भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS

MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG, NEW DELHI 110002
Phone: + 91 11 23230131, 23233375, 23239402 Extn 4402; Fax: + 91 11 23235529

व्यापक परिचालन मसौदा

हमारा संदर्भ : सीईडी/46 :टी-20 **11 नवंबर 2015**

तकनीकी समिति :राष्ट्रीय भवन निर्माण संहिता विषय समिति, सीईडी 46

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प्राप्तकर्ता :

1 सिविल इंजीनियरी विभाग परिषद् के सभी सदस्य

2 राष्ट्रीय भवन निर्माण संहिता विषय समिति, सीईडी 46 व नल-साजी सेवाओं के लिए पैनल, सीईडी 46:P17 के सभी सदस्य

3 रूचि रखने वाले अन्य निकाय ।

महोदय/महोदया,

निम्नलिखित मसौदा संलग्न है:

प्रलेख संख्या	शीर्षक
सीईडी 46(8059)WC	राष्ट्रीय भवन निर्माण संहिता का मसौदा: भाग 9 नल-साजी सेवाएं, अनुभाग 2 जल निकास और स्वछता [SP7(भाग9/अनुभाग 2) का तीसरा पुनरीक्षण]

कृपया इस मसौदे का अवलोकन करें और अपनी सम्मतियॉ यह बताते हुए भेजें कि यदि यह मसौदा भारत की राष्ट्रीय भवन निर्माण संहिता के भाग के रूप में प्रकाशित हो तो इस पर अमल करने में आपके व्यवसाय अथवा कारोबार में क्या कठिनाइयॉ आ सकती हैं ।

सम्मतियॉ भेजने की अंतिम तिथि :**11 दिसंबर 2015**

यदि कोई सम्मति हो तो कृपया अधोहस्ताक्षरी को उपरिलिखित पते पर संलग्न फोर्मेट में भेजें । हो सके तो कृपया अपनी सम्मतियॉ ई-मेल द्वारा **sanjaypant@bis.org.in** पर भेजें ।

यदि कोई सम्मति प्राप्त नहीं होती है अथवा सम्मति में केवल भाषा सम्बन्धी त्रुटि हुई तो उपरोक्त प्रलेखों को यथावत अंतिम रूप दे दिया जाएगा । यदि सम्मति तकनीकी प्रकृति की हुई तो विषय समितिके अध्यक्ष के परामर्श से अथवा उनकी इच्छा पर आगे की कार्यवाही के लिए विषय समिति को भेजे जाने के बाद प्रलेख को अंतिम रूप दे दिया जाएगा ।

यह प्रलेख भारतीय मानक ब्यूरो की वैबसाइट **www.bis.org.in** पर भी उपलब्ध है ।

धन्यवाद ।

भवदीय,

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(बी.के. सिन्हा)
प्रमुख (सिविल इंजीनियरी)

संलग्न: उपरिलिखित

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS

MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG, NEW DELHI 110002
Phone: + 91 11 23230131, 23233375, 23239402 Extn 4402; Fax: + 91 11 23235529

DRAFT IN WIDE CIRCULATION

DOCUMENT DESPATCH ADVICE

Reference	Date
CED 46/T-20	11 November 2015

TECHNICAL COMMITTEE:
NATIONAL BUILDING CODE SECTIONAL COMMITTEE, CED 46

ADDRESSED TO:

1. All Members of Civil Engineering Division Council, CEDC
2. All Members of National Building Code Sectional Committee, CED 46 and Panel for Plumbing Services, CED 46:P17
3. All other interests.

Dear Sir/Madam,

Please find enclosed the following draft:

Doc. No.	Title
CED 46 (8059)WC	**Draft National Building Code of India: Part 9 Plumbing Services, Section 2 Drainage and Sanitation [Third Revision of SP 7(Part 9/Section 2)]**

Kindly examine the draft and forward your views stating any difficulties which you are likely to experience in your business or profession if this is finally adopted as Part of the National Building Code of India.

Last Date for comments: **11 December 2015.**

Comments if any, may please be made in the format as attached, and mailed to the undersigned at the above address. You are requested to send your comments preferably through e-mail to **sanjaypant@bis.org.in**.

In case no comments are received or comments received are of editorial nature, you may kindly permit us to presume your approval for the above document as finalized. However, in case of comments of technical nature are received then it may be finalized either in consultation with the Chairman, Sectional Committee or referred to the Sectional Committee for further necessary action if so desired by the Chairman, Sectional Committee.

This document is also hosted on BIS website **www.bis.org.in**.

Thanking you,

Yours faithfully,

Sd/-

(B. K. Sinha)
Head (Civil Engg)

Encl: as above

FORMAT FOR SENDING COMMENTS ON THE DOCUMENT

[Please use A4 size sheet of paper only and type within fields indicated. Comments on each clause/sub-clause/ table/figure, etc, be stated on a fresh row. Information/comments should include reasons for comments, technical references and suggestions for modified wordings of the clause. **Comments through e-mail in MS WORD format to sanjaypant@bis.org.in shall be appreciated**.]

Doc. No.:CED 46(8059)WC **BIS Letter Ref**: CED 46/T-20 **Dated**: 11 November 2015

Title: NATIONAL BUILDING CODE OF INDIA: Part 9 'PLUMBING SERVICES, Section 2 Drainage and Sanitation' [*Third Revision of* SP 7 (Part 9/Sec 2)]

Name of the Commentator *or* **Organization**: _____

Clause No. with**Para No.** or**Table No.** or **Figure No.** commented*(as applicable)*	**Comments/Modified Wordings**	**Justification for the Proposed Change**

Doc: CED 46(8059)WC
November 2015

Draft NATIONAL BUILDING CODE OF INDIA

PART 9 PLUMBING SERVICES (INCLUDING SOLID WASTE MANAGEMENT)

Section 2 Drainage and Sanitation

[*Third Revision of* SP 7 (Part 9/ Section 2)]

BUREAU OF INDIAN STANDARDS

C O N T E N T S

IMPORTANT EXPLANTORY NOTE FOR USERS OF THE CODE

In this Part of the Code, where reference is made to 'good practice' in relation to design, constructional procedures or other related information, and where reference is made to 'accepted standard' in relation to material specification, testing, or other related information, the Indian Standards listed at the end of this Part may be used as a guide to the interpretation.

At the time of publication, the editions indicated in the standards were valid. All standards are subject to revision and parties to agreements based on this Part are encouraged to investigate the possibility of applying the most recent editions of the standards.

In the list of standards given at the end of this part, the number appearing in the first column indicates the number of the reference in this Part. For example:

a) Good practice [9-2(10)] refers to the Indian Standard given at serial number (10) of the above list given at the end of this Section 2 of Part 9, that is IS 5329 : 1983 'Code of practice for sanitary pipe work above ground for buildings (*first revision*)'.

b) Accepted standard [9-2(9)] refers to the Indian Standard given at serial number (9) of the above list given at the end of this Section 2 of Part 9, that is IS 1536:2001 'Specification for centrifugally cast (spun) iron pressure pipes for water, gas and sewage (fourth revision)'

BUREAU OF INDIAN STANDARDS

DRAFT FOR COMMENTS ONLY

Draft NATIONAL BUILDING CODE OF INDIA:

PART 9 PLUMBING SERVICES (INCLUDING SOLID WASTE MANAGEMENT)

Section 2 Drainage and Sanitation

[*Third Revision* of SP 7(Part 9/Section 2)]

ICS: 01.120; 91.040.01

National Building Code	Last Date for Comments:
Sectional Committee, CED 46	**11 December 2015**

National Building Code Sectional Committee, CED 46

FOREWORD

This Section covers the drainage and sanitation requirements of buildings, design, construction and maintenance of drains inside buildings and from the buildings up to the connection to public sewer, private sewer, individual sewage disposal system, cesspool, or to other approved point of disposal/treatment work. It also covers drainage systems peculiar to high altitudes and/or sub-zero temperature regions of the country.

In the first version of the Code formulated in 1970, two separate sections of Part 9 Plumbing services, were brought out, namely, Section 1 Water supply, Section 2 Drainage and sanitation, and Section 3 Gas supply. These sections were subsequently revised in 1983.

The major changes incorporated in the first revision in Section 2 Drainage and sanitation were*:*

a) Rationalization of definitions.
b) The requirements for fitments for drainage and sanitation in the case of buildings other than residences were modified.
c) A table for sanitation facilities in fruit and vegetable markets were added.

d) A table giving detailed guidance regarding the selection of plumbing system, depending on the nature of drainage load in buildings and height of buildings, was introduced.
e) Provision relating to safeguards to be adopted in single stack system was amplified.
f) The values of gradients, pipe sizes and the corresponding discharges were modified.
g) Sizes of manholes/inspection chambers were rationalized.
h) The sizing of rain water pipe for roof drainage were modified to take into account rainfall intensities and recommend sizes on a more rational basis.
j) Provisions for drainage and sanitation system peculiar to high altitudes and/or sub-zero temperature regions of the country were added.
k) Requirements of the refuse chute system were covered.

As a result of experience gained in implementation of 1983 version of the Code and feedback received as well as revision of some of the standards based on which this section was prepared, a need to revise this section was felt. The last revision was therefore prepared to take care of these. In the last revision, the erstwhile two sections were merged and a combined and comprehensive section, namely Section 1 Water supply, drainage and sanitation (including solid waste management), was brought out. Gas supply was brought out as Section 2. Following significant changes were incorporated in the last revision of Section 1 on Water supply, drainage and sanitation, in respect to drainage and sanitation:

a) Rationalization and addition of new definitions under terminology.
b) Certain basic principles for water supply and drainage were enunciated.
c) A new clause on sanitary appliances was added.
d) Tables 1 to 14 of the existing version, regarding drainage and sanitation requirement were updated.
e) Additional requirements under layout clause of design considerations were added.
f) Provisions regarding choice of plumbing systems were modified and rationalized.
g) New clause on drain appurtenances having details on trap, floor drain and cleanout was added.
h) Provisions on indirect wastes, special wastes (covering laboratory wastes, infected wastes, research laboratory wastes, etc), grease traps, oil interceptors, radio-active wastes, etc were incorporated.
j) Manhole details on size were revised and construction clause was enhanced.
k) Provisions on rain water harvesting were included.
m) The minimum rainfall intensity which is drain design basis for discharge of storm water drain into a public storm water drain, was revised to 50 mm/hour.

n) The table for sizing of rain water pipes for roof drainage was modified with inclusion of rainfall data which were not available in the earlier version.
p) Figure on detail of subsoil drainage was included.
q) Details on support/protection of pipes were added.

The last revision also incorporated for the first time the provisions on solid waste management.

In this revision to comprehensively address the various and distinct features related to the plumbing aspects, this Part 9 Plumbing Services has been rearranged as follows:

Section 1 Water Supply
Section 2 Drainage and Sanitation
Section 3 Gas Supply
Section 4 Solid Waste Management

Further, in this revision of the section, following significant changes/modifications have been incorporated:

a) New Table 15 on the requirements for fitments for drainage and sanitation for Shopping Malls and Retail Buildings has been included
b) Enabling provisions for use of Corrugated pipes have been included in clause 4.3.2.7 for use in sewerage and drainage applications
c) Enabling provisions for use of Low noise pipes have been included in clause 4.3.2.8 for use in sewerage and drainage applications
d) Enabling provisions for use of Under slung pipes have been included in clause 4.3.2.9
e) Venting System for High rise buildings have been included in clause 4.5.3.4.7
f) General provisions on Design of drainage pipes have been elaborated in clause 4.5.3.5
g) Provisions related to Gradients under clause 4.5.3.5.2.1 have been elaborated
h) Type of fixtures under Table 16 on Fixture Units for Different Sanitary Appliances or Groups has been updated.
j) New provisions on Design requirement for high rise buildings drainage system have been included under clause 4.5.3.5.2.1 (c)
k) The minimum diameter for floor drains outlets before connecting to floor trap has been included in clause 4.5.3.6.2.5.
m) Enabling provisions for Supports for drainage and Sewerage pipes have been included in clause 4.5.3.6.3.5
n) Provisions related to Manhole covers and recommended locations have been included under 4.5.10.6
p) Coefficient of roughness of PVC pipes used as rain water pipes have been modified in clause 4.5.11.6.8

q) Table 21 on Sizing of Rain-Water Pipes for Roof Drainage has been updated.
r) Enabling provisions on Siphonic drainage system have been included at clause 4.5.12.5
s) Enabling provisions on Rain water harvesting for plotted development/Group housing developments have been included at clause 4.5.12.6
t) Other methods of rain water harvesting have been suggested at clause 4.5.12.7
u) Provisions related to Deep well/bore well recharging have been included under clause 4.5.13.5
w) Clarifications and recommendations on use of Septic tanks have been made in clause 4.5.14.5.2
y) New provisions related to Pumping of Sewage have been included at clause 4.11
z) Certain terminologies have been included and some have been updated based on the above mentioned changes in the draft.
aa) Cross-referred standards have been updated.

This Section is largely based on the following Indian Standards.

IS 1742:1983	Code of practice for building drainage (*second revision*)
IS 4111(Part 1):1986	Code of practice for ancillary structures in sewage system : Part 1 Manholes (*first revision*)
IS 5329:1983	Code of practice for sanitary pipe work above ground for buildings (*first revision*)
IS 6295:1986	Code of practice for water supply and drainage in high altitudes and or sub-zero temperature regions (*first revision*)

A reference to SP 35:1987 'Handbook on Water Supply and Drainage' may be useful, from where also, assistance has been derived.

All standards, whether given herein above or cross-referred to in the main text of this section, are subject to revision. The parties to agreement based on this section are encouraged to investigate the possibility of applying the most recent editions of the standards.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2:1960 `Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this Section.

BUREAU OF INDIAN STANDARDS

DRAFT FOR COMMENTS ONLY

Draft NATIONAL BUILDING CODE OF INDIA:

PART 9 PLUMBING SERVICES (INCLUDING SOLID WASTE MANAGEMENT)

Section 2 Drainage and Sanitation

[*Third Revision* of SP 7(Part 9/Section 2)]

ICS: 01.120; 91.040.01

National Building Code	Last Date for Comments:
Sectional Committee, CED 46	**11 December 2015**

1 SCOPE

1.1 This section also covers the design, layout, construction and maintenance of drains for foul water, surface water and subsoil water and sewage; together with all ancillary works, such as connections, manholes and inspection chambers used within the building and from building to the connection to a public sewer, private sewer, individual sewage-disposal system, cess-pool, soakaway or to other approved point of disposal/ treatment work.

NOTE - A sanitary drainage system consists of a building sewer, a building drain, a soil and/or waste stack, horizontal branches or fixture drain, and vents. The sanitary drainage of a large building may have a number of primary and secondary branches, and several soil and/or waste stacks, each of them in turn may have a number of horizontal branches.

2 TERMINOLOGY

2.1 For the purpose of this section, the following definitions shall apply in addition to the definitions given in accepted standards [9-2(1)].

2.1.1 *Air Gap, Drainage* – Unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe, plumbing fixture or appurtenance conveying waste to flood level of the receptor.

2.1.2 *Back Siphonage* – The flowing back of used, contaminated, or polluted water from a plumbing fixture or vessel into a water supply due to a reduced pressure in such pipe (*see* Backflow).

2.1.3 *Back Up* – A condition where the wastewater may flow back into another fixture or compartment but not back into the potable water system.

2.1.4 *Backflow*

a) The flow of water or other liquids, mixtures or substances into the distributing pipes of a system of supply of potable water from any source or sources other than its intended source.
b) The flow of a liquid in a direction reverse of that intended.

2.1.5 *Backflow Prevention Device* – Any approved measure or fitting or combination of fittings specifically designed to prevent backflow or back siphonage in a water service.

2.1.6 *Back Pressure Back Flow* – Due to an increased pressure above the supply pressure, which may be due to pumps, other equipment's , gravity or other source of pressure.

2.1.7 *Back Siphonage* – Flowing back of used, contaminated or polluted water from a plumbing fixture into a water supply pipe due to a pressure less than atmospheric.

2.1.8 *Back Water Valve* – Device installed in a drainage system to prevent reverse flow.

2.1.9 *Battery of Fixtures* – Any group of two or more similar adjacent fixtures which discharge into a common horizontal waste or soil pipe.

2.1.10 *Bed Pan Washer* – Bed pan washer which is to be used for disposing human waste and sterilizing the Bed Pan for reuse. Bed pan washer requires water connection and electrical heating arrangement. This is to be considered as soil appliance.

2.1.11 *Benching* – Sloping surfaces constructed on either side of channels at the base of a manhole or inspection chamber for the purpose of confining the flow of sewage, avoiding the accumulation of deposits and providing a safe working platform.

2.1.12 *Branch*

a) Special form of sewer pipe used for making connections to a sewer or water main. The various types are called 'T', 'Y', 'T-Y', double Y and V branches, according to their respective shapes.

b) Any part of a piping system other than a main or stack.

2.1.13 *Branch Soil Pipe (BSP)* – A pipe connecting one or more soil appliances to the main soil pipe.

2.1.14 *Branch Soil Waste Pipe (BSWP)* – A pipe connecting one or more soil and/or waste appliances to the main soil waste pipe (one pipe system).

2.1.15 *Branch Ventilating Pipe (BVP)* – A pipe, one end of which is connected to the system adjacent to the trap of an appliance and the other to a main ventilating pipe or a drain-ventilating pipe. It is fitted to prevent loss of water seal from a trap owing to partial vacuum, back-pressure, or surging caused by air movement within the pipe system. It also provides ventilation for the branch waste pipe.

2.1.16 *Branch Waste Pipe (BWP)* – A pipe connecting one or more waste appliances to the main waste pipe.

2.1.17 *Building Drain-Combined* – A building drain which conveys both sewage and storm water or other drainage.

2.1.18 *Building Drain-Sanitary* – A building drain which conveys sewage and sullage only.

2.1.19 *Building Drain-Storm* – A building drain which conveys storm water or other drainage but no sewage.

2.1.20 *Building Sewer* – That part of the horizontal piping of a drainage system which extends from the end of the building drain and which receives the discharge of the building drain and conveys it to a public sewer, private sewer, individual sewage-disposal system or approved point of disposal.

2.1.21 *Building Sub-Drain* – That portion of a drainage system which cannot drain by gravity in the building sewer.

2.1.22 *Building Trap* – A device, fitting or assembly of fittings installed in the building drain to prevent circulation of air between the drainage of the building and the building sewer. It is usually installed as running trap.

2.1.23 *Cesspool*

a) An underground chamber for the reception and storage of foul water, the contents of which are periodically removed for disposal.
b) A box-shaped receiver constructed in a roof or gutter for collecting rainwater which then passes into a rainwater pipe connected thereto.

2.1.24 *Cistern* – A fixed container for water in which water is at atmospheric pressure. The water is usually supplied through a float operated valve.

2.1.25 *Cleaning Eye* – An access opening in a pipe or pipe fitting arranged to facilitate the cleaning of obstructions and fitted with removable cover.

2.1.26 *Clear Waste Water* – Cooling water and condensate drainage from refrigeration and air conditioning equipment, cooled condensate from steam heating systems, cooled boiler blow-down water, waste water drainage from equipment rooms and other areas where water is used without an appreciable addition of oil, gasoline, solvent, acid, etc., and treated effluent in which impurities have been reduced below a minimum concentration considered harmful.

2.1.27 *Collection Chamber* – A compartment situated at the lower end of the chute for collecting and housing the refuse during the period between two successive cleanings.

2.1.28 *Connection* – The junction of a foul water drain, surface water drain or sewer from building or building with public sewer treatment works, public sewer, private sewer, individual sewage-disposal system, cess-pool, soakaway or to other approved point of disposal/ treatment work.

2.1.29 *Consumer* – Any person who uses or is supplied water or on whose application such water is supplied by the Authority.

2.1.30 *Crown of Trap* – The topmost point of the inside of a trap outlet.

2.1.31 *Deep Manhole* – A manhole of such depth that an access shaft is required in addition to the working chamber.

2.1.32 *Depth of Manhole* – The Vertical distance from the top of the manhole cover to the outgoing invert of the main drain channel.

2.1.33 *Developed Length* – The length measured along the center line of a pipe and fittings.

2.1.34 *Diameter* – The nominal internal diameter of pipes and fittings.

2.1.35 *Direct Tap* – A tap which is connected to a supply pipe and is subject to pressure from the water main.

2.1.36 *Down take Tap* – A tap connected to a system of piping not subject to water pressure from the water main.

2.1.37 *Drain* – A *conduit*, channel or pipe for the carriage of storm water, sewage, *waste water or other water-borne wastes in a building drainage system.*

2.1.38 *Drain Ventilating Pipe (DVP)* – A pipe installed to provide flow of air to or from a drain to prevent undue concentration of foul air in the drain. The main soil pipe or main waste pipe may serve as drain ventilating pipe wherever their upper portions, which do not receive discharges, are extended to the roof level and let open to air.

2.1.39 *Drainage* – The removal of any liquid by a system constructed for the purpose.

2.1.40 *Drainage Work* – The design and construction of a system of drainage.

2.1.41 *Drop Connection* – A length of conduit installed vertically immediately before its connection to a sewer or to another drain.

2.1.42 *Drop Manhole* – A manhole installed in a sewer where the elevation of the incoming sewer considerably exceeds that of the outgoing sewer; a vertical waterway outside the manhole is provided to divert the waste from the upper to the lower level so that it does not fall freely into the manhole except at peak rate of flow.

2.1.43 *Fittings* – Fittings shall mean coupling, flange, branch, bend, tees, elbows, unions, waste with plug, P or S trap with vent, stop ferrule, stop tap, bib tap, pillar tap, globe tap, ball valve, cistern storage tank, baths, water-closets, boiler, geyser, pumping set with motor and accessories, meter, hydrant, valve and any other article used in connection with water supply, drainage and sanitation.

2.1.44 *Fixture Unit* – A quantity in terms of which the load producing effects on the plumbing system of different kinds of plumbing fixtures is expressed on some arbitrarily chosen scale.

2.1.45 *Fixture Unit Drainage* – A measure of probable discharge into the drainage system by various types of plumbing fixtures. The drainage fixture unit value for a particular fixture depends on its volume rate of drainage discharge, on the time duration of a single drainage operation and on the average time between successive operations.

2.1.46 *Formation* – The finished level of the excavation at the bottom of a trench or heading prepared to receive the permanent work.

2.1.47 FOG (Fat, Oil and Grease) reducing system: Grease interceptor that reduces non petroleum fats, oils and grease in effluent by separation and volume reduction.

2.1.48 *French Drain or Rubble Drain* – A shallow trench filled with coarse rubble, clinker, or similar material with or without field drain pipes.

2.1.49 *Frost Line* – The line joining the points of greatest depths below ground level up to which the moisture in the soil freezes.

2.1.50 *Grease Interceptor* – Plumbing fixture that is preferably installed in a sanitary drainage system to intercept fats, oils and grease from a wastewater discharge.

2.1.51 *Gully Chamber* – The chamber built of masonry round a gully trap for housing the same.

2.1.52 *Gully Trap* – A trap provided in a drainage system with a water seal fixed in a suitable position to collect waste-water from the scullery, kitchen sink, wash basins, baths and rain water pipes.

2.1.53 *High Altitudes* – Elevations higher than 1 500 m above mean sea level (MSL).

2.1.54 *Highway Authority* – The public body in which is vested, or which is the owner of, a highway repairable by the inhabitants collectively; otherwise the body or persons responsible for the upkeep of the highway.

2.1.55 *Horizontal Pipe* – Any pipe of fitting which makes an angle of more than 45° with the vertical.

2.1.56 *Indirect Waste Pipe* – The pipe that does not connect directly with the drainage system, but conveys liquid wastes by discharging into a plumbing fixture/interceptor that is directly connected to the drainage system.

2.1.57 *Inlet Fittings* – An arrangement of connecting the internal waste branch pipe from wash basin, sinks & shower drains to the main deep seal trap with the help of hopper extension.

2.1.58 *Inlet Hopper* – A receptacle fitting for receiving refuse from each floor and dropping it into the chute.

2.1.59 *Insanitary* – Condition that is contrary to sanitary principles or is injurious to health*.*

2.1.60 *Inspection Chamber* – A water-tight chamber constructed in any house-drainage system which takes wastes from gully traps and disposes of to manhole with access for inspection and maintenance.

2.1.61 *Interceptor* – A device designed and installed so as to separate and retain deleterious, hazardous or undesirable matter from normal wastes and permit normal sewage or liquid wastes to discharge into the disposal terminal by gravity.

2.1.62 *Interceptor Manhole or Interceptor Chamber* – A manhole incorporating an intercepting trap and providing means of access thereto.

2.1.63 *Invert* – The lowest point of the internal surface of a pipe or channel at any cross section.

2.1.64 *Junction Pipe* – A pipe incorporating one or more branches.

2.1.65 *Lagging* – Thermal insulation or pipes.

2.1.66 *Licensed Plumber* – A person licensed under the provisions of this Code.

2.1.67 *Main Soil Pipe (MSP)* – A pipe connecting one or more branch soil pipes to the drain.

2.1.68 *Main Soil and Waste Pipe (MSWP)* – A pipe connecting one or more branch soil and waste pipes to the drain.

2.1.69 *Main Ventilating Pipe (MVP)* – A pipe which receives a number of branch ventilating pipes.

2.1.70 *Main Waste Pipe (MWP)* – A pipe connecting one or more branch waste pipes to the drain.

2.1.71 *Manhole* – An opening by which a main may enter or leave a drain, a sewer or other closed structure for inspection, cleaning and other maintenance operations, fitted with suitable cover.

2.1.72 *Manhole Chamber* – A Chamber constructed on a drain or sewer so as to provide access thereto for inspection, testing or clearance of obstruction.

2.1.73 *Non-Service Laterine* – Other than 'service latrine"

2.1.74 *Offset* – A pipe fitting used to connect two pipes whose axes are parallel but not in line.

2.1.75 *Pipe System* – The system to be adopted will depend on the type and planning of the building in which it is to be installed and will be one of the following:

a) *Single Stack System* (*see* Fig. 1) – The one-pipe system in which there is no trap ventilation the stack itself acts as vent through roof. In this system care shall be taken for proper sizing of the pipes and the trap arm distance. This system is restricted to residential occupancy up to 2 to 3 stories.

b) *Single Stack – Partially Vented* (*see* Fig. 2) – Soil and waste pipe connected to a single vertical stack with additional venting pipe for ventilation of traps of water closets. This system is generally practiced for the buildings up to 15 meter height.

c) *Single Stack – Fully Ventilated* – The system of plumbing in which the wastes from the sinks, baths and wash basins, and the soil pipe branches are all collected into one main pipe, which is connected, directly to the drainage system. The traps of the water closets, waste appliances etc., are completely ventilated with a separate pipe to preserve the water seal.

d) *Two Stack Systems* (*see* Fig. 3) –

1) Two Stack System with Common Vent - A system in which there is one soil pipe into which all water closets, urinals and any other soil appliances discharge. Additionally there is one waste stack into which all non-soil waste such as baths, sinks, and basins are discharged through deep seal trap. In addition, there is a relief vent, which ventilates traps of water closets/soil stack and also vents connection from waste appliances/stack.

2) Two Stack System with Independent Vents - The system of plumbing in which soil and waste pipes are distinct and separate. Soil stack shall have discharge from water closets, urinals and any other soil appliances. Waste stack shall have discharge of non-soil waste such as baths, sinks, and basins through deep seal trap. Each soil and waste pipe shall have independent vents.

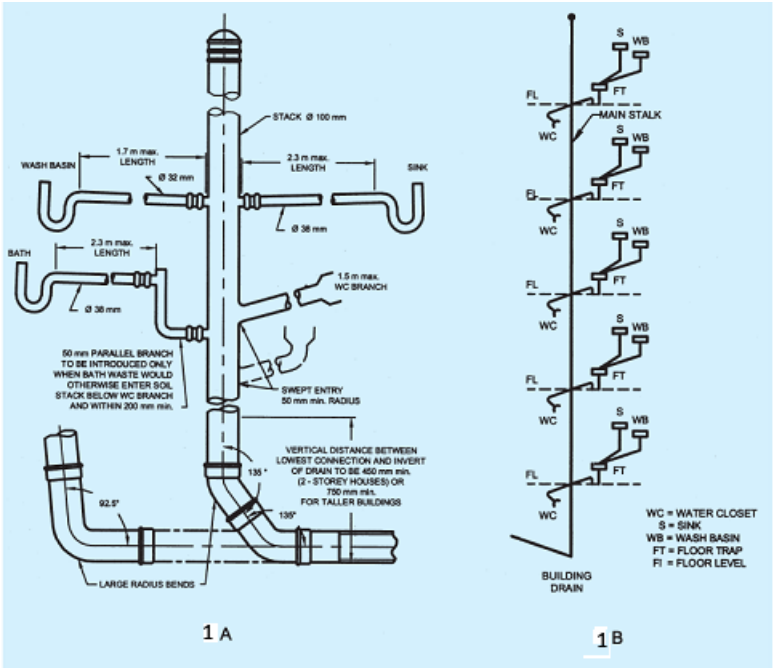

FIG. 1 SINGLE STACK SYSTEM – MAIN FEATURE OF DESIGN

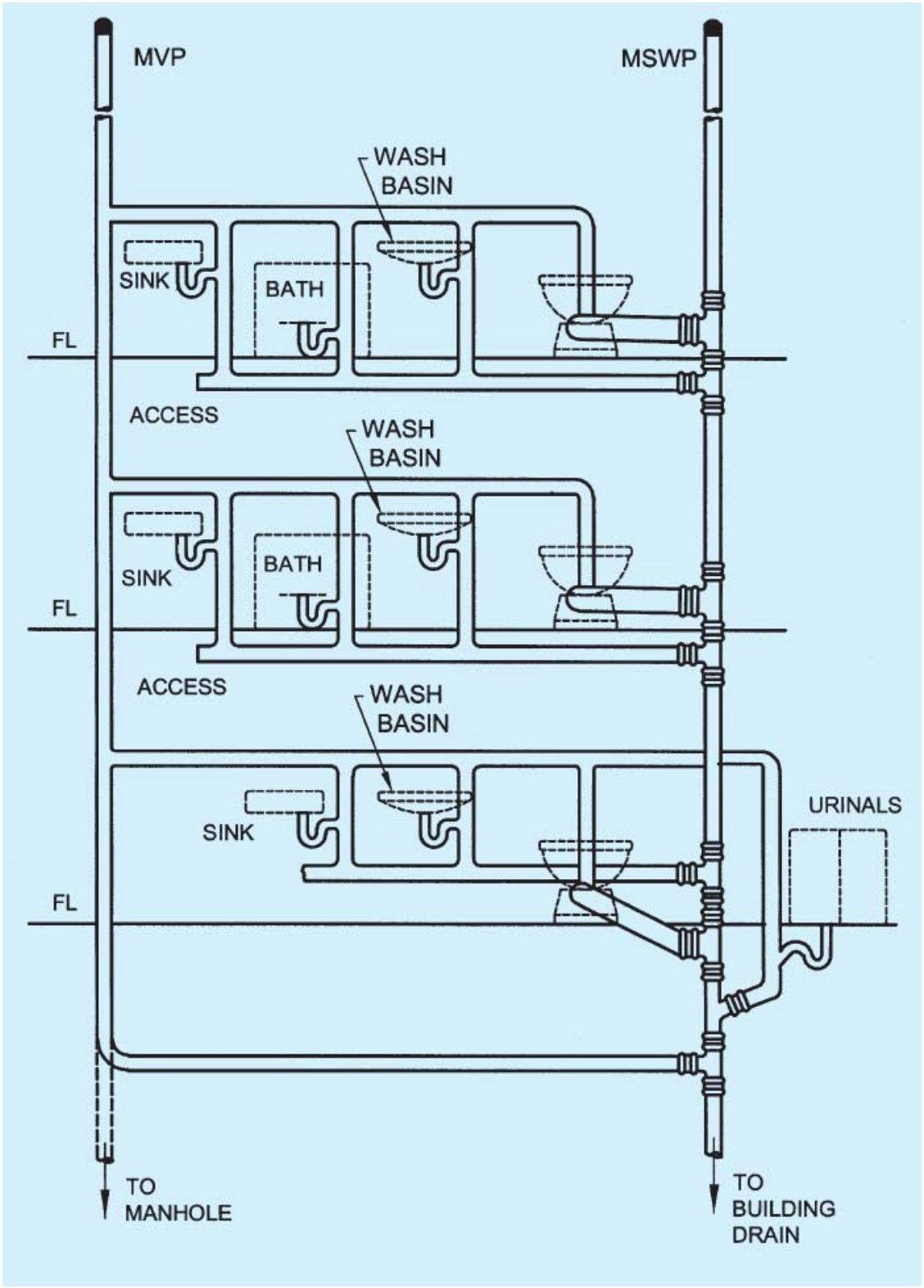

FIG. 2 DIAGRAM OF ONE PIPE SYSTEM

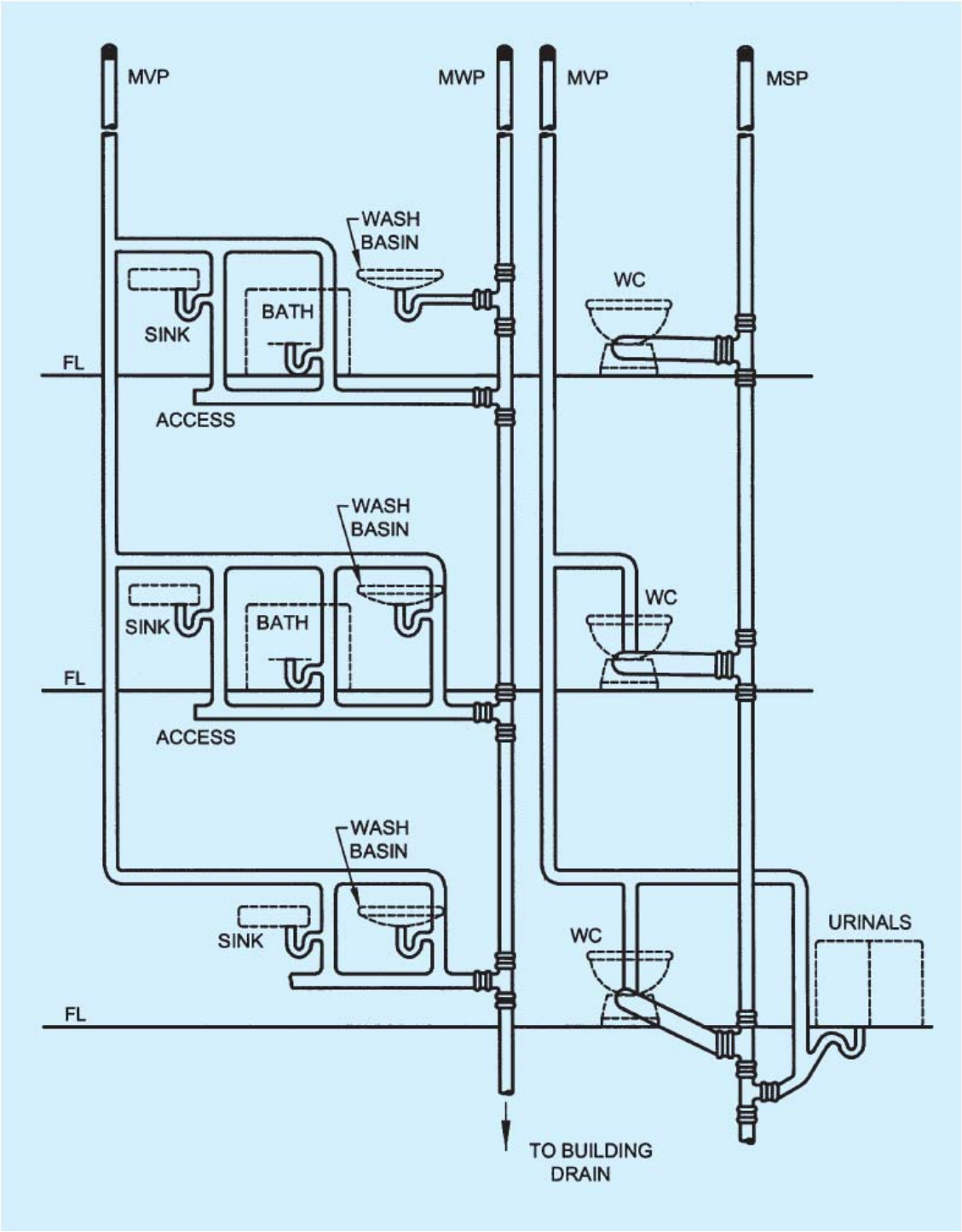

FIG. 3 DIAGRAM OF TWO PIPE SYSTEM

2.1.76 *Plumbing*

a) The pipes, fixtures and other apparatus inside a building for bringing in the water supply and removing the liquid and water borne wastes.
b) The installation of the foregoing pipes, fixtures and other apparatus.

2.1.77 *Plumbing System* – The plumbing system shall include the water supply and distribution pipes; plumbing fittings and traps; soil, waste, vent pipes and anti-siphonage pipes; building drains and building sewers including their respective connections, devices and appurtenances within the property lines of the premises; and water-treating or water-using equipment.

2.1.78 *Premises* – Premises shall include passages, buildings and lands of any tenure, whether open or enclosed, whether built on or not, and whether public or private in respect of which a water rate or charge is payable to the Authority or for which an application is made for supply of water.

2.1.79 *Puff Ventilation* – The ventilation provided for waste traps in two-pipe system, in order to preserve the water seal.

2.1.80 *Saddle* – A purpose made fitting, so shaped as to fit over a hole cut in a sewer or drain used to form connections.

2.1.81 *Sanitary* Appliances – *The appliances for the collection and discharge of soil or waste matter.*

2.1.82 *Service Latrine* – A latrine from which the excreta are removed by manual agency and not by water carriage.

2.1.83 *Sewer* – A pipe or conduit, generally closed, but normally not flowing full for carrying sewage *and/* or other waste liquids.

2.1.84 *Slop Hopper (Slop Sink)* – A hopper shaped sink, with a flushing run and outlet similar to those of a WC pan, for the reception and discharge of human excreta.

2.1.85 *Soakaway* – A pit, dug into permeable ground lined to form a covered perforated chamber or filled with hard-core, to which liquid is led, and from which it may soak away into the ground.

2.1.86 *Soffit (Crown)* – The highest point of the internal surface of a sewer or culvert at any cross-section.

2.1.87 *Soil Appliances* – A sanitary appliance for the collection and discharge of excretory matter.

2.1.88 *Soil Pipe* – A pipe that conveys the discharge of water closets or fixtures having similar functions, with or without the discharges from other fixtures.

2.1.89 *Soil Waste* – The discharge from water closets, urinals, slop hooper, stable yard or cowshed gullies and similar appliances.

2.1.90 *Sub-Soil Water* – Water occurring naturally in the subsoil.

2.1.91 *Sub-Soil Water Drain*

a) A drain intended to collect and carry away subsoil *water.*
b) A drain intended to disperse into the subsoil from a septic tank.

2.1.92 *Sullage* – *See* **2.1.107**.

2.1.93 *Supply Pipe* – So much of any service pipe as is not a communication pipe.

2.1.94 *Supports* – Hangers and anchors or devices for supporting and securing pipe and fittings to walls, ceilings, floors or structural members.

2.1.95 *Surface Water* – Natural water from the ground surface, paved areas and roofs.

2.1.96 *Surface Water Drain* – A drain conveying surface water including storm water.

2.1.97 *Systems of Drainage*

a) *Combined System* – A system in which foul water (sewage) and surface water are conveyed by the same sewers and drains.
b) *Separate System* – A system in which foul water (sewage) and surface water are conveyed by the separate sewers and drains.
c) *Partially Separate System* – A modification of the separate system in which part of the surface water is conveyed by the foul (sanitary) sewers and drains.

2.1.98 *Trade Effluent* – Any liquid either with or without particles of matter in suspension which is wholly or in part produced in the course of any trade or industry, at trade premise. It includes farm wastes but does not include domestic sewage.

2.1.99 *Trap* – A fittings or device so designed and constructed as to provide, when properly vented, a liquid seal which will prevent the back passage of air without materially affecting the flow of sewage or waste water through it.

2.1.100 *Vertical Pipe* – Any pipe *or fitting* which is installed in a vertical position or which makes an angle or not more than 45° with the vertical.

2.1.101 *Vent Stack/Vent Pipe* – A vertical vent pipe installed primarily for the purpose of proving circulation of air to and from any part of the drainage system. It also protects trap seals from excessive pressure fluctuation.

2.1.102 *Vent System* – A pipe or pipes installed to provide a flow of air to or from a drainage system or to provide a circulation of air with in such system to protect traps seals from siphonage and back-pressure.

2.1.103 *Warning Pipe* – An overflow pipe so fixed that its outlet, whether inside or outside a building, is in a conspicuous position where the discharge of any water there from can be readily seen.

2.1.104 *Wash-Out Valve* – A device located at the bottom of the tank for the purpose of draining a tank for cleaning, maintenance, etc.

2.1.105 *Waste Appliance* – A sanitary appliance for the collection and discharge of water after use for ablutionary, culinary and other domestic purpose.

2.1.106 *Waste Pipe* – In plumbing, any pipe that receives the discharge of any fixtures, except water-closets or similar fixtures and conveys the same to the house drain or soil or waste stack. When such pipe does not connect directly with a house drain or soil stack, it is called an indirect waste pipe.

2.1.107 *Waste-Water (Sullage)* – The discharge from wash basins, sinks and similar appliances, which does not contain human or animal excreta.

2.1.108 *Water* hammer Arrestor – Device designed to provide protection against hydraulic shock in the building water supply system*.*

2.1.109 *Water Main (Street Main)* – A pipe laid by the water undertakers for the purpose of giving a general supply of water as distinct from a supply to individual consumers and includes any apparatus used in connection with such a pipe.

2.1.110 *Water Outlet* – A water outlet, as used in connection with the water distributing system, is the discharge opening for the water(a) to a fitting; (b) to atmospheric pressure (except into an open tank which is part of the water supply system); and (c) to any water-operated device or equipment requiring water to operate.

2.1.111 *Water Seal* – The water in a trap, which acts as a barrier to the passage of air through the trap.

2.1.112 *Water Supply System* – Water supply system of a building or premises consists of the water service pipe, the water distribution pipes, and the necessary connecting pipes, fittings, control valves, and all appurtenances in or adjacent to the building or premises.

2.1.113 *Waterworks* – Waterworks for public water supply include a lake, river, spring, well, pump with or without motor and accessories, reservoir, cistern, tank, duct whether covered or open, sluice, water main, pipe, culvert, engine and any machinery, land, building or a thing used for storage, treatment and supply of water.

3 GENERAL

3.1 Basic Principles

3.1.1 *Potable Water*

All premises intended for human habitation, occupancy, or use shall be provided with supply of potable water. This water supply shall not be connected with unsafe water resources, nor shall it be subject to the hazards of backflow.

3.1.2 *Safety Devices*

Plumbing system shall be designed and installed with safety devices to safeguard against dangers from contamination, explosion, overheating, etc.

3.1.3 *Plumbing Fixtures*

It is recommended that each family dwelling unit should have at least one water closet, one lavatory, one kitchen wash place or a sink, and one bathing wash place or shower to meet the basic requirements of sanitation and personal hygiene.

3.1.4 *Drainage System*

The drainage system shall be designed, installed and maintained to guard against fouling, deposit of solids and clogging and with adequate cleanouts so arranged that the pipes may be readily cleaned.

3.1.5 *Materials and Workmanship*

The plumbing system shall have durable material, free from defective workmanship and so designed and installed as to give satisfactory service for its reasonable expected life.

3.1.6 *Fixture Traps and Vent Pipes*

Each fixture directly connected to the drainage system shall be equipped with a liquid seal trap. Trap seals shall be maintained to prevent sewer gas, other potentially dangerous or noxious fumes, or vemin from entering the building. Further, the drainage system shall be designed to provide an adequate circulation of air in all pipes with no danger of siphonage, aspiration, or forcing of trap seals under conditions of ordinary use by providing vent pipes throughout the system.

3.1.7 *Foul Air Exhaust*

Each vent terminal shall extend to the outer air and be so installed as to minimize the possibilities of clogging and the return of foul air to the building, as it conveys potentially noxious or explosive gases to the outside atmosphere. All vent pipes shall be provided with a cowl.

3.1.8 *Testing*

The drainage system shall be subjected to required tests to effectively disclose all leaks and defects in the work or the material.

3.1.9 *Exclusion from Plumbing System*

No substance that will clog or accentuate clogging of pipes, produce explosive mixtures, destroy the pipes or their joints, or interfere unduly with the sewage-disposal process shall be allowed to enter the drainage system.

3.1.10 *Light and Ventilation*

Wherever water closet or similar fixture shall be located in a room or compartment, it should be properly lighted and ventilated.

3.1.11 *Individual Sewage Disposal Systems*

If water closets or other plumbing fixtures are installed in buildings where connection to public sewer is not possible, suitable provision shall be made for acceptable treatment and disposal.

3.1.12 *Maintenance*

Plumbing systems shall be maintained in a safe and serviceable condition.

3.1.13 *Accessibility*

All plumbing fixtures shall be so installed with regard to spacing as to be accessible for their intended use and for cleaning. All doors, windows and any

other device needing access within the toilet shall be so located that they have proper access.

3.1.14 *Fixture for Disabled*

Special toilet fixtures shall be provided for the disabled with required fixtures and devices.

3.1.15 *Structural Safety*

Plumbing system shall be installed with due regard to preservation of the structural members and prevention of damage to walls and other surfaces.

3.1.16 *Protection of Ground and Surface Water*

Sewage or other waste shall not be discharged into surface or sub-surface water without acceptable form of treatment.

3.2 Drainage and Sanitation

3.2.1 *Preparation and Submission of Plan*

No person shall install or carry out any water-borne sanitary installation or drainage installation or any works in connection with anything existing or new buildings or any other premises without obtaining the previous sanction of the Authority.

The owner shall make an application in the prescribed form (*see* Annex A) to the Authority to carry out such a work.

3.2.2 *Site Plan*

A site plan of the premises on which the building is to be situated or any such work is to be carried out shall be prepared drawn to a scale not smaller than 1:500 (*see* Part 2 Administration). The site plan of the building premises shall show :

a) the adjoining plots and streets with their names;
b) the position of the municipal sewer and the direction of flow in it;
c) the invert level of the municipal sewer, the road level, and the connection level of the proposed drain connecting the building in relation to the sewer,
d) the angle at which the drain from the building joints the sewer; and
e) the alignment, sizes and gradients of all drains and also of surface drains, if any.

A separate site plan is not necessary if the necessary particulars to be shown in such a site plan are already shown in the drainage plan.

3.2.3 *Drainage Plan*

The application (**3.3.1**) shall be accompanied by a drainage plan drawn to a scale of not smaller than 1:100 and furnished along with the building plan (*see* Part 2 Administration). The plans shall show the following :

a) Every floor of the building in which the pipes or drains are to be used;
b) The position, forms, level and arrangement of the various parts of such building, including the roof thereof;
c) All new drains as proposed with their sizes and gradients;
d) Invert levels of the proposed drains with corresponding ground levels;
e) The position of every manhole, gully, soil and waste pipe, ventilating pipe, rain water pipe, water-closet, urinal, latrine, bath, lavatory, sink, trap or other appliances in the premises proposed to be connected to any drain and the following colours are recommended for indicating sewers, waste water pipes, rain-water pipes an existing work.

Description of Work	*Colour*
Sewers	Red
Waste water pipes and rain-water pipes	Blue
Existing work	Black

f) The position of refuse chute, inlet hopper and collection chamber.

3.2.3.1 In the case of an alteration or addition to an existing building, this clause shall be deemed to be satisfied if the plans as furnished convey sufficient information for the proposals to be readily identified with previous sanctioned plans and provided the locations of tanks and other fittings are consistent with the structural safety of the building.

3.2.3.2 The plans for the building drainage shall in every case be accompanied by specifications for the various items of work involved. This information shall be supplied in the prescribed from given in Annex B.

3.2.4 In respect of open drains, cross-sectional details shall be prepared to a scale not smaller than 1:50 showing the ground and invert levels and any arrangement already existing or proposed for the inclusion of any or exclusion of all storm water from the sewers.

3.2.5 *Completion Certificate*

At the completion of the plumbing installation work, the licensed plumber shall give a completion certificate in the prescribed form, which is given in Annex C.

3.3 Licencing/Registration of Plumbers

3.3.1 *Execution of Work*

The work which is required to be carried out under the provisions of this section, shall be executed only by a licensed plumber under the control of the Authority and shall be responsible to carry out all lawful directions given by the Authority. No individual shall engage in the business of plumbing unless so licensed under the provisions of this section.

3.3.1.1 No individual, firm, partnership or corporation shall engage in the business of installing, repairing or altering plumbing unless the plumbing work performed in the course of such business is under the direct supervision of a licensed/ certified plumber from approved Authority*.*

3.3.2 *Examination and Certification*

The Authority shall establish standards and procedure for the qualification, examination and licensing/ certification of plumbers and shall issue licences//certificate to such persons who meet the qualifications thereof and successfully pass the examination.

3.3.3 For guidelines for registration of plumbers including the minimum standards for qualifications for the grant of licences, reference may be made to good practice [9-2(1A)].

4 DRAINAGE AND SANITATION

4.1 Types of Sanitary Appliances

4.1.1 *Soil Appliances*

4.1.1.1 *Water-closet*

It shall essentially consist of a closet consisting of a bowl to receive excretory matter, trap and a flushing apparatus. It is recommended to provide ablution tap adjacent to the water closet, preferably on right hand side wall. The various types/style of water closets may be:

a) Squatting Indian type water closet,
b) Washdown type water closet,
c) Siphonic washdown type water closet, and
d) Universal or Anglo-Indian water closet.

4.1.1.2 *Bidet*

It is provided with hot and cold water connection. The bidet outlet should essentially connect to soil pipe in a two-pipe system.

4.1.1.3 *Urinal*

It is a soil appliance and is connected to soil pipe after a suitable trap. Urinal should have adequate provision of flushing apparatus. The various types/style of urinal may be:

a) Bowl type urinal: Flat back or Angle back.
b) Slab (single) type urinal.
c) Stall (single) type urinal.
d) Squatting plate type urinal.
e) Syphon jet urinal with integral trap.
f) Water less (Non - water) urinal

4.1.1.4 *Slop sink and bed pan sink*

Slop sink is a large sink of square shape. The appliance is used in hospitals installed in the nurse's station, operation theatres and similar locations for disposal of excreta and other foul waste for washing bed pans and urine bottles/pans. It is provided with a flushing mechanism.

4.1.2 *Waste Appliances*

4.1.2.1 *Wash-basin*

It is of one piece construction having a combined overflow and preferably should have soap holding recess or recesses that should properly drain into the bowl. Each basin shall have circular waste hole through which the liquid content of the basin shall drain.

4.1.2.2 *Wash-trough*

It is a linear trough for simultaneous use by number of persons.

4.1.2.3 *Sink*

It is used in kitchen and laboratory for the purpose of cleaning utensils/ apparatus and also serve the purpose of providing water for general usage. The sink may be made with or without overflow arrangement. The sink shall be of one piece construction including combined over flow, where provided. The sink shall have a circular waste hole into which the interiors of the sink shall drain.

4.1.2.4 *Bath tub*

Bath tub may be of enamelled steel, cast iron, gel-coated, glass fibre reinforced plastic or may be cast *in-situ*. It shall be stable, comfortable, easy to get in and out, water tight, with anti-skid base, and easy to install and maintain. The bath tub shall be fitted with overflow and waste pipe of nominal diameter of not less than 32 mm and 40 mm respectively.

4.1.2.5 *Drinking fountain*

It is a bowl fitted with a push button tap and a water bubbler or a tap with a swan neck outlet fitting. It has a waste fitting, a trap and is connected to the waste pipe.

4.1.3 The requirements of various soil appliances and waste appliances shall be in accordance with accepted standards [9-2(2)].

4.2 Drainage and Sanitation Requirements

4.2.1 *General*

There should be at least one water tap and arrangement for drainage in the vicinity of each water closet or group of water-closet in all the buildings.

4.2.2 Each family dwelling unit on premises (abutting on a sewer or with a private sewage disposal system) shall have, at least, one water closet and one kitchen type sink. A bath or shower shall also be installed to meet the basic requirements of sanitation and personal hygiene.

4.2.3 All other structures for human occupancy or use on premises, abutting on a sewer or with a private sewage-disposal system, shall have adequate sanitary facilities, but in no case less than one water-closet and one other fixture for cleaning purposes.

4.2.4 *For Residences*

4.2.4.1 Dwelling with individual convenience shall have at least the following fitments:

a) One bath room provided with a tap and a floor trap;
b) One water-closet with flushing apparatus with an ablution tap; and
c) One tap with a floor trap or a sink in kitchen or wash place.

4.2.4.1.1 Where only one water-closet is provided in a dwelling, the bath and water-closet *desirably* shall be separately accommodated.

4.2.4.2 Dwellings without individual conveniences shall have the following fitments:

a) One water tap with floor trap in each tenement,
b) One water-closet with flushing apparatus and one ablution tap bath for every two tenements, and
c) One bath with water tap and floor trap for every two tenements.

4.2.5 *For Buildings other than Residences*

4.2.5.1 The requirements for fitments for drainage and sanitation in the case of buildings other than residences shall be in accordance with Table 1 to Table 15. The following shall be, in addition, taken into consideration:

a) The figures shown are based upon one (1) fixture being the minimum required for the number of persons indicated or part thereof.

b) Building categories not included in the tables shall be considered separately by the Authority.

c) Drinking fountains shall not be installed in the toilets.

d) Where there is the danger of exposure to skin contamination with poisonous, infectious or irritating material, washbasin with eye wash jet and an emergency shower (safety shower with eye wash unit) located in an area accessible at all times with the passage/right of way suitable for access to a wheel chair, shall be provided.

e) When applying the provision of these tables for providing the number of fixtures, consideration shall be given to the accessibility of the fixtures. Using purely numerical basis may not result in an installation suited to the need of a specific building. For example, schools should be provided with toilet facilities on each floor. Similarly toilet facilities shall be provided for temporary workmen employed in any establishment according to the needs; and in any case one WC and one washbasin shall be provided.

f) All buildings used for human habitation for dwelling, work, occupation, medical care or any purpose detailed in the various tables, abutting a public sewer or a private sewage disposal system, shall be provided with minimum sanitary facilities as per the schedule in the tables. In case the disposal facilities are not available, they shall be provided as a part of the building design for ensuring high standards of sanitary conditions in accordance with this section.

g) Workplaces where crèches are provided, they shall be provided with one WC for 10 persons or part thereof, one wash basin for 15 persons

or part thereof, one kitchen sink with floor trap for preparing food/milk preparations. The sink provided shall with a drinking water tap.

h) In all types of buildings, individual toilets and pantry should be provided for executives, and for meeting/seminar/conference rooms, etc as per the user requirement.

j) Where food is consumed indoors, water stations may be provided in place of drinking water fountains.

Table 1 Office Buildings

(*Clause* 4.2.5.1)

Sl No	Fixtures	Public Toilets		Staff Toilets	
		Male	**Females**	**Male**	**Females**
1	**Executive rooms and Conference Halls in Office Buildings**				
	Toilet suite comprising one WC , one washbasin (with optional shower stall if building is used round the clock at user's option) Pantry optional as per user requirement	Unit could be common for Male/Female or separate depending on the number of user of each facility		For individual officer rooms	
2	**Main Office Toilets for Staff and Visitors**				
2.1	Water closets	1 per 25	1 per 15	1 per 25	1 per 15
2.2	Ablution tap with each water-closet	← 1 in each water-closet →			
2.3	Urinals	Nil up to 6 1 for 7-20 2 for 21-45 3 for 46-70 4 for 71-100 Add @ 3% for 101-200 Add @ 2.5 % Over 200	-	Nil up to 6	-
2.4	Wash Basins	1 per 25	1 per 25	1 per 25	1 per 25
2.5	Drinking Water Fountain	1 per 100	1 per 100	1 per 100	1 per 100
2.6	Cleaner's Sink	← 1 per floor →			

Table 2 Factories

(*Clause* 4.2.5.1)

Sl No	Fixtures	Offices / Visitors		Workers	
		Male	Female	Male	Female
1	Water closets (Workers & Staff)	1 for up to 25	1 for up to 15	1 for up to 15	1 for up to 12
		2 for 16-35	2 for 16-25	2 for 16-35	2 for 13-25
		3 for 36-65	3 for 26-40	3 for 36-65	3 for 26-40
		4 for 66-100	4 for 41-57	4 for 66-100	4 for 41-57
			5 for 58-77		5 for 58-77
			6 for 78-100		6 for 78-100
	For persons 101-200 add	3%	5%	3%	5%
	For persons over 200 add	2.5%	4%	2.50%	4%
2	Ablution tap	1 in each water-closet	1 in each water-closet	1 in each water-closet	1 in each water-closet
3	Urinals	Nil up to 6	-	Nil up to 6	-
		1 for 7-20		1 for 7-20	
		2 for 21-45		2 for 21-45	
		3 for 46-70		3 for 46-70	
		4 for 71-100		4 for 71-100	
	For persons 101-200 add	3%		3%	
	For persons over 200 add	2.50%		2.50%	
4	Wash Basins	1 per 25 or part thereof	1 per 25 or part thereof	1 per 25 or part thereof	1 per 25 or part thereof
		Wash Basins in rows or troughs and taps spaced 750 mm c/c			
5	Drinking Water Fountain	1 per every 100 or part thereof with minimum one on each floor		1 per every 100 or part thereof with minimum one on each floor	

6	Cleaner's Sink	1 on each floor	1 on each floor	1 on each floor	1 on each floor
7	Showers /Bathing Rooms	←	As per trade requirements		→
8	Emergency Shower and Eye Wash fountain	-	-	1 per every shop floor per 500 persons	

NOTE – For factories requiring workers to be engaged in dirty and dangerous operations or requiring them to being extremely clean and sanitized conditions additional and separate (if required so) toilet facilities and if required by applicable Industrial and safety laws and the Factories Act shall be provided in consultation with the user.

Table 3 Cinema, Multiplex Cinema, Concerts and Convention Halls, Theatres

(*Clause* 4.2.5.1)

Sl No.	Fixtures	Public		Staff	
		Male	Female	Male	Female
1	Water Closets	1 per 100 up to 400 Over 400 add at 1 per 250 or part thereof	3 per 100 up to 200 Over 200 add at 2 per 100 or part thereof	1 for up to 15 2 for 16-35	1 for up to 12 2 for 13-25
2	Ablution tap	1 in each water-closet	1 in each water-closet	1 in each water-closet	1 in each water-closet
		1 water tap with draining arrangements shall be provided for every 50 persons or part thereof in the vicinity of water-closets and urinals			
3	Urinals	1 per 25 or part thereof	-	Nil up to 6 1 for 7-20 2 for 21-45	-
4	Wash Basins	1 per 200 or part thereof		1 for up to 15 2 for 16-35	1 for up to 12 2 for 13-25
5	Drinking Water Fountain	← 1 per 100 persons or part thereof →			
6	Cleaner's Sink	← 1 per floor →			
7	Showers /Bathing Rooms	← As per trade requirements →			

NOTES

1 Some WCs may be European style if desired

2 Male population may be assumed as two third and Female population as one third

Table 4 Art Galleries, Libraries and Museums

(*Clause* 4.2.5.1)

Sl No.	Fixtures	Public		Staff	
		Male	Female	Male	Female
1	Water Closets	1 per 200 up to 400 Over 400 add at 1 per 250 or part thereof	1 per 100 up to 200 Over 200 add at 1 per 150 or part thereof	1 for up to 15 2 for 16-35	1 for up to 12 2 for 13-25
2	Ablution tap	One in each water-closet	One in each water-closet	One in each water-closet	One in each water-closet
		1 water tap with draining arrangements shall be provided for every 50 persons or part thereof in the vicinity of water-closets and urinals			
3	Urinals	1 per 50	-	Nil up to 6 1 per 7 to 20 2 per 21-45	-
4	Wash Basins	1 for every 200 or part thereof. For over 400, add at 1 per 250 persons or part thereof	1 for every 200 or part thereof. For over 200, add at 1 per 150 persons or part thereof	1 for up to 15 2 for 16-35	1 for up to 12 2 for 13-25
5	Drinking Water Fountain	← 1 per 100 persons or part thereof →			
6	Cleaner's Sink	← 1 per floor (Minimum) →			
7	Showers /Bathing Rooms	← As per requirements →			

NOTES

1 Some WC's may be European style if desired
2 Male population may be assumed as two third and Female population as one third.

Table 5 Hospitals with Indoor Patient Wards

(*Clause* 4.2.5.1)

Sl No.	Fixtures	Patient Toilets		Staff Toilets	
		Male	Female	Male	Female
1	Toilet suite comprising one WC and one washbasin and shower stall	Private room with up to 4 patients		For individual doctor's/officer's rooms	
	For General Wards, Hospital Staff and Visitors				
2	Water Closets	1 per 8 beds or part thereof	1 per 8 beds or part thereof	1 for up to 15 2 for 16-35	1 for up to 12 2 for 13-25
3	Ablution tap	One in each water-closet	One in each water-closet	One in each water-closet	One in each water-closet
		1 water tap with draining arrangements shall be provided for every 50 persons or part thereof in the vicinity of water-closets and urinals			
4	Urinals	1 per 30 beds	-	Nil up to 6 1 for 7 to 20 2 for 21-45	-
5	Wash Basins	2 for every 30 beds or part thereof. Add 1 per additional 30 beds or part thereof		1 for up to 15 2 for 16-35	1 for up to 12 2 for 13-25
6	Drinking Water Fountain	1 per ward		1 per 100 persons or part thereof	
7	Cleaner's Sink	1 per ward		-	
8	Bed Pan sink	1 per ward		-	
9	Kitchen Sink	1 per ward		-	

NOTES

1 Some WC's may be European style if desired

2 Male population may be assumed as two third and Female population as one third.

3 Provision for additional and special hospital fittings where required shall be made.

Table 6 Hospitals Outdoor Patient Department

(*Clause* 4.2.5.1)

Sl No.	Fixtures	Patient Toilets		Staff Toilets	
		Male	Female	Male	Female
1	Toilet suite comprising one WC and one washbasin (with optional shower stall if building used for 24 h)	For up to 4 patients		For individual doctor's/officer's rooms	
2	Water Closets	1 per 100 persons or part thereof	2 per 100 persons or part thereof	1 for up to 15 2 for 16-35	1 for up to 12 2 for 13-25
3	Ablution tap	One in each water-closet	One in each water-closet	One in each water-closet	One in each water-closet
		1 water tap with draining arrangements shall be provided for every 50 persons or part thereof in the vicinity of water-closets and urinals			
4	Urinals	1 per 50 persons or part thereof	-	Nil up to 6 1 for 7 to 20 2 for 21-45	-
5	Wash Basins	1 per 100 persons of part thereof	2 per 100 persons or part thereof	1 for up to 15 2 for 16-35	1 for up to 12 2 for 13-25
6	Drinking Water Fountain	1 per 500 persons or part thereof		1 per 100 persons or part thereof	

NOTES

1 Some WC's may be European style if desired

2 Male population may be assumed as two third and Female population as one third.

3 Provision for additional and special hospital fittings where required shall be made.

Table 7 Hospitals, Administrative Buildings

(*Clause* 4.2.5.1)

Sl No.	Fixtures	Staff Toilets	
		Male	Female
1	Toilet suite comprising one WC and one washbasin (with optional shower stall if building used for 24 h)	For individual doctor's/officer's rooms	
2	Water Closets	1 per 25 persons or part thereof	1 per 15 persons or part thereof
3	Ablution tap	One in each water-closet 1 water tap with draining arrangements shall be provided for every 50 persons or part thereof in the vicinity of water-closets and urinals	One in each water-closet
4	Urinals	Nil up to 6 1 for 7 to 20 2 for 21-45	-
5	Wash Basins	1 per 25 persons or part thereof	1 per 25 persons or part thereof
6	Drinking Water Fountain	1 per 100 persons or part thereof	
7	Cleaner's Sink	1 per floor, Min	
8	Kitchen Sink	1 per floor, Min	

NOTES

1 Some WC's may be European style if desired

Table 8 Hospitals Staff Quarters and Nurses Homes

(*Clause* 4.2.5.1)

Sl No.	Fixtures	Staff Quarters		Nurses Homes	
		Male	Female	Male	Female
1	Water Closets	1 per 4 persons or part thereof	1 per 4 persons or part thereof	1 per 4 persons or part thereof 2 for 16-35	1 per 4 persons or part thereof 2 for 13-25
2	Ablution tap	One in each water-closet	One in each water-closet	One in each water-closet	One in each water-closet
		1 water tap with draining arrangements shall be provided for every 50 persons or part thereof in the vicinity of water-closets and urinals			
3	Wash Basins	1 per 8 persons or part thereof		1 per 8 persons or part thereof	
4	Bath (Showers)	1 per 4 persons or part thereof		1 per 4 to 6 persons or part thereof	
6	Drinking Water Fountain	1 per 100 persons or part thereof, Min 1 per floor		1 per 100 persons or part thereof, Min 1 per floor	
7	Cleaner's Sink	1 per Floor		1 per Floor	

NOTES

1 Some WC's may be European style if desired

2 For independent housing units fixtures shall be provided as for residences.

Table 9 Hotels

(Clause 4.2.5.1)

Sl No.	Fixtures	Public Rooms		Non Residential Staff	
		Male	Female	Male	Female
1	Toilet suite comprising one WC, Wash Basin with Shower or a Bath tub	Individual guest rooms with attached toilets		–	
	Guest Rooms with Common Facilities				
2	Water Closets	1 per 100 persons up to 400 Over 400 add at 1 per 250 or part thereof	2 per 100 persons up to 200 Over 200 add at 1 per 100 or part thereof	1 for up to 15 2 for 16-35 3 for 36-65 4 for 66-100	1 for up to 12 2 for 13-25 3 for 26-40 4 for 41-57 5 for 58-77 6 for 78-100
3	Ablution tap	One in each water-closet	One in each water-closet	One in each water-closet	One in each water-closet
	1 water tap with draining arrangements shall be provided for every 50 persons or part thereof in the vicinity of water-closets and urinals				
4	Urinals	1 per 50 persons or part thereof	-	Nil up to 6 1 for 7 to 20 2 for 21-45 3 for 46-70 4 for 71-100	-
5	Wash Basins	1 per WC/ Urinal	1 per WC	1 for up to 15 2 for 16-35 3 for 36-65 4 for 66-100	1 for up to 12 2 for 13-25 3 for 26-40 4 for 41-57
6	Bath (Showers)	1 per 10 persons or part thereof		-	-

7	Cleaner's Sink	1 per 30 rooms, Min 1 per floor
8	Kitchen Sink	1 per kitchen

NOTES

1 Some WC's may be European style if desired

2 Male population may be assumed as two third and Female population as one third.

3 Provision for additional and special fittings where required shall be made.

Table 10 Restaurants

(Clause 4.2.5.1)

Sl No.	Fixtures	Public Rooms		Non Residential Staff	
		Male	Female	Male	Female
1	Water Closets	1 per 50 seats up to 200 Over 200 add at 1 per 100 or part thereof	2 per 50 seats up to 200 Over 200 add at 1 per 100 or part thereof	1 for up to 15 2 for 16-35 3 for 36-65 4 for 66-100	1 for up to 12 2 for 13-25 3 for 26-40 4 for 41-57 5 for 58-77 6 for 78-100
2	Ablution tap	One in each water-closet	One in each water-closet	One in each water-closet	One in each water-closet
		1 water tap with draining arrangements shall be provided for every 50 persons or part thereof in the vicinity of water-closets and urinals			
3	Urinals	1 per 50 persons or part thereof	-	Nil up to 6 1 for 7 to 20 2 for 21-45 3 for 46-70 4 for 71-100	-
4	Wash Basins	1 per WC	1 per WC	1 per WC	1 per WC
5	Cleaner's Sink	1 per each restaurant			
8	Kitchen Sink /Dish Washer	1 per kitchen			

NOTES

1 Some WC's may be European style if desired

2 Male population may be assumed as two third and Female population as one third.

3 Provision for additional and special fittings where required shall be made.

Table 11 Schools and Educational Institutions

(Clause 4.2.5.1)

Sl No.	Fixtures	Nursery School	Non-Residential		Residential	
			Boys	Girls	Boys	Girls
1	Water Closets	1 per 15 pupils or part thereof	1 per 40 pupils or part thereof	1 per 25 pupils or part thereof	1 per 8 pupils or part thereof	1 per 6 pupils or part thereof
2	Ablution tap	One in each water-closet	One in each water-closet	One in each water-closet	One in each water-closet	One in each water-closet
		1 water tap with draining arrangements shall be provided for every 50 persons or part thereof in the vicinity of water-closets and urinals				
3	Urinals	-	1 per 20 pupils or part thereof	-	1 per 25 pupils or part thereof	-
4	Wash Basins	1 per 15 pupils or part thereof	1 per 60 pupils or part thereof	1 per 40 pupils or part thereof	1 per 8 pupils or part thereof	1 per 6 pupils or part thereof
5	Bath/Showers	1 per 40 pupils or part thereof	-	-	1 per 8 pupils or part thereof	1 per 6 pupils or part thereof
6	Drinking Water Fountain or Taps	1 per 50 pupils or part thereof	1 per 50 pupils or part thereof	1 per 50 pupils or part thereof	1 per 50 pupils or part thereof	1 per 50 pupils or part thereof
7	Cleaner's Sink	1 per each floor				

NOTES

1 Some WC's may be European style if desired

2 For teaching staff, the schedule of fixtures to be provided shall be the same as in case of office building.

Table 12 Hostels

(Clause 4.2.5.1*)*

Sl No.	Fixtures	Resident		Non Resident		Visitor/Common Rooms	
		Males	Females	Males	Females	Males	Females
1	Water Closets	1 per 8 or part thereof	1 per 6 or part thereof	1 for up to 15 2 for 16-35 3 for 36-65 4 for 66-100	1 for up to 12 2 for 13-25 3 for 26-40 4 for 41-57 5 for 58-77 6 for 78-100	1 per 100 up to 400 Over 400 add at 1 per 250	2 per 100 up to 200 Over 200 add at 1 per 100
2	Ablution tap	One in each water-closet	One in each water-closet	One in each water-closet	One in each water-closet	One in each water-closet	One in each water-closet
		1 water tap with draining arrangements shall be provided for every 50 persons or part thereof in the vicinity of water-closets and urinals					
3	Urinals	1 per 25 or part thereof	-	Nil up to 6 1 for 7 - 20 2 for 21-45 3 for 46-70 4 for 71-100	-	1 per 50 or part thereof	-
4	Wash Basins	1 per 8 persons or part thereof	1 per 6 persons or part thereof	1 for up to 15 2 for 16-35 3 for 36-65 4 for 66-100	1 for up to 12 2 for 13-25 3 for 26-40 4 for 41-57 5 for 58-77 6 for 78-100	1 per WC/ Urinal	1 per WC
5	Bath/Showers	1 per 8 persons or part thereof	1 per 6 persons or part thereof	-	-	-	-
6	Cleaner's Sink	1 per each floor					

NOTES

1 Some WC's may be European style if desired

Table 13 Fruit and Vegetable Markets

(*Clause* 4.2.5.1)

Sl No.	Fixtures	Shop Owners		Common Toilets in Market Building		Public Toilet for floating population	
		Males	Females	Males	Females	Males	Females
1	Water Closets	1 per 8 or part thereof		1 for up to 15 2 for 16-35 3 for 36-65 4 for 66-100	1 for up to 12 2 for 13-25 3 for 26-40 4 for 41-57 5 for 58-77 6 for 78-100	1 per 50 (Min 2)	1 per 50 (Min 2)
2	Ablution tap	One in each water-closet	One in each water-closet	One in each water-closet	One in each water-closet	One in each water-closet	One in each water-closet
		1 water tap with draining arrangements shall be provided in receiving/ sale area of each shop and for every 50 persons or part thereof in the vicinity of water-closets and urinals					
3	Urinals	-	-	Nil up to 6 1 for 7 - 20 2 for 21-45 3 for 46-70 4 for 71-100	-	1 per 50	-
4	Wash Basins	1 per 8 or part thereof		1 for up to 15 2 for 16-35 3 for 36-65 4 for 66-100	1 for up to 12 2 for 13-25 3 for 26-40 4 for 41-57	-	-
5	Bath/Showers	1 per 8 persons or part thereof	1 per 6 persons or part thereof	-	-	1 per 50 persons	1 per 50 persons

NOTES

1 Toilet facilities for individual buildings in a market should be taken same as that for office buildings

2 Common Toilets in the market buildings provide facilities for persons working in shops and their regular visitors

3 Special toilet facilities for a large floating population of out of town buyers/sellers, labour, drivers of vehicles for whom special toilet (Public Toilets)

Table 14 Airports and Railway Stations

(Clause 4.2.5.1*)*

Sl No.	Fixtures	Junction Stations, Intermediate Stations and Bus Stations		Terminal Railway and Bus Stations		Domestic and International Airports	
		Males	Females	Males	Females	Males	Females
1	Water Closets	3 for up to 1 000 Add 1 per additional 1 000 or part thereof	4 for up to 1 000 Add 1 per additional 1 000 or part thereof	4 for up to 1 000 Add 1 per additional 1 000 or part thereof	5 for up to 1 000 Add 1 per additional 1 000 or part thereof	Min 2 For 200 5 For 400 9 For 600 12 For 800 16 For 1000 18	Min 2 For 200 8 For 400 15 For 600 20 For 800 26 For 1000 29
2	Ablution tap	One in each water-closet	One in each water-closet	One in each water-closet	One in each water-closet	One in each water-closet	One in each water-closet
		1 water tap with draining arrangements shall be provided for every 50 persons or part thereof in the vicinity of water-closets and urinals					
3	Urinals	4 for up to 1 000 Add 1 per additional 1 000	-	6 for up to 1 000 Add 1 per additional 1 000	-	1 per 40 or part thereof	-
4	Wash Basins	1 per WC/ Urinal	1 per WC	1 per WC/ Urinal	1 per WC	1 per WC/ Urinal	1 per WC
5	Bath/Showers	2 per 1 000		3 per 1 000		4 per 1 000	
6	Drinking Water Fountain or Taps (in common lobby for male/female)	2 per 1 000 or part thereof		3 per 1 000 or part thereof		4 per 1 000 or part thereof	
7	Cleaner's Sink	1 per toilet compartment with 3 WC's	1 per toilet compartment with 3 WC's	1 per toilet compartment with 3 WC's	1 per toilet compartment with 3 WC's	1 per toilet compartment with 3 WC's	1 per toilet compartment with 3 WC's

8	Toilet for Disabled	1 per 4 000	1 per 4 000	1 per 4 000	1 per 4 000	1 per 4 000 (Min 1)	1 per 4 000 (Min 1)

NOTES

1 Some WC's may be European style if desired
2 Male population may be assumed as three fifth and Female population as two fifth.
3 Separate provision shall be made for staff and workers.

Table 15 Shopping Malls and Retail Buildings

(Clause 4.2.5.1*)*

Sl No.	*Fixtures*	*Staff Toilets in Shopping Building*		*Public Toilet for floating population*	
		Males	*Females*	*Males*	*Females*
1	*Water Closets*	*1 for up to 15* *2 for 16-35* *3 for 36-65* *4 for 66-100*	*1 for up to 12* *2 for 13-25* *3 for 26-40* *4 for 41-57* *5 for 58-77* *6 for 78-100*	*1 per 50 (Min 2)*	*1 per 50 (Min 2)*
2	*Ablution tap*	*One in each water-closet*	*One in each water-closet*	*One in each water-closet*	*One in each water-closet*
3	*Urinals* - -	*Nil up to 6* *1 for 7 - 20* *2 for 21-45* *3 for 46-70* *4 for 71-100*	-	*1 per 50*	-
4	*Wash Basins*	*1 for up to 15* *2 for 16-35* *3 for 36-65* *4 for 66-100*	*1 for up to 12* *2 for 13-25* *3 for 26-40* *4 for 41-57*	-	-
5	*Bath/Showers*	-	-	*1 per 50 persons*	*1 per 50 persons*

NOTES

1 Toilet facilities for individual buildings in a shopping building should be taken same as that for office buildings

2 Staff Toilets in the shopping buildings provide facilities for persons working in shops and building maintenance staff

3 Public toilet facilities for a large floating population for buyers and visitors

4.3 Materials, Fittings and Appliances

4.3.1 *Standards for Materials, Fittings and Sanitary Appliances*

All materials, fittings and sanitary appliances shall conform to Part 5 'Building Materials'.

4.3.2 *Choice of Material for Pipes*

4.3.2.1 *Salt glazed stoneware pipe*

For all sewers and drains in all soils, except where supports are required as in made-up ground, glazed stoneware pipe shall be used as far as possible in preference to other types of pipes. These pipes are particularly suitable where acid effluents or acid subsoil conditions are likely to be encountered. Salt glazed stoneware pipes shall conform to accepted standards [9-2(3)].

4.3.2.2 *Cement concrete pipes*

When properly ventilated, cement concrete pipes with spigot and socket or collar joints present an alternative to glazed stoneware sewers of over 150 mm diameter. These shall not be used to carry acid effluents or sewage under conditions favorable for the production of hydrogen sulphide and shall not be laid in those sub-soils that are likely to affect adversely the quality or strength of concrete. Owing to the longer lengths of pipes available, the joints would be lesser in the case of cements concrete pipes. These pipes may be used for surface water drains in all diameters. Cement Concrete pipes shall conform to accepted standards [9-2(4)].

4.3.2.3 *Cast iron pipes*

4.3.2.3.1 These pipes shall be used in the following situation:

a) in bed or unstable ground where soil movement is expected;
b) in-made-up or tipped ground;
c) to provide for increased strength where a sewer is laid at insufficient depth, where it is exposed or where it has to be carried on piers or above ground;
d) under buildings and where pipes are suspended in basements and like situations;
e) in reaches where the velocity is more than 2.4 m/s; and
f) for crossings of watercourses.

NOTE - In difficult foundation condition such a in the case of black cotton soil, the cast iron pipes shall be used only when suitable supporting arrangements are made.

4.3.2.3.2 It shall be noted that cast iron pipes even when given a protective paint are liable to severe external corrosion in certain soils; among such soils are :

a) Soils permeated by peaty waters; and
b) soils in which the subsoil contains appreciable concentrations of sulphates. Local experiences shall be ascertained before cast iron pipes are used where corrosive soil conditions are suspected. Where so used, suitable measures for the protection of the pipes may be resorted to as an adequate safeguard.

4.3.2.3.3 Cast iron pipes shall conform to accepted standards [9-2(5)].

4.3.2.4 *Asbestos cement pipes*

Asbestos cement pipes are commonly used for house drainage systems and they shall conform to accepted standards [9-2(6)]. They are not recommended for underground situations. However, asbestos cement pressure pipes conforming to accepted standards [9-2(6)] may be used in underground situations also, provided they are not subject to heavy superimposed loads. These shall not be used to carry acid effluents or sewage under conditions favorable for the production of hydrogen sulphide and shall not be laid in those sub-soils which are likely to affect adversely the quality or strength of asbestos cement pipes. Where so desired, the life of asbestos cement pipes may be increased by lining inside of the pipe with suitable coatings like epoxy/polyester resins etc.

4.3.2.6 *PVC pipes*

Unplasticized PVC pipes may be used for drainage purposes; however, where hot water discharge is anticipated, the wall thickness shall be minimum 3 mm irrespective of the size and flow load.

PVC and HDPE Pipes shall conform to accepted standards [9-2(7)].

NOTE – Where possible, high density polyethylene pipes (HDPE) and PVC pipes may be used for drainage and sanitation purposes, depending upon the suitability.

4.3.2.7 *Corrugated pipes*

These pipes are used for sewerage and drainage applications. They are light weight and have long life. The leakage and infiltration at joints are less. The operational cost is low and can easily withstand natural settlements without suffering cracks or leakages. They consume fewer raw material and have less carbon dioxide emission.

4.3.2.8 *Low noise pipes*

Waste water systems encompass the system of drainage and pressure relief pipes within a building and terminate 0.5 m outside the external wall. Waste water systems are based on the primary pressure-relief system in which water and air-flow occurs in

the same pipe. The waste water system shall be separated from the roof drainage system.

Noise is a variance in air pressure that spreads like a wave. If quick changes in pressure occur between 20 and 20,000 times a second (frequency 20 Hz and 20 kHz), they are audible to humans. The loudness of noise is determined by the amplitude of the wave, which is measured in decibels (dB).

The main cause of noise in indoor drainage systems (primarily focused on the downpipe) are the choice of the pipe system, the bracket type and the design of drainage system. Optimizing these factors will therefore have the best influence on noise reduction.

4.3.2.9 *Under slung pipes*

In under slung plumbing, the toilet slab is built at the same level as the slabs outside the toilet. Holes / core cuts are punctured through the slab wherever pipes have to pass through, and the plumbing is clamped to the bottom of the slab. It is then concealed above a false ceiling, which is accessible above the false ceiling for routine maintenance. In this type of plumbing, any leaks will drip onto the false ceiling which is easily detectable thus allow quick maintenance without much damage to the structure or occupied premises

4.4 Preliminary Data for Design

4.4.1 *General*

Before the drainage system for a building or group of buildings is designed and constructed, accurate information regarding the site conditions is essential. This information may vary with the individual scheme but shall, in general, be covered by the following:

a) *Site Plan* (*see* **3.2.2***).*
b) *Drainage* Plan (*see* **3.2.3**).
c) *Use* – A description of the use for which the building is intended and periods of occupation in order that peak discharges may be estimated;
d) *Nature of Waste* – While dealing with sewage from domestic premises, special problems under this head may not arise; however, note shall be taken of any possibility of trade effluents being discharged into the pipes at a future date;
e) *Outlet Connection* – The availability of sewers or other outlets;
f) *Cover* – The depth (below ground) of the proposed sewers and drains and the nature and weight of the traffic on the ground above them;
g) *Subsoil Condition* :

1) The approximate level of the subsoil water, and any available records of flood levels shall be ascertained, as also the depth of the water table

relative to all sewer connections, unless it is known to be considerably below the level of the latter;

2) In the case of deep manholes, this information will influence largely the type of construction to be adopted. The probable safe bearing capacity of the subsoil at invert level may be ascertained in the case of a deep manhole.

3) Where work of any magnitude is to be undertaken, trial pits or boreholes shall be put at intervals along the line of the proposed sewer or drain and the data therefrom tabulated, together with any information available from previous works carried out in the vicinity. In general the information derived from trial pits is more reliable than that derived from boreholes. For a long length of sewer or drain, information derived from a few trial pits at carefully chosen points may be supplemented by that obtained from number of intermediate boreholes.

Much useful information is often obtained economically and quickly by the use of a soil auger;

4) The positions of trial pits or boreholes shall be shown on the plans, together with sections showing the strata found and the dates on which water levels are recorded.

h) *Location of Other Services* – The position, depth and size of all other pipes, mains, cables, or other services, in the vicinity of the proposed work, may be ascertained from the Authority, if necessary;

j) *Reinstatement of Surfaces* – Information about the requirements of the highway authority is necessary where any part of the sewer or drain is to be taken under a highway. Those responsible for the sewer or drain shall be also responsible for the maintenance of the surface until permanently reinstated. The written consent of the highway authority to break up the surface and arrangement as to the charges thereof and the method and type of surface reinstatement shall always be obtained before any work is commenced;

k) *Diversion and Control of Traffic*

1) In cases where sewers cross roads or foot-paths, cooperation shall be maintained with the police and Authorities regarding the control and diversion of vehicular and / or pedestrian traffic as may be necessary. Access to properties along the road shall always be maintained and adequate notice shall be given to the occupiers of any shops or business premises, particularly if obstruction is likely;

2) During the period of diversion, necessary danger lights, red flags, diversion boards, caution boards, watchmen, etc, shall be provided as required by the Authority;

m) *Way-leaves (Easements)* – The individual or authority carrying out the work is responsible for negotiating way-leaves where the sewer crosses land in other ownership. The full extend and conditions of such way-leaves shall be made known to the contractor and his employees, and prior notice of commencement of excavation shall always be given to the owners concerned, and cooperation with them shall be maintained at all stages, where sewers run across fields or open ground, the exact location of manholes shall be shown on way-leaves or easement plans. The right of access to manhole covers and the right to maintain the sewer shall be specifically included in any wayleave or easement arrangements which may be made with the owner of the land; and

n) *Damage to Buildings and Structures* – When sewer trenches have to be excavated near buildings or walls a joint inspection with the owners of the property shall be made to establish whether any damage or cracks exist before starting the work, and a properly authenticated survey and record of the condition of buildings likely to be affected shall be made. Tell tales may be placed across outside cracks and dated, and kept under observation. Un-retouched photographs taken by an independent photographer may provide useful evidence.

4.4.2 *Drainage into a Public Sewer*

Where public sewerage is available, the following information is particularly necessary and may be obtained from the Authority:

a) the position of the public sewer or sewers in relation to the proposed buildings.
b) the invert level of the public sewer;
c) the system on which the public sewers are designed (combined, separate or partially separate), the lowest level at which connection may be made to it, and the Authority in which it is vested;
d) the material of construction and condition of the sewer if connection is not to be made by the Authority;
e) the extent to which surcharge in the sewer may influence the drainage scheme;
f) whether the connection to the public sewer is made, or any part of the drain laid, by the Authority, or whether the owner is responsible for this work; if the latter, whether the Authority imposes any special conditions;
g) Whether an intercepting trap is required by the Authority on the drain near the boundary of the curtilage; and
h) Where manholes are constructed under roads, the approval of the Highway Authority for the type of cover to be fitted shall be obtained.

4.4.3 *Other Methods of Disposal of Sewage*

4.4.3.1 Where discharge into a public sewer is not possible, the drainage of the building shall be on a separate system. Foul water shall be disposed of by adequate treatment approved by the Authority on the site. The effluent from the plant shall be discharged after meeting the norms specified by the statutory authority into a natural watercourse or on the surface of the ground or disposed of subsoil dispersion preferably draining to a suitable outlet channel.

4.4.3.2 In the case of dilution into a natural stream course, the quality of the effluent shall conform and the requirements of the Authority controlling the prevention of pollution of streams.

4.4.3.3 In the case of subsoil dispersion, the requirements of the Authority for water supply shall be observed to avoid any possible pollution of local water supplies or wells.

4.4.3.4 The general subsoil water level and the subsoil conditions shall be ascertained, including the absorptive capacity of the soil.

4.4.3.5 A subsoil dispersion is not desirable near a building or in such positions that the ground below the foundations is likely to be affected.

4.4.3.6 Where no other method of disposal is possible, foul water may be diverted to cesspools and arrangements made with the Authority for satisfactory periodical removal and conveyance to a disposal works.

4.4.3.7 Under the separate system, drainage of the building shall be done through septic tanks of different sizes or by stabilization ponds or by any other treatment methods such as Extended Aeration Activated Process , Sequential Batch process, Fluidized Bio reactors, Membrane Bio Reactor, Submerged Aerobic Fixed Film, Rotating Biological Contactor , Electrolyte process etc as approved by the Authority.

For detailed information on the design and construction of septic tanks and waste stabilization ponds, Sewage treatment plants reference may be made to good practice [9-2(8)].

4.4.4 *Disposal of Surface and Subsoil Waters*

All information which may influence the choice of methods of disposal of surface and/or subsoil waters shall be obtained. In the absence of surface water drainage system, and if practicable and permissible, disposal into a natural water-course or soakaway may be adopted. The location and flood levels of the water course as also the requirements of the Authority controlling the river or the waterway shall be ascertained.

4.5 Planning and Design Considerations

4.5.1 *Aim*

The efficient disposal of foul and surface water from a building is of great importance to public health and is an essential part of the construction of the building. In designing a drainage system for an individual building or a housing colony, the aim shall be to provide a system of self-cleaning conduits for the conveyance of foul, waste, surface or subsurface waters and for the removal of such wastes speedily and efficiently to a sewer or other outlet without risk of nuisance and hazard to health.

4.5.1.1 To achieve this aim a drainage system shall satisfy the following requirements :

a) rapid and efficient removal of liquid wastes without leakage;
b) prevention of access of foul gases to the building and provision for their escape from the system.
c) adequate and easy access for clearing obstructions;
d) prevention of undue external or internal corrosion, or erosion of joints and protection of materials of construction; and
e) avoidance of air locks, siphonage, proneness to obstruction, deposit and damage.

4.5.1.2 The realization of an economical drainage system is added by compact grouping of fitments in both horizontal and vertical directions. This implies that if care is taken and ingenuity brought into play when designing the original building or buildings to be drained, it is possible to group the sanitary fittings and other equipment requiring drainage; both in vertical and horizontal planes, as to simplify the drainage system and make it most economical.

4.5.1.3 Efficient and an economical plumbing system can be achieved by planning the toilets in compact grouping with the layout of the bathrooms and observing the following guidelines :

a) Placing of plumbing fixtures around an easily accessible pipe shaft; in high rise buildings the pipe shafts may have to be within the building envelope and easy provision for access panels and doors should be planned in advance, in such cases so as not to inconvenience the owners during the maintenance.
b) Adopting repetitive layout of toilets in the horizontal and vertical directions.
c) Avoiding any conflict with the reinforced cement concrete structure by avoiding embedding pipes in it, avoiding pipe crossings in beams, columns and major structural elements.
d) Identifying open terraces and areas subject to ingress of rainwater directly or indirectly and providing for location of inlets at each level for down takes for disposal at ground levels.
e) Avoiding crossing of services of individual property through property of other owners.

f) Planning to avoid accumulation of rain water or any backflow from sewers particularly in planned low elevation areas in a building.

4.5.2 *Layout*

4.5.2.1 *General*

Rain-water should preferably be dealt separately from sewage and sullage. Sewage and sullage shall be connected to sewers. However, Storm water from the courtyard may be connected to the sewer where it is not possible to drain otherwise; after obtaining permission of the Authority.

4.5.2.2 *Additional Requirement*

The following requirements are suggested to be considered in the design of drainage system:

a) The layout shall be as simple and direct as practicable.
b) The pipes should be laid in straight lines, as far as possible, in both vertical and horizontal planes.
c) Anything that is likely to cause irregularity of flow, as abrupt changes of direction, shall be avoided.
d) The pipes should be non-absorbent, durable, smooth in bore and of adequate strength.
e) The pipes should be adequately supported without restricting movement.
f) Drains should be well ventilated, to prevent the accumulation of fowl gases and fluctuation of air pressure within the pipe, which could lead to unsealing (siphoning) of gully or water-closet traps.
g) All the parts of the drainage system should be accessible for feasibility of inspection and practical maintenance.
h) No bends and junctions whatsoever shall be permitted in sewers except at manholes and inspection chambers.
j) Sewer drain shall be laid for self-cleaning velocity of 0.75 m/s and generally should not flow more than half-full.
k) Pipes crossing in walls and floors shall be through mild steel sleeves of diameter leaving an annular space of 5 mm around the outer diameter of the pipe crossing the wall.
m) Pipes should not be laid close to building foundation.
n) Pipes should not pass near large trees because of possibility of damage by the roots.
p) Branch connections should be swept in the direction of flow.
q) Sewer pipes should be at least 900 mm below road and at least 600 mm below fields and gardens.
r) Pipes should not pass under a building unless absolutely necessary.

Where it is necessary to lay pipes under a building, the following conditions shall be observed:

1) Pipes shall be Centrifugally cast (spun) iron pressure pipe as per good practice [9-2(9)];
2) The pipe shall be laid in straight line and at uniform gradient;
3) Means of access in form of manholes/inspection chamber shall be provided at each end, immediately outside the building;
4) In case the pipe or any part of it is laid above the natural surface of the ground, it shall be laid on concrete supports, the bottom of which goes at least 150 mm below the ground surface.

NOTE – It is desirable that pipe/drains should not be taken through a living room or kitchen and shall preferably be taken under a staircase room or passage.

s) Consideration shall be given to alternative layouts so as to ensure that the most economical and practical solution is adopted. The possibility of alterations shall be avoided by exercising due care and forethought.

4.5.2.3 *Protection against vermin and dirt*

The installation of sanitary fittings shall not introduce crevices which are not possible to inspect and clean readily.

Pipes, if not embedded, shall be run well clear of the wall. Holes through walls to lay pipes shall be made good on both sides to prevent entry of insects. Materials used for embedding pipes shall be rodent-proof. Passage of rodents from room-to-room or from floor-to-floor shall be prevented by suitable sealing. The intermediate lengths of ducts and chases shall be capable of easy inspection. Any unused drains, sewers, etc, shall be demolished or filled in to keep them free from rodents.

All pipe shafts shall be plastered before any pipes are installed in the shaft. It is advisable to lay pipes on the steel supports with adequate gap between plastered wall and support structure. This will provide a smooth surface and prevent location for survival of insects and vermins.

4.5.2.4 Choice of plumbing system

In selecting one or more of the type of piping systems, the building and the layout of toilets; relationship with other services; acceptability to the Authority; and any special requirements of users, shall be studied.

a) *Two stack system*

1) *Two stack System with Common Vent* – A system in which there is one soil pipe into which all water closets, urinals and any other soil appliances discharge. Additionally there is one waste stack into

which all non-soil waste such as baths, sinks, and basins are discharged through deep seal trap. In addition, there is a relief vent, which ventilates traps of water closets/ soil stack and also vents connection from waste appliances/ stack.

2) *Two Stack System with Independent Vents* - The system of plumbing in which soil and waste pipes are distinct and separate. Soil stack shall have discharge from water closets, urinals and any other soil appliances. Waste stack shall have discharge of non-soil waste such as baths, sinks, and basins through deep seal trap. Each soil and waste pipe shall have independent vents.

i) This system is ideal when the location of toilets and stacks for the WCs and waste fittings is not uniform or repetitive.

ii) In large buildings and houses with open ground and gardens the sullage water from the waste system can be usefully utilized for gardening and agriculture.

iii) In larger and multi storied buildings, the sullage is treated within the building for reuse as makeup water for cooling towers for air conditioning system and is also used for flushing water-closets provided it has absolutely no connection with any water supply line, tank or system used for domestic and drinking supply.

b) *Single stack system*

The one-pipe system in which there is no trap ventilation, the stack itself acts as vent through roof. In this system care shall be taken for proper sizing of the pipes and the trap arm distance. This system is restricted to residential occupancy up to 2 to 3 stories

1) This system is suitable for buildings where the toilet layouts and the shafts are repetitive. It requires less space, and is economical.
2) Continuous flow of water in the pipe from waste appliances makes it less prone to blockage and makes the system more efficient.
3) The system eliminates the need for a gully trap which requires constant cleaning.
4) The system is ideal when the main pipes run at the ceiling of the lowest floor or in a service floor. Two pipes system may; present space and crossing problems which this system eliminates.

c) *Single Stack System Fully Ventilated*

The system of plumbing in which the wastes from the sinks, baths and wash basins, and the soil pipe branches are all collected into one main pipe, which is connected, directly to the drainage system. The traps of the water closets, waste appliances etc., are completely ventilated with a separate pipe to preserve the water seal

1) The single stack system fully ventilated is ideal when the toilet layouts are repetitive and there is less space for pipes on the wall.
2) In any system so selected there should be not more than two toilet connections per floor.
3) The system requires minimum 100 mm diameter stack.
4) All the safeguards for the use of this system given in **4.5.2.4.1** shall be complied with.

d) *Single stack system (partially ventilated)*

Soil and waste pipe connected to a single vertical stack with additional venting pipe for ventilation of traps of water closets. This system is generally practiced for the buildings up to 15 meter height
The system and the applicable safeguards under this system are the same as for single stack system. The prime modification is to connect the waste appliances, such as wash basin, bath tub or sink to a floor trap.

For detailed information regarding design and installation of soil, waste and ventilating pipes, reference may be made to good practice [9-2(10)].

4.5.2.4.1 *Safeguards for single-stack system*

a) as far as practicable, the fixtures on a floor shall be connected to stack in order of increasing discharge rate in the downward direction;
b) the vertical distance between the waste branch (from floor trap or from the individual appliance) and the soil branch connection, when soil pipe is connected to stack above the waste pipe, shall be not less than 200 mm;
c) depth of water seal traps from different fixtures shall be as follows:

Water closets	50 mm
Floor traps	50 mm

Other fixtures directly connected to the stack.

i)	Where attached to branch waste pipes of 75 mm dia or more	40 mm
ii)	Where attached to branch waste pipes of less than 75 mm dia	75 mm

NOTE– When connection is made through floor trap, no separate seals are required for individual fixtures.

d) branches and stacks which receive discharges from WC pans should not be less than 100 mm, except where the outlet from the siphonic water closet is 80 mm, in which case a branch pipe of 80 mm may be used. For outlet of floor traps 75 mm dia pipes may be used;

e) the horizontal branch distance for fixtures from stack, bend(s) at the foot of stack to avoid back pressure as well as vertical distance between the lowest connection and the invert of drain shall be as shown in Fig. 1A; and
f) for tall buildings, ground floor appliances are recommended to be connected directly to manhole/inspection chamber.

4.5.3 *Drainage (Soil, Waste and Ventilating) Pipes*

4.5.3.1 *General considerations*

4.5.3.1.1 Drainage pipes shall be kept clear of all other services. Provisions shall be made during the construction of the building for the entry of the drainage pipes. In most cases this may be done conveniently by installing sleeves or conduit pipes into or under the structure in appropriate positions. This will facilitate the installation and maintenance of the services.

4.5.3.1.2 Horizontal drainage piping should be so routed as not to pass over any equipment or fixture where leakage from the line could possibly cause damage or contamination. Drainage piping shall never pass over switch-gear or other electrical equipment. If it is impossible to avoid these areas and piping shall run in these locations, then a pan or drain tray should be installed below the pipe to collect any leakage or condensation. A drain line should run from this pan to a convenient floor drain or service sink.

4.5.3.1.3 All vertical soil, waste, ventilating and anti-siphonage pipes shall be covered on top with a copper or heavily galvanized iron wire dome or cast iron terminal guards. All cast iron pipes, which are to be painted periodically, shall be fixed to give a minimum clearance of 50 mm clear from the finished surface of the wall by means of a suitable clamps.

NOTE – Asbestos cement cowls may be used in case asbestos cement pipes are used as soil pipes.

4.5.3.1.4 Drainage pipes shall be carried to a height above the buildings as specified for ventilating pipe (*see* **4.5.3.4**).

4.5.3.2 *Soil pipes*

A soil pipe, conveying to a drain, any solid or liquid filth, shall be circular and shall have a minimum diameter of 100 mm.

4.5.3.2.1 Except where it is impracticable, the soil pipe shall be situated outside the building or in suitably designed pipe shafts and shall be continued upwards without diminution of its diameter, and (except where it is unavoidable) without any bend or angle, to such a height and position as to afford by means of its open end a safe outlet for foul air. The position of the open end with its covering shall be such as to comply with the conditions set out in **4.5.3.4** relating to ventilating pipe. Even if the pipes are

laid externally, the soil pipes shall not be permitted on a wall abutting a street unless the Authority is satisfied that it is unavoidable. Where shafts for pipes are provided, the cross-sectional area of the shaft shall be suitable to allow free and unhampered access to the pipes and fittings proposed to be installed in the shaft. However in no case cross-section area of the shaft shall be less than a square of one meter side. All pipe shafts shall be provided with an access door at ground level and facilities for shaft ventilation.

4.5.3.2.2 Soil pipes, whether insider or outside the building, shall not be connected with any rain-water pipe and there shall not be any trap in such soil pipe or between it and any drain with which it is connected.

4.5.3.2.3 Soil pipes shall preferably be of cast iron. Asbestos cement building pipes may also be used as soil pipes only above ground level.

4.5.3.2.4 The soil pipe shall be provided with heel rest bend which shall rest on sound footing, if terminating at firm ground level. When the stack is terminating at the ceiling of a floor, the bend shall be provided with sufficient structural support to cater for the stack dead weight and the thrust developed from the falling soil/waste. Vertical stack shall be fixed at least 50 mm clear of the finished surface of the wall by means of a suitable clamps of approved type.

4.5.3.3 *Waste pipes*

Every pipe in a building for carrying off the waste or overflow water from every bath, wash basin or sink to a drain shall be of 32 mm to 50 mm diameter, and shall be trapped immediately beneath such wash basins or sink by an efficient siphon trap – P trap with adequate means for inspection and cleaning. Such P traps shall be ventilated into the external air whenever such ventilation is necessary to preserve the seal of the trap. Waste pipes, P traps, etc. shall be constructed of iron, lead, brass, PVC, engineering plastics, stoneware, asbestos cement or other approved material. The overflow pipe from wash basin, sinks, etc, shall be connected with the waste pipe immediately above the trap. Vertical pipes carrying off waste water shall have a minimum diameter of 75 mm.

NOTE – Whenever wash basins and inks have in-built overflow arrangements, there is no need to provide overflow pipes in such cases.

4.5.3.3.1 Every pipe in a building for carrying off waste water to a drain shall be taken through an external wall of the building by the shortest practicable line, and shall discharge below the grating or surface box of the chamber but above the *inlet* of a properly trapped gully. The waste pipe shall be continued upwards without any diminution in its diameter and (except when unavoidable) without any bend or angle to such a height and position as to afford by means of the open end of the waste pipe, a safe outlet for foul air, the position of the open end and its covering being such as to comply with the conditions.

4.5.3.3.2 Except where it is impracticable, the common waste pipe shall be situated outside the building and shall be continued upwards without diminution of its diameter (except where it is unavoidable) without any bend or angle being formed to such a height and position as to avoid by means of the open end a safe outlet for foul air, the position of the open end and the covering threat being such as to comply with the conditions set out in **4.5.3.4** relating to ventilating pipe.

4.5.3.3.3 If the waste pipe is of cast iron, it shall be firmly attached 50 mm clear of the finished surface of the wall by means of a suitable clamps or with properly fixed holder bats or equally suitable and efficient means.

4.5.3.4 *Ventilating pipes*

Ventilating pipes should be so installed that water can not be retained in them. They should be fixed vertically. Whenever possible, horizontal runs should be avoided. Ventilating pipe shall be carried to such a height and in such a position as to afford by means of the open end of such pipe or vent shaft, a safe outlet for foul air with the least possible nuisance.

4.5.3.4.1 The upper end of the main ventilating pipe may be continued to the open air above roof level as a separate pipe, or it may join the MSP and/or MWP above the floor level of the highest appliance. Its lower end may be carried down to join the drain, at a point where air relief may always be maintained.

4.5.3.4.2 Branch ventilating pipes should be connected to the top of the BSP and BWP between 75 mm and 450 mm from the crown of the trap.

4.5.3.4.3 The ventilating pipe shall always be taken to a point 1500 mm above the level of the eaves or flat roof or terrace parapet whichever is higher or the top of any window within a horizontal distance of 3 meter. The least dimension shall be taken as a minimum and local conditions shall be taken into account. The upper end of every ventilating pipe shall be protected by means of a cowl.

4.5.3.4.4 In case the adjoining building is taller, the ventilating pipe shall be carried higher than the roof of the adjacent building, wherever it is possible.

4.5.3.4.5 The building drain intended for carrying waste water and sewage from a building shall be provided with at least one ventilating pipe situated as near as practicable to the building from an inspection chamber and as far away as possible from the point at which the drain empties into the sewer or other carrier.

4.5.3.4.6 *Size of ventilating pipe*

a) The building drain ventilating pipe shall be of not less than 75 mm diameter when, however, it is used as MSP or MWP. The upper portion, which does not carry discharges, shall not be of lesser diameter than the remaining portion;

b) The diameter of the main ventilating pipe in any case should not be less than 50 mm;
c) A branch ventilating pipe on a waste pipe in both one-and two-pipe systems shall be of not less than two-thirds the diameter of the branch waste ventilated pipe; subject to a minimum of 25 mm; and
d) A branch ventilating pipe on a soil pipe in both one-and two-pipe systems shall be not less than 32 mm in diameter.
e) Ventilating pipes to be sized/ designed considering the drainage fixture units of individual fixtures / appliances as per good engineering practice

4.5.3.4.7 *Venting system for high rise buildings*

In the case of fully ventilated system, suitable sized pipe stacks carry soil and waste drainage, wherein each sanitary fixture is individually vented. The practical way of implementation of this system is by venting each water closet and floor drain. A fully ventilated one pipe drainage system is most popular in advanced plumbing installations.

Properly sized vent pipe would ensure maintenance of atmospheric pressure within gravity drainage pipes.

Sizing of vent pipe is based on cumulative drainage fixture units of all fixtures served by the pipe. Sizing also depends on maximum permissible lengths. Maximum lengths are also subject to the limitation that one third of length shall be horizontal. Horizontal pipes always rise towards termination point, avoiding vertical loops.

NOTE - In case, if fully ventilated one-pipe system is not implemented then it shall indicate the case of two-pipe system alongwith common vent pipe for which the guideline for sizing shall be provided. Also, it shall provide a sketch for two-pipe system alongwith connection of branch pipes from wash basin to the deep seal trap through inlet fitting as per prevailing conditions as approved by Authority.

4.5.3.5 *Design of drainage pipes*

A stack is the main vertical pipe that carries away discharge from water closets and urinals (soil stack) or other clear waste water from equipment (waste stack) with adequate suitable fittings, which may be a long-turn, tee-wye or short-turn or sanitary tee. Depending on the rate of flow in to the drain stack, the diameter of the stack, the type of stack fittings and the flow down the stack from higher levels (if any), the discharge from the fixture drain may or may not fill the cross section of the stack at the level of entry. In any event, as soon as the water enters the stack, the force of gravity rapidly accelerates it downward and before it travels very far, it assumes the form of a sheet around the wall of the stack, leaving the center of the pipe open for the flow of air.

This sheet of water continues to accelerate until the frictional force exerted by the wall of the falling sheet of water equals the gravitational force. If the distance the water travel is sufficient enough and provided that no flow enters the stack at lower levels to interfere the sheet, the sheet remains unchanged in thickness and velocity until it

reaches the bottom of the stack. The ultimate vertical velocity the sheet attains is called the “terminal velocity”. The distance the sheet must fall to attain this terminal velocity is called the “terminal length”.

Following are the formulae developed for calculating the terminal velocity and terminal length:

$$Vt \text{ (terminal velocity)} = 3.0\ (Q/d)^{2/5}$$

$$Lt \text{ (terminal length)} = 0.052\ Vt^2$$

where
Vt = Terminal velocity in the stack in meters per second
Lt = Terminal length below the point of flow entry, meters
Q = Quantity rate of flow, litres per second
d = Diameter of stack, millimeters

At the center of the stack is a core of air that is dragged along with the water by friction. A supply source of air shall be provided to avoid excessive pressures in the stack. The usual means of supplying this air are through the stack vent or vent stack. The entrained air in the stack causes a pressure reducing inside the stack, which is caused by the frictional effect of the falling sheet of water dragging the core of air with it.

4.5.3.5.1 *Estimation of maximum flow of sewer*

a) Simultaneously Discharge Flow

1) The maximum flow in a building drain or a stack depends on the probable maximum number of simultaneously discharging appliances. For the calculation of this peak flow certain loading factors have been assigned to appliances in terms of fixture units, considering their probability and frequency of use. These fixture unit values are given in Table 16.
2) For any fixtures not covered under Table 16, Table 17 may be referred to for deciding their fixture unit rating depending on their drain or trap size.
3) From Table 16 and 17, the total load on any pipe in terms of fixtures units may be calculated knowing the number and type of appliances connected to this pipe.
4) For converting the total load in fixture units to the peak flow in litres per minute, Fig. 4 is to be used.
5) The maximum number of fixture units that are permissible various recommended pipe size in the drainage system are given in Table 18 and Table 19.
6) Results should be checked to see that the soil, waste and building sewer pipes are not reduced in diameter in the direction of flow. Where appliances are to be added in fixture, these should be taken

into account in assessing the pipe sizes by using the fixture units given in Table 16 and Table 17.

b) *Maximum Discharge Flow* – The maximum rate of *discharge* flow shall be taken as thrice the average rate, allowance being made in addition for any exceptional peak discharges. A good average rule is to allow for a flow of liquid wastes from buildings at the rate of 3 litres per minute per 10 persons.

4.5.3.5.2 *Gradients*

4.5.3.5.2.1 The discharge of water through a domestic drain is intermittent and limited in quantity and, therefore, small accumulations of solid matter are liable to form in the drains between the building and the public sewer. There is usually a gradual shifting of these deposits as discharges take place. Gradients should be sufficient to prevent these temporary accumulations building up and blocking the drains.

a) *Drainage Loads* – Single family dwellings contain plumbing fixtures, such as one or more bathroom groups, each consisting of a toilet, wash basin and bathtub or shower unit, a kitchen sink, dishwasher and washing machine. Large buildings also have other fixtures, slop sinks and drinking water coolers. The important characteristic of these fixtures is that they are not used continuously. Rather, they are used with irregular frequencies that vary greatly during the day. In addition the various fixtures have quite different discharge characteristics regarding both the average flow rate per use and the duration of a single discharge. Consequently the probability of all the fixtures in the building operating simultaneously is small.

b) *Stack capacities* – The criterion of flow capacities in drainage stacks is based on the limitation of the water occupied cross-section to a specified fraction of the cross-section of the stack where terminal velocity exists, as suggested by earlier investigations.

Flow capacity can be expressed in terms of the stack diameter and the water cross-section.

$$Q = 27.8 \times rs^{5/3} \times D^{8/3}$$

Where

Q = Capacity in litres per second

rs = Ratio of the cross-sectional area of the sheet of water to the cross-sectional area of the stack

D = Diameter of the stack in millimeters

Table 16 Fixture Units for Different Sanitary Appliances or Groups

[*Clause* 4.5.3.5.1]

Sl No.	Type of Fixture	Fixture Unit Value as Load Factors
(1)	(2)	(3)
i)	One bathroom group consisting of water-closet, wash basin and bath tub or shower stall:	
	a) Tank water-closet	6
	b) Flush-valve water-closed	8
ii)	Bath tub*	3
iii)	Bidet	3
iv)	Combination sink-and-tray (drain board)	3
v)	Drinking fountain	½
vi)	Floor traps+	1
vii)	Kitchen sink, domestic	2
viii)	Wash basin, ordinary++	1
ix)	Wash basin, surgeon's	**2**
x)	Shower stall, domestic	2
xi)	Showers (group) per head	**3**
xii)	Urinal, wall lip	**4**
xiii)	Urinal, stall	4
xiv)	Water-closet, tank-operated	**4**
xv)	Water-closet, valve-operated	8
xvi)	Washing Machine	4
xvii)	Dish washer	3

* A shower head over a bath tub does not increase the fixture unit value.
+ Size of floor trap shall be determined by the area of surface water to be drained.
++Wash basins with 32 mm and 40 mm trap have the same load value.

Table 17 Fixture Unit Values for Fixtures Based on Fixture Drain on Trap Size

[*Clauses* 4.5.3.5.1]

Sl No.	Fixture Drain on Trap Size	Fixture Unit Value
(1)	(2)	(3)
i)	32 mm and smaller	1
ii)	40 mm	2
iii)	50 mm	3
iv)	65 mm	4
v)	80 mm	5
vi)	100 mm	6

Table 18 Maximum Number of Fixture Units that can be Connected to Branches and Stocks

[*Clause* 4.5.3.5.1]

Sl No.	Dia-meter of Pipe	Maximum Number of Fixture Units* That can be Connected			
		Any Horizontal Fixture Branch`	One Stack of 3 Storeys in Height or 3 Intervals	More Than 3 Storeys in Height Total For Stack	Total at One Storey or Branch Interval
(1)	(2) mm	(3)	(4)	(5)	(6)
i)	30	1	2	2	1
ii)	40	3	4	8	2
iii)	50	6	10	24	6
iv)	65	12	20	42	9
v)	75	20	30	60	16
vi)	100	160	240	500	90
vii)	125	360	540	1100	200
viii)	150	620	960	1900	350
ix)	200	1400	2200	3600	600
x)	250	2500	3800	5600	1000
xi)	300	3900	6000	8400	1500
xii)	375	7000	-	-	-

* Depending upon the probability of simultaneous use of appliances considering the frequency of use and peak discharge rate.

+ Does not include branches of the building sewer.

Table 19 Maximum Number of Fixture Units that can be Connected to Building Drains and Sewers
[*Clause* 4.5.3.5.1]

Sl. No.	Dia-meter of Pipe	Maximum Number of Fixture Units Hat can be Connected to Any Portion* of the Building Drain or the Building Sewer for Gradient			
		1/200	1/100	1/50	1/25
(1)	(2) mm	(3)	(4)	(5)	(6)
	75		***20***	***42***	***50***
i)	100	-	180	216	250
ii)	150	-	700	840	1000
iii)	200	1400	1600	1920	2300
iv)	250	2500	2900	3300	4200
v)	300	3900	4600	5600	6700
vi)	375	7000	8300	10000	12000

*Includes branches of the building sewer.

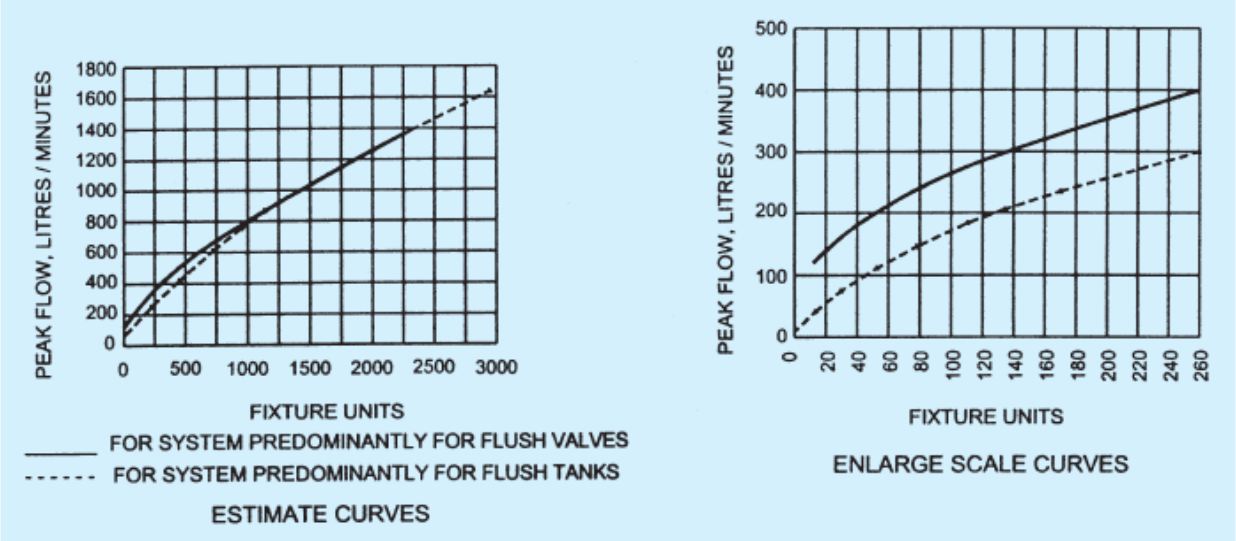

FIG. 4 PEAK FLOW LOAD CURVES

c) *Design requirement for high rise buildings drainage system* – Drainage pipe stacks are sized for one third of their carrying capacity. Plumbing codes provides values of drainage fixture units for each fixture. Different values for fixture units are based on the nature of occupancy and the place of installation. Sizing of drainage pipes is based on the cumulative values of drainage fixture units connected to the pipe. A vertical pipe shall always have larger carrying capacity when compared to horizontal pipe of same size. Carrying capacity of horizontal pipe is dependent on gradient provided. Carrying capacities of vertical pipes are restricted by their maximum permissible lengths. This restriction does

not apply to horizontal pipes. Irrespective of drainage fixture units, the minimum size for the fixture shall be adopted. The minimum size of horizontal pipe are critical to ensure self cleansing velocities in sewers.

4.5.3.5.2.2 When flow occurs in drain piping, it should not entirely fill the cross-section of the pipe under flow condition. If the pipe were to flow full, pressure fluctuations would occur which could possibly destroy the seal of the traps within the building. Normally, the sewer shall be designed for discharging the peak flow as given in **5.5.3.5.1**, flowing half-full with a minimum self-cleansing velocity of 0.75 m/s. The approximate gradients which give this velocity for the sizes of pipes likely to be used in building drainage and the corresponding discharges when following half-full are given in Table 20.

4.5.3.5.2.3 In cases where it is practically not possible to conform to the ruling gradients, a flatter gradient may be used, but the minimum velocity in such cases shall on no account be less than 0.61 m/s and adequate flushing should be done.

NOTE – Where gradients are restricted, the practice of using a pipe of larger diameter than that required by the normal flow, in order to justify laying at a flatter gradient does not result in increasing the velocity of flow, further this reduces the depth of flow and thus for this reasons the above mentioned practice should be discouraged.

4.5.3.5.2.4 On the other hand, it is undesirable to employ gradients giving a velocity of flow greater than 2.4 m/s. Where it is unavoidable, cast iron pipes shall be used. The approximate gradients, which give a velocity of 2.4 m/s for pipes of various sizes and the corresponding discharge when flowing half-full are given in Table 20.

4.5.3.5.2.5 The discharge values corresponding to nominal diameter and gradient given in Table 20 are based on Manning's formula (n=0.015).

NOTE - Subject to the minimum size of 100 m, the sizes of pipes shall be decided in relation to the estimated quantity of flow and the available gradient.

Table 20 Different Dia Pipes Giving Velocity and Corresponding Discharge at Minimum and Maximum Gradient

[*Clauses* 4.5.3.5.2.2, 4.5.3.5.2.4, 4.5.3.5.2.5]

Sl No.	**Diameter**	**Minimum Gradient (Velocity : 0.75 M/S)**	**Discharge at the Minimum Gradient**	**Maximum Gradient (Velocity : 2.4 M/S)**	**Discharge at the Maximum Gradient**
	mm		(m^3/min)		(m^3/min)
(1)	(2)	(3)	(4)	(5)	(6)
i)	100	1 in 57	0.18	1 in 5.6	0.59
ii)	150	1 in 100	0.42	1 in 9.7	1.32
iii)	200	1 in 145	0.73	1 in 14	2.40
iv)	230	1 in 175	0.93	1 in 17	2.98
v)	250	1 in 195	1.10	1 in 19	3.60
vi)	300	1 in 250	1.70	1 in 24.5	5.30

4.5.3.6 *Drain appurtenances*

4.5.3.6.1 *Trap*

All traps shall be protected against siphonage and back pressure ensuring access to atmospheric air for air circulation and preserving the trap seal in all conditions.

4.5.3.6.1.1 A trap may be formed as an integral trap with the appliance during manufacture or may be a separate fitting called an attached trap which may be connected to the waste outlet of the appliance.

4.5.3.6.1.2 Traps should always be of a self-cleansing pattern. A trap, which is not an integral part of an appliance, should be directly attached to its outlet and the pipe should be uniform throughout and have a smooth surface.

4.5.3.6.1.3 The trap should have minimum size of outlet/exit, same as that of largest waste inlet pipe.

4.5.3.6.1.4 Traps for use in domestic waste installations and all other traps should be conveniently accessible and provided with cleansing eyes or other means of cleaning.

4.5.3.6.1.5 The minimum internal diameter for sanitary appliances shall be as follows:

	Sanitary Appliance	*Minimum Internal Diameter of Waste Outlet (mm)*
	Soil appliances	
a)	Indian and European type water closets	100
b)	Bed pan washers and slop sinks	100
c)	Urinal with integral traps	75
d)	Stall urinals (with not more than 120 mm of channel drainage)	50
e)	Lipped urinal small/large	40
	Waste appliances	
f)	Drinking fountain	25
g)	Wash basin	32
h)	Bidets	32
j)	Domestic sinks and baths	40
k)	Shower bath trays	40
m)	Domestic bath tubs	50
n)	Hotel and canteen sinks	50
p)	Floor traps (outlet diameter)	65

4.5.3.6.2 *Floor drains*

All toilets/bathrooms in a building desirably should be provided with floor drains to facilitate cleaning.

4.5.3.6.2.1 Floor drains shall connect into a trap so constructed that it can be readily cleaned and of a size to serve efficiently the purpose for which it is intended. The trap shall be either accessible from the floor drain or by a separate cleanout within the drain.

4.5.3.6.2.2 Floor Drain also receives, waste piping which does not connect to the sanitary system, known as indirect waste. This discharge from an indirect waste should be conveyed into a water supplied, trapped and vented floor drain.

4.5.3.6.2.3 Floor drain should be provided in mechanical equipment rooms, where pumps, boilers, water chillers, heat exchangers and other air-conditioning equipments are periodically drained for maintenance and repair. Boiler requires drain at safety relief valve discharge.

4.5.3.6.2.4 Strategically floor drains are required to be located in buildings with wet fire protection sprinkler systems to drain water in case of activation of sprinkler heads.

4.5.3.6.2.5 The minimum diameter for floor drains outlets before connecting to floor trap is 75 mm.

4.5.3.6.3 *Cleanouts*

The cleanout provides access to horizontal and vertical lines and stacks to facilitate inspection and means to remove obstructions common to all piping systems, such as solid objects, greasy wastes, hair and the like.

4.5.3.6.3.1 Cleanouts in general should be gas and water tight, provide quick and easy plug removal, allow ample space for rodding tools, have means of adjustments to finished floor level, be attractive and be designed to support whatever load is directed over them.

4.5.3.6.3.2 Waste lines are normally laid beneath the floor slab at a sufficient distance to provide adequate back-fill over the joints. Cleanouts are then brought up to floor level grade by pipe extension pieces.

4.5.3.6.3.3 The size of the cleanout within a building should be the same size as the piping up to 100 mm. For larger size piping 100 mm cleanouts are adequate for their intended purpose.

4.5.3.6.3.4 Cleanouts are suggested to be provided at the following locations:

a) Inside the building at a point of exit. Use a wye branch or a trap.

b) At every change of direction greater than 45 degrees.
c) At the base of all stacks.
d) At the horizontal header, receiving vertical stacks and serving the purpose of offset header.

4.5.3.6.3.5 Supports for drainage and Sewerage pipes

The supports for the above pipes and fittings shall be in accordance with manufacturer's recommendations and shall comply with the applicable standards.

4.5.4 *Indirect Wastes*

4.5.4.1 *General*

Waste, overflow and drain pipes from the following types of equipment shall not be connected into any drainage system directly to prevent backflow from the drainage system into the equipment/installation:

a) *Plumbing and kitchen appliances*

1) Underground or overhead water tanks
2) Drinking water fountains
3) Dishwashing sinks and culinary sinks used for soaking and preparation of food
4) Cooling counters for food and beverages
5) Kitchen equipment for keeping food warm
6) Pressure drainage connections from equipment

b) *Air Conditioning, heating and other mechanical equipments*

1) Air handling equipment
2) Cooling tower and other equipments
3) Condensate lines from equipments
4) Storage tanks
5) Condensate lines
6) Boiler blow down lines
7) Steam trap drain lines

c) *Laboratories and other areas*

1) Water stills
2) Waste from laboratory in specified sinks
3) Sterlizers and similar equipments
4) Water purification equipments

4.5.4.2 *Indirect waste receptors*

All plumbing fixtures or other receptors receiving the discharge of indirect waste pipes shall be of such shape and capacity as to prevent splashing or flooding and shall be located where they are readily accessible for inspection and cleaning.

4.5.4.3 *Pressure drainage connections*

Indirect waste connections shall be provided for drains, overflows or relief vents from the water supply system, and no piping or equipment carrying wastes or producing wastes or other discharges under pressure shall be directly connected to any part of the drainage system.

The above shall not apply to any approved sump pump or to any approved plumbing fixture discharging pressurized waste or device when the Authority has been satisfied that the drainage system has the capacity to carry the waste from the pressurized discharge.

An indirect waste is required for any type of fixture or equipment that may come in contact with the food. The purpose is to isolate the fixture or equipment from drainage system waste.

Indirect waste piping shall be a minimum of 25mm in size , but not smaller than drain of the equipment or fixture. There is no limitation on the length of indirect waste piping.

4.5.5 *Special Wastes*

4.5.5.1 *General*

Wastes having characteristics which may be detrimental to the pipes in which it is disposed as well as to the persons handling it .Such wastes used in a building need to be specially identified and a suitable and safe method of its disposal installed to ensure that the piping system is not corroded nor the health and safety of the occupants is affected in any way.

Whenever the occupant or the user of any wastes is unaware of the dangers of the consequences of disposing the waste, he shall be made aware of the dangers of his action along with providing suitable warning and instruction for correct disposal be provided to him.

Piping system for all special wastes should be separate and independent for each type of waste and should not be connected to the building drainage system. Other applicable provisions for installation of soil and waste pipe system shall be however be followed.

4.5.5.2 *Laboratory wastes*

A study of the possible chemical and corrosive and toxic properties of wastes handled and disposed off in a laboratory need to be ascertained in advance. The relevant statutory rules and regulation regarding the method of disposal of strong and objectionable wastes shall be followed.

All sinks, receptacles ,traps, pipes, fittings and joints shall of materials resistant to the liquids disposed off in the system.

In laboratories for educational, research and medical institutions, handling mildly corrosive and toxic wastes, they may be neutralized in chambers using appropriate neutralizing agents. The chamber shall be provided with chambers at inlet and outlet for collecting samples of the incoming and outgoing waste for monitoring its characteristics.

4.5.5.3 *Infected wastes*

Infected liquid wastes are generated in hospitals from patient excreta; operation theatres; laboratories testing samples of stools, urine, blood, flesh; etc which shall not be disposed off into the drainage system. Such waste shall be collected separately and pre-treated before disposal into the building drainage system.

Soiled and linen from infectious patients needs to be collected from the respective areas of the hospital in separate linen bins and pre-washed and sterilized in the laundry before final wash in the hospital laundry. Liquid wastes from the washing operations shall be neutralized to prevent any cross contamination before disposal in the building's drainage system.

4.5.5.4 *Research laboratory wastes*

Research laboratories conducting research in all areas of science and technology for example chemical industry, pharmacy, metallurgy, bio-sciences, agriculture, atomic energy, medicine, etc shall follow the established procedures laid down by statutory bodies to handle, treat and dispose wastes which are highly toxic, corrosive, infectious, inflammable, explosive and having bacterial cultures, complex organic and inorganic chemicals. Such wastes shall not be disposed off in a building drainage system or the city sewerage system unless they are pre-treated and meet the disposal criteria in accordance with the relevant rules/regulations.

4.5.6 *Grease Traps*

Oil and grease is found in wastes generated from kitchens in hotels, industrial canteens, restaurant, butcheries, some laboratories and manufacturing units having a high content of oil and greases in their final waste.

Waste exceeding temperature of 60^0 C should not be allowed in the grease trap. When so encountered it may be allowed to cool in a holding chamber before entering the grease trap.

Oil and greases tend to solidify as they cool within the drainage system. The solidified matter clogs the drains and the other matter in the waste stick to it due to the adhesion properties of the grease. Oil and greases are lighter than water and tend to float on the top of the waste water.

Grease traps shall be installed in building having the above types of wastes. In principle the grease laden water is allowed to retain in a grease trap which enables any solids to be settled or separated for manual disposal. The retention time allows the incoming waste to cool and allow the grease to solidify. The clear waste is then allowed to discharge into the building's drainage system.

4.5.7 *Oil Interceptors*

Oils and lubricants are found in wastes from vehicle service stations, workshops manufacturing units whose waste may contain high content of oils. Oils for example, petroleum, kerosene and diesel used as fuel, cooking, lubricant oils and similar liquids are lighter than water and thus float on water in a pipe line or in a chamber when stored. Such oils have a low ignition point and are prone to catch fire if exposed to any flame or a spark and may cause explosion inside or outside the drainage system. The flames from such a fire spread rapidly if not confined or prevented at the possible source. Lighter oils and lubricants are removed from the system by passing them through an oil interceptor/petrol gully. They are chambers in various compartments which allow the solids to settle and allow the oils to float to the top. The oil is then decanted in separate containers for disposal in an approved manner. The oil free waste collected from the bottom of the chamber is disposed in the building drainage system.

4.5.8 *Radioactive Waste*

Scientific research institutions, hospital and many types of manufacturing processes use radio active material in form of radio isotopes and other radio active sources for their activities. Manufacture, sale, use and disposal of radio active material is regulated by the statutory rules and regulation. Proposal for usage and disposal of radio active materials shall be done in consultation with and prior permission of the Authority by the users of the materials. No radio active material shall be disposed off in any building drainage system without the authorization of the Authority.

4.5.9 *Special Situations of Waste Water Disposal*

Buildings may generate uncontaminated waste water from various sources continuously, intermittently or in large volumes for a short time for example, emptying any water tanks or pools, testing fire and water lines for flow conditions, etc. Connections from all such sources shall be made to the building drainage system indirectly through a trap. It should be ensured in advance that the building drain or a

sump with a pump has the capacity to receive to rate of flow. In case the capacity is less the rate of discharge from the appliances should be regulated to meet the capacity of the disposal. Under no circumstances shall any waste water described above shall be disposed off in any storm water drains.

4.5.10 *Manholes*

4.5.10.1 *General*

A manhole or inspection chamber shall be capable of sustaining the loads which may be imposed on it, exclude subsoil water and be water tight. The size of the chamber should be sufficient to permit ready access to the drain or sewer for inspection, cleaning and rodding and should have a removable cover of adequate strength, constructed of suitable and durable material. Where the depth of the chamber so requires, access rungs, step irons, ladders or other means should be provided to ensure safe access to the level of the drain or sewer. If the chamber contains an open channel, benching should be provided having a smooth finish and formed so as to allow the foul matter to flow towards the pipe and also ensure a safe foothold.

No manhole or inspection chamber shall be permitted inside a building or in any passage therein. The minimum depth of the Manhole shall not be less than 800 mm to facilitate gully trap connection. Further, ventilating covers shall not be used for domestic drains. At every change of alignment, gradient or diameter of a drain, there shall be a manhole or inspection chamber. Bends and junctions in the drains shall be grouped together in manholes as far as possible.

4.5.10.2 *Spacing of manholes*

The spacing of manholes for a given pipe size should be as follows:

Pipe Diameter mm	*Spacing of Manhole* m
a) Up to 300	45
b) 301 to 500	75
c) 501 to 900	90
d) Beyond 900	Spacing shall depend upon local condition and shall be gotten approved by the Authority

Where the diameter of a drain is increased, the crown of the pipes shall be fixed at the same level and the necessary slope given in the invert of the manhole chamber. In exceptional cases and where unavoidable, the crown of the branch sewer may be fixed at a lower level, but in such cases the peak flow level of the two sewers shall be kept the same.

4.5.10.3 *Size of manhole*

The manhole or chamber shall be of such size as will allow necessary examination or clearance of drains. The size of shall be adjusted to take into account any increase in the number of entries into the chamber.

4.5.10.3.1 Manholes may be rectangular, arch or circular type. The minimum internal size of manholes, chambers (between faces of masonry) shall be as follows:

a) *Rectangular Manholes*

1) For depths less than 0.90 m	900 mm x 800 mm
2) For depths from 0.90 m and up to 2.5 m	1200 mm x 900 mm

b) *Arch Type Manholes*

a) For depths of 2.5 m and above	1400 mm x 900 mm

NOTE - The width of manhole chamber shall be suitably increased more than 900 mm on bends, junctions or pipes with diameter greater than 450 mm so that benching width in either side of channel is minimum 200 mm.

c) *Circular Manholes*

1) For depths above 0.90 m and upto 1.65 m	900 mm diameter
2) For depths above 1.65 m and upto 2.30 m	1200 mm diameter
3) For depths above 2.30 m and upto 9.00 m	1500 mm diameter
4) For depths above 9.00 m and upto 14.00 m	1800 mm diameter

NOTES

1 In adopting the above sizes of chambers, it should be ensured that these sizes accord with full or half bricks with standard thickness of mortar joints so as to avoid wasteful cutting of bricks.

2 The sizes of the chambers/***manhole*** may be adjusted to suit the availability of local building materials, economics of construction ***and to meet local authority approval.***

3 The access shaft shall be corbelled inwards on three sides at the top to reduce its size to that of the cover frame to be fitted or alternatively the access shaft shall be covered over by a reinforced concrete slab of suitable dimensions with an opening for manhole cover and frame.

4. The minimum sewer pipe diameter is 200 mm based on good practice [9-2(11)].

4.5.10.4 *Construction*

4.5.10.4.1 *Excavation*

The manhole shall be excavated true to dimensions and levels as shown on the plan. The excavation of deep manholes shall be accompanied with safety measures like timbering, staging, etc. In areas where necessary, appropriate measures for dewatering should be made.

4.5.10.4.2 *Bed Concrete*

The manhole shall be built on a bed of concrete 1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 mm nominal size). The thickness of bed concrete shall be at least 150 mm for manholes upto 0.9 m in depth, at least 200 mm for manholes from 0.90 m upto 2.5 min depth and at least 300 mm for manholes of greater depth, unless the structural design demands higher thickness.

This thickness may be verified considering the weight of wall, cover, the wheel loads, impact of traffic which are transmitted through cover and the shaft walls and for water pressure, if any. In case of weak soil, special foundation as suitable shall be provided

4.5.10.4.3 *Brickwork*

The thickness of walls shall be designed depending upon its shape and taking onto account all loads coming over it, including earth pressure and water pressure.

Generally the brickwork shall be with first class bricks in cement mortar 1:5 (1 cement : 5 coarse sand). All brickwork in manhole chambers and shafts shall be carefully built in English Bond, the jointing faces of each brick being well “buttered” with cement mortar before laying, so as to ensure a full joint. The construction of walls in brickwork shall be done in accordance with good practice [9-2(12)],

For various depths the recommended thickness of wall may be as follows:

Depth of the chamber	*Thickness of wall*
a) Upto 2.25 m	200 mm (one brick length)
b) From 2.25 m upto 3.0 m	300 mm (one and half brick length)
c) From 3.00 m upto 5.0 m	400 mm (two brick length)
d) From 5.00 m upto 9.0 m	500 mm (two and half brick length)
e) Above 9.00 m	600 mm (three brick length)

The actual thickness in any case shall be calculated on the basis of engineering design. Typical sections of the manholes are illustrated in Fig. 5, 6 and 7.

NOTES

1 Rich mix of cement mortar, not weaker than 1:3, should be used in brick masonry, where subsoil water conditions are encountered.

2 For arched type of manholes, the brick masonry in arches and arching over pipes shall be in cement mortar 1:3.

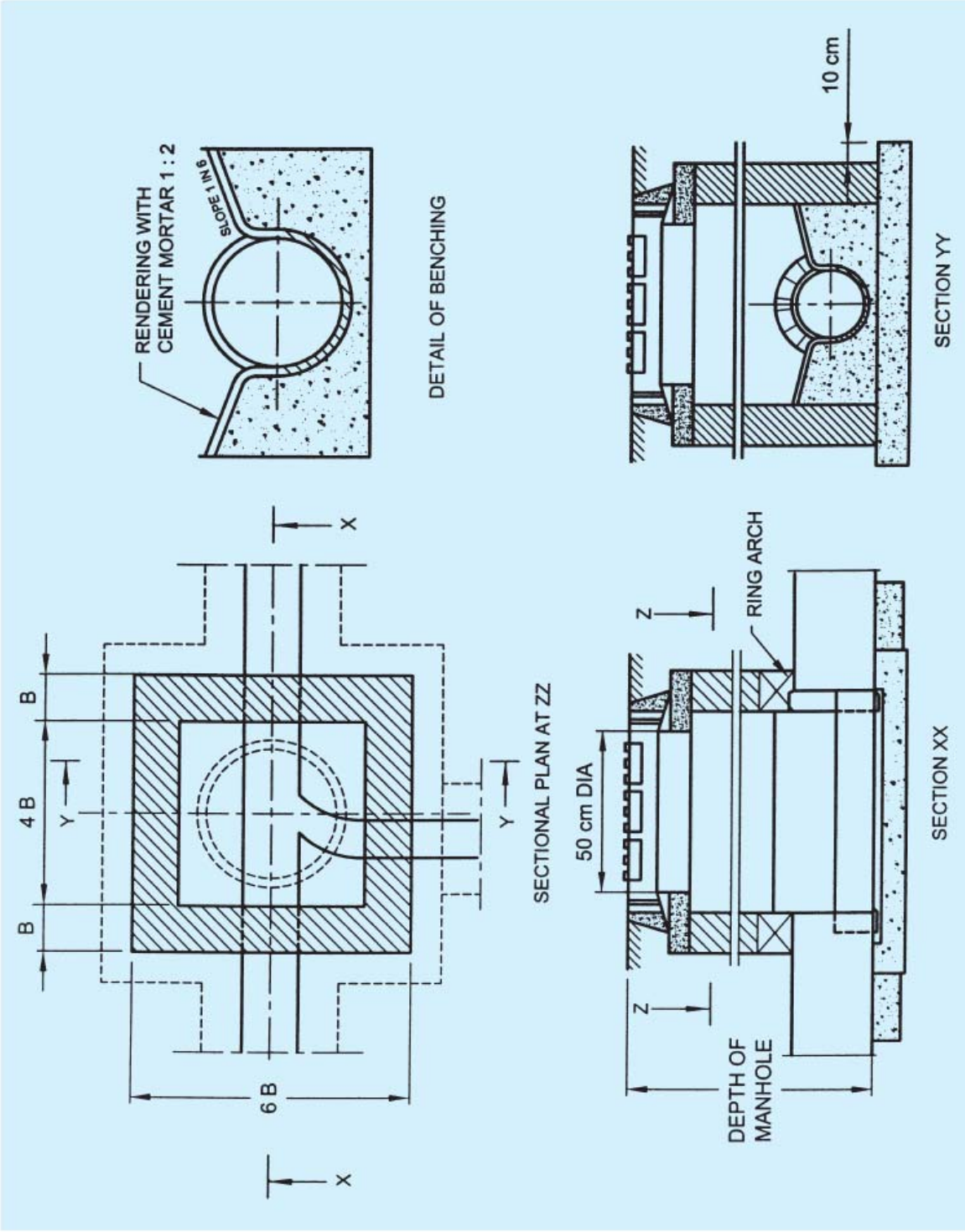

FIG. 5 DETAIL OF MANHOLE (DEPTH LESS THAN 0.90 M)

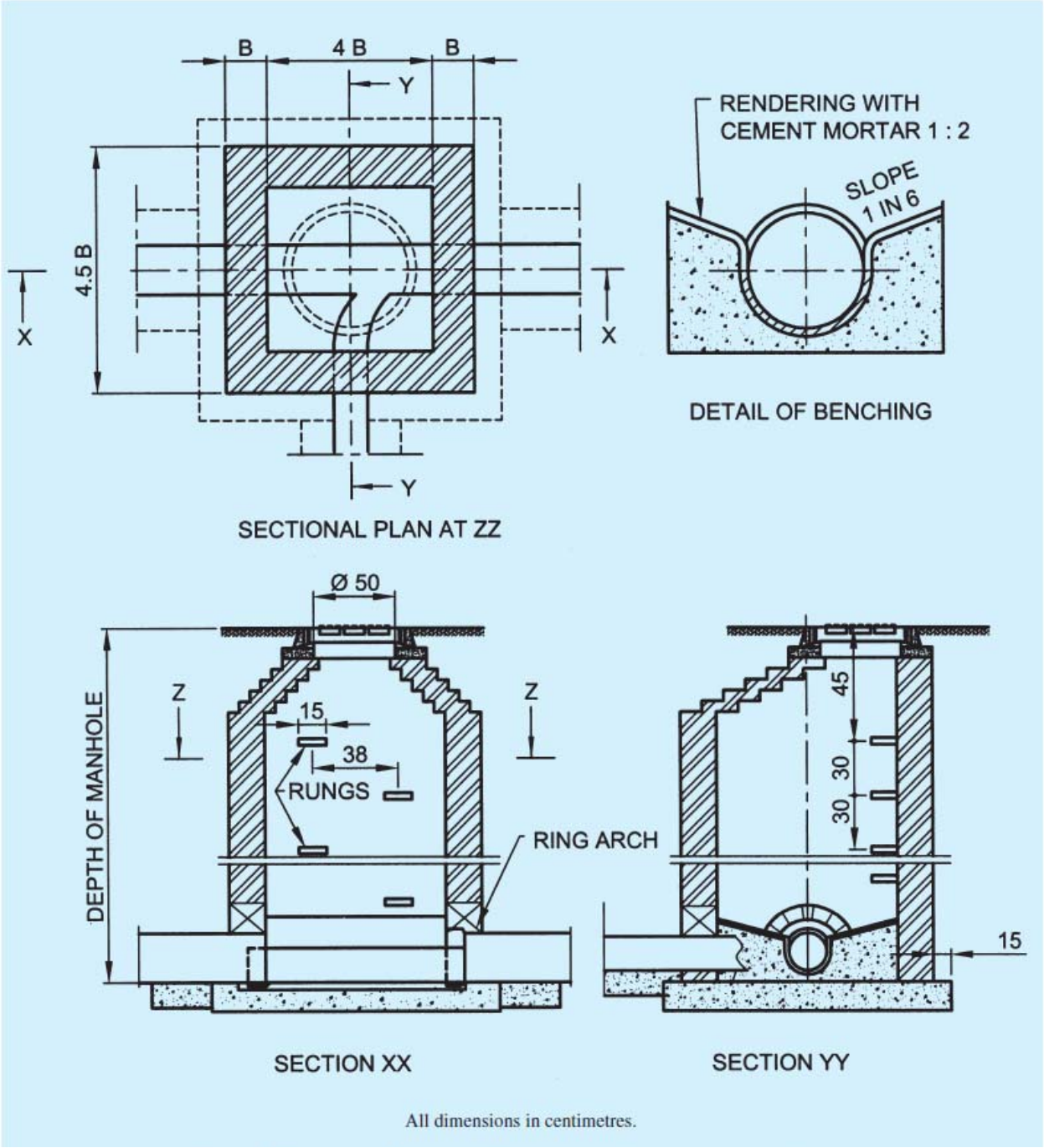

FIG. 6 DETAIL OF MANHOLE (DEPTH FROM 0.9 m AND UPTO 2.5 m)

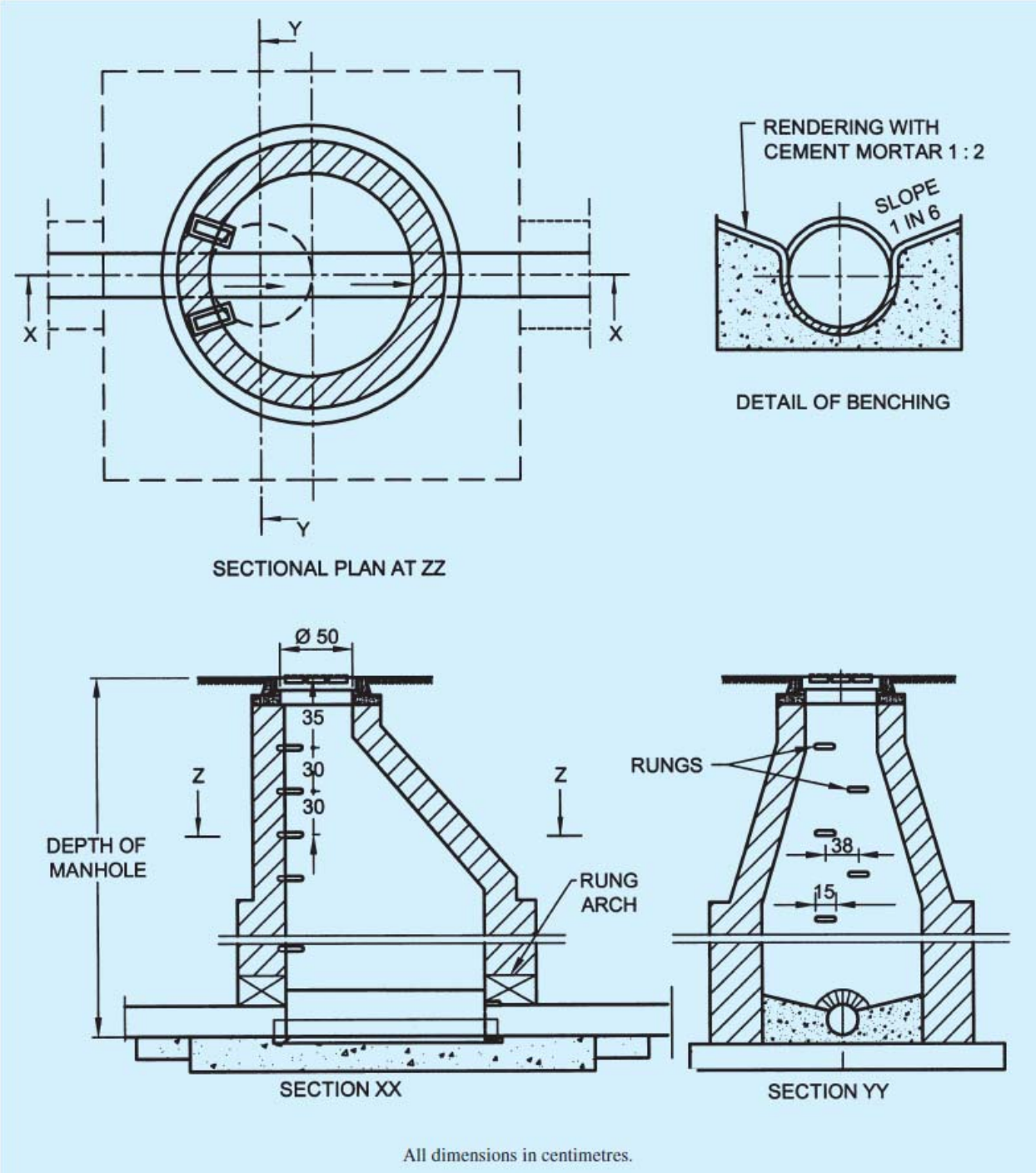

FIG. 7 DETAIL OF MANHOLE (DEPTH 2.5 m AND ABOVE)

4.5.10.4.4 *Plastering*

The wall shall be plastered (15 mm, min) both inside and outside within cement mortar 1:3 and finished smooth with a coat of neat cement. Where sub-soil water conditions

exit, a richer mix may be used and it shall further waterproofed with addition of approved waterproofing compound in a quantity as per manufacturer specifications.

All Manholes shall be so constructed as to be water-tight under test.

All angles shall be rounded to 75 mm radius and all rendered internal surface shall have hard impervious finish obtained using a steel trowel.

4.5.10.4.5 *Channels and benching*

These shall be semi-circular in the bottom half and of diameter equal to that of the sewer. Above the horizontal diameter, the sides shall be extended vertically 50 mm above the crown of sewer pipe and the top edge shall be suitably rounded off. The branch channels shall also be similarly constructed with respect to the benching, but at their junction with the main channel an appropriate fall, if required suitably rounded off in the direction of flow in the main channel shall be given.

The channel/drain and benching at the bottom of the chamber shall be done in cement concrete 1:2:4 and subsequently plastered with cement mortar of 1:2 proportion or weaker cement mortar with a suitable waterproofing compound and finished smooth, to the grade (where required). The benching at the sides shall be carried up in such a manner as to provide no lodgment for any splashing in case of accidental flooding of the chamber.

Channels shall be rendered smooth and benchings shall have slopes towards the channel.

4.5.10.4.6 *Rungs*

Rungs shall be provided in all manholes over 0.8 m in depth and shall be of preferably of cast iron and of suitable dimensions, conforming to accepted standards [9-2(13)]. These rungs may be set staggered in two vertical rungs which may be 300 mm apart horizontally as well as vertically and shall project a minimum of 100 mm beyond the finished surface if the manhole wall. The top rung shall be 450 mm below the manhole cover and the lowest not more than 300 mm above the benching.

4.5.10.4.7 *Manhole covers and frames*

The size of manhole covers shall be such that there shall be a clear opening of at least 500 mm in diameter for manholes exceeding 0.90 m in depth. The manhole covers and frames are used they shall conform to accepted standards [9-2(14)].

The frame of manhole shall be firmly embedded to concrete alignment and level in plain concrete on the top of masonry.

4.5.10.5 *Drop manhole*

Where it is uneconomic or impracticable to arrange the connection within 600 mm height above the invert of the manholes, the connection shall be made by constructing a vertical shaft outside the manhole chamber, as shown in Fig. 8. If the difference in level between the incoming drain and the sewer does not exceed 600 mm, and there is sufficient room in the manhole, the connecting pipe may be directly brought through the manhole wall and the fall accommodated by constructing a ramp in the benching of the manhole.

For detailed information regarding manholes in sewerage system, reference may be made to good practice [9-2(15)].

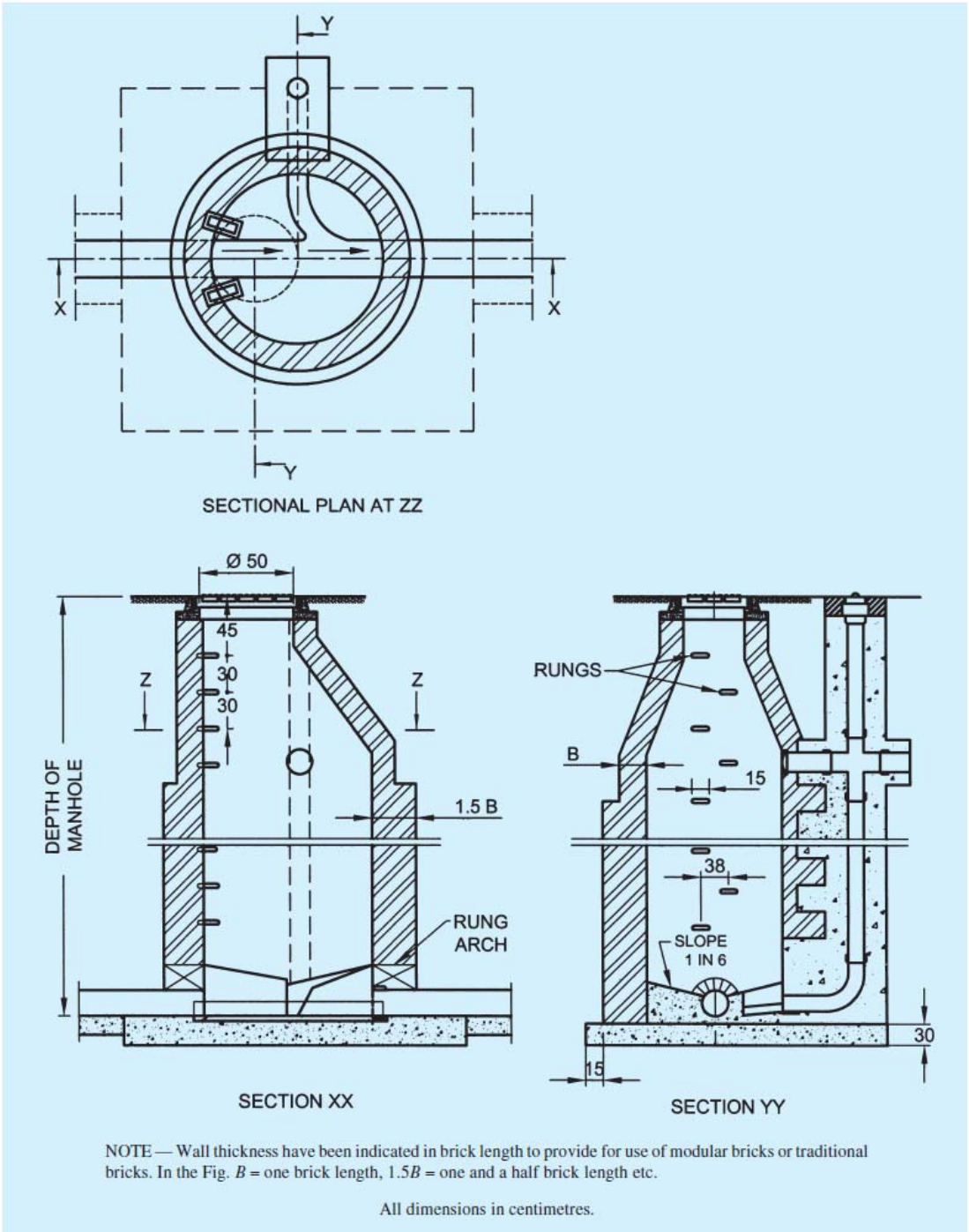

FIG. 8 DROP MANHOLE

4.5.10.6 *Manhole covers and recommended locations*

Manhole covers were traditionally and presently manufactured from concrete, steel fibre reinforced concrete, cast iron and ductile iron or PVC materials and these materials is used based on the load carrying efficiency and the following type of applications:

a) Inspection chambers for sewerage
b) Underground Electrical Cabling
c) Telecom Cabling
d) Water, Gas and Petroleum Installations
e) Beautification of Gardens and Landscapes

Recommended locations conforming to load capacity shall be as per accepted standard [9-2(14)].

a) LD-2.5 (Light Duty - Test load - 2.5 Ton)

   Suitable for use within residential and institutional complexes, areas with pedestrian but occasional Light Motor Vehicle traffic. These round and square manhole covers are also used for 'Inspection Chambers'.

b) MD-10 (Medium Duty - Test load – 10 Ton)

   Suitable for use in service lanes and roads on pavements for use under medium duty vehicular traffic including for car parking areas.

c) HD-20 (Heavy Duty - Test load - 20Ton)

   Suitable for use in institutional, commercial areas, carriage, city trunk roads and bus terminals with heavy duty vehicular traffic of wheel loads between 5 to 10 ton.

d) EHD-35 (Extra Heavy Duty - Test load - 35 Ton)

   Suitable for use on carriageways in commercial, industrial, port areas and warehouses with frequent vehicular traffic having wheel loads up to 11.5 ton like heavy trucks, trailers.

4.5.11 *Storm Water Drainage*

4.5.11.1 *General*

The object of storm water drainage is to collect and carry, the rain-water collected within the premises of the building, for suitable disposal.

4.5.11.2 *Design factors*

Estimate of the quantity that reaches the storm water drain depends on the following factors:

a) Type of soil and its absorption capacity determined by its soil group.
b) Ground slope and the time in which the area is drained.
c) Intensity of the rainfall for a design period.
d) Duration of the rain/storm.

4.5.11.2.1 *Imperviousness*

The soil conditions and the ground slope determine the impermeability factor. Impermeability factor is the proportion of the total rainfall received on the surface which will be discharging into the a storm water drain after allowing for initial abstraction (in local pond and lakes), ground absorption by evaporation, vegetation and other losses. The net flow reaching the storm water drain is called runoff.

The percentage of imperviousness of the drainage area may be obtained from available data for a particular area. In the absence of such data, the following figures may serve as a guide:

Type of area	*Imperviousness factor (percent)*
Commercial and industrial areas	70-90
Residential areas (high density)	60-75
Residential areas (low density)	35-60
Parks and underdeveloped areas	10-20

4.5.11.2.2 *Terrain modelling*

Areas planned for urbanization from agricultural land, forest or low grade land for example, low lying areas prone to flooding, marshy or abandoned quarries, etc need detailed and careful consideration with respect to its drainage. A detailed contour survey shall be carried out not only with respect to the site but also the surrounding areas to verify the quantity/area contributing runoff, presence of any low lying and natural water body acting as holding pond or any natural drain passing through the area and beyond whose filling up or diversion may cause water logging problem on the site or to the surrounding areas.

The planning of the area should ensure that:

a) All areas become self draining by gravity with respect to the high flood level of the area or the drainage channels passing which ever is higher.

b) As far as possible, natural drainage pattern with respect to the whole area be maintained except when low lying areas need to be filled up for grading purposes.
c) The drainage in the area shall be planned in accordance with the natural slopes.
d) Levels of the main highway or road connecting to the property shall be determined to ensure proper drainage and protection of the site.

The formation levels of the entire area shall be prepared to determine proposed formation levels by preparing a terrain model which will show the proposed the site contours, ground and road levels and connections to all services including storm water disposal system.

4.5.11.2.3 *Design frequency*

Storm water drainage system for an urbanized area is planned on the basis of the design frequency of the storm which shall be determined by the designer. Frequency is the period in which the selected design intensity recurs in a given period of time in years.

4.5.11.2.4 *Time of concentration*

Time of concentration is the time required for the rainwater to flow to reach the farthest point of the drainage system or the outfall under consideration. Time of concentration is equal to the inlet time plus the time required for the flow to reach the main or branch drain. The inlet time is the time dependent on the distance of the farthest point in the drainage area to the inlet of the manhole and the surface slopes, etc and will vary between 5 minutes to 30 minutes.

In highly developed sections for example with impervious surfaces it may be as low as 3 minutes or lower (with good slopes) as in building terraces and paved areas. Correspondingly the design intensity for the drainage for such areas will be much higher. Rainwater pipes have to be designed for an intensity for a very low time of concentration.

4.5.11.2.5 *Natural infiltration*

In planning any area with buildings, layout with paved and non permeable surfaces, care should be taken to allow maximum discharge of the rainwater to flow directly or indirectly to permeate into the ground for enabling the ground water to be recharged. Some of the techniques which allow infiltration that may be considered are:

a) Use of brick paved open jointed storm water drains.
b) Providing bore holes in the storm water drains.
c) Using paving tiles with open joints which enable water to percolates as it flows on it.

4.5.11.3 *Combined system*

A combined system of drainage is one which carries the sewerage as well as the runoff from the storm water drainage. Relevant applicable statutory rules/regulations may not allow such system in new areas and the sewerage and the storm water drainage have to be separate and independent of each other. Such systems are however existing in many old cities and the storm water may have to be discharged into the combined drainage system.

Where levels do not permit for connection to a public storm water drain, storm water from courtyards of buildings may be connected to the public sewer, provided it is designed to or has the capacity to convey combined discharge. In such cases, the surface water shall be admitted to the soil sewer through trapped gullies in order to prevent the escape of foul air.

4.5.11.4 *Discharging into a watercourse*

It may often be convenient to discharge surface water to a nearby stream or a watercourse. The invert level of the outfall shall be about the same as the normal water level in the watercourse or ideally should be above the highest flood level of the watercourse. The out-fall shall be protected against floating debris by a screen.

4.5.11.5 *Discharge to a public storm water drain*

Where it is necessary to connect the discharge rainwater into a public storm water drain, such drains shall be designed for the intensity of rain based on local conditions, but in no case shall they be designed for intensity of rainfall of less than 50 mm/hour. Rainwater from each building plot shall be connected to the storm water drainage through a separate pipe or an open public drain directly. No trap shall be installed before the connection.

4.5.11.6 *Rain water pipes for roof drainage*

4.5.11.6.1 The roofs of a building shall be so constructed or framed as to permit effectual drainage of the rain-water therefrom by means of a sufficient number of rain-water pipes of adequate size so arranged, jointed and fixed as to ensure that the rain-water is carried away from the building without causing dampness in any part of the walls or foundations of the building or those of an adjacent building.

4.5.11.6.2 The rain-water pipes shall be fixed to the outside of the external walls of the building or in recesses or chases cut or formed in such external wall or in such other manner as may be approved by the Authority.

4.5.11.6.3 Rain-water pipes conveying rain water shall discharge directly or by means of a channel into or over an inlet to a surface drain or shall discharge freely in a compound, drained to surface drain but in no case shall it discharge directly into any closed drain.

4.5.11.6.4 Whenever it is not possible to discharge a rain-water pipe into or over an inlet to a surface drain or in a compound or in a street drain within 30 m from the boundary of the premises, such rain-water pipe shall discharge into a gully trap which shall be connected with the street drain for storm water and such a gully-trap shall have a screen and a silt catcher incorporated in its design.

4.5.11.6.5 If such streets drain is not available within 30 m of the boundary of the premises, a rain-water pipe may discharge directly into the kerb drain and shall be taken through a pipe outlet across the foot path, if any, without obstructing the path.

4.5.11.6.6 A rain water pipe shall not discharge into or connect with any soil pipe or its ventilating pipe or any waste pipe or its ventilating pipe nor shall it discharge into a sewer unless specifically permitted to do so by the Authority, in which case such discharge into a sewer shall be intercepted by means of a gully trap.

4.5.11.6.7 Rain-water pipes shall be constructed of cast iron, *PVC*, asbestos cement, galvanized sheet or other equally suitable material and shall be securely fixed.

4.5.11.6.8 The factors that decide the quantity of rain water entering are:

a) Intensity of rainfall, and
b) Time of concentration selected for rain water pipe.

A bell mouth inlet at the roof surface is found to give better drainage effect, provided proper slopes are given to the roof surface. The spacing of rain water pipes depends on the locations available for the down takes and the area which each pipe serves. The spacing will also be determined by the amount of slopes that can be given to the roof. The recommended slopes for the flat roofs with smooth finish would be 1:150 to 1:133, with rough stone/tiles 1:100 and for gravel set in cement or losely packed concrete finish 1:75 to 1:66. The effective strainer area should preferably be 1.5 to 2 times the area of pipe to which it connects to considerably enhance the capacity of rain water pipes.

The rain water pipes of PVC (coefficient of roughness 0.009) shall normally be sized on the basis of roof areas according to Table 21. The vertical down take rain water pipes, having a bell mouth inlet on the roof surface with effective cross sectional area of grating 1.5 to 2 times the rain water pipe area, may be designed by considering the outlet pipe as weir.

For full circumference of pipe acting as weir, the roof area (RA) for drainage may be worked out by using:

$$RA = 0.084 \times d^{5/2}/I$$

where

d = pipe diameter (mm)
I = Intensity of rainfall (mm/h)

Table 21 Sizing of Rain-Water Pipes for Roof Drainage
(*Clause* 4.5.11.6.8)

Dia of Pipe mm	**Average Rate of Rainfall** mm/hr Roof Area (m^2)					
	50	75	100	125	150	200
50	19.29	12.81	9.50	7.63	6.33	4.75
65	3470	23.04	17.28	13.82	11.52	8.64
75	58.72	38.88	29.37	23.47	19.58	14.68
100	122.97	82.08	61.48	49.24	41.04	30.67
125	229.98	153.69	115.92	92.59	77.04	57.60
150	359.42	240.22	180.38	144.00	120.38	90.28

NOTE - For rain water pipes of other materials, the roof areas shall be multiplied by (0.009/coefficient of roughness of surface of that material).

4.5.11.6.9 The storm water *may* be led off in a suitable open drain to a watercourse. The open drain, if not a pucca masonry through out, shall be so at least where there is either a change in direction or gradient.

4.5.12 *Rainwater Harvesting*

4.5.12.1 *General*

To supplement the ever growing shortage of protected, pure and safe water supply for human consumption rainwater is an ideal source which can be conserved and used in a useful manner by the people. The amount of rainfall available varies from region to region Each area has to develop it own method and system to conserve, store and use it to suit its requirement and local conditions. There are several methods by which rainwater can be stored, used and conserved. Each system depends on the amount of precipitation, the period in which the rainfall occurs in a year and the physical infrastructure e.g. space available to store the water etc.

There are several techniques available for catching and storing the rainwater. Most of the techniques are applicable for large open areas, farms, sloping grounds etc. with a low population base. Two major systems that are ideal for urban and semi-urban developed areas are:

a) Artificial ground water recharge
b) Roof top rainwater harvesting

NOTE - Type and number of recharge pits and roof top rainwater harvesting capacity shall be provided as per the local state bye-laws.

4.5.12.2 *Artificial ground water recharge*

With increase in the impermeable surfaces in modern built up areas a large quantity of water normally percolating into the ground runs off to the natural drains and into the rivers causing increased runoff and flooding of downstream areas as it also deprives the original catchment area of the natural percolation that would have recharged the area in the normal course if the ground was in its natural condition for example a farm, open ground, forest, etc. It is therefore essential to catch the runoff and use it for augmentation of ground water reservoir by modifying the natural movement of surface water by recharging it by artificial means for example, construction recharge structures (*see* Fig. 9). The main objectives achieved may be:

a) Enhancement of sustainable yield in areas where over development and depletion of the aquifers.
b) Conservation and storage of excess surface water in the aquifers.
c) Improve the quality of the existing ground water through dilution.
d) Remove bacteriological and suspended impurities during the surface water transition within the sub-soil.
e) Maintain the natural balance of the ground water and its usage as the rainwater is a renewable supply source. A well managed and controlled tapping of the aquifers will provide constant, dependable and safe water supply.

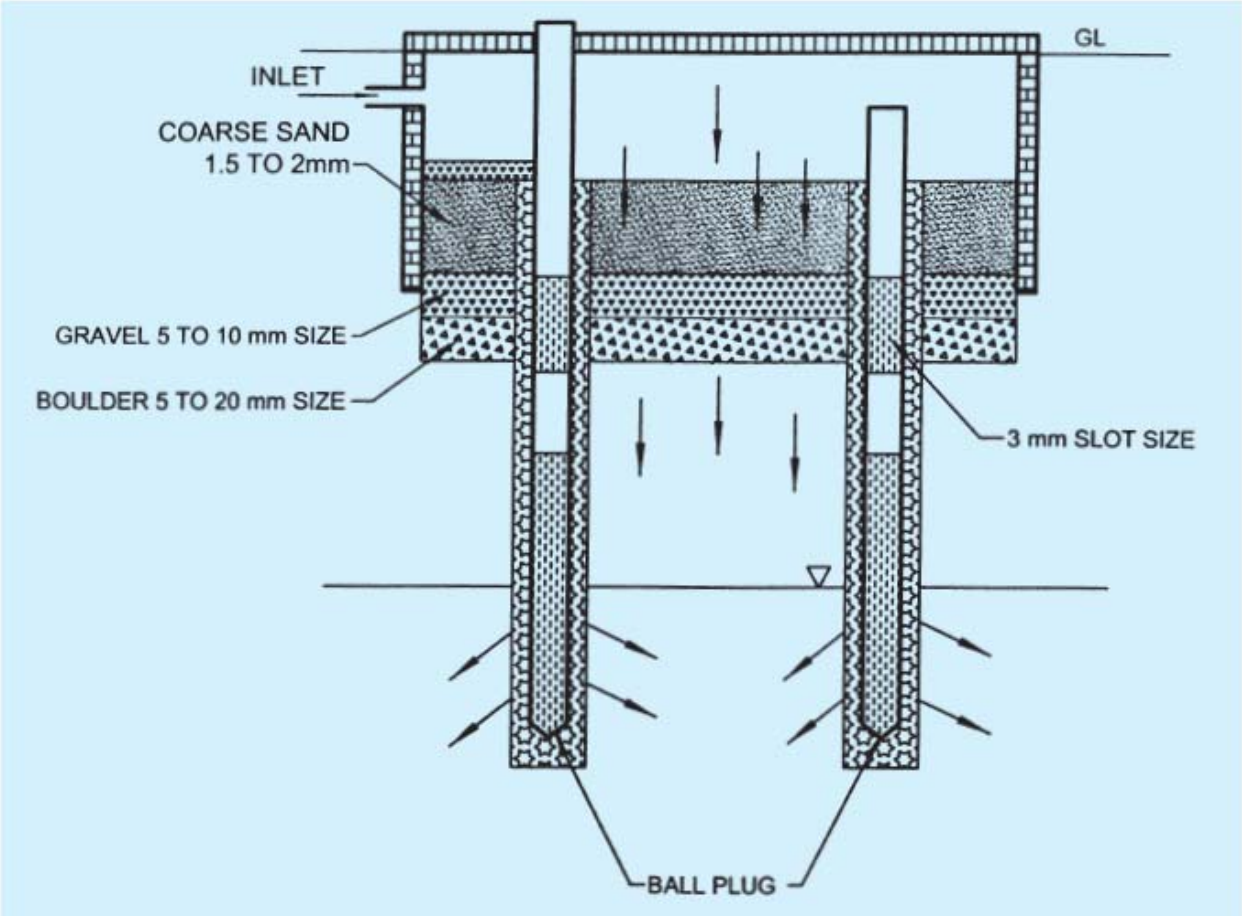

FIG. 9 ARTIFICIAL GROUND WATER RECHARGE STRUCTURE

In planning and designing the ground water recharge structures following should be taken into consideration:

a) Annual rainfall (for estimating approx. rain water recharge per year).
b) Peak intensity and duration of each storm.
c) Type of soil and sub-soil conditions and their permeability factor.
d) Ground slopes and run off which cannot be caught.
e) Location of recharge structures and its overflow outfall.
f) Rainwater measuring devices for finding the flow of water in the system.

For artificial recharge to ground water code for guidelines for Artificial Recharge to Ground Water [9-2(16)] may be referred, which is under preparation.

NOTE - Rain water harvesting with underground recharging will depend from region to region as per the climatic, topography, soil conditions and data about intensity of rainfall & retention time for calculating the capacity of recharge wells to be obtained from reference documents from the Authority.

4.5.12.3 *Roof top rainwater harvesting*

4.5.12.3.1 *Harvesting in regular rainfall areas*

In areas having rainfall over a large period in a year e.g. in hilly areas, coastal regions, etc constant and regular rainfall can be usefully harvested and stored in suitable water tanks. Water shall be collected through roof gutters and down take pipes. Provision should be made to divert the 1st rainfall after a dry spell so that ant dust, soot and leaves etc. are drained away before the water is collected into the water tank. The capacity of the water tank should be enough for storing water required for consumption between two dry spells. The water tank shall be located in a well protected area and shall not be exposed to any hazards of water contamination from any other sources. The water shall be chlorinated using chlorine tablets or solution to maintain a residual chlorine of approx. 1 mg/l. The tank shall have an overflow leading to a natural water courses or to any additional tanks (*see* Table 22).

4.5.12.3.2 *Harvesting in urban areas*

In urban areas with the rainfall limited during the monsoon period, (usually from 15-90 days) roof top rainwater cannot be stored and used as mentioned above and is best used for recharging the ground water. For individual properties and plots the roof top rainwater should be diverted to existing open or abandoned tubewells. In an well planned building complex the system should be laid out so that the runoff is discharged in bore-wells as per designs specified by the Central Ground Water Board of the Government of India.

For roof top rain water harvesting, reference may be made to good practice [9-2(17)].

4.5.12.4 *Care to taken in rainwater harvesting*

Water conservation technique discussed above shall be constructed with due care taking following precautions:

a) No sewage or waste water should be admitted into the system.
b) No waste water from areas likely to have oil, grease or other pollutants should be connected to the system.
c) Each structure/well shall have a inlet chamber with a silt trap to prevent any silt from finding its way into the sub soil water.
d) The wells should be terminated at least 5 m above the natural static sub soil water at its highest level so that the incoming flow passes through the natural ground condition and prevent contamination hazards.
e) No recharge structure or a well shall be used for drawing water for any purposed.

Table 22 Rainwater Available from Roof Top Harvesting

(*Clause* 4.5.12.3)

Rain fall in mm->	100	200	300	400	500	600	700	800	900	1 000	1 100	1 200	1 300	1 400	1 500	1 600	1 700	1 800	1 900	2 000
Roof top area	Harvested Water from Roof Tops (80 percent of gross precipitation)																			
20	2	3	5	6	8	10	11	13	14	16	18	19	21	22	24	26	27	29	30	32
30	2	5	7	10	12	14	17	19	22	24	26	29	31	34	36	38	41	43	46	48
40	3	6	10	13	16	19	22	26	29	32	35	38	42	45	48	51	54	58	61	64
50	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80
60	5	10	14	19	24	29	34	38	43	48	53	58	62	67	72	77	82	86	91	96
70	6	11	17	22	28	34	39	45	50	56	62	67	73	78	84	90	95	101	106	112
80	6	13	19	26	32	38	45	51	58	64	70	77	83	90	96	102	109	115	122	128
90	7	14	22	29	36	43	50	58	65	72	79	86	94	101	108	115	122	130	137	144
100	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120	128	136	144	152	160
110	9	18	26	35	44	53	62	70	79	88	97	106	114	123	132	141	150	158	167	176
120	10	19	29	38	48	58	67	77	86	96	106	115	125	134	144	154	163	173	182	192
130	10	21	31	42	52	62	73	83	94	104	114	125	135	146	156	166	177	187	198	208
140	11	22	34	45	56	67	78	90	101	112	123	134	146	157	168	179	190	202	213	224
150	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228	240
200	16	32	48	64	80	96	112	128	144	160	176	192	208	224	240	256	272	288	304	320
250	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400
300	24	48	72	96	120	144	168	192	216	240	264	288	312	336	360	384	408	432	456	480
400	32	64	96	128	160	192	224	256	288	320	352	384	416	448	480	512	544	576	608	640
500	40	80	120	160	200	240	280	320	360	400	440	480	520	560	600	640	680	720	760	800
1 000	80	160	240	320	400	480	560	640	720	800	880	960	1 040	1 120	1 200	1 280	1 360	1 440	1 520	1 600
2 000	160	320	480	640	800	960	1 120	1 280	1 440	1 600	1 760	1 920	2 080	2 240	2 400	2 560	2 720	2 880	3 040	3 200
3 000	240	480	720	960	1 200	1 440	1 680	1 920	2 160	2 400	2 640	2 880	3 120	3 360	3 600	3 840	4 080	4 320	4 560	4 800

4.5.12.5 *Siphonic drainage system*

It is an installation generally used for special situations such as roofs with large spans for structures like hangars, airport terminals, stadiums and industrial sheds, where the number of down pipes has to be limited. These are designed for full flow of pipes and the roof outlets are different from conventional ones.

4.5.12.6 *Rain water harvesting for plotted development/group housing developments*

The rain water harvesting methods adopted for plotted and group housing are through collection of rooftop rainwater and surface runoff harvesting.

A network of storm water drains in the entire residential area is used for harvesting rooftop rainwater and surface runoff. More number of recharge wells measuring 1m x 1m x 2m are constructed in the storm water drain for facilitating groundwater recharge. The quality of runoff, which passes through the bore well installed inside the recharge well, is ensured through a filter bed of pebbles.

4.5.12.7 *Other methods of rain water harvesting*

a) *Creation of artificial reservoirs /lakes for utilisation of available storm water:*

Estimation of amount of runoff volume based on rainfall data(for a period of 10 years) considering the percolation & evaporation losses and efforts to be made to collect all available runoff for proper utilization.

b) *Water balancing methods*:

Refers to optimum utilization of available water from different sources namely Ground water, recycled waste water, storm water and municipal supply and its adoption would ensure that there is no wastage of water.

4.5.13 *Subsoil Water Drainage*

4.5.13.1 *General*

Subsoil water is that portion of the rainfall which is absorbed into the ground.

The drainage of subsoil water may be necessary for the following reasons:

a) to increase the stability of the surface;
b) to avoid surface flooding;
c) to alleviate or to avoid causing dampness in the building, especially in the cellars;
d) to reduce the humidity in the immediate vicinity of the building; and
e) to increase the workability of the soil.

4.5.13.2 *Depth of water table*

The standing level of the subsoil water will vary with the season, the amount of rainfall and the proximity and level of drainage channels. Information regarding this level by may be obtained by means of boreholes or trial pits, preferably the latter. It is desirable though not always practicable to ascertain the level of the standing water over a considerable period so as to enable the seasonal variations to be recorded and in particular the high water level. The direction of flow of the subsoil water may usually be judged by the general inclination of the land surface and the main lines of the subsoil drains shall follow the natural falls, wherever possible.

4.5.13.3 *Precautions*

Subsoil drains shall be so sited as not to endanger the stability of the buildings or earthwork. In some portions of the drain, it may be necessary to use non-porous jointed pipes.

4.5.13.3.1 No field pipe shall be laid in such a manner or in such a position as to communicate directly with any drain constructed or adopted to be used for conveying sewage, except where absolutely unavoidable and in such case a suitable efficient trap shall be provided between subsoil drain and such sewer.

4.5.13.4 *Systems of subsoil drainage*

Clay or concrete porous field drain pipes may be used and shall be laid in one of the following ways (*see also* Fig. 10):

a) *Natural* – The pipes are laid to follow the natural depressions or valleys of the site; branches discharge into the main as tributaries do into a river.
b) *Herringbone* –The system consists of a number of drains into which discharges from both sides smaller subsidiary branch drains parallel to each other, but an angle to the mains forming a series of herringbone pattern. Normally these branch drains should not exceed 30 m in length.
c) *Grid* – A main or mains drain is laid to the boundaries if the site into which subsidiary branches discharge from one side only.
d) *Fan-Shaper* – The drains are laid converging to a single outlet at one point on the boundary of a site, without the use of main or collecting drains.
e) *Moat or Cut-Off System* – This system consists of drains laid on one or more sides of a building to intercept the flow of subsoil water and carry it away, thereby protecting the foundations of a building.

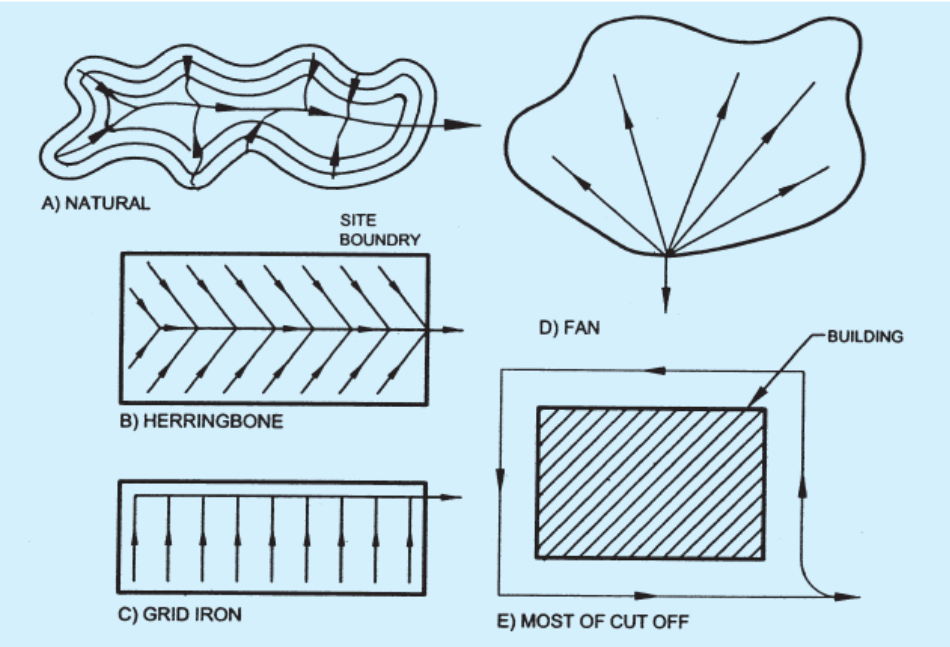

FIG. 10 DETAILS OF SUB-SOIL DRAINAGE SYSTEM

The choice of one or more of these systems will naturally depend on the local conditions of the site. For building sites, the mains shall be not less than 75 mm in diameter and the branches not less than 65 mm in diameter and the branches not less than 65 mm in diameter but normal practice tends towards the use of 100 mm and 75 mm respectively. The pipes shall generally be laid at 60 to 90 cm depth, or to such a depth to which it is desirable to lower the water-table and the gradients are determined rather by the fall of the land than by considerations of self-cleansing velocity. The connection of the subsidiary drain to the main drain is best made by means of a clayware or concrete junction pipe. The outlet of a subsoil system may discharge into a soakaway or through a catch pit into the nearest ditch or watercourse. Where these are not available, the subsoil drains may be connected, with the approval of the Authority, through an intercepting trap to the surface water drainage system.

NOTE – Care shall be taken that there is no backflow from sub-surface drains during heavy rains.

4.5.13.5 *Deep well/bore well recharging*

Recharge well is one which pushes back surface water into ground water system. The recharge well would be of 1 m in diameter and 6 m deep lined with concrete rings having perforations.

Direct recharge is recommended when the well has gone dry and is yielding negligible amount of water. Indirect recharge is adopted for functioning borewells.

4.5.14 *Waste Disposal Systems in High Altitudes and or Sub-zero Temperature Regions*

4.5.14.1 In general, all the cases to be exercised regarding water supply systems shall also be applicable in the case of waste disposal systems shall also be applicable in the case of waste disposal systems. The biological and chemical reduction of organic material proceeds slowly under low temperature conditions, consequently affecting the waste disposal systems. The waste disposal methods given in **4.5.14.2**, **4.5.14.3** and **4.5.14.4** shall be used only where it is not practical to install water carriage system.

4.5.14.2 *Box and can system*

Where box and can systems are employed, adequate arrangements shall be made for the cleaning and disinfection of the can after it is emptied of its contents. The excrement from the can shall be disposed of by burial in isolated spots far from habitation or by incineration, where feasible. The can shall be fitted with a tight fitting lid for use when it is carried for emptying.

4.5.14.3 *Trench or pit latrines*

Trench or pit latrines shall be used only where soil and sub-soil conditions favor their use. Whenever they are used, they shall not be closer than 18 m from any source of drinking water, such as well, to *eliminate* the possibility of bacterial pollution of water.

4.5.14.4 *Chemical toilets*

For the successful functioning of chemical toilets, they shall preferably be installed in heated rooms or enclosures.

> NOTE – Chemical toilet essentially consists of small cylindrical tanks with a water-closer seat for the use of 8 to 10 persons. A ventilation pipe is fitted to the seat. A strong solution of caustic soda is used as a disinfectant. It kills bacteria, liquefies the solids and thus checks the decomposition of organic matter. The tank is provided with a drain plug for which liquid runs to a soak pit at the time of disposal.

4.5.14.5 *Water-borne sanitation systems*

Water-borne sanitation systems shall be used, where practicable. Sanitation systems for the collection of sewage should be constructed in such a manner that maximum heat is retained by insulation, if necessary.

4.5.14.5.1 *Sewerage laying*

Under normal circumstances, sewers shall be laid below the frost line. Manholes shall be made of air-tight construction so as to prevent the cold air from gaining access inside and freezing the contents. The trenches for sewers shall be

loosely filled with earth after laying sewers, since loose soil is a better insulator than compacted soil. Consequently, sewers laid under traffic ways and other places where soil compaction may be expected are required to be given adequate insulation. Where feasible, sewers shall be so located that the trench line is not in shadow, when the sun is shining. Concrete, cast iron and stoneware pipes conduct heat relatively rapidly and as such should be adequately insulated.

4.5.14.5.2 *Septic tanks*

Septic tanks can function only when it can be ensured that the contents inside these do not freeze at low temperature. For this purpose, the septic tanks shall be located well below the frost line. The location of manhole openings shall be marked by staves. Fencing around the septic tanks shall be provided for discouraging traffic over them. As the rate of biological activity is reduced by 50 percent for every 10°C fall in temperature, the capacity of septic tanks shall be increased by 100 percent for operation at 10°C over that for operation at 20°C.

The construction of septic tanks is preferred in rural and fringe areas of suburban and isolated buildings where underground system may neither be feasible nor economical. Septic tanks are only recommended for small communities and institutions whose contributory population does not exceed 300.

For other details, refer good practice [9-2(8)].

4.5.14.5.3 *Seepage pits*

Seepage pits can function only when the soil and sub-soil conditions are favorable. Frozen soil extending to a great depth would preclude the use of such disposal devices in view of the lower water absorption capacity. The discharge of effluent should be made below the frost line.

4.5.14.5.4 *Sewage treatment plants*

Suitable design modifications for sedimentation, chemical and biological processes shall be applied to sewage treatment plants for satisfactory functioning.

NOTE - Lavatories and bathrooms shall be kept heated to avoid freezing of water inside traps and flushing cisterns.

4.6 Construction Relating to Conveyance of Sanitary Wastes

4.6.1 *Excavation*

4.6.1.1 *General*

The safety precautions as given in Part 8 Constructional Practices and Safety shall be ensured.

4.6.1.2 Turf, topsoil or other surface material shall be set aside, turf being carefully rolled and stacked for use in reinstatement. All suitable broken surface material and hard-core shall be set on one side for use in subsequent reinstatement.

4.6.1.3 Excavated material shall be stacked sufficiently away from the edge of the trench and the size of the spoil bank shall not be allowed to become such as to endanger the stability of the excavation. Spoil may be carried away and used for filling the trench behind the work.

4.6.1.4 Excavation shall proceed to within about 75 mm of the finished formation level. This final 75 mm is to be trimmed and removed as a separate operation immediately prior to the laying of the pipes or their foundations.

4.6.1.5 Unless specified otherwise by the Authority, the width at bottom of trenches for pipes of different diameters laid at different depths shall be as given below:

a) For all diameters, up to an average depth of 1 200 mm, width of trench in mm = diameter of pipe + 300 mm ;
b) For all diameters for depths above 1 200 mm; width of trench in mm = diameter of pipe + 400 mm ; and
c) Notwithstanding (a) and (b), the total width of trench at the top should not be less than 750 mm for depths exceeding 900 mm.

4.6.1.6 Excavation in roads shall be so arranged, in agreement with the proper authority, as to cause the minimum obstruction to traffic. The methods to be adopted shall depend on local circumstances.

4.6.1.7 All pipes, ducts, cables, mains or other services exposed in the trench shall be effectively supported by timber and / or chain or rope-slings.

4.6.1.8 All drainage sumps shall be sunk clear of the work outside the trench or at the sides of manholes. After the completion of the work, any pipes or drains leading to such sumps or temporary subsoil drains under permanent work shall be filled in properly with sand and consolidated.

4.6.2 *Laying of Pipes*

Laying of pipes shall be done in accordance with good practice [9-2(18)].

4.6.3 *Jointing*

All soil pipes, waste pipes, ventilating pipes and other such pipes above ground shall be gas-tight. All sewers and drains laid below the ground shall be water-tight. Jointing shall be done in accordance with good practice [9-2(18)].

4.6.4 *Support or Protection for Pipes*

4.6.4.1 *General*

It may be necessary to support or surround pipe sewers or drains by means of concrete in certain circumstances. Some of the suggested methods are given in **4.6.4.2** to **4.6.4.4**.

4.6.4.2 *Bedding*

Bedding (*see* Fig. 11) shall be rectangular in section and shall extend laterally at least 150 mm beyond and on both sides of the projection of the barrel of the pipe. The thickness of the concrete below the barrel of the pipe shall be not less than 100 mm for pipes under 150 mm diameter and 150 mm for pipes 150 mm and over in diameter. Where bedding is used alone, the concrete shall be brought up at least to the invert level of the pipe to form a cradle and to avoid line contact between the pipe and the bed.

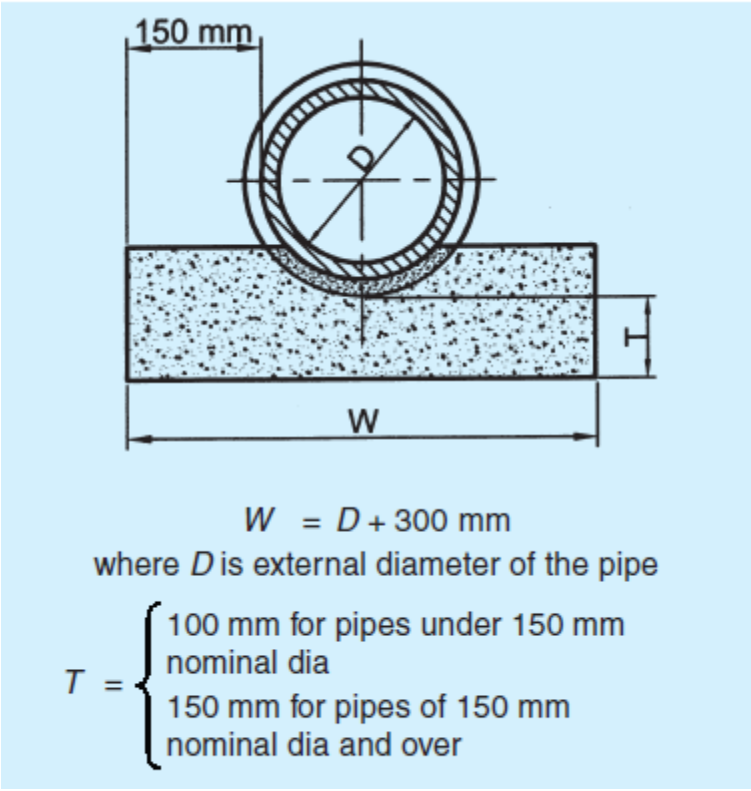

FIG. 11 BEDDING

4.6.4.3 *Haunching*

Concrete haunching (see Fig. 12) shall consist of:

a) A Concrete bed as described for bedding (see **4.6.4.2**)
b) The full width of the bed carried up to the level of the horizontal diameter of the pipe; and
c) Splays from this level carried up on both sides of the pipe, from the full width of the bed to meet the pipe barrel tangentially.

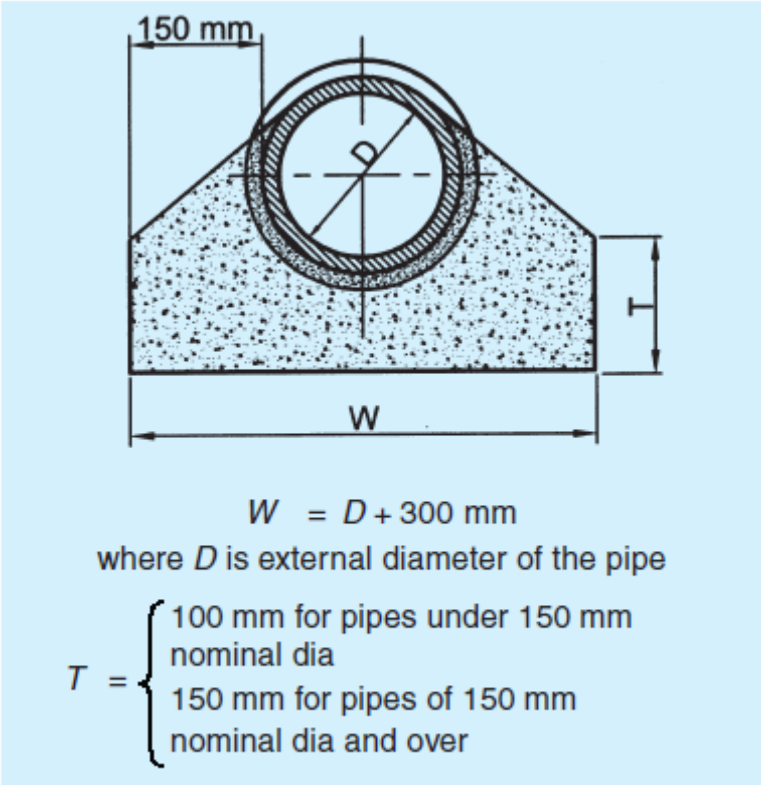

FIG. 12 HAUNCHING

4.6.4.4 *Surround or encasing* – The surround or encasing (*see* Fig. 13) shall be similar to haunching up to the horizontal diameter of the pipe and the top portion over this shall be finished in a semicircular form to give a uniform encasing for the top half of the pipe.

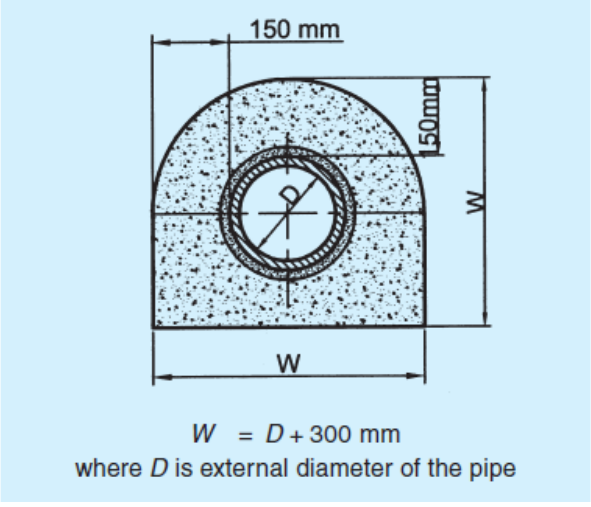

FIG. 13 SURROUND OR ENCASING

4.6.5 *Connection to Existing Sewers*

The connection to an existing sewer shall, as far as possible, be done at the manholes. Where it is unavoidable to make connection in between two manholes, the work of breaking into the existing sewer and forming the connection shall be carried out by the Authority or under its supervision.

4.6.5.1 Breaking into the sewer shall be effected by the cautious enlargement of a small hole and every precaution shall be taken to prevent any material from entering the sewer. No connection shall be formed in such a way as to constitute a projection into the sewer or to cause any diminution in its effective size.

4.6.6 *Back-Filling*

4.6.6.1 Filling of the trench shall not be commenced until the length of pipes therein has been tested and passed (*see* **5.10.2**).

4.6.6.2 All timber which may be withdrawn with safety shall be removed as filling proceeds.

4.6.6.3 Where the pipes are unprotected by concrete haunching, the first operation in filling shall be carefully done to hand-pack and tamp selected fine material around the lower half of the pipes so as to buttress them to the sides of the trench.

4.6.6.4 The filling shall then be continued to 150 mm over the top of the pipe using selected fine hand-packed material, watered and rammed on both sides of the pipe with a wooden rammer. On no account shall material be tipped into the trench until the first 150 mm of filling has been completed. The process of filling and tamping shall proceed evenly so as to maintain an equal pressure on both sides of the pipeline.

4.6.6.5 Filling shall be continued in layers not exceeding 150 mm in thickness, each layer being watered and well rammed.

4.6.6.6 In roads, surface materials previously excavated shall be replaced as the top layer of the filling, consolidated and maintained satisfactorily till the permanent reinstatement of the surface is made by the Authority.

4.6.6.7 In gardens, the top soil and turf, if any, shall be carefully replaced.

4.7 Construction Relating to Conveyance of Rain or Storm Water

4.7.1 *Roof Gutters*

Roof gutters shall be of any material of suitable thickness. All junctions and joints shall be water-tight.

4.7.2 *Rain-Water Pipes*

Rain water pipes shall conform to the accepted standards [9-2(19)].

4.7.3 *Subsoil Drain Pipes*

4.7.3.1 *Field drain pipes*

Suitable pipes for this purpose are plain cylindrical glazed water pipes, or concrete porous pipes through the latter may prove unsuitable where sub-soil water carries sulphates or is acidic owing to the presence of peat. Trenches for these pipes need be just wide enough at the bottom to permit laying the pipes, which shall be laid with open joints to proper lines and gradients.

It is advisable to cover the pipes with clinker free from fine ash, brick ballast or other suitable rubble, or a layer of inverted turf, brush-wood or straw before refilling the trench, in order to prevent the infiltration of silt through the open joints. Where the subsoil drain is also to serve the purpose of collecting surface water, the rubble shall be carried upto a suitable level and when required for a lawn or playing field, the remainder of the trench shall be filled with pervious top soil. When refilling the trenches, care shall be taken to prevent displacement of pipes in line of levels. When they pass near trees or through hedges, socket pipes with cement or bitumen joints shall be used to prevent penetration by roots.

4.7.3.2 *French Drain*

A shallow trench is excavated, the bottom neatly trimmed to the gradient and the trench filled with broken stone, gravel or clinker, coarse at the bottom and finer towards the top.

4.8 Selection and Installation of Sanitary Appliances

4.8.1 Selection, installation and maintenance of sanitary appliances shall be done in accordance with good practice [9-2(20)].

4.9 Inspection and Testing

4.9.1 *Inspection*

4.9.1.1 All sanitary appliances and fitments shall be carefully examined for defects before they are installed and also on the completion of the work.

4.9.1.2 Pipes are liable to get damaged in transit and, not withstanding tests that may have been made before despatch, each pipe shall be carefully examined on arrival on the site. Preferably, each pipe shall be rung with a hammer or mallet and those that do not ring true and clear shall be rejected. Sound pipes shall be

carefully stored to prevent damage. Any defective pipes shall be segregated, marked in a conspicuous manner and their use in the works prevented.

4.9.1.3 Cast iron pipes shall be carefully examined for damage to the protective coating. Minor damage shall be made good by painting over with hot tar or preferably bitumen. But if major defects in coating exit, the pipes shall not be used unless recoated. Each pipe shall be carefully re-examined for soundness before laying.

4.9.1.4 Close inspection shall be maintained at every stage in the work, particularly as to the adequacy of timber supports used in excavation and the care and thoroughness exercised in filling.

4.9.1.4.1 Careful note shall be kept of the condition of any sewer, manhole or other existing work which may be uncovered and any defects evident shall be pointed out immediately to the Authority.

4.9.1.4.2 No work shall be covered over or surrounded with concrete until it has been inspected and approved by the Authority.

4.9.2 *Testing*

4.9.2.1 Comprehensive tests of all appliances shall be made by simulating conditions of use. Overflow shall be examined for obstructions.

4.9.2.2 *Smoke test*

All soil pipes, waste pipes, and vent pipes and all other pipes when above ground shall be approved gas-tight by a smoke test conducted under a pressure of 25 mm of water and maintained for 15 min after all trap seals have been filled with water. The smoke is produced by burning only waste or tar paper or similar material in the combustion chamber of a smoke machine. Chemical smokes are not satisfactory.

4.9.2.3 *Water test*

4.9.2.3.1 *For pipes other than cast iron*

Glazed and concrete pipes shall be subjected to a test pressure of at least 1.5 m head of water at the highest point of the section under test. The tolerance figure of 2 litres/cm of diameter/km may be allowed during a period of ten minutes. The test shall be carried out by suitably plugging the low end of the drain and the ends of connections, if any, and filling the system with water. A knuckle bend shall be temporarily jointed in at the top end and a sufficient length of the vertical pipe jointed to it so as to provide the required test head, or the top end may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitably for observation.

Subsidence of the test water may be due to one or more of the following causes:

a) absorption by pipes and joints;
b) sweating of pipes or joints;
c) leakage at joints or from defective pipes; and
d) trapped air.

Allowance shall be made for (a) by adding water until absorption has ceased after which the test proper should commence. Any leakage will be visible and the defective part of the work should be cut out and made good. A slight amount of sweating which is uniform may be overlooked, but excessive sweating from a particular pipe or joint shall be watched for and taken as indicating a defect to be made good. A slight amount of sweating which is uniform may be overlooked, but excessive sweating from a particular pipe or joint shall be watched for and taken as indicating a defect to be made good.

NOTE – This test will not be applicable to sanitary pipe work above ground level.

4.9.2.3.2 *For cast iron pipes*

Cast iron sewers and drains shall be tested as for glazed and concrete pipes. The drain plug shall be suitably strutted to prevent their being forced out of the pipe during the test.

4.9.2.4 *Tests for straightness and obstruction*

The following tests shall be carried out:

a) by inserting at the high end of the sewer or drain a smooth ball of a diameter 13 mm less than the pipe bore. In the absence of obstruction, such as yarn or mortar projecting through the joints, the ball should roll down the invert of the pipe, and emerge at the lower end; and
b) by means of a mirror at one end of the line and lamp at the other. If the pipeline is straight, the full circle of light may be observed. If the pipe line is not straight, this will be apparent. The mirror will also indicate obstruction in the barrel.

4.9.2.5 *Test records*

Complete records shall be kept of al tests carried out on sewers and drains both during construction and after being put into service.

4.10 Maintenance

4.10.1 *General*

Domestic drainage system shall be inspected at regular intervals. The system shall be thoroughly cleaned out at the same time and any defects discovered shall be made good.

4.10.2 *Cleaning of Drainage System*

4.10.2.1 Sewer maintenance crews, when entering a deep manhole or sewer where dangerous gas or oxygen deficiencies may be present, shall follow the following procedures :

a) allow no smoking or open flames and guard against parks.
b) erect warning signs.
c) use only safety gas-proof, electric lighting equipment.
d) test the atmosphere for noxious gases and oxygen deficiencies (presence of hydrogen sulphide is detected using lead acetate paper and that of oxygen by safety lamps).
e) if the atmosphere is normal, workmen may enter with a safety belt attached and with two men available at the top. For extended jobs, the gas tests shall be repeated at frequent intervals, depending on circumstances.
f) if oxygen deficiency or noxious gas is found, the structure shall be ventilated with pure air by keeping open at least one manhole cover each on upstream and downstream side for quick exit of toxic gases or by artificial means. The gas tests shall be repeated and the atmosphere cleared before entering. Adequate ventilation shall be maintained during this work and the tests repeated frequently.
g) if the gas or oxygen deficiency is present and it is not practicable to ventilate adequately before workers enter, a hose mask shall be worn and extreme care taken to avoid all sources of ignition. Workers shall be taught how to use the hose equipment. In these cases, they shall always use permissible safety lights (not ordinary flash lights), rubber boots or non-sparking shoes and non-sparking tools;
h) Workmen descending a manhole shaft to inspect or clean sewers shall try each ladder step or rung carefully before putting the full weight on it to guard against insecure fastening due to corrosion of the rung at the manhole wall. When work is going on in deep sewers, at least two men shall be available for lifting workers from the manhole in the event of serious injury; and
j) Portable air blowers, for ventilating manhole, are recommended for all tank, pit or manhole work where there is a question as to the presence of noxious gas, vapors or oxygen deficiency. The motors for these shall be of weather proof and flame-proof types; compression ignition diesel type (without sparking plug) may be used. When used, these shall be placed not less than 2 m away from the opening and on the leeward side protected form wind, so that they will not serve as a source of ignition for any inflammable gas which might be present. Provision should be made for ventilation and it should be of the forced type which can be

provided by a blower located at ground level with suitable flexible ducting to displace out air from the manhole.

4.10.2.2 The following operations shall be carried out during periodical cleaning of a drainage system.

a) The covers of inspection chambers and manholes shall be removed and the side benching and channels scrubbed;
b) The interceptive trap, if fitted, shall be adequately cleaned and flushed with clean water. Are shall be taken to see that the stopper in the rodding arm is securely replaced;
c) All lengths of main and branch drains shall be rodded by means of drain rods and a suitable rubber or leather plunger. After rodding, the drains shall be thoroughly flushed with clean water. Any obstruction found shall be removed with suitable drain cleaning tools and the system thereafter shall be flushed with clean water;
d) The covers of access plates to all gullies shall be removed and the traps plunged and flushed out thoroughly with clean water. Care shall be taken not to flush the gully deposit into the system;
e) Any defects revealed as a result of inspection or test shall be made good;
f) The covers or inspection chambers and gullies shall be replaced, bedding them in suitable grease or other materials; and
g) Painting of ladders/rings in deep manholes and external painting of manhole covers shall be done with approved paints.

4.10.3 All surface water drains shall be periodically rodded by means of drain rods and a suitable rubber or leather plunger. After rodding, they shall be thoroughly flushed with clean water. Any obstruction found shall be removed with suitable drain cleaning tools.

4.10.4 All subsoil drains shall be periodically examined for obstruction at the open joints due to the roots of plants or other growths.

4.11 Pumping of Sewage

4.11.1 In the design of sewerage system, it is necessary to collect the sewage of a low lying area at some convenient point from which it shall be lifted by pumps. At the treatment plant also, lifting of sewage may be necessary to provide head for the flow by gravity of sewage.

4.11.2 *Sewage Pump Stations, Sizing Of Sumps and Pumps*

They are required as onsite pump stations to cater to drainage from toilets and kitchen. The stations would be located in basement floors and leading the sewage to onsite treatment plants. Submersible centrifugal pumps are used for pumping the sewage. The Sump capacity depends on effective holding capacity

considering the flow from drainage fixtures. Usually, retention period of 15 minutes is adopted. The Size of sump depends on the availability of space. Minimum size of discharge pipe may be 80mm with a velocity of 1 m/sec and pumps are sized for 100 percent design flow.

NOTE - For other details reference to good practice [9-2(11)] shall be made.

ANNEX A
(*Clause* 3.2.1)

APPLICATION FOR DRAINAGE OF PREMISES

I/We hereby make application to the *……
…….for permission to drain the premises……Ward No……..Street No……
Road/Street known as……

The sanitary arrangement and drains of the said premises are shown in the accompanying plans and a description of the specification of the work/material used is also appended (Annex B).

I/We undertake to carryout the work in accordance with Part 9 Plumbing services, Section 1 Water Supply, drainage and sanitation of the Code.

……...	……
Signature of the licensed plumber	Signature of the owner
Name and address of the	Name and address…….
……	…….
……	…….
Date……..	Date……

NOTE – The application should be signed by the owner of the premises and shall be countersigned by the licensed plumber.

_____

* Insert the name of the Authority.

ANNEX B

(*Clause* 3.2.3.2)

FORM FOR DETAILED DESCRIPTION OF WORK AND SPECIFICATION OF MATERIALS

1) Separation of rain-water and foul water……

2) Rain-water drains, curbs and points of discharge……..

3) Rain-water gutters, pipes or spouts where discharging……

4) Open-full-water drains, materials, sizes, curbs and other means places, verandahs, latrines

5) Silt-catcher and grating, size and position……

6) Drains……

   a) Main sewage drains : Fall ……..
      Size……
   b) Branch drains : Fall ……..
      Size……
   c) Materials……
   d) Method of jointing……

7) Bedding of pipes :

   a) Method of bedding……..
   b) Thickness and width of beds of concrete……
   c) Thickness of concrete round pipes……..

8) Protection of drain laid under wall……

9) Traps, description and intercepter :

   a) Lavatory waste pipes……
   b) Bath waste pipes……
   c) Sink……
   d) Gully-traps……
   e) Water-closet traps……
   f) Grease traps……
   g) Slop sink……..
   h) Urinal……..
   j) Others……

10) Manholes and inspection chambers :

a) Thickness of walls……
b) Description of bricks……..
c) Description of rendering……
d) Description of invert channels……
e) Depth of chambers……
f) Size and description of cover and manner of fixing…….

11) Ventilation of drain :

a) Position – Height above nearest ground level……..
b) Outlet shaft position of terminal at top……

12) Soil pipe, waste pipe and ventilating pipe connections :

a) Lead and iron pipes……..
b) Lead pipe of trap with cast iron pipe……..
c) Stoneware pipe or trap with lead pipe……
d) Lead soil pipe or trap with stoneware pipe or trap……
e) Cast iron pipe with stoneware drain……
f) Stoneware trap with cast iron soil pipe……..

13) Ventilation of water-closet trap sink, lavatory and other traps material and supports.

14) Water-closets (apartments):

a) i) At or above ground level……..
ii) Approached from……
iii) Floor material……..
iv) Floor fall towards door……
v) Size of window opening in wall made to open……
vi) Position of same……
vii) Means of constant ventilation……
viii) Position of same……..

b) Water-closet apparatus :

i) Description of pan, basin, etc……
Kind……...
ii) Flushing cistern…….
iii) Material of flushing pipe……
iv) Internal diameter……
v) Union with basin……

15) Sanitary fittings, water storage tank, etc :

a) Number and description of sanitary fittings in room and rooms in which they are to be installed……
b) Capacity and position of water storage tanks…….
c) Size and number of draw off taps and whether taken off storage tanks or direct from main supply……...
d) Details of draw off taps, that is, whether they are of plain screw down pattern or `waste not' and description of any other sanitary work to be carried out not included under above headings……...

16) Depth of sewer below surface of street……...

17) Level of invert of house drain at point of junction :

a) with sewer…….
b) Level of invert of sewer at point of junction with house drain……..
c) Distance of nearest manhole on sewer from the point at which the drain leaves the premises……

18) Schedule of pipes :

Description of pipe/drain	*Materials*	*Diameter*	*Weight*	*Method of Jointing*
a) Subsoil drains				
b) Main sewage drains				
c) Branch sewage drains				
d) Soil pipes				
e) Ventilating pipes other than soil pipes				
f) Waste pipes				
g) Rain-water pipes				
h) Anti-syphon pipes				

Signature of the licensed plumber……
Name and address of the licensed plumber……...
……
……
……
Date……...

ANNEX C
(*Clause* 3.2.5)

FORM FOR LICENSED PLUMBER'S COMPLETION CERTIFICATE

Certified that I/we have completed the plumbing work of drainage and sanitation system for the premises as detailed below. This may be inspected, approved and connection given.

Ward No……..

Street……..

Locality……

Block No…….

House No……

Details of work…….
……
……

The work was sanctioned by the Authority*
vide
…… ……

Signature of the owner Signature of the licensed plumber

Name and address…… Name and address ……
…… ……..

Date……

The Authority's Report

Certified that the plumbing work of drainage and sanitation system for the premises, have been laid, applied, executed in accordance with Part 9 Plumbing services, Section 1 Water supply, drainage and sanitation of the Code.

Drainage Connection to the main sewer will be made on……

Date…… The Authority……

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* Insert the name of the Authority

LIST OF STANDARDS

The following list records those standards which are acceptable as 'good practice' and 'accepted standards' in the fulfillment of the requirements of the code. The latest version of a standard shall be adopted at the time of enforcement of the code. The standards listed may be used by the Authority as a guide in conformance with the requirements of the referred clauses in the code.

(1)	IS 10446 : 1983	Glossary of terms relating to water supply and sanitation
(1A)	IS 11208:1985	Guidelines for registration of plumbers
(2)	IS 771	Specification for glazed fire-clay sanitary appliances
	(Part 1):1979	Part 1 General requirements (*second revision*)
	(Part 2):1985	Part 2 Specific requirements of kitchen and laboratory sinks (*third revision*)
	(Part 3/Sec 1):1979	Part 3 Specific requirements of urinals, Section 1 Slab urinals (*second revision*)
	(Part 3/Sec 2):1985	Part 3 Specific requirements of urinals: Section 2 Stall urinals (*third revision*)
	(Part 4):1979	Part 4 Specific requirements of postmortom slabs (*second revision*)
	(Part 5):1979	Part 5 Specific requirements of shower trays (*second revision*)
	(Part 6):1979	Part 6 Specific requirements of bed-pan sinks (*second revision*)
	(Part 7):1981	Part 7 Specific requirements of slop sinks (*second revision*)
	IS 772:1973	Specification for general requirements for enamelled cast iron sanitary appliances (*second revision*)
	IS 773:1988	Specification for enamelled cast iron water-closets railway coaching stock type (*fourth revision*)
	IS 774:1984	Specification for flushing cistern for water closets and urinals (other than plastic cistern) (*fourth revision*)
	IS 775:1970	Specification for cast iron brackets and supports for wash basins and sinks (*second revision*)
	IS 1700:1973	Specification for drinking fountains (*first revision*)
	IS 2326:1987	Specification for automatic flushing cisterns for urinals (*second revision*)
	IS 2548	Specification for plastic seats and covers for water-closets
	(Part 1):1996	Part 1 Thermoset seats and covers (*fifth revision*)
	(Part 2):1996	Part 2 Thermo plastic seats and covers (*fifth revision*)

	IS 2556	Specification for vitreous sanitary appliances (vitreous china)
	(Part 1):1994	Part 1 General requirements (*third revision*)
	(Part 2):1994	Part 2 Specific requirements of wash-down water-closets (*fourth revision*)
	(Part 3):1994	Part 3 Specific requirements of squatting pans (*fourth revision*)
	(Part 4):1994	Part 4 Specific requirements of wash basins (third revision)
	(Part 5):1994	Part 5 Specific requirements of laboratory sinks (*third revision*)
	(Part 6):1995	Part 6 Specific requirements of urinals and partition plates (*fourth revision*)
	(Part 7):1995	Part 7 Specific requirements of accessories for sanitary appliances (third revision)
	(Part 8):1995	Part 8 Specific requirements of siphonic wash-down water closets (*fourth revision*)
	(Part 9):1995	Part 9 Specific requirements of bidets (*fourth revision*)
	(Part 14):1995	Part 14 Specific requirements of integrated squatting pans (*first revision*)
	(Part 15):1995	Part 15 Specific requirements of universal water closets (*first revision*)
	(Part 16):2002	Part 16 Specific requirements for wash down wall mounted water closets
	(Part 17):2001	Part 17 Specific requirements for wall mounted bidets
	IS 3489:1985	Specification for enamelled steel bath tubs (*first revision*)
	IS 6411:1985	Specification for gel-coated glass fibre reinforced polyester resin bath tubs (*first revision*)
	IS 7231:1994	Specification for plastic flushing cisterns for water closets and urinals (*second revision*)
	IS 8718:1978	Specification for vitreous enamelled steel kitchen sinks
	IS 8727:1978	Specification for vitreous enamelled steel wash basins
	IS 9076:1979	Specification for vitreous integrated squatting pans for marine use
	IS 11246:1992	Specification for glass fibre reinforced polyester resins (GRP) squatting pans (*first revision*)
	IS 13983:1994	Specification for stainless steel sinks for domestic purposes
(3)	IS 651:1992	Specification for salt glazed stoneware pipes and fittings (*fifth revision*)

	IS 3006:1979	Specification for chemically resistant salt glazed stoneware pipes and fittings (*first revision*)
(4)	IS 458:2003	Specification for precast concrete pipes (with and without reinforcement) (*fourth revision*)
	IS 784:2001	Specification for prestressed concrete pipes (including specials) (*second revision*)
	IS 1916:1989	Specification for steel cylinder with concrete lining and coating (*first revision*)
	IS 4350:1967	Specification for concrete porous pipes for under drainage
	IS 7319:1974	Specification for perforated concrete pipes
(5)	IS 1536:2001	Specification for centrifugally cast (spun) iron pressure pipes for water, gas and sewage (*fourth revision*)
	IS 1537:1976	Specification for vertically cast iron pressure pipes for water, gas and sewage (*first revision*)
	IS 1538:1993	Specification for cast iron fittings for pressure pipes for water, gas and sewage (*third revision*)
	IS 3989:2009	Specification for centrifugally cast (spun) spigot and socket soil, waste ventilating and rain water pipes, fittings and accessories (*third revision*)
	IS 7181:1986	Specification for horizontally cast iron double flanged pipes for water, gas and sewage (*first revision*)
(6)	IS 1592:2003	Specification for asbestos cement pressure pipes and joints (*fourth revision*)
	IS 1626	Specification for asbestos cement building pipes and pipe fittings, gutters and gutter fittings, and roofing fittings
	(Part 1):1994	Specification for asbestos cement building pipes and pipe fittings, gutter fittings, and roofing fittings: Part 1 Pipes and pipe fittings (*second revision*)
	(Part 2):1994	Specification for asbestos cement building pipes and pipe fittings, gutter fittings, and roofing fittings: Part 2 Gutters and gutter fittings (*second revision*)
	(Part 3):1994	Specification for asbestos cement building pipes and pipe fittings, gutter fittings, and roofing fittings : Part 3 Roofing accessories (*second revision*)
	IS 6908:1991	Specification for asbestos cement pipes and fittings for sewerage and drainage (*first revision*)
(7)	IS 13592:2013	Specification for UPVC pipes for soil and waste discharge systems inside buildings including ventilation and rainwater system (*first revision*)
	IS 14333:1996	Specification for High density polyethylene pipe for sewerage

	IS 14735:1999	Specification for Unplasticized Polyvinyl Chloride (UPVC) Injection Moulded Fittings for Soil and Waste Discharge System for inside and outside buildings including ventilation and rain water system
(8)	IS 2470	Code of practice for installation of septic tanks
	(Part 1):1985	Code of practice for installation of septic tanks : Part 1 Design criteria and construction (*second revision*)
	(Part 2):1985	Code of practice for installation of septic tanks : Part 2 Secondary treatment and disposal of septic tank effluent (*second revision*)
(9)	IS 1536:2001	Specification for centrifugally cast (spun) iron pressure pipes for water, gas and sewage (*fourth revision*)
(10)	IS 5329:1983	Code of practice for sanitary pipe work above ground for buildings (*first revision*)
(11)	SP 35 : 1987	Handbook on water supply and drainage with special emphasis on plumbing
(12)	IS 2212:1991	Code of practice for brickwork (*first revision*)
(13)	IS 5455:1969	Specification for cast iron steps for manholes
(14)	IS 1726:1991	Specification for cast iron manhole covers and frames (*third revision*)
	IS 12592:2002	Specification for precast concrete manhole covers and frames (*first revision*)
(15)	IS 4111(Part 1): 1986	Code of practice for ancillary structures in sewerage system : Part 1 Manholes (*first revision*)
(16)	IS 14961:2001	Guidelines for rain water harvesting in hilly areas by roof water collection system
(17)	IS 15797 : 2008	Roof top rainwater harvesting - Guidelines
(18)	IS 783:1985	Code of practice for laying of concrete pipes (*first revision*)
	IS 1742:1983	Code of practice for building drainage (*second revision*)
	IS 3114:1994	Code of practice for laying of cast iron pipes (*second revision*)
	IS 4127:1983	Code of practice for laying of glazed stoneware pipes (*first revision*)
	IS 6530:1972	Code of practice for laying of asbestos cement pressure pipes
(19)	IS 2064:1993	Code of practice for selection, installation and maintenance of sanitary appliances (*second revision*)
(20)	IS 6924:1973	Code of practice for the construction of refuse chutes in multi-storeyed buildings