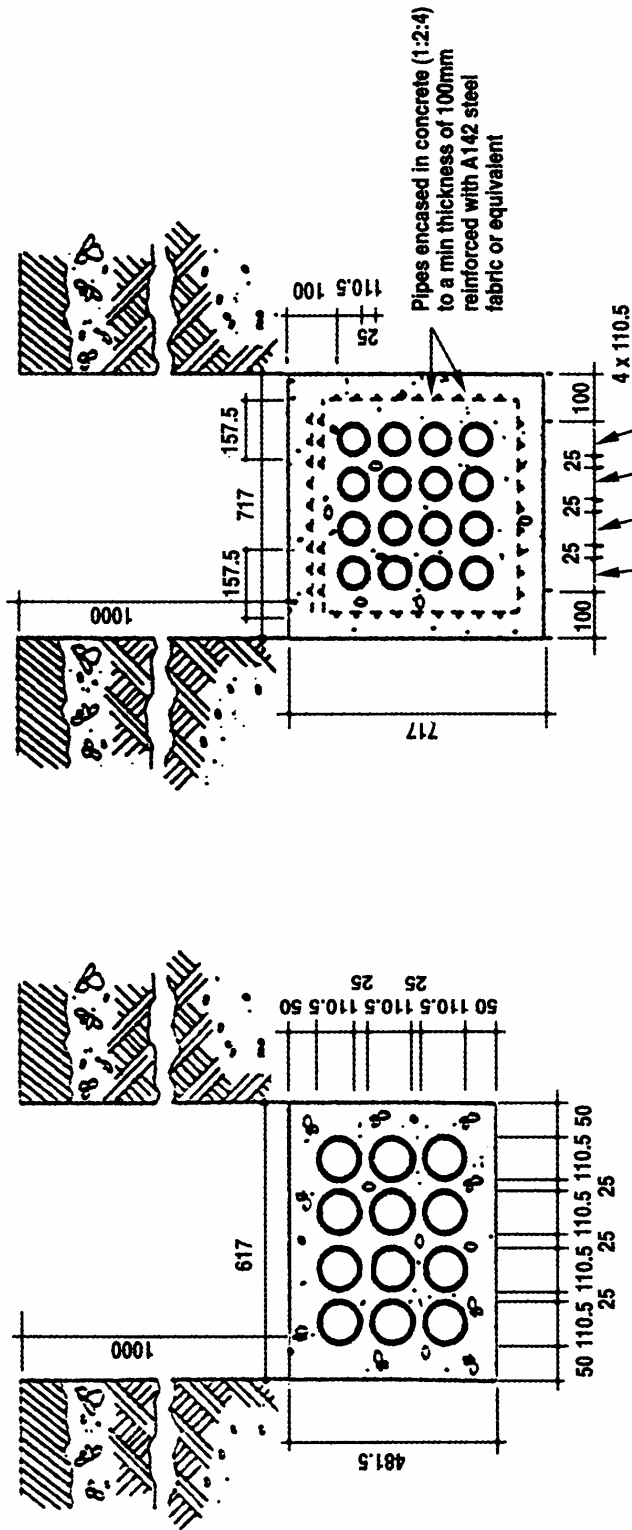


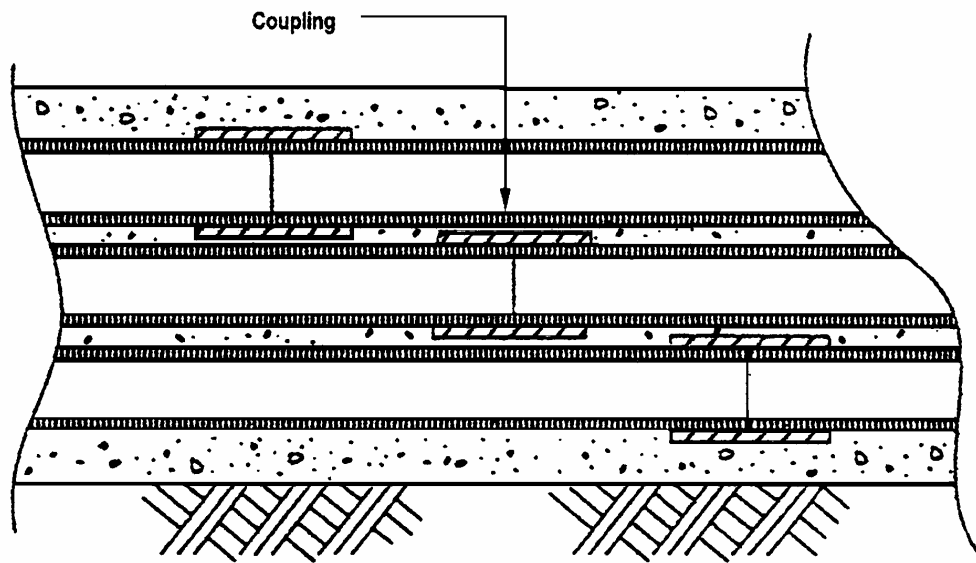
FIGURE 10.31: DRAWINGS OF MULTI-WAY PIPELINES (CONT'D)



SECTION
12 Way pipe formation
DRAWING NO 1f

SECTION
16 Wat pipe formation
DRAWING NO 1g

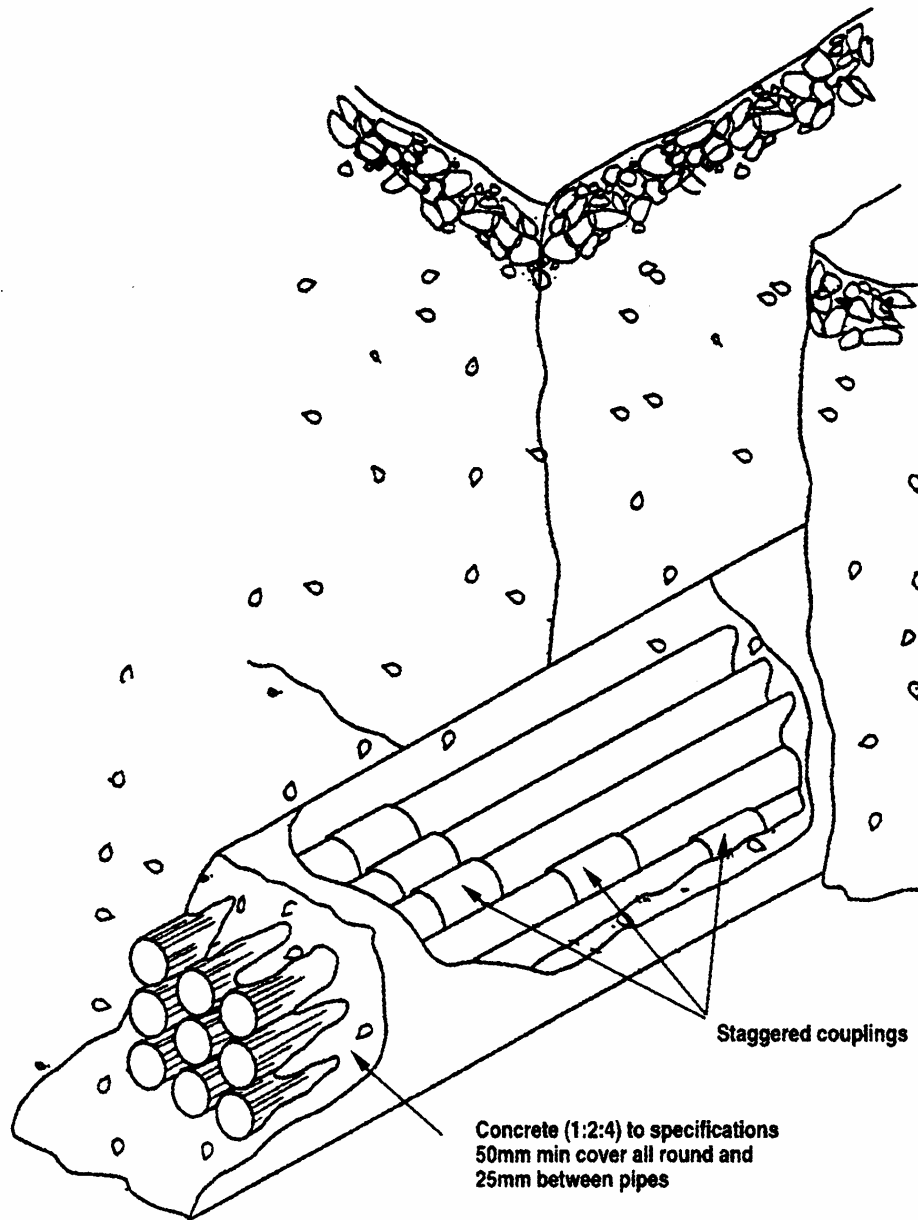
**FIGURE 10.31: DRAWINGS OF MULTI-WAY PIPELINES
(CONT'D)**



**Detail showing staggered joints of
PVC applicable to all multiple ways**

DRAWING NO 2

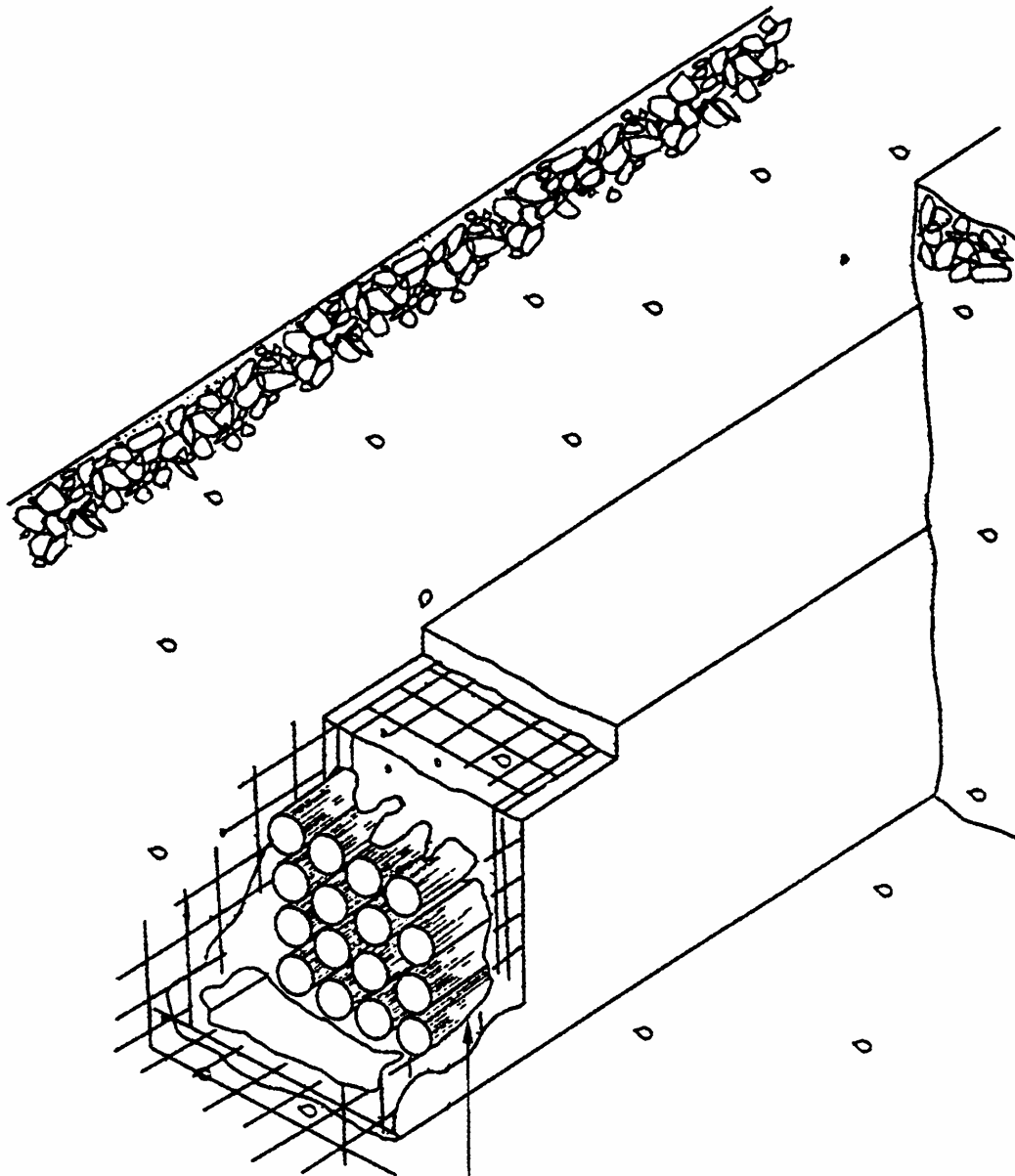
**FIGURE 10.31: DRAWINGS OF MULTI-WAY PIPELINES
(CONT'D)**



9 way pipe formation

DRAWING NO 3

**FIGURE 10.31: DRAWINGS OF MULTI-WAY PIPELINES
(CONT'D)**



NOTES :

- 1) 16 Way pipe formation
- 2) All pipe formation exceeding 16 ways

Pipes encased in concrete (1:2:4) to a min thickness of 100mm reinforced with A142 steel fabric or equivalent

DRAWING NO 4

CHAPTER 11. MAIN DISTRIBUTION FRAME ROOM & TELECOMMUNICATION EQUIPMENT ROOM

11.1 Overview

11.1.1 This chapter sets out the additional requirements for the provision of main distribution frame room(s) and telecommunication equipment room(s).

11.1.2 IDA may require the developer or owner to provide such rooms of larger size or additional main distribution frame rooms or telecommunication equipment rooms in those buildings where there are greater demand for telecommunication services if such additional provision is necessary.

11.2 Location

11.2.1 Every developer or owner who is required to provide a main distribution frame room and/or telecommunication equipment room shall –

- (a) site the main distribution frame room and/or telecommunication equipment room as close as possible to the telecommunication risers;
- (b) not site the main distribution frame room and/or telecommunication equipment room –
 - (i) in an area through which any system or network of water pipes, gas pipes or electrical trunking is running;
 - (ii) under any area that is susceptible to dampness or moisture such as a vehicle washing bay, swimming pool, washroom or toilet;
 - (iii) in any area which will subject the plant deployed therein to vibration of more than 0.05 G, where G is the acceleration due to gravity ($G=9.81 \text{ m/s}^2$); or
 - (iv) in any area where it will be directly subjected to the discharge of water, steam, fumes, gases or dust; and
- (c) where there is no practicable alternative but to site the main distribution frame room and/or telecommunication equipment room in an area that places any opening of the room in close proximity to the discharge of water, steam, fumes, gases or dust, ensure that –
 - (i) such opening is sealed to protect the plant deployed in the room; and
 - (ii) provide appropriate ventilation to the room.

11.3 Construction

11.3.1 Every developer or owner who is required to provide a main distribution frame room and/or telecommunication equipment room shall –

- (a) construct the main distribution room of reinforced concrete or brick wall;

- (b) finish the surface of the main distribution frame room and/or telecommunication equipment room with cement plaster and ensure that it is free of cracks, blister or other defects;
- (c) paint the wall of the main distribution frame room and/or telecommunication equipment room with a light colour durable paint;
- (d) ensure that room is of a minimum height of 3.5 m (measured from the floor to ceiling) throughout the entire room. However, where it is not practicable to provide a minimum height of 3.5 m, provide a cable ladder from the lead-in pipes which is to –
 - (i) rise up vertically to a height of at least 2.5 m and from there run horizontally to all sides of the walls of the main distribution frame room with a height clearance of at least 300 mm from any obstruction above it; and
 - (ii) have a width which is similar to the collective width of all the pipes entering the main distribution frame room;
- (e) finish the floor of the main distribution frame room and/or telecommunication equipment room with vinyl tiles or screed;
- (f) ensure that the floor of the main distribution room and/or telecommunication equipment room is able to withstand a loading of 480 kg/m²;
- (g) ensure that all doors to the main distribution frame room and/or telecommunication equipment room open outwards fully; and
- (h) ensure that the door frames for the doors of the main distribution frame room and/or telecommunication equipment room have a 100 mm high concrete skirting/kerb to prevent the ingress of water.

11.3.2 Where the developer or owner provides a main distribution frame room in the form of a standalone structure, such owner shall in addition to the requirements specified in chapter 11.3.1 ensure that –

- (a) the floor of the main distribution frame room is at least 150 mm above the immediate external final road or driveway level;
- (b) the floor of the main distribution frame room is waterproofed;
- (c) the walls of the main distribution frame room are waterproofed;
- (d) the emulsion painting system used for the outside wall of the main distribution is suitable for external application;
- (e) the ceiling of the main distribution frame room is smoothly finished and emulsion painted;
- (f) the roof of the main distribution room is constructed of flat reinforced concrete, suitably waterproofed and constructed to a fall of approximately 1:80 away from the door direction;

- (g) proper drainage is provided around the main distribution frame room such as hinged hot-dipped galvanized m.s. gratings;
- (h) where applicable, the gate and perimeter fencing is of a minimum height of 1.8 m;
- (i) the driveway to the main distribution frame room is of a minimum width of 4m and designed to withstand a minimum vehicular load of a 3-tonne vehicle that is typically used; and
- (j) all vacant space from the main distribution frame room to the perimeter fencing is paved using tarmac or weld-mesh reinforced concrete with fall designed for quick dispersion of water to surrounding drains.

11.4 Ventilation and air-conditioning

11.4.1 Every developer or owner of a non-residential building who is required to provide a main distribution frame room shall –

- (a) provide air-conditioning to the main distribution room from a central system where available;
- (b) ensure that temperature in the main distribution room is $22^{\circ}\text{C} \pm 2^{\circ}\text{C}$; and
- (c) ensure that the relative humidity in the main distribution room is $< 70\%$.

11.4.2 Where the developer or owner of a non-residential building is unable to provide air-conditioning from a central system, such owner shall –

- (a) provide louvres on the wall above the door of the main distribution frame room; and
- (b) where it is necessary to further ventilate the room, install mechanical exhaust fans at the top corners of the main distribution frame room.

11.4.3 Every developer or owner of a residential building who is required to provide a main distribution frame room and/or telecommunication equipment room shall –

- (a) provide louvres on the wall above the door of the main distribution frame room and/or telecommunication equipment room; and
- (b) where it is necessary to further ventilate the room, install mechanical exhaust fans at the top corners of the main distribution frame room and/or telecommunication equipment room.

11.5 Electrical

11.5.1 Every developer or owner who is required to provide a main distribution frame room and/or telecommunication equipment room shall –

- (a) provide electrical mains to the main distribution frame room and/or telecommunication equipment room from the main distribution board

which shall be successfully tested by qualified persons licensed or certified by the competent authority or electricity company;

- (b) ensure that the mean lighting illuminance in the main distribution frame room and/or telecommunication equipment room is at least 450 lux at floor level.

11.6 Earthing

11.6.1 Every developer or owner who is required to provide a main distribution frame room and/or telecommunication equipment room shall –

- (a) ensure that the earthing point is connected to the earth electrode system via earth cable with a cross section area of not less than 50 mm²;
- (b) ensure that the copper earth bar with screw holes that are spaced 50 mm apart measured from centre to centre; and
- (c) place the certified test result of the earth system together with actual layout diagrams showing the earth system arrangement in the main distribution frame room and/or telecommunication equipment room.

CHAPTER 12. TELECOMMUNICATION RISERS**12.1 Overview**

12.1.1 This chapter sets out the additional requirements for the provision of telecommunication riser(s).

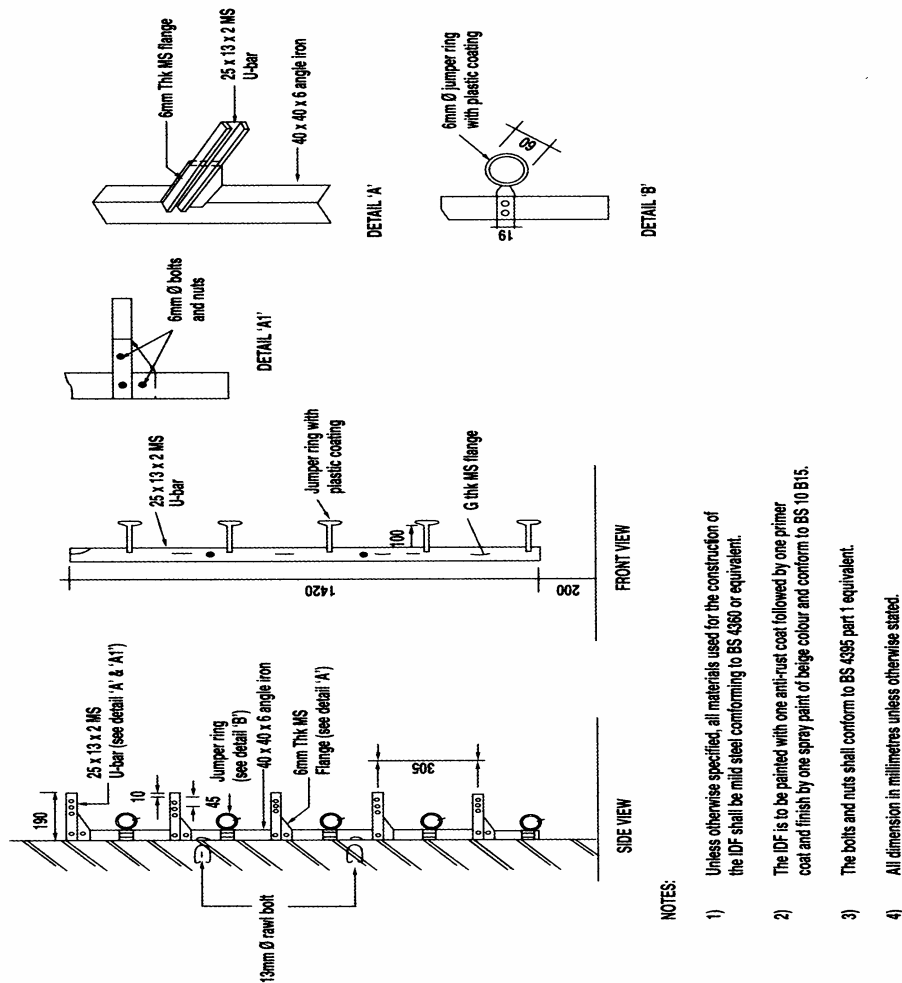
12.2 General requirements

12.2.1 Every developer or owner who is required to provide telecommunication risers shall -

- (a) provide a single-leave door on the width side of each telecommunication riser on every storey that can be opened fully outwards and is approximately 2.1 m in height;
- (b) provide a double-leave door on the width side of each telecommunication riser on every storey that can be opened fully outwards and is approximately 2.1 m in height if the width of the riser exceeds 1.1 m;
- (c) ensure that the fire-rating of the doors and compartment walls of the telecommunication risers comply with the Fire Code;
- (d) provide a 100 mm high concrete skirting or kerb around the doors of the telecommunication risers;
- (e) ensure that a label with the words "Telecoms Riser" is affixed to the door of the telecommunication risers on every storey and properly numbered;
- (f) provide locks for all doors to the telecommunication risers and ensure that the doors are locked at all times except that the developer or owner of a residential building shall not be required to provide locks for the telecommunication risers where he provides 1 vertical metal trunking for telecommunication (non-broadband coaxial cable) system and 1 vertical metal trunking for broadband coaxial cable system in place of cable trays in the telecommunication risers;
- (g) provide adequate lighting to enable licensees to carry out their installation and maintenance work in the telecommunication risers;
- (h) ensure that the width and depth of the inter-floor openings for the telecommunication risers are 1.25 times the width and depth of the cable trays or metal trunking;
- (i) ensure that the inter-floor openings for the telecommunication risers are sealed with fire resistant material in compliance with the Fire Code after the installation of cables;
- (j) ensure that the walls of the telecommunication risers are smoothly plastered and painted with a light colour;

- (k) where telecommunication (non-broadband coaxial cable) system cables are laid from the tenant or residential units in the building to the telecommunication risers, ensure that such cables are terminated onto terminal blocks mounted on the intermediate distribution frames (as shown in Figure 12.2 for a non-residential building) or laid up to the distribution points (for a residential building) located in the telecommunication risers;

FIGURE 12.2: DETAIL OF IDF INSTALLATION



- (l) where broadband coaxial cable system cables are laid from the residential or tenant units in the building to the telecommunication

risers, ensure that such cables are terminated onto an amplifier (where applicable) or the taps/splitters located in the telecommunication risers; and

- (m) ensure that the internal wiring to all units by licensed telecommunication wiring contractors is performed strictly in accordance with the internal wiring schedule.

12.3 Internal wiring schedule

12.3.1 Every developer or owner who is required to provide internal wiring shall –

- (a) prominently display an internal wiring schedule in the main distribution frame room indicating the unit number of the tenants to be served by the telecommunication riser branching from such main distribution frame room;
- (b) ensure that the internal wiring schedule is in the format shown in Table 12.3.1 below; and

Table 12.3.1 Internal wiring schedule

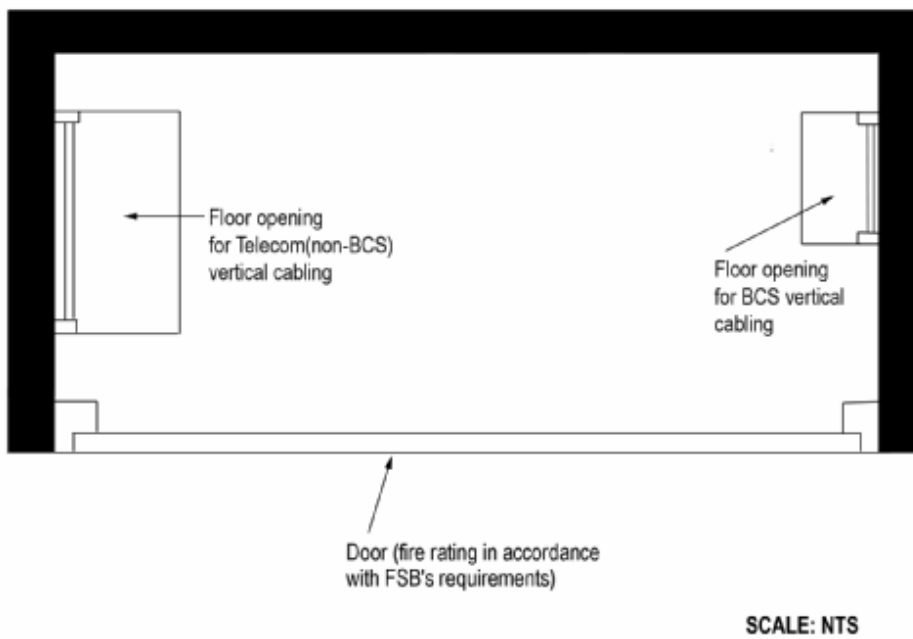
Telecom riser number	Address of unit served

- (c) extend a copy of the internal wiring schedule to licensees upon their request.

12.4 Placement of cables in telecommunication riser

Every developer or owner who is required to provide telecommunication riser(s) shall ensure that the cables and associated cabling facilities for telecommunications (non-broadband coaxial cable) system and broadband coaxial cable system are placed on opposite side walls of the telecommunication riser as shown in Figure 12.4 below.

FIGURE 12.4: TYPICAL LAYOUT IN TELECOMMUNICATION RISER



CHAPTER 13. REQUIREMENTS FOR PROPER INSTALLATION OF A BROADBAND COAXIAL CABLE SYSTEM

13.1 General

13.1.1 This chapter sets out the requirements for the erection, cabling, safety, and performance requirements of a broadband coaxial cable system for the transmission of signals operating between 5 MHz and 824 MHz.

13.1.2 This chapter also provides detailed technical specifications relating to the proper installation, safety and performance of a broadband coaxial cable system for buildings that are to be made “cable-ready”, i.e. to be interconnected to the broadband coaxial cable system operated by the licensee.

13.1.3 Based on the requirements specified in this chapter, there should not be any significant wiring change when a broadband coaxial cable system is made “cable-ready”. However, the developer or owner may be required to install additional passive and active devices such as filters, decoders, reverse signal path amplifiers, interdiction equipment, etc, in order to keep abreast of technological changes and new technical requirements. Minor adjustments of the signal levels at various distribution points may also be required. There will be no change to the subscribers’ feeders.

13.1.4 Necessary provisioning is critical for the proper transmission of two-way interactive applications on the broadband coaxial cable system, especially on the reverse path. The radio frequency resources of the broadband coaxial cable system can be classified into two distinct categories as follows:

- (a) Downstream Bandwidth (54-824MHz); and
- (b) Upstream Bandwidth (5-42 MHz).

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

- (ii) The various requirements highlighted in this chapter is intended to provide the common reference for the provisioning, installation, safety and performance of a qualified broadband coaxial cable system.

13.1.5 With reference to Figure 1, in this chapter –

“head end” means a 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. The head end may, for example, include antennae amplifiers, frequency converters, combiners, separators and generators; and

“feeder” means 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.

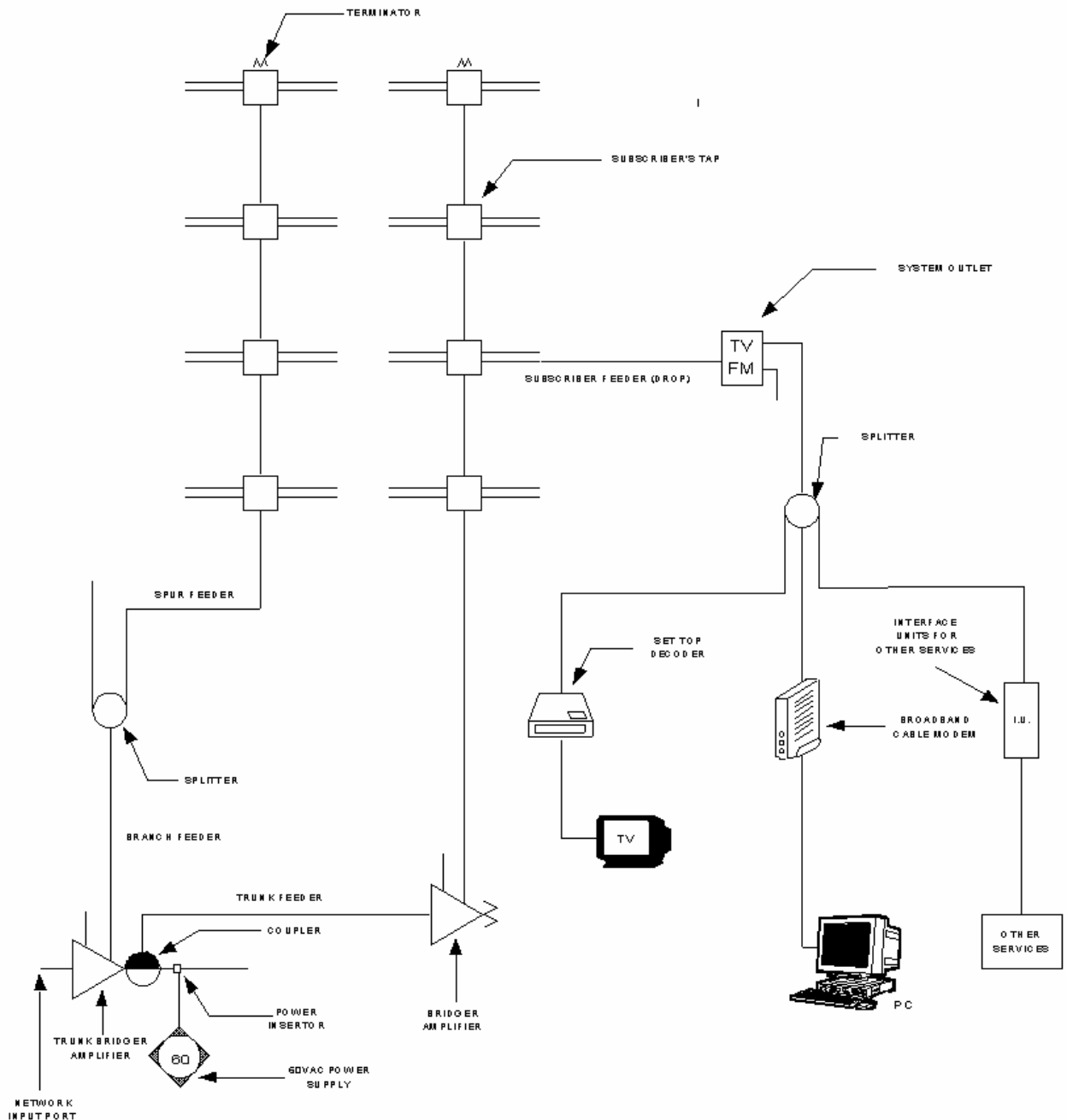


Figure 1: Principal items of equipment employed in a BCS system

13.2 Performance requirements for systems operating between 5 MHz to 824 MHz

13.2.1 Objective

The objective of the requirements included in this chapter is to ensure that the system performance limits are well optimised for the transmission of both the upstream and downstream signals. Most of the technical requirements in this chapter are in line with and comply with published standards (please refer to Appendix 7 of the Guidelines For Info-communications Facilities in Buildings for the relevant standards) developed by the Society of Cable Telecommunications Engineers (SCTE), which is an accredited standards developing organisation of the American National Standards Institute (ANSI). However, given the specific operating conditions of the local broadband coaxial cable system, the requirements stated in this chapter shall apply, over and above the standards published by the SCTE. IDA reserves the right to revise the various requirements stated herein as technology develops and evolves over time.

13.2.2 General Requirements

All requirements refer to the performance limits that shall be obtained between the input(s) to the head end or head ends and any system outlet when terminated in a resistance equal to the nominal load impedance of the system, unless otherwise specified. To cater for future bi-directional operation, all system components shall also be suitable for bi-directional operation with the reverse path in the frequency range 5-42 MHz. Where system outlets are not used, the above applies at the subscriber's end of the subscriber's feeder. In paragraph 13.2, all references to "system outlet" shall also apply to this case.

13.2.3 Impedance

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

13.2.4 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 13.2.4(a).

Table 13.2.4(a) Carrier signal levels at system outlets

Frequency Range and Service	Max. Level (dB μ V)	Min. Level (dB μ V)	Definitions
(i) 54-824 MHz television	80	60 (FCC 76.605-a-3)	These levels are expressed as the r.m.s. voltage of each carrier at the peak of the modulation envelope when measured at the system outlet across an external 75 Ω termination or relative to

			75Ω
(ii)	FM sound VHF Band (mono)	75	40
	FM sound VHF Band (stereo)	75	50

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

(b) Carrier level differences

The differences in carrier levels shall not exceed the values given in Table 13.2.4(b).

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

Table 13.2.4(b) Maximum level difference at each system outlet between distributed television channels

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

13.2.5 Mutual isolation between system outlets

(a) General

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

(b) Additional requirements if unwanted frequencies are unavoidable

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

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

13.2.6 Frequency response within a television channel at any system outlet

(a) Amplitude Response

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

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

(b) Phase Response

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

13.2.7 Frequency stability of distributed carrier signals

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

13.2.8 Generation of spurious signals

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

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

13.2.9 Intermediate frequency interference

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

13.2.10 Random Noise

The carrier to noise ratio for systems from the head end input to the system outlets (see paragraph 13.2.4) shall be not less than the value shown in Table 13.2.10. 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 13.2.4(a), in which case the minimum levels given in that table should be used.

Table 13.2.10 Minimum carrier to noise ratio for TV and FM systems outlets

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

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

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

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

Note 2: This value applies when the level at the system outlet is the minimum given in Table 13.2.4(a).

13.2.11 Interference to television channels

(a) Single-frequency interference to television channels

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

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

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

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

(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 65 dB for 30 channel loading, measured according to IEC 728-1 Clause 9.

13.2.12 Cross-modulation between television channels

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

13.2.13 Differential gain and phase in television channels

The differential gain and phase in any television channel shall not exceed the figures as given in Table 13.2.13.

Table 13.2.13 Differential gain and phase in television channels

System	Max. Differential gain	Max. Differential Phase
PAL	10 %	5°

13.2.14 Echoes in television channels

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

13.2.15 Data signal transmission

- (a) In the context of this sub-clause “data” is taken as any pulse modulation digitally encoded signal regardless of original information format.
- (b) Data signals carried in the vertical interval of a television signal
- (i) Data echo rating
The data echo rating on any television channel employed to carry such signals within the vertical interval shall not exceed 4%.
 - (ii) Data delay inequality
The data delay inequality in any television channel employed to carry such signals in the vertical interval shall not exceed 50 ns.

13.2.16 Hum modulation of carriers in television channels

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

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

13.2.17 Radiation from individual system components

The radiation from any individual component to be used in the system shall not exceed 1×10^{-10} W (-70 dBmW) within the operating frequency range of

that system, when measured in accordance with pr EN 50083-2:1992 unless otherwise stated.

13.2.18 Immunity to external fields

(a) Immunity of complete system

The immunity of the system shall be such that at any system outlet (see paragraph 13.2 (b)) on any distributed channel, the ratio of carrier to interfering signal (caused by an external field) shall be not less than the limits given for single-frequency interference in paragraph 13.2.11 (a).

(b) Immunity of individual system components

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

13.2.19 Chrominance / luminance delay inequality

At any system outlet (see paragraph 13.2.4) on any television channel, the difference in transmission delay between luminance and chrominance information shall not exceed 170 ns. (FCC 76.605-a-11)

13.2.20 FM radio: additional performance requirements

(a) Amplitude response within an FM channel

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

(b) Adjacent Channel Spacing

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

(c) Relative level of adjacent carriers

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

(d) Regulation of power supplies

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

13.3 Network topology

13.3.1 The network input port shall be designed for proper broadband coaxial cable system network operation with input levels and TV channel loading as follows:

- at 824 MHz – Between 14 and 25 dBmV
- at 54 MHz – Between 11 and 25 dBmV
- Channel loading – 60 PAL TV channels

13.3.2 Wiring facilities for broadband coaxial cable system cables

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

13.3.3 Routing to residential units

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

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

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

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

13.3.4 Distribution panels and boxes

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

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

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

13.4 Cables

13.4.1 Coaxial cables shall be used for the installation of a broadband coaxial cable system. The cables used meet or exceed the minimum requirement stated herein -

13.4.2 Subscriber feeder (drop) cables (above ground) – RG6 coaxial cable

General requirements:

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

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

13.4.4 Underground cables

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

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

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

13.5 Safety

13.5.1 Safety requirement

A cabled distribution system shall be so designed, constructed and installed as to present no danger, either in normal use or under fault conditions to

subscribers, personnel working on or externally inspecting the system, or to any other person, providing particularly:

- (a) personal protection against electric shock;
- (b) personal protection against physical injury; 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.

13.5.2 Main-supplied apparatus

- (a) The devices used in a cabled distribution system shall meet the requirements of SS 143 and the requirements of the Energy Market Authority ("EMA"). In addition, the special requirements of the following sub-paragraphs (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; and
- (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.

13.5.3 Safety bonding terminals

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

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

13.5.4 Connection to supply main

- (a) Connection of apparatus to the supply mains shall conform to the requirements of EMA; and
- (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.

13.5.5 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 4 mm²;
- (f) The maximum value of earth-loop impedance shall comply with the EMA's requirement concerning earth leakage protection; and
- (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.

13.5.6 Proximity to power distribution systems

- (a) The cabled network shall be adequately protected against inadvertent contact with, or induction from electrical power distribution systems; and
- (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 respects and at all times.

13.5.7 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 65V; and
- (b) The installation for the remote power supply including the coaxial cable shall comply with EMA's requirement.

13.5.8 Weather protection

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

13.6 Installation practices and procedures

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

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

- (a) Using corrosion-resistant material, such as stainless steel;
- (b) Galvanic protection;
- (c) Protective coating such as painting with rust-inhibiting paints; and
- (d) Other suitable corrosion prevention measures.

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

13.6.3 Operating ambient conditions

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

13.7 Workmanship

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

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

13.7.3 Adequate measures should be undertaken to ensure protection against moisture and corrosion (see paragraphs 13.6.1 and 13.6.2).

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

13.8 Other technical details

13.8.1 Where amplifiers, passive devices (such as taps, splitters and system outlets), connectors and splices are provided by the developer or owner for the purposes of the broadband coaxial cable system, such amplifiers, passive devices, connectors and splices shall comply with the broadband coaxial cable system equipment specifications as set out in Appendix 4 of these Guidelines.

13.8.2 The developer or owner shall refer to Appendix 8 of these Guidelines for typical broadband coaxial cable system schematic diagram for strata-landed dwelling houses and multi-storey residential buildings.

CHAPTER 14. USE OF SPACE AND FACILITIES BY LICENSEES

14.1 Application of this chapter

- 14.1.1 This chapter specifies the requirements to be observed by every licensee that deploys its installation or plant within the space and facilities of any development provided pursuant to this Code or any previous codes.
- 14.1.2 For the purposes of this chapter, where a licensee connects its pipes to the lead-in pipes of a development, such connection shall be regarded as a deployment of plant by such licensee.

14.2 Eligibility to use

- 14.2.1 Only licensees who provide telecommunication services via fixed-line method or fixed-wireless method may deploy their installation or plant in the relevant space and facilities of a development.
- 14.2.2 Unless otherwise permitted by IDA, no licensee that –
- (a) is granted a licence to provide services only to itself; or
 - (b) is granted a public cellular mobile telecommunication service licence,
- shall deploy its installation or plant in the relevant space and facilities for the purpose of providing such services.

14.3 Access to relevant space and facilities

- 14.3.1 Every licensee who wishes to deploy its installation or plant in the relevant space and facilities of any development shall notify and obtain the permission of the developer or owner of that development in relation to the licensee's proposed use of the relevant space and facilities.
- 14.3.2 Every licensee who wishes to access the relevant space and facilities of any development for the purpose of inspecting, maintaining or repairing any installation or plant which it has deployed in such space and facilities shall give reasonable notice to the developer or owner of that development to obtain grant of access.

14.4 Rules of usage

- 14.4.1 Subject to paragraphs 14.5 and 14.6, every licensee who deploys its installation or plant in the relevant space and facilities of any development shall –
- (a) ensure that it deploys its installation or plant in the most efficient manner possible;
 - (b) only deploy such installation or plant as is reasonably necessary to meet the demand of its customers (including those which it has firmly committed to provisioning in the reasonably near future) and

where the licensee is a public telecommunication licensee, to also meet its basic service obligations;

- (c) not deploy its installation or plant in a manner which unreasonably prevents any other licensee who wishes to deploy its plant within the same space and facilities from doing so;
- (d) co-operate in good faith with any other licensee who wishes to deploy its installation or plant within the same space and facilities to enable such licensee to carry out its deployment in an expedient manner;
- (e) not make any structural alteration to the relevant space and facilities without the approval of the developer or owner of that development;
- (f) take due care to maintain the cleanliness and condition of the relevant space and facilities in which it deploys its installation or plant and those parts of the land which it accesses in connection with such deployment;
- (g) where it causes any damage to the relevant space and facilities in which it deploys its installation or plant or to those parts of the land which it accesses in connection with such deployment, inform the developer or owner of that development and make good the damage caused;
- (h) when carrying out any activities in connection with its deployment of plant in the relevant space and facilities, take reasonable steps to minimise the disturbance and inconvenience caused to the occupants of the building and comply with all requirements imposed by public authorities including limits on noise levels, working hours and safety;
- (i) pay for all utility charges incurred for the operation of the installation or plant deployed in the relevant space and facilities unless otherwise agreed with the owner; and
- (j) where it ceases to provide any service to that building, remove any installation or plant deployed in the relevant space and facilities which is no longer required with all reasonable speed.

14.4.2 For the purposes of paragraph 14.4.1, all references to the act of deployment of any installation or plant shall include the act of inspecting, maintaining or repairing such installation or plant.

14.5 Installation or plant deployed before Effective Date

14.5.1 Where a licensee has deployed its installation or plant in a manner which does not efficiently optimise the use of the relevant space and facilities, the licensee shall co-operate in good faith with any other licensee (the "Requesting Licensee") who wishes to deploy its installation or plant within the same space and facilities to rearrange, remove or alter such installation or plant or any part thereof with all reasonable speed to facilitate deployment by the Requesting Licensee subject to the Requesting

Licensee's payment of reasonable costs for such rearrangement, removal or alteration.

- 14.5.2 In the event that the licensees are unable to reach agreement on the rearrangement, removal or alteration that should be effected, they may refer the matter to IDA for a decision which shall be binding on the licensees.

14.6 Connections to lead-in pipes before Effective Date

- 14.6.1 Where a licensee has connected its pipes to the lead-in pipes of any development before the Effective Date but is not using any of the pipes that it has connected, and the Requesting Licensee requires the use of such lead-in pipes, that licensee shall either –

- (a) allow the Requesting Licensee to use those pipes which it has connected but is not using, including the use of the associated lead-in manholes, at cost-based prices; or
- (b) disconnect those pipes which it has connected but is not using with all reasonable speed subject to the payment of reasonable costs by the Requesting Licensee for such disconnection,

subject to the preference of the Requesting Licensee and the feasibility of the preferred option. For the avoidance of doubt, this paragraph 14.6.1 shall not apply to the connection to a lead-in pipe made by a public telecommunication licensee for reserve use in accordance with paragraph 14.6.2.

- 14.6.2 A public telecommunication licensee who is providing services to the building in accordance with its basic service obligations may leave 1 additional lead-in pipe connected for reserve use.

14.7 Connections to lead-in pipes on or after Effective Date

- 14.7.1 Subject to paragraph 14.7.2, every licensee that connects its pipes to the lead-in pipes of a development on or after the Effective Date shall only make such number of connections as are necessary to meet the actual demand of its customers including those which it has firmly committed to provisioning in the reasonably near future.

- 14.7.2 A public telecommunication licensee who is providing services to a development in accordance with its basic service obligations may connect 1 additional lead-in pipe for reserve use.

- 14.7.3 Where a licensee connects its pipes to the lead-in pipes of any development on or after the Effective Date but is not using any of the pipes that it has connected, and the Requesting Licensee requires the use of such lead-in pipes, that licensee shall either –

- (a) allow the Requesting Licensee to use those pipes which it has connected but is not using, including use of the associated lead-in manholes, without any charge; or

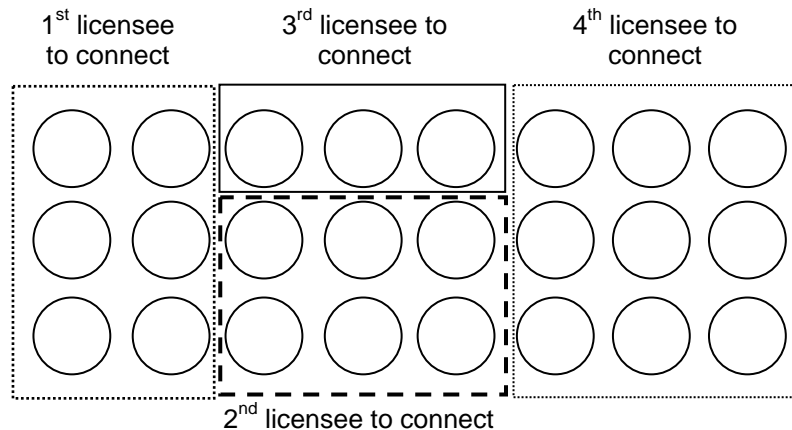
- (b) disconnect those pipes which it has connected to the lead-in pipes but is not using with all reasonable speed at its own expense,

subject to the preference of the Requesting Licensee and the feasibility of the preferred option. For the avoidance of doubt, this paragraph 14.7.3 shall not apply to the connection to a lead-in pipe made by a public telecommunication licensee for reserve use in accordance with paragraph 14.7.2.

14.7.4 Every licensee that connects its pipes to the lead-in pipes of a development on or after the Effective Date shall –

- (a) ensure that the pipes and the associated lead-in manholes which it connects to the lead-in pipes are grouped together and not placed in a manner which obstructs any other licensee from connecting its own pipes to the lead-in pipes; and
- (b) connect its pipes to the lead-in pipes in a left-to-right or right-to-left method (depending on where the previous connection has been made) or in a bottom-up manner as illustrated in Figure 14.7.4(b).

Figure 14.7.4(b) Method in which licensees are to connect to lead-in pipes



14.7.5 IDA may require any licensee who fails to comply with paragraph 14.7.4 to remove or re-position its connections to the lead-in pipes or to remove or re-position its manholes at its own expense.

14.7.6 Every licensee who deploys multiple fibre or copper cables to the same development on or after the Effective Date shall, where practicable, install sub-ducts or their equivalent in the lead-in pipes such that each lead-in pipe is able to accommodate multiple fibre or copper cables.

14.8. Concurrent deployment or connections by two or more licensees on or after the Effective Date

14.8.1 Where two or more licensees concurrently seek to deploy their installation or plant in the relevant space and facilities or concurrently seek to connect their pipes to the lead-in pipes of any development on or after the Effective

Date, and such relevant space and facilities are insufficient to accommodate all the installation or plant sought to be deployed or the lead-in pipes are insufficient to accommodate all the connections sought to be made, the licensees shall first attempt to reach a voluntary sharing arrangement in good faith.

14.8.2 In the event that the licensees are unable to reach a sharing arrangement, they may refer the matter to IDA for a decision which shall be binding on the licensees.

14.8.3 In determining the sharing arrangement, IDA will generally grant priority as follows –

- (a) public telecommunication licensees who require use of the relevant space and facilities to provide services to the development in accordance with their basic service obligations shall have first priority;
- (b) telecommunication system licensees who require use of the relevant space and facilities to provide services to the development shall have second priority; and
- (c) telecommunication system licensees who require use of the relevant space and facilities for any other purpose shall have last priority.

14.9 Co-operation to resolve interference

14.9.1 Where any installation or plant deployed by a licensee in the relevant space and facilities of a development causes interference to the operation of installation or plant deployed by any other licensee in the same space and facilities, such licensees shall co-operate in good faith to resolve the interference to ensure minimal disruption to service provisioning.

14.10 IDA's right to require rearrangement, removal, alteration or disconnection

14.10.1 Where any licensee contravenes any requirement in this chapter, IDA may require such licensee to rearrange, remove, alter or disconnect any of the installation or plant which it has deployed in the relevant space and facilities of any development at its own expense.