भारतीय मानक ब्यूरो
(उपभोक्ता मामले, खाद्य एवं सार्वजनिक वितरण मंत्रालय, भारत सरकार)
BUREAU OF INDIAN STANDARDS
(Ministry of Consumer Affairs, Food & Public Distribution, Govt. of India)

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व्यापक परिचालन मसौदा

हमारा संदर्भ: सीईडी 46 /□□-19 **30 मार्च 2025**

तकनीकी समिति: भारत की राष्ट्रीय भवन निर्माण विषय समिति, सीईडी 46

प्राप्तकर्ता :

1. **सिविल अभियांत्रिकी विभाग परिषद, सीईडीसी के सभी सदस्य**
2. **राष्ट्रीय भवन निर्माण संहिता विषय समिति, सीईडी 46 के सभी सदस्य**
3. **सीईडी 46 की पैनल और अन्य कार्यदल के सभी सदस्य**
4. **रुचि रखने वाले अन्य निकाय।**

महोदय/महोदया,

निम्नलिखित मानक का मसौदा संलग्न हैं:

प्रलेख संख्या	शीर्षक
सीईडी 46 (27002) WC	**भारत की राष्ट्रीय भवन निर्माण संहिता भाग 9 प्लंबिंग सेवाएँ (ठोस कचरे के प्रंबधन सहित) अनुभाग 1 जल आपूर्ति** [SP7(भाग 9 / अनुभाग 1) का चौथा पुनरीक्षण] (आई सी एस नंबर: 01.120: 91.040.01)

कृपया इस मसौदे का अवलोकन करें और अपनी सम्मतियाँ यह बताते हुए भेजे कि यह मसौदा प्रकाशित हो तो इस पर अमल करने में आपको व्यवसाय अथवा कारोबार में क्या कठिनाइयां आ सकती हैं।

सम्मतियाँ भेजने की अंतिम तिथि: 29 अप्रैल 2025

सम्मति यदि कोई हो तो कृपया अधोहस्ताक्षरी को ई-मेल द्वारा ced46@bis.gov.in पर या उपरलिखित पते पर, संलग्न फोर्मेट में भेजें। सम्मतियाँ बीआईएस ई-गवर्नेंस पोर्टल, www.manakonline.in के माध्यम से ऑनलाइन भी भेजी जा सकती हैं।

यदि कोई सम्मति प्राप्त नहीं होती है अथवा सम्मति में केवल भाषा संबंधी त्रुटि हुई तो उपरोक्त प्रलेख को यथावत अंतिम रूप दे दिया जाएगा। यदि सम्मति तकनीकी प्रकृति की हुई तो विषय समिति के 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.gov.in पर भी उपलब्ध हैं।
धन्यवाद।

भवदीय

ह/-

(द्वैपायन भद्र)
वैज्ञानिक 'ई' एवं प्रमुख (सिविल अभियांत्रिकी विभाग)

सलंग्न: उपरिलिखित

भारतीय मानक ब्यूरो
(उपभोक्ता मामले, खाद्य एवं सार्वजनिक वितरण मंत्रालय, भारत सरकार)
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WIDE CIRCULATION DRAFT

Our Reference: CED 46/T-19 **30 March 2025**

National Building Code of India Sectional Committee, CED 46

ADDRESSED TO:

1. All Members of Civil Engineering Division Council, CEDC
2. All Members of the National Building Code Sectional Committee, CED 46
3. All Members of Panels and Working Groups under CED 46
4. All others interests

Dear Sir/Madam,

Please find enclosed the following draft:

Doc No.	Title
CED 46 (27002) WC	**National Building Code of India Part 9 Plumbing Services (including Solid Waste Management) Section 1 Water Supply** [Fourth Revision of SP 7 (Part 9 / Section 1)] (ICS No. 01.120: 91.040.01)

Kindly examine the attached 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 National Standard.

Last Date for comments: 29 April 2025

Comments if any, may please be made in the enclosed format and emailed at ced46@bis.gov.in or sent at the above address. Additionally, comments may be sent online through the BIS e-governance portal, www.manakonline.in.

In case no comments are received or comments received are of editorial nature, kindly permit us to presume your approval for the above document as finalized. However, in case comments, technical in 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.

The document is also hosted on BIS website www.bis.gov.in.

Thanking you,

Yours faithfully,

Sd/-
(Dwaipayan Bhadra)
Scientist 'E' / Director & Head
(Civil Engineering Department)

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 to ced46@bis.gov.in shall be appreciated**.

Doc. No.: CED 46 (27002) WC **BIS Letter Ref**: CED 46/T-19

Title: National Building Code of India Part 9 Plumbing Services (including Solid Waste Management) Section 1 Water Supply [Fourth Revision of SP 7 (Part 9 / Section 1)] (ICS No.01.120:91.040.01)

Last date of comments: **29 April 2025**

Name of the Commentator/ Organization: _____

Clause/ Para/ Table/ Figure No. commented	Comments/Modified Wordings	Justification of Proposed Change

NOTE- Kindly insert more rows as necessary for each clause/table, etc

BUREAU OF INDIAN STANDARDS

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Draft **National Building Code of India**

PART 9 PLUMBING SERVICES (INCLUDING SOLID WASTE MANAGEMENT)

SECTION 1 WATER SUPPLY

[Fourth Revision of SP 7 (Part 9 / Section 1)]

(ICS No. 01.120: 91.040.01)

National Building Code Sectional Committee, CED 46	Last Date for Comments: **29 April 2025**

C O N T E N T S

National Building Code Sectional Committee, CED 46

FOREWORD

This Code (Part 9/Section 1) covers the requirements of water supply in buildings. The water supply provisions covered in this Section encompass the requirements of water supply, plumbing connected to public water supply, design of water supply systems, principles of conveyance and distribution of water within the premises, hot water supply system, inspection and maintenance of water supply systems. It also covers design of water supply systems in high altitudes and/or sub-zero temperature regions.

In the first version of the Code formulated in 1970, three 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 1 Water supply, were: rationalization of definitions and addition of definitions for more terms; addition of universal pipe friction diagram and nomogram of Hazen and Willam's equation for discharge computation, deleting the discharge curves based on Chezy's formula; introduction of a detailed clause giving guidance on the design of water supply system for multi-storeyed buildings; modification to indicate that no separate storage need be provided for flushing and domestic purposes for health reasons and a single storage tank may be provided; modification/amplification of provisions relating to domestic hot water supply installations; introduction of a detailed clause covering recommendations to be considered while planning and designing water supply systems peculiar to high altitude and/or sub-zero temperature regions of the country; and addition of requirements relating to inspection, testing and maintenance applicable to hot water supply system.

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 formulated, a need to revise this Section was felt. The second revision of 2005 was therefore formulated to take care of these. In the 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 second revision of Section 1 on water supply, drainage and sanitation, in respect to water supply: modification of provision of water supply requirement; addition of a new clause on water supply for other than residential purposes; addition of a new clause on quality of water, also including therein a sub-clause on waste water reclamation; modification of the provision regarding storage of water and introduction of guidelines for calculating storage capacity; modification, in the design of distribution system provisions for discharge computation, to include designed consumer pipes based on fixtures unit also taking into account probable simultaneous demand instead of earlier computation based on Reynold's Number; introduction of an alternative option of

variable speed drive pumping system to hydro pneumatic system; addition of a new clause on backflow prevention; addition of provision for suitability of galvanized mild steel tanks on the basis of *p*H of the water; detailing of types of hot water heater; and restructuring of the section was done to make it more user friendly.

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

In the third revision in 2016, to address the various and distinct features related to the plumbing aspects and solid waste management comprehensively, this Part 9 was rearranged as follows:

Section 1 Water supply
Section 2 Drainage and sanitation
Section 3 Solid waste management
Section 4 Gas supply

The revision of Section 1 in 2016 incorporated several modifications; provisions on water supply requirements for buildings were related to the estimated occupancy in the chosen type of building; Table 1 on water requirements for buildings other than residences was updated concerning building types and included domestic and flushing requirements separately; water demand for landscaping purposes was included; requirements related to wastewater treatment and the usage of recycled wastewater were included; materials used for storage water tanks were updated; provisions regarding the quantity of water to be stored were revised; measures for protecting the water supply were included to prevent cross-connection between treated and raw water supplies, ensure backflow prevention, and secure identification of non-potable water supply pipes; the list of materials used for manufacturing pipes was updated; general requirements for the design of distribution systems were introduced; Table 2 on fixture units for different types of fixtures was updated; Table 3 on probable simultaneous demand was revised with demand values covering various intermediate and up to 10,000 fixture units, along with graphs for probable demand; maximum flow rate and flush volumes were specified; provisions concerning inadequate and excessive water pressure were introduced; guidance on water hammer effects was included; distribution system provisions for multi-storeyed buildings were updated with illustrations; provisions related to zoning of distribution systems were included; hot water supply systems were incorporated under the existing clause on hot water supply installations; detailed provisions for swimming pools were included; guidance on allowance for expansion of water pipes was provided; a new clause on colour coding for different types of water pipes was added; provisions were reviewed and updated to ensure accessibility for the elderly and persons with disabilities, duly giving cross-references to **13** of Part 3 ‘Development Control Rules and General Building Requirements’; certain terminologies were introduced and some were revised; and cross-references to Indian Standards were updated.

In this revision of the Section 1, the following significant changes/modifications have been incorporated:

a) Population requirements for residential buildings have been updated, in **4.1**.
b) Occupant factor is introduced to arrive at water demand for warehouses and industrial occupancies.
c) Suggestive breakup of water for general consumption is included, in **4.1.1.1**.
d) Table 1 'Water requirements for buildings other than residences' now provides the quantity for various categories of Hotels.
e) Storage requirement for hydro-pneumatic/pressurized water supply system have been included, in **4.4.10**.
f) Terminology has been updated by including drinking fountain, design flood elevation, demand recirculation water system, vacuum breaker, etc.

This Section is largely based on the following Indian Standards:

IS 1172:1993	Code of basic requirements for water supply, drainage and sanitation (*fourth revision*)
IS 2065:1983	Code of practice for water supply in buildings (*second revision*)
IS 6295:1986	Code of practice for water supply and drainage in high altitudes and or sub-zero temperature regions (*first revision*)
IS 7558:1974	Code of practice for domestic hot water installations
IS 12183(Part 1) :1987	Code of practice for plumbing in multi-storeyed buildings: Part 1 Water supply

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.

In the formulation of this Section, reference has also been made to the following:

International Plumbing Code 2024, International Code Council, and

Uniform Plumbing Code 2024, International Association of Plumbing and Mechanical Officials

For the purpose of deciding whether a particular requirement of this Section 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 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this Section.

Code users are requested to share their inputs/comments on the draft particularly w.r.t the changes listed above in the foreword; and especially on those text highlighted in yellow in this draft.

Important Explanatory Note for Users of the Code

In any Part/Section of this 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 the Part/Section shall 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 any Part/ Section 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 a Part/Section, the number appearing within parentheses in the first column indicates the number of the reference of the standard in the Part/Section. For example:

a) Good practices [9-1(1)] refers to the Indian Standard(s) given at serial number (1) of the list of standards given at the end of this Part/Section, that is, IS 10446 : 1983 'Glossary of terms relating to water supply and sanitation'

BUREAU OF INDIAN STANDARDS

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Draft **National Building Code of India**

PART 9 PLUMBING SERVICES (INCLUDING SOLID WASTE MANAGEMENT)

SECTION 1 WATER SUPPLY

[Fourth Revision of SP 7 (Part 9 / Section 1)]

(ICS No. 01.120: 91.040.01)

National Building Code Sectional Committee, CED 46	Last Date for Comments: **29 April 2025**

1 SCOPE

1.1 This Section covers the basic requirements of water supply for residential, business and other types of buildings, including traffic terminal stations. This Section also deals with general requirements of plumbing connected to public water supply and design of water supply systems along with general guidelines about expansion in piping systems, and swimming pools.

1.1.1 This Section does not take into consideration the requirements of water supply for industrial plants and processes, which have to be provided for separately. It also does not provide the requirements of water supply for other purposes, such as firefighting and street cleaning.

2 TERMINOLOGY

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

2.1 Definitions Relating to Water Supply

2.1.1 *Access Panel* – A removable panel mounted in a frame, normally secured with screws and mounted in a wall or ceiling, to provide access to concealed valves or items which may require maintenance.

2.1.2 *Air Gap, Water Distribution* – Unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet conveying water to a tank or plumbing fixture and flood level rim of the receptacle.

2.1.3 *Air Valve* – A valve that releases air from a pipeline automatically without loss of water, or introduce air into a line automatically if the internal pressure becomes less than that of the atmosphere.

2.1.4 Aspirator – A device supplied with water or other fluid under positive pressure that passes through an integral orifice causing a vacuum. Aspiration are also referred as suction apparatus.

2.1.5 *Authority Having Jurisdiction* – The authority which has been created by a statute and which for the purpose of administering the Code/Part may authorize a committee or an official to act on its behalf; hereinafter called the 'Authority'.

2.1.6 *Available Head* – The head of water available at the point of consideration due to mains' pressure or overhead tank or any other source of pressure.

2.1.7 *Anti-siphon*–A device or mechanism to prevent siphonage.

2.1.8 *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.

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

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

2.1.11 *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* **2.1.7**).

2.1.12 *Barrel* – This portion of a pipe in which the diameter and wall thickness remain uniform throughout.

2.1.13 *Base* – The lowest portion or lowest point of a stack of vertical pipe.

2.1.14 *Bath Room Group* – Group of fixtures consisting of water closet, lavatory, bath tub or shower and other fittings with a floor drain located together.

2.1.15 *Bedding* – The material on which the pipe is laid and which provides support for the pipe. Bedding can be concrete, granular material or the prepared trench bottom.

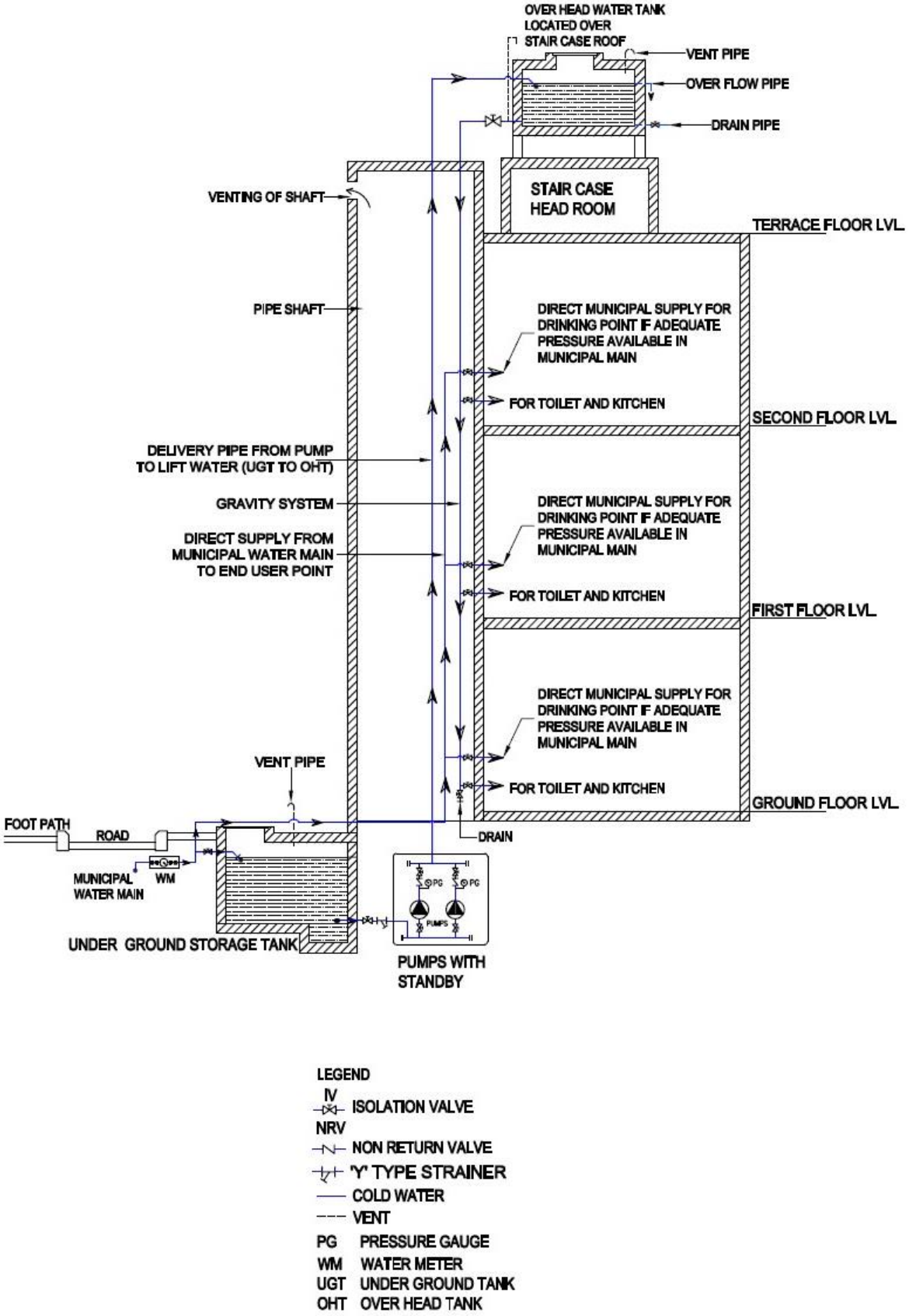
2.1.16 *Chair* – A bed of concrete or other suitable material on the trench floor to provide a support for the pipes at intervals.

2.1.17 *Channel* – The open waterway through which sewage, storm water or other liquid wastes flow at the invert of a manhole or an inspection chamber.

2.1.18 *Communication Pipe* – That part of a service pipe which vests in the water undertakes. It starts at the water main and terminate at a point which differs according to the circumstances of the case.

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

2.1.20 *Consumer's Pipe* – The portion of service pipe used for supply of water and which is not the property of the Authority (*see* Fig. 1).



LEGEND

IV ISOLATION VALVE

NRV NON RETURN VALVE

'Y' TYPE STRAINER

COLD WATER

VENT

PG PRESSURE GAUGE

WM WATER METER

UGT UNDER GROUND TANK

OHT OVER HEAD TANK

FIG. 1 IDENTIFICATION OF DIFFERENT TYPES OF WATER SUPPLY SYSTEM

2.1.21 *Cover*

a) A removable plate for permitting access to a pipe, fitting, vessel or appliance.
b) The vertical distance between the top of the barrel of a buried pipe or other construction and the surface of the ground.

2.1.22 *Cross-Connection*– A connection between two normally independent pipelines which permits flow from either pipeline into the other.

2.1.23 *Circulating Hot Water System* – A specifically designed water distribution system where one or more pumps are operated in the service hot water piping to circulate heated water from the water heating equipment to fixture supply and back to the water heating equipment.

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

2.1.25 *Demand Recirculation Water System* – A water distribution system where one or more pumps prime the service hot water piping with heated water upon a demand for hot water.

2.1.26 *Design Flood Elevation* – The elevation of the 'design flood', including wave height, relative to the datum specified on the authorities legally designated flood hazard map. In areas designated as zone, the design flood elevation shall be the elevation of the highest existing grade of the building's perimeter plus the depth specified in the flood hazard map. In case the depth is not specified in the map the depth shall be taken as 610 mm.

2.1.27 *Drinking Fountain* – A plumbing fixture that is connected to the potable water distribution system and the drainage system. The fixture allows the user to obtain the potable water directly from a stream of flowing water without the use of any accessories.

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

2.1.29 *Effective Opening* – The minimum cross-sectional area at the point of water supply, measured or expressed in terms of,

a) the diameter of a circle; and
b) the diameter of a circle of equivalent cross-sectional area, if the opening is not circular.

2.1.30 *Feed Cistern* – A storage vessel used for supplying cold water to a hot water apparatus, cylinder or tanks.

2.1.31 *Fittings* – The appurtenances such as coupling, flange, branch, bend, tees, elbows, unions, waste (with or without plug), P or S trap (with or without vent), stop

ferrule, bib tap, pillar tap, bath faucet, water meter, garden hydrant, valves and any other article used in connection with water supply, drainage and sanitation.

2.1.32 *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.

2.1.33 *Float Operated Valve* – Ball valves or ball taps and equilibrium valves operated by means of a float.

2.1.34 *Flushing Cistern* – A cistern provided with a device for rapidly discharging the contained water and used in connection with a sanitary appliance for the purpose of cleaning the appliance and carrying away its contents into a drain.

NOTE – The nominal size of a cistern is the quantity of water discharged per flush.

2.1.35 *Flushometer Tank* –A tank integrated with an air accumulator vessel that is designed to discharge a predetermined quantity of water to fixtures for flushing purposes.

2.1.36 *Flow Pressure* – The pressure in the water supply pipe measured near the faucet or water outlet while the faucet or outlet is open or in use.

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

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

2.1.39 *General Washing Place* – A washing place provided with necessary sanitary arrangement and common to more than one tenement.

2.1.40 *Geyser* – An apparatus for heating water with supply control on the inlet side and delivering it from an outlet.

2.1.41 *Gridded Water Distribution System* – A water distribution system where every water distribution pipe is interconnected so as to provide two or more path to each fixture supply line.

2.1.42 *Haunching* – Outward sloping concrete support to the sides of a pipe or channel above the concrete bedding.

2.1.43 *Heel Rest Bend or Duck-Foot Bend* – A bend, having a foot formed integrally in its base, used to receive a vertical pipe.

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

2.1.45 *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.

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

2.1.47 *Hot Water Tank* – A vessel for storing hot water under pressure greater than atmospheric pressure.

2.1.48 *Hydro-pneumatic System*–The water supply pumping system which operates automatically in conjunction with pump(s), pressure vessel and pressure switch*.*

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

2.1.50 *Lagging* **–** Thermal insulation or pipes.

2.1.51 *Licensed (or Registered) Plumber* – A person licensed (or registered) under the provisions of this Code.

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

2.1.53 *Period of Supply* – The period of the day or night during which water supply is made available to the consumer.

2.1.54 *Pipe Work* – Any installation of piping with its fittings.

2.1.55 *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.

2.1.56 *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.

2.1.57 *Potable Water* – Water which is satisfactory for drinking, culinary and domestic purposes and meets the requirements of the Authority.

2.1.58 *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.

2.1.59 *Pressure Balancing Valve*– Mixing valve that senses incoming hot and cold water pressures and compensates for fluctuations*.*

2.1.60 *Residual Head* – The head available at any particular point in the distribution system.

2.1.61 *Residual Pressure* – The pressure available at the fixture after allowance is made for pressure drop due to friction loss and head in the system during maximum demand periods*.*

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

2.1.63 *Service Pipe* – Pipe that runs between the distribution main in the street and the riser in case of a multi-storeyed building or the water meter in the case of an individual house and is subject to water pressure from such main.

2.1.64 *Static Pressure* – The pressure exerted by a fluid that is not moving or flowing.

2.1.65 *Stop-Cock* – A cock fitted in a pipe line for controlling the flow of water.

2.1.66 *Stop Tap* – Stop tap includes stop-cock, stop valve or any other device for stopping the flow of water in a line or system of pipes at will.

2.1.67 *Storage Tank* – A container used for storage of water which is connected to the water main or tube-well by means of supply pipe.

2.1.68 *Studio Apartment* – An apartment unit consisting of a single room and a bathroom, the single room functioning as living room, bedroom and kitchen.

2.1.69 *Subsoil Water* – Water occurring naturally in the subsoil.

2.1.70 *Subsoil 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.

2.1.71 *Sub-zero Temperature Regions* – Regions where temperatures fall below 0°C and freezing conditions occur.

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

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

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

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

2.1.76 *Thermostatic/Pressure Balancing Valve* – Mixing valve that senses outlet temperature and incoming hot and cold water pressure and compensates for fluctuations for stabilization.

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

2.1.78 *Vacuum Breaker* – Type of back flow preventer installed on openings subject to normal atmospheric pressure that prevents back flow by admitting atmospheric pressure through ports to the discharge side of device.

2.1.79 *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.

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

2.1.81 *Water Hammer Arrestor* – A device designed to provide protection against hydraulic shock in the building water supply system.

2.1.82 *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.

2.1.83 *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.

2.1.84 *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.

2.1.85 *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.

2.2 Definitions Relating to Swimming Pool

2.2.1 *Appurtenance* – An accessory facility or feature at a swimming pool, such as a diving board, slide, wading pool, plunge pool, spray pool.

2.2.2 *Bather Load* – The maximum number of persons that may be allowed in the pool area at one time without creating undue health or safety hazards.

2.2.3 *Deep Area* – An area of a swimming pool in which the water depth exceeds five feet.

2.2.4 *Diving Pool* – A pool designed and intended for use exclusively for diving.

2.2.5 *Inlet* – An opening or fitting through which filtered water enters the pool.

2.2.6 *Main Drain* –The outlet or outlets for drain provided in the pool.

2.2.7 *Make-up Water* – The water added to a pool to replace that which is lost.

2.2.8 *Pool* – A swimming pool or other recreational water basin utilized in conjunction with or as an appurtenance to a swimming pool.

NOTE – The term does not refer to spas and therapy pools not designed or intended for swimming or to basins for individual use that are drained after each use.

2.2.9 *Pool Depth* – The vertical distance between the pool floor and the water level.

2.2.10 *Shallow Area* – An area in a swimming pool, in which the water depth does not exceed 1.5 m at any point.

2.2.11 *Skimmer* – A mechanical device connected to the recirculation piping which is used to skim the pool surface.

2.2.12 *Swimming Pool User Load*– The number of bathers using the pool in a 24 h period for which a certain per capita capacity is often considered.

NOTE – The capacity of a swimming pool in terms of its user load is dictated by the capacity of water treatment equipment.

2.2.13 *Transition Point* – A location in a shallow area of a swimming pool where an area, having a floor slope of no more than 300 mm vertical in 3.65 m horizontal, adjoins an area where the floor slope exceeds 1 in 12.

2.2.14 *Turnover Period* – The time required to recirculate a volume of water equivalent to the water volume of the pool through the filtration system.

2.2.15 *Wading Pool* – A pool having a maximum water depth not exceeding 76 cm.

2.2.16 *Water Level* – The level of the overflow lip of a perimeter overflow system or the mid-level of surge weirs, if present, or the mid-level of the skimmer operating range.

2.2.17 *Zero-Depth Edge* – That portion of the perimeter of a zero-depth pool where the pool floor intersects the pool water surface.

2.2.18 *Zero-Depth Pool* – A swimming pool where the pool floor intersects the water surface along a portion of its perimeter.

3 GENERAL

3.1 Basic Principles

The design of water supply takes the following into consideration:

a) Number of occupants;
b) Minimum water requirements for different purposes;
c) Treatment of water based on the quality of water;
d) Quantity of water stored; and
e) Sizing of pipes.

The basic principles of water supply, drainage and sanitation are given below, and the design of water supply should in general be guided by the applicable 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 *Water Provision*

Plumbing fixtures, devices and appurtenances shall be provided with water in sufficient volume and at pressures adequate to enable them to function properly and without undue noise under normal conditions of use.

There should be at least a residual head of 0.018 N/mm^2 at the consumer's tap. There may be certain fixtures or appliances in the installation that may require a higher pressure, such as 0.05 N/mm^2 or even higher pressure (such as 0.1 N/mm^2 in case of flush valves), in which case the system shall be designed using pumps, tanks or both to achieve the required minimum pressure.

NOTE – The residual head shall be taken at the highest/farthest outlets in the building.

3.1.3 *Water Efficiency*

Plumbing system shall be designed, installed and adjusted to use the optimum quantity of water consistent with proper performance and cleaning.

3.1.4 *Safety Devices*

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

3.1.5 *Minimum Water Amenities*

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

In case of a group housing, the requirements relating to toilet or sanitary room and kitchen as given in **13** and **B-9** of Part 3 'Development Control Rules and General Building Requirements' of the Code shall also be complied with.

3.1.6 *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.

3.1.7 *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. The accessories of the plumbing system should be of such specifications as to meet the functional requirements of the installation, so as to also avoid any inconsistency leading to leakage and resultant seepage.

3.1.8 *Fixture Traps and Ventilating 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 vermin 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 ventilating pipes throughout the system.

3.1.9 *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 ventilating pipes shall be provided with a cowl.

3.1.10 *Testing*

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

3.1.11 *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.

3.1.12 *Light and Ventilation*

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

3.1.13 *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.

3.1.14 *Maintenance*

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

3.1.15 *Approach for Use and Cleaning*

All plumbing fixtures shall be so installed with regard to spacing as to be approachable 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 approach.

3.1.16 *Accessibility for Persons with Disabilities*

All doors, windows and fixtures, including WC, urinals, grab bars, washbasin, mirror and all other accessories for use by persons with disabilities shall be so installed/located that they have proper access with appropriate width, height, space, centerlines, and ease of operation (*see* **13** of Part 3 'Development Control Rules and General Building Requirements' of the Code).

3.1.17 *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.

3.1.18 *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 Water Supply Connection

3.2.1 *Application for Obtaining Supply Connection*

Every consumer, requiring a new supply of water or any extension or alteration to the existing supply shall apply in writing in the prescribed form (*see* Annex A) to the Authority.

3.2.2 *Bulk Supply*

In the case of large housing colonies or campuses, or where new services are so situated that it will be necessary for the Authority to lay new mains or extend an existing main, full information about the proposed scheme shall be furnished to the Authority. Information shall also be given regarding their phased requirements of

water supply with full justification. Such information shall include site plans, showing the layout of roads, footpaths, building and boundaries and indicating thereon the finished line and level of the roads or footpaths and water supply lines and appurtenances.

3.2.3 *Completion Certificate*

On completion of the plumbing work for the water supply system, the licensed/registered plumber shall give a completion certificate in the prescribed form (*see* Annex B) to the Authority for getting the water connection from the mains.

3.3 Licensing/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/registered 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/registered 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/registered plumber.

3.3.2 *Examination and Certification*

The Authority shall establish standards and procedure for the qualification, examination and licensing/registration of plumbers and shall issue licences 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/registration, reference may be made to good practice [9-1(2)]. The Authority may also utilize the services of the certified plumbers who are certified for the required skill level under the appropriate scheme of the Government.

4 WATER SUPPLY

4.1 Water Supply Requirements for Buildings

The total quantity of water per day is estimated based on the proposed occupancy and activities catered. Designer has to identify all the possible sources for augmenting the shortfall in water supply. The analysis of available water is done to decide the treatment for consumption and treatment process depends on the quality of water and the purpose for which it is used.

Projection of population for each building shall be made on the basis of its usage. Population for each type of building shall be estimated on the basis of information

obtained from the users. Alternatively, population may be worked on the following basis, for different type of buildings:

a) *Residential buildings*

Accommodation	*Population Requirements*
1 bedroom dwelling unit	~~4~~ 3
2 bedroom dwelling unit	~~5~~ 4
3 bedroom dwelling unit	~~6~~ 5
4 bedroom dwelling unit and above	~~7~~ 6

NOTES

1 The above figures consider a domestic household including support personnel, wherever applicable.

2 For plotted development, the population may be arrived at after due consideration of the expected number and type of domestic household units.

3 Dwelling unit under EWS category shall have population requirement of 4 and studio apartment shall have population requirement of 2.

b) *Other than residential buildings*

Occupancy	*Population Requirement*
Offices	1 person per 10 m^2 of floor area (*see* Note 1)
Schools	Strength of school + teaching and non-teaching staff
Hostels	Number of beds + 4.5 x (warden's residence) + staff
Hotels	Number of beds + staff + requirement of restaurant seats
Hospitals	Number of beds + staff + patient attendants (generally population density per bed in secondary care hospital is 5, tertiary care is 7 and quaternary care is 9)
Mercantile	1 person per 3 m^2 of street floor and sales basement areas + 1 person per 6 m^2 of upper sale floors (Total Population may be segregated into 10 percent for fixed and 90 percent for floating/visitors)
Traffic terminal stations	Average Number of users per day (Total annual passenger traffic/365) + Staff + Vendors
Ware house	1 person per 20 m^2 of floor area (see Note 1)
Industrial / Hazardous	1 person per 10 m^2
Storage	1 person per 30 m^2
Assembly (*maximum shall be as per Part 4 of the Code*) a) Concentrated use without fixed seating	0.65 m^2 per person

b) Less concentrated use without fixed seating	1.2 m^2 per person
c) Fixed seating	1.2 * Number of fixed seats
d) Dining area and restaurants with seating and tables	1.80 m^2 per person

NOTES
1 Wherever there are multiple work shifts, the number of users within a 24 h period may be considered as per actuals.
2 Population of 5 to 15 percent, depending on the usage of building, shall be considered for visitors and floating population likely to use the buildings facilities.

4.1.1 *Water Supply for Residences*

A minimum of 70 to 100 litre per head per day may be considered adequate for domestic needs of urban communities, apart from non-domestic needs as flushing requirements (which varies based on type of building occupancy). As a general rule the following rates per capita per day may be considered for domestic and non-domestic needs:

a) For communities with population up to 20 000:

1) Water supply through stand post	40 lphd (*Min*)
2) Water supply through house service connection	70 to 100 lphd

b) For communities with population 20 000 to 100 000 together with full flushing system — 100 to 135 lphd

c) For communities with population above 100 000 together with full flushing system — 150 to 200 lphd

NOTES
1 The value of water supply given as 150 to 200 litre per head per day may be reduced to 135 litre per head per day for houses for Medium Income Group (MIG) and Lower Income Groups (LIG) and Economically Weaker Section of Society (EWS), depending upon prevailing conditions and availability of water.
2 The value of flow per fixtures should be suitably modified considering the usage of water savings fixtures, complaint to accepted standard [9-1(22)].

4.1.1.1 Out of the 150 to 200 (100 to 135) litre per head per day [in (c) & (b) above respectively], 45 (30) litre per head per day respectively shall be taken for flushing requirements and the remaining quantity for other domestic purposes. For commercial buildings, typically 15 litre per head per day may be taken as water for flushing requirement and 30 litre per head per day for other purposes. The following

depicts the general breakdown of the water consumption in residential and commercial buildings:

Description	*Residential lphd*	*Commercial (Other than residential) lphd*
Drinking	5	5
Bathing	25 *(Suggested cold and hot water is 60:40)*	-
Cooking	5	5
Washing utensils	15	5
Floor cleaning	5	-
Washing clothes	15	-
Total	**70**	**15**

4.1.2 *Water Supply for Buildings Other than Residences*

Minimum requirements for water supply for buildings other than residences shall be in accordance with Table 1.

The water demand for the laboratory facilities will depend on actual requirements based on functional point of view.

Table 1 Water Requirements for Buildings Other than Residences
(*Clause* 4.1.2)

Sl No.	**Type of Building**	**Domestic per Day** litre	**Flushing per Day** litre	**Total Consumption per Day** litre
(1)	(2)	(3)	(4)	(5)
i)	Factories including canteen where bath rooms are required to be provided	30 per head	15 per head	45 per head
ii)	Factories including canteen where no bath rooms are required to be provided	20 per head	10 per head	30 per head
iii)	Hospital (excluding laundry and kitchen) (*see* Note 2):			
	a) Number of beds not exceeding 100	a) 230 per head	a) 110 per head	a) 340 per head
	b) Number of beds exceeding 100	b) 300 per head	b) 150 per head	b) 450 per head
	c) Out patient department (OPD)	a) 10 per head	a) 5 per head	a) 15 per head
iv)	Nurses' homes and medical quarters	90 per head	45 per head	135 per head
v)	Hostels	90 per	45 per	135 per head

		head	head	
vi)	Hotel (up to 3 star) excluding laundry, kitchen, staff and water bodies without bath tub	120 per head	60 per head	180 per head
vii)	Hotel (4 Star and above) excluding laundry, kitchen, staff and water bodies (and excluding bath tub)	260 per head	60 per head	320 per head
viii)	Hotel with bath tub	320 per head	60 per head	380 per head
ix)	Banquet area	30 per head	15 per head	45 per head
x)	Health club			
	a) with shower	25 per head	20 per head	45 per head
	b) without shower	15 per head	10 per head	25 per head
xi)	Offices (including canteen)	25 per head	20 per head	45 per head
xii)	Restaurants and food court including water requirement for kitchen			
	a) Restaurants	55 per seat	15 per seat	70 per seat
	b) Food court	25 per seat	10 per seat	35 per seat
xiii)	Clubhouse	25 per head	20 per head	45 per head
xiv)	Cinemas, concert halls and theatres and multiplex	5 per seat	10 per seat	15 per seat
xv)	Schools/Educational institutions:			
	a) Without boarding facilities	a) 25 per head	a) 20 per head	a) 45 per head
	b) With boarding facilities	b) 90 per head	b) 45 per head	b) 135 per head
xvi)	Shopping and retail (mall)			
	a) Staff	25 per head	20 per head	45 per head
	b) Visitors	5 per head	10 per head	15 per head
xvii)	Traffic terminal stations (*see* Notes 3 and 4)			
	a) Airports	40 per	30 per	70 per head

		head	head	
	b) Railway stations (Junctions) with bathing facility	40 per head	30 per head	70 per head
	c) Railway stations (Junctions) without bathing facility	30 per head	15 per head	45 per head
	d) Railway Stations (Intermediate) with bathing facility	25 per head	20 per head	45 per head
	e) Railway Stations (Intermediate) without bathing facility	15 per head	10 per head	25 per head
	f) Interstate bus terminals	25 per head	20 per head	45 per head
	g) Intrastate Bus Terminals/Metro Stations	10 per head	5 per head	15 per head
xviii)	Hospitals			
	a) Secondary care hospitals	–	–	800 per head
	b) Tertiary care hospitals	–	–	850 per head
	c) Super specialty hospitals	–	–	950 per head

NOTES
1 For calculating water demand for visitors, consumption of 15 litre per head per day may be taken.
2 The water demand includes requirements of patients, attendants, visitors and staff. Additional water demand for kitchen, laundry and clinical water shall be computed as per actual requirements.
3 The number of persons shall be determined by the average number of passengers handled by stations, with due consideration given to the staff and vendors who are using these facilities.
4 Consideration should be given to seasonal average peak requirements.
5 The hospitals may be categorized as Category A (25 to 50 beds), Category B (51 to 100 beds), Category C (101 to 300 beds), Category D (301 to 500 beds) and Category E (501 to 750 beds).
6 The daily hot water requirement for domestic use across different categories shall follow a ratio of 60:40 (Cold : Hot) as a percentage of the total domestic water demand in litres.

4.1.3 *Water Supply Requirements of Traffic Terminal Stations*

The water supply requirements of traffic terminal stations (railway stations, bus stations, harbours, airports, etc) include provisions for waiting rooms and waiting halls. They do not, however, include requirements for retiring rooms. Requirements of water supply for traffic terminal stations shall be as per Table 1.

4.1.4 *Water Supply for Firefighting Purposes*

4.1.4.1 The Authority shall make provision to meet the water supply requirements for firefighting in the city/area, depending on the population density and types of occupancy. *See also* Part 4 ‘Fire and Life Safety’ of the Code.

4.1.4.2 Provision shall be made by the owner of the building for water supply requirements for firefighting purposes within the building, depending upon the height and occupancy of the building, in conformity with the requirements laid down in Part 4 ‘Fire and Life Safety’ of the Code.

4.1.4.3 The requirements regarding water supply in storage tanks, capacity of fire pumps, arrangements of wet riser-cum-down comer and wet riser installations for buildings, depending upon the occupancy use and other factors, shall be in accordance with Part 4 'Fire and Life Safety' of the Code.

4.1.5 *Water Supply for Other Purposes*

4.1.5.1 Water supply in many buildings is also required for many other applications other than domestic use, which shall be identified in the initial stages of planning so as to provide the requisite water quantity, storage capacity and pressure as required for each application. In such instances information about the water use and the quality required may be obtained from the users. Some typical uses other than domestic use and firefighting purposes are air conditioning, swimming pools and water bodies, and gardening. Treated water from sewage treatment plant, with suitable tertiary treatment, should be used for flushing purpose (with dual piping system), gardening purpose, cooling tower make up, and/or for other non-potable usage.

4.1.5.2 The water demand for landscaping purposes is generally taken as 6 to 8 litre/m^2/day for lawns. For shrubs and trees the above value can be reduced considerably.

4.2 Water Sources and Quality

4.2.1 *Sources of Water*

The origin of all sources of water is rainfall. Water can be collected as it falls as rain before it reaches the ground; or as surface water when it flows over the ground or is pooled in lakes or ponds; or as ground water when it percolates into the ground and flows or collects as ground water; or from the sea.

Contamination of water supplies can occur in the source water as well as in the distribution system after water treatment has already occurred. There are many sources of water contamination, including naturally occurring chemicals and minerals (for example, arsenic, radon, uranium), local land use practices (fertilizers, pesticides, concentrated animal feeding operations), manufacturing processes, and sewer overflows or wastewater releases. The presence of contaminants in water can lead to adverse health effects, including gastrointestinal illness, reproductive problems, and neurological disorders.

4.2.2 The water supplied shall be free from pathogenic organisms, clear, free from undesirable taste and odour, neither corrosive nor scale forming and free from minerals which could produce undesirable physiological effects. The quality of water to be used for drinking shall be as per accepted standard [9-1(3)].

4.2.3 For purposes other than drinking, water if supplied separately, shall be absolutely safe from bacteriological contamination so as to ensure that there is no danger to the health of the users due to such contaminants.

For purposes other than drinking, where there is an overall risk of legionella growth, it is advisable that for cold water supplies, the temperature does not exceed 20°C and a minimum temperature of 50°C for hot water supplies be maintained at all points of network so as to ensure that it is absolutely safe from bacteriological contamination and there is no danger to the health of the users due to such contaminants.

4.2.4 *Waste Water Reclamation*

Treated sewage or other waste water of the community may be utilized for non-domestic purposes such as water for flushing, landscape irrigation, cooling towers of HVAC system, in fountains and recreational lakes where swimming is not allowed, and for certain industrial purposes after its necessary treatment to suit the nature of the use. This supply system shall be allowed in residences only if proper provision is made to avoid any cross-connection of this treated waste water with domestic water supply system for which it is recommended to use dual piping system.

4.2.4.1 *Treatment of waste water and usage of recycled water*

Waste water is generated by residential and other establishments like institutional, business, mercantile and industrial. It includes household waste liquid from toilets, baths, showers, kitchens and sinks that is disposed of *via* sewers. Waste water treatment is the process of removing contaminants from wastewater, including household sewage and runoff (effluents). It includes physical, chemical, and biological processes to remove contaminants. Treatment of waste water and usage of recycled waste water may be done to make it usable for appropriate applications. The objective is to produce an environmentally safe fluid waste stream (or treated effluent) and a solid waste (or treated sludge) suitable for disposal or reuse.

Separation of household waste into grey water and black water (and draining of black water into sewerage system) is becoming more common with grey water being permitted to be used for watering plants or recycled for flushing toilets after proper treatment. Waste water collection and treatment is typically subject to statutory regulations. Treatment depends on the characteristics of influent and the treatment requirements that are needed for treating the same. Waste water treatment generally involves the following three stages:

a) *Primary treatment* – It consists of temporarily holding the wastewater for settlement of heavy solids at the bottom while oil, grease and lighter solids float to the surface.
b) *Secondary treatment* – It removes dissolved and suspended biological matter.
c) *Tertiary treatment* – It is more intensive treatment done in order to allow rejection into a highly sensitive or fragile ecosystem. The tertiary treatment is generally followed by disinfection.

4.2.5 *Water Conservation, Water Balance and Use of Recycled Water*

Water conservation encompasses the policies, strategies and activities to manage fresh water as a sustainable resource, to protect the water environment and to meet

current and future demand. Population, household size, and growth and affluence all affect the quantity of water used. Water balance studies should be carried out to study the availability of water from different sources and its usage for different purposes.

4.2.6 Whenever a building is used after long intervals, the water quality of the stored water shall be checked so as to ensure that the water is safe for use as per water quality requirements specified in this Code.

4.3 Estimate of Demand Load

4.3.1 Estimates of total water supply requirements for buildings shall be based on the occupant load consistent with the provisions of **4.1**.

4.3.2 In making assessment of water supply requirements of large complexes, the future occupant load shall be kept in view. The following methods may be used for estimating future requirements:

a) Demographic method of population projection,
b) Arithmetic progression method,
c) Geometrical progression method,
d) Method of varying increment or incremental increase,
e) Logistic method,
f) Graphical projection method, or
g) Graphical comparison method.

4.4 Storage of Water

4.4.1 In a building, provision is required to be made for storage of water for the following reasons:

a) To provide against interruptions of the supply caused by repairs to mains, etc;
b) To reduce the maximum rate of demand on the mains;
c) To tide over periods of intermittent supply; and
d) To maintain storage for the firefighting requirement of the building (taking into consideration the water for sprinklers and hydrants separately, apart from domestic water requirements).

4.4.2 The water may be stored in overhead tanks (OHT) and/or underground tanks (UGT).

4.4.3 *Materials Used*

Reservoirs and tanks for the storage of water shall be constructed using any of reinforced concrete, brick masonry, ferrocement, mild steel, stainless steel, plastic or glass reinforced panels.

4.4.3.1 Tanks made of steel may be of welded, riveted or panel/pressed construction. The metal shall be galvanized or coated externally with a good quality

anti-corrosive weather-resisting paint. Lead-based paint shall not be used in the tank. Lead-lined tanks shall not be used. Rectangular pressed steel tanks shall conform to good practice [9-1(4)].

4.4.4 Each tank shall be provided with the following:

a) *Manholes* – Adequate number of manholes for access and repair. The manholes shall be made of corrosion resistant material (for example, cast iron, reinforced cement concrete, steel fibre reinforced concrete, galvanized steel, high density polyethylene, fibre glass reinforced plastic or such other materials) acceptable to the Authority. Manholes shall be provided with locking arrangement to avoid misuse and tampering.
b) *Ladders* – Tanks higher than 900 mm deep shall be provided with corrosion resistant ladders according to the depth to enable a person to reach the bottom of the tank.
c) *Overflow pipe* – Each tank shall be provided with an overflow pipe terminating above the ground/terrace level to act as a 'Warning Pipe' to indicate overflow conditions. The size of the overflow pipe shall be adequate to accept the flow. Normally the overflow pipe size shall be one size higher than the inlet pipe. When the inlet pipe diameter is large, two or more overflow pipes of equivalent cross-section may be provided.
d) *Vent pipes* – Tanks larger than 5 000 litre capacity shall be provided with vent pipes to prevent development pressure in the tank which might result in 'NO FLOW' condition or inward collapse of the tank.
e) *Scour pipe* – Each tank shall be provided with a scour pipe with an accessible valve for emptying the tank.
f) *Connection of overflow and scour pipe* – Under no circumstances tank overflow and scour pipe shall be connected to any drain, gully trap or manhole to prevent back flow and contamination of the water. All such connections shall be discharged over a grating with an air gap of 50 mm. All overflow and vent pipes shall be provided with a mosquito proof brass grating to prevent ingress of mosquito, vermin and other insects.
g) The top slab of the tank shall be suitably sloped away from its centre for proper drainage of the rainwater.
h) Tanks on terraces and above ground shall be supported by appropriate structural members so as to transfer the load of the tank and the water directly on the structural members of the building.

4.4.5 Every storage tank shall be easily accessible and placed in such a position as to enable thorough inspection and cleaning to be carried out. If the storage capacity required is more than 5 000 litre, it is advantageous to arrange it in a series of tanks so interconnected that each tank can be isolated for cleaning and inspection without interfering with the supply of water. In large storage tanks, the outlet shall be at the end opposite the inlet to avoid stagnation of the water.

4.4.6 The outlet pipe shall be fixed 50 mm to 75 mm above the bottom of the tank and fitted with a strainer, preferably of brass.

4.4.7 In the case of underground storage tanks, the design of the tank shall be such as to provide for the draining of the tank when necessary and water shall not be

allowed to collect around the tank. The tank shall be perfectly water-proof and shall be provided with a cement concrete cover, having a manhole opening, with a properly fitting hinged cast iron cover on a leak-proof cast iron frame.

The underground tanks should not be located in low lying areas or near any public or private sewer, septic tank, leaching pool or soakage pit to prevent any contamination. The overflow of the tank should be well above (preferably 600 mm) the external surface level and terminate as a warning pipe with a mosquito proof grating. Care shall be taken to prevent backflow of local surface water into the tank in case of local flooding. Otherwise the overflow shall be terminated in a safer manner as per the site conditions. For tanks with at least one side exposed to a basement, it is safer to discharge the overflow into the basement level.

The tank top slab shall also be designed to carry the load due to fire tender movement where anticipated as in the case of an extended basement.

There should be no common wall between the tanks storing safe water and tanks storing water from unsafe sources.

4.4.8 In case of overhead tanks, bottom of the tanks shall be placed clear off the terrace slab such that the elevation difference between the outlet pipe of the tank and the highest fixture at the top floor of the building is minimum 2 m, which shall also prevent leakage into the structural slab. In tall buildings, the top of the tank shall be provided with the safe ladder or staircase. The top slab shall be provided with railing or a parapet wall.

4.4.9 For jointing steel pipe to a storage tank, the end of the pipe shall be screwed, passed through a hole in the tank and secured by backnuts, both inside and outside. The pipe end shall be flush with the face of the inside backnut. For jointing copper pipe to steel or copper tank, a connector of non-ferrous material shall be used. The connector shall have a shoulder to bear on the outside of the tank and shall be secured by a backnut inside.

4.4.10 The quantity of water to be stored shall be calculated taking into account the following factors:

a) Hours of supply at sufficiently high pressure to fill up the overhead storage tanks;
b) Frequency of replenishment of overhead tanks, during the 24 h;
c) Rate and regularity of supply; and
d) Consequences of exhausting storage particularly in case of public buildings like hospitals.

In case of intermittent water supply, the following guidelines should be adopted for calculation of capacity:

1) When the supply is from main OHT, such as in case of plotted development, the capacity of individual OHT may be taken as half a day demand.

2) In case of all the other buildings (apartments, hotels, hospitals, and commercial), the capacity of UGT and OHT may be taken as one and a half days and half a day demand. Wherever raw water and treated water are stored in separate UGTs, the combined storage capacity shall be of one and a half day's demand.
3) In case of sewage treatment plant, for treated water storage in respect of flushing, one-day flushing demand shall be stored in UGT or treated effluent storage tank which is part of the plant, and half a day demand shall be stored in OHT.

NOTE – Minimum requirements for calculation of capacity of these storage tanks are as follows:

a) In case only OHT is provided, it may be taken as 33.33 to 50 percent of one day's requirement;
b) In case only UGT is provided, it may be taken as 50 to 150 percent of one day's requirement; and
c) In case combined storage is provided, it may be taken as 66.6 percent UGT and 33.33 percent OHT of one day's requirement.
d) In the case of hydro-pneumatic/pressurized water supply system from UGT, the storage of water in UGT to be considered as 200 percent of one day's requirement.

For additional requirement of water storage for firefighting purposes, reference may be made to Part 4 'Fire and Life Safety' of the Code.

4.4.11 Where the water supply distribution system is catering for separate potable water and flushing water supply, and where reclaimed or recycled treated water is being used within the building, it shall be considered as dual water supply system. In such cases, storages for flushing/reclaimed/recycled water shall be separated proportionately. Adequate measures and precautions shall be taken for physical segregation for sanitary purposes and to avoid cross-contamination in the distribution system and to prevent back contamination of water supply sources (*see* **4.5**).

4.4.12 When only one communication pipe is provided for water supply to a building, it is not necessary to have separate storage for flushing and sanitary purposes for health reasons. In such cases when only one storage tank has been provided, tapping of water may be done at two different levels (the lower tapping for flushing) so that a part of the water will be exclusively available for flushing purposes.

4.5 Protection of Water Supply

4.5.1 *General*

The water supply system shall be designed, installed and maintained in such a manner so as to prevent contamination from non-potable liquids, solids or gases being introduced into the potable water supply system through cross-connections or any other connection to the system.

4.5.2 *Plumbing Fixtures*

The water supply lines and fittings for plumbing fixtures shall be installed so as to prevent back flow and shall provide required back flow protections in accordance with **4.11**.

The devices, appurtenance intended for special function such as sterilization, processing, distillation, etc, shall be provided with back flow protection devices.

The water supply for hospital fixtures shall be protected against backflow with a reduced pressure principle back flow assembly, an atmospheric or spill resistant vacuum breaker assembly, or an air gap. Vacuum breakers for bed pan washer hoses shall not be located less than 1 525 mm above floor. Vacuum breakers for hose connections in health care or laboratory areas shall not be less than 1 800 mm above floor.

4.5.3 *Cross-Connection Control*

Cross-connections shall be prohibited, except where approved back flow prevention assemblies/devices are installed to protect the potable water supply (*see* **4.11**).

Potable water outlets and combination stop and waste valves shall not be installed underground or below grade. Freeze proof yard hydrants that drain the riser into the ground are considered to be stop and waste valves.

Back flow prevention can be achieved by means of providing proper air gap, reduced pressure principle back flow prevention assemblies, back flow preventer with intermediate atmospheric vent, barometric loop, pressure vacuum breaker assemblies, atmospheric type vacuum breakers, double check back flow prevention assemblies, spill resistant pressure vacuum breaker, dual check back flow preventer, etc.

4.5.4 *Identification of Non-potable Water Systems*

Where non-potable water systems are installed, the piping conveying the non-potable water shall be identified either by colour marking, metal tags or tapes in accordance with the relevant standards and good engineering practices.

4.6 Materials, Fittings and Appliances

4.6.1 *Standards for Materials, Fittings and Appliances*

All materials, water fittings and appliances shall conform to Part 5 ‘Building Materials’ of the Code.

4.6.2 *Materials for Pipes*

Pipes may be of any of the following materials:

a) Cast iron, vertically cast or centrifugally (spun) cast;
b) Steel (internally lined or coated with bitumen or a bituminous composition, and out-coated with cement concrete or mortar, where necessary);

c) Ductile iron, internally lined;
d) Reinforced concrete;
e) Prestressed concrete;
f) Galvanized mild steel tubes;
g) Copper;
h) Brass;
j) Wrought iron;
k) Stainless steel;
m) Polyethylene;
n) High density polyethylene (HDPE);
p) Unplasticized PVC;
q) Chlorinated PVC;
r) Polypropylene-random copolymer (PPR);
s) Composite pipes (PE-AL-PE) or any other combination;
t) Cross-linked polyethylene (PEX); or
u) Polybutylene pipe.

4.6.2.1 The material chosen shall be resistant to corrosion, both inside and outside or shall be suitably protected against corrosion.

4.6.2.2 Polyethylene and unplasticized PVC pipes shall not be installed near hot water pipes or near any other heat sources. For temperature limitations in the use of polyethylene and unplasticized PVC pipes to convey water, reference may be made to accepted standards[9-1(5)].

4.7 Design of Distribution Systems

4.7.1 *General*

For designing the distribution system, the following guidelines, in addition to those given in **4.7.2** to **4.7.6** shall be followed:

a) All plumbing systems in buildings shall conform to the general requirements given in **3.1**.
b) Peak factor for calculation in case of intermittent flows may generally be adopted in design as 2 to 3.
c) The residual head at consumer's tap shall be as per **3.1.2**.

4.7.2 *Rate of Flow*

One of the important items that needs to be determined before the sizes of pipes and fittings for any part of the water piping system may be decided upon, is the rate of flow in the service pipe which in turn depends upon the number of hours for which the supply is available at sufficiently high pressure. If the number of hours for which the supply is available is less, there will be large number of fittings in use simultaneously and the rate of flow will be correspondingly large.

The data required for determining the size of the communication and service pipes are,

a) the maximum rate of discharge required;
b) the length of the pipe; and
c) the head loss by friction in pipes, fittings and meters.

4.7.3 *Discharge Computation*

4.7.3.1 *Design of consumer's pipes based on fixture units*

The design of the consumers' pipes or the supply pipe to the fixtures is based on,

a) the number and kind of fixtures installed;
b) the fixture unit flow rate; and
c) the probable simultaneous use of these fixtures.

The rates at which water is desirably drawn into different types of fixtures are known. These rates become whole numbers of small size when they are expressed in fixture unit.

The water supply fixture units (WSFU) for different sanitary appliances or groups of appliances are given in Table 2.

4.7.3.2 *Probable simultaneous demand*

The possibility that all water supply taps in any system in domestic and commercial use will draw water at the same time is extremely remote. Designing the water mains for the gross flow will result in bigger and uneconomical pipe mains and may not be necessary. A probability study made by Hunter suggests the relationship shown in Fig. 2 and Table 3. In the absence of similar studies in India, the curves based on Hunter's study may be followed. In making use of these curves, special allowances are made as follows:

a) Demands for service sinks are ignored in calculating the total fixture demand.
b) Demands of supply outlets such as hose connections and air conditioners through which water flows more or less continuously over a considerable length of time shall be added to the probable flow rather than the fixture demand.
c) Fixtures supplied with both hot and cold water exert reduced demands upon main hot water and cold water branches (not fixture branches).

Table 2 Water Supply Fixture Units (WSFU) for Different Fixtures with Minimum Pipe Sizes
(*Clause* 4.7.3.1)

Sl No.	**Type of Fixture**	**Application**		**Minimum Pipe Size** mm
		Private	Public	
(1)	(2)	(3)	(4)	(6)
i)	Bath tub	4	–	15

ii)	Ablution faucet/Bidet	1	1	15
iii)	Clothes washer	4	4 (*see* Note 7)	15
iv)	Dishwasher	1.5	1.5	15
v)	Drinking fountain	–	0.5 (0.75)	15
vi)	Hose bib	2.5	2.5	15
vii)	Wash basin (with metered faucet)	1	1	15
viii)	Wash basin (with standard faucet)	1.5	1.5 (2)	15
ix)	Service sink	–	3	15
x)	Kitchen sink	2	4	15
xi)	Surgical sink	–	2	15
xii)	Scrub station in hospital (per outlet)	–	3	15
xiii)	Shower	2	3	15
xiv)	Bathroom group (flush tank)	5	6	20
xv)	Bathroom group (flush valve)	8	10	25/32
xvi)	Urinal (flush valve)	3	5 (6)	20
xvii)	Urinal (flush tank)	2	2 (3)	15
xviii)	Urinal (sensor operated)	2	2 (3)	15
xix)	Water closet (flush valve)	~~6~~ 5	~~8~~ 5(10)	25/32
xx)	Water closet (flush tank)	2	3 (5)	15
xxi)	Combination fixture (faucet)	3	–	15
xxii)	Laundry trays (faucet)	3	–	15

NOTES

1 The above table is based on Hunter's method.

2 Hunter's method of estimating load in plumbing systems is based on assigning a fixture unit (FU) weight to the plumbing fixtures and then converting these to equivalent litres per minute, based on the theory of probability of usage and based on the observation that all fixtures are not used simultaneously.

3 The fixture unit concept is a method of calculating maximum probable water demand within large buildings based on theory of probability. The method is based on assigning a fixture unit (FU) value to each type of fixture based on its rate of water consumption, on the length of time it is normally in use and on the average period between successive uses.

4 The values of probable demand will not change in respect of systems with flush valves and flush tanks for fixture units more than 1 000.

5 The fixtures or appliances which are not included in the above table may be sized referring to fixtures having similar flow rate and frequency of usage.

6 The minimum supply branch pipe sizes for individual fixtures are nominal sizes.

7 The clothes washer for public does not include large washer extractors, and in such cases the pipe sizing shall be determined as per manufacturer's recommendations.

8 For more information on bathroom groups, reference may be made to specialist literature.

9 The fixture units listed in the above table represent the load for cold water

service. The separate cold and hot water fixture unit value for fixtures having both hot and cold water connections may each be taken as three quarter of the listed total value of fixture.

10 A shower head over a bath tub does not increase the fixture unit value.

11 The values given in parantheses pertain to such public use buildings where an enhanced requirement is expected to be encountered as compared to the normal maximum use in public use buildings.

Table 3 Probable Simultaneous Demand
(*Clause* 4.7.3.2)

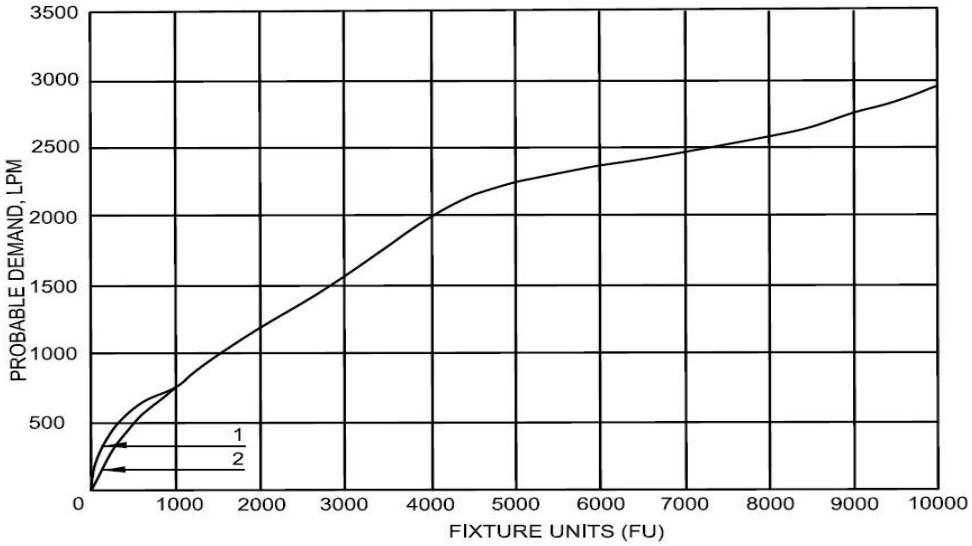
Sl No.	Demand in Fixture Units	Demand with Flush Tanks	Demand with Flush Valves
		litre/min	litre/min
(1)	(2)	(3)	(4)
i)	1	0	–
ii)	2	3.8	–
iii)	3	11.4	–
iv)	4	15.1	–
v)	5	22.7	–
vi)	6	25.5	–
vii)	8	28.1	–
viii)	10	30.3	102.20
ix)	20	53.0	132.48
x)	30	75.7	155.19
xi)	40	94.6	177.90
xii)	50	109.8	196.82
xiii)	60	121.1	208.18
xiv)	70	132.5	223.32
xv)	80	143.8	234.67
xvi)	90	155.2	246.03
xvii)	100	166.5	257.38
xviii)	140	200.6	295.23
xix)	180	230.9	329.30
xx)	200	246.0	348.22
xxi)	250	283.9	382.29
xxii)	300	321.7	416.35
xxiii)	400	397.4	476.91
xxiv)	500	473.1	537.47
xxv)	750	643.5	673.73
xxvi)	1 000	787.3	787.28
xxvii)	1 250	908.4	908.40
xxviii)	1 500	1 010.6	1 010.60
xxix)	1 750	1 112.8	1 112.79
xxx)	2 000	1 215.0	1 214.99

xxxi)	2 500	1 419.4	1 419.38
xxxii)	3 000	1 635.1	1 635.12
xxxiii)	3 500	1 811.1	1 811.12
xxxiv)	4 000	1 987.1	1 987.13
xxxv)	4 500	2 115.8	2 115.82
xxxvi)	5 000	2 244.5	2 244.51
xxxvii)	5 500	2 312.6	2 312.64
xxxviii)	6 000	2 380.8	2 380.77
xxxix)	6 500	2 411.0	2 411.05
xl)	7 000	2 479.2	2 479.18
xli)	7 500	2 547.3	2 547.31
xlii)	8 000	2 615.4	2 615.44
xliii)	8 500	2 683.6	2 683.57
xliv)	9 000	2 751.7	2 751.70
xlv)	9 500	2 831.2	2 831.18
xlvi)	1 0000	2 910.7	2 910.67

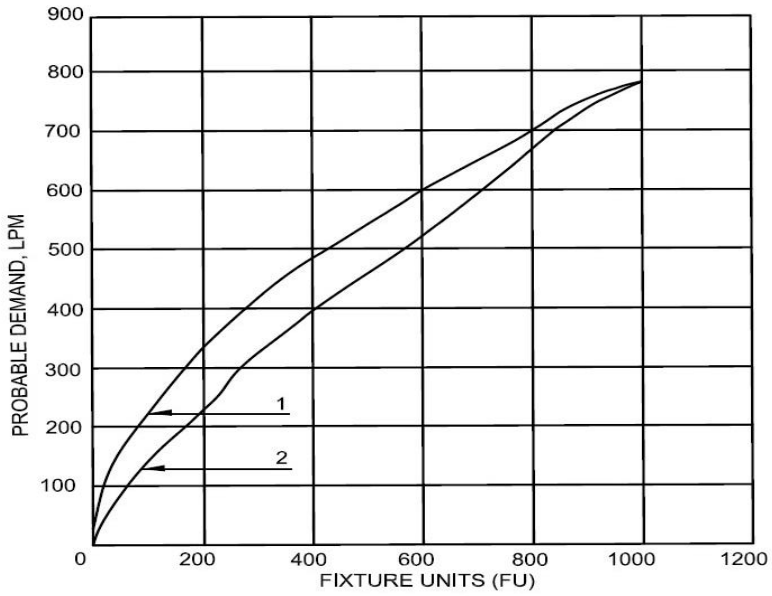
4.7.3.3 The maximum flow rate and flush volumes shall be as below:

Plumbing Fixtures/Fittings	*Baseline (Max) Flow Rate*	*Max. Flow Rate for 1 or 2 or 3 Star Water Efficient Fixture/Fitting [*accepted standard [9-1(22)]*]*
Water closets	6 litre/flush	6.0/4.8/4.0 litre/full flush & 3.0/2.8/2.0 litre/reduced flush
Urinals	3.8 litre/flush	3.0/2.0/1.0 litre/flush
Lavatory, metered faucet (Public)	1 litre/use	1.0/0.8/0.6 litre/use
Lavatory, faucet (Private)	8 litre/min	8.0/6.0/3/0 litre/min
Sink, faucet	8 litre/min	8.0/6.0/4/5 litre/min
Bidet, hand-held spray	8 litre/min	6.0/5.0/4.0 litre/min
Shower head	10 litre/min	10.0/8.0/6.8 litre/min

NOTE – The maximum flow rates of plumbing fixtures and fittings provided are at the pressure of 0.42 N/mm^2. Water closets with dual flush cisterns and urinals with reduced flush volumes are recommended. Users/designers are encouraged to use low-flow fixtures.



2A GRAPH FOR PROBABLE DEMAND UP TO 10 000 FU



2B GRAPH FOR PROBABLE DEMAND UP TO 1000 FU

CURVE 1 - SYSTEM WITH FLUSH VALVES
CURVE 2 - SYSTEM WITH FLUSH TANKS

FIG. 2 GRAPH FOR PROBABLE DEMAND

4.7.4 *Pipe Size Computation*

Commercially available standard sizes of pipes are only to be used against the sizes arrived at by actual design. Therefore, several empirical formulae are used, even though they give less accurate results. The Hazen and William's formula and the charts based on the same may be used without any risk of inaccuracy in view of the

fact that the pipes normally to be used for water supply are of smaller sizes. Nomogram of Hazen and William's equation has been provided in Annex C.

4.7.5 *Adequate and Excessive Water Pressure*

The requirements shall be as follows:

a) *Adequate water pressure* – A minimum water pressure in accordance with **3.1.2** shall be ensured in the distribution system. The maximum pressure shall be maintained at 0.42 N/mm^2. Also, while designing, the maximum/minimum pressure required for operation of special fixtures and fittings is to be maintained as per the technical data sheet.

b) *Excessive water pressure* – Whenever pressure exceeds 0.42 N/mm^2, and the distribution system may not be able to withstand the same, pressure reducing valves shall be installed for reduction of pressure.

4.7.6 *Water Hammer Effects*

Water hammer is recognized by the noise that is heard when valves are shut off. This occurs when flow of moving water is suddenly stopped due to closure of valve. Water hammer arrestors may be used to absorb high pressures resulting from sudden closure of valves.

4.8 Distribution Systems in Multi-Storeyed Buildings

4.8.1 There are following four basic methods of distribution of water to a multi-storeyed buildings:

a) Direct supply system from mains – public or private.
b) Gravity distribution system.
c) Pressurized distribution system (Hydro-pneumatic pumping system).
d) Combined distribution system.

4.8.2 *Direct Supply System from Mains – Public or Private*

This system is adopted when adequate pressure is available in the mains to supply water at adequate pressure at the topmost floor. With limited pressure available in most city mains, water from direct supply is normally not available above two or three floors. However, in gated communities or large campuses, this system can be adopted for taller buildings by incorporating design parameters such as elevated centralized water tank(s) or central hydro-pneumatic pumping system(s). For details of this system, reference may be made to good practice [9-1(6)] may be referred.

4.8.3 *Gravity Distribution System*

This is the most common water distribution system. The system comprises pumping water to one or more overhead water tanks. Water transferred to overhead tank(s) is distributed by gravity to various parts of the building by the system of piping network.

4.8.4 *Pressurized Distribution System (Hydro-pneumatic Pumping System)*

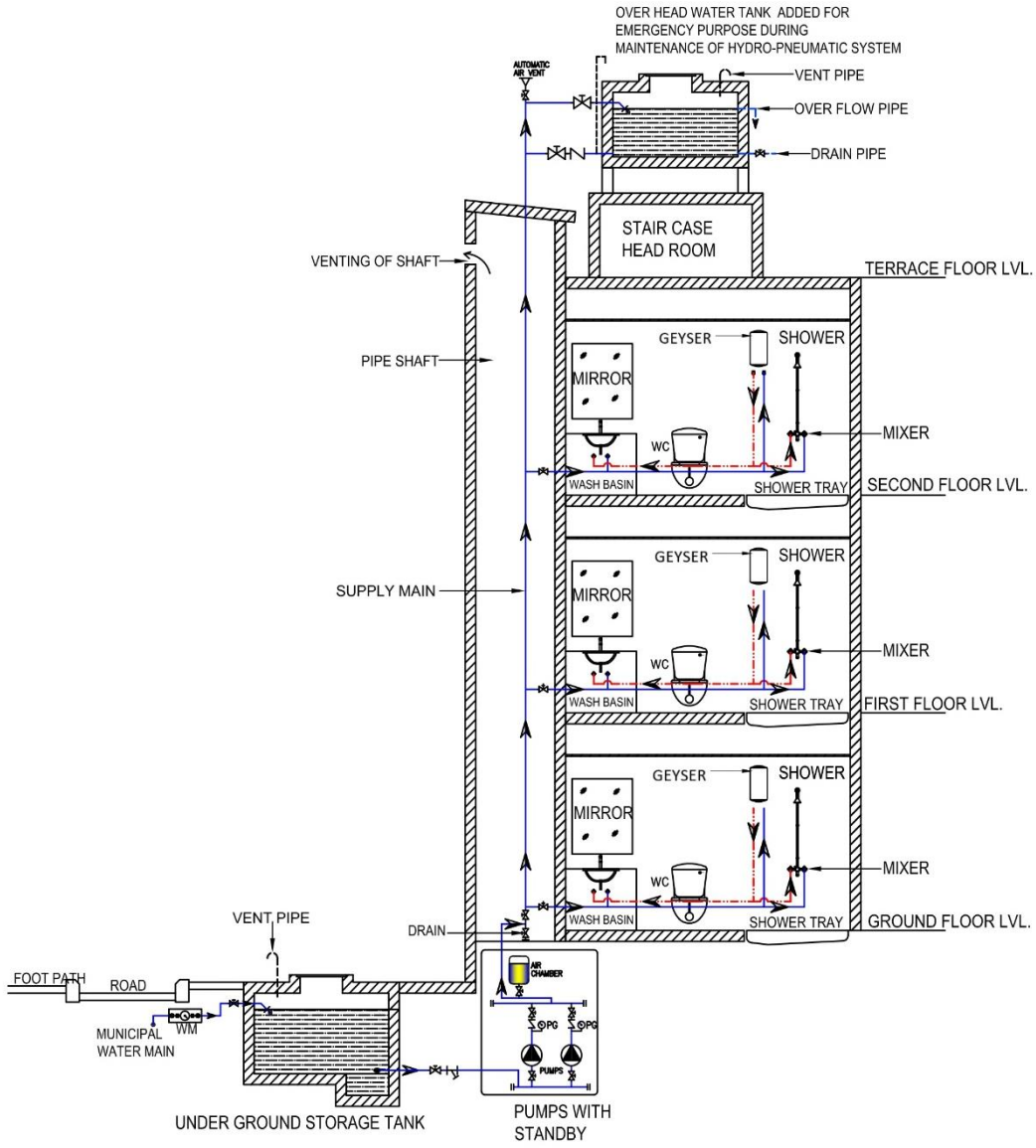
4.8.4.1 Pressurized distribution system is a direct pumping system incorporating a recharge diaphragm vessel.

4.8.4.2 The system may incorporate multiple pumps with suction and discharge manifolds and a control panel to facilitate automatic operation. Total discharge capacity required may be shared by a number of pumps, where the pumps operate in duty, assist and standby configuration.

4.8.4.3 The system shall also incorporate automatic sequencing of pumps to ensure even wear and tear also a low level cut-off, to prevent dry run of the pumps. The system shall be provided with continuous power supply with provision of emergency power backup.

4.8.4.4 Modern hydro-pneumatic systems are available with variable frequency drive, where the pump is efficiently used to deliver water at rates of flow as required by the system, by varying its speed with the assistance of an electronic device, thereby meeting the demand flow through variation in speed of the motor from 960 rpm to 3 000 rpm. With this arrangement, the same pump is able to deliver water at required pressure and flow as required at different times of the day. The system consumes energy in proportion to the work done and also helps in controlling the water surge in the distribution line.

4.8.4.5 Hydro-pneumatic system generally eliminates the need of an overhead tank. As a good engineering practice and to take care of emergencies, an overhead of smaller capacity should be provided which feeds by gravity to the system (*see* Fig. 3).



LEGEND

IV — ISOLATION VALVE
NRV — NON RETURN VALVE
'Y' TYPE STRAINER
COLD WATER
VENT
HOT WATER
PG PRESSURE GAUGE
WM WATER METER

NOTES

1 Hot water supply to be planned as per requirement by provision of geyser and hot water piping.
2 Flushing water supply from WC to be planned in case of availability of recycled waste water.
3 For large and commercial buildings, water supply to be based on zone-based distribution for domestic and flushing water supply.
4 Presentation of layout and location of fixtures/appliances are only typical in nature.

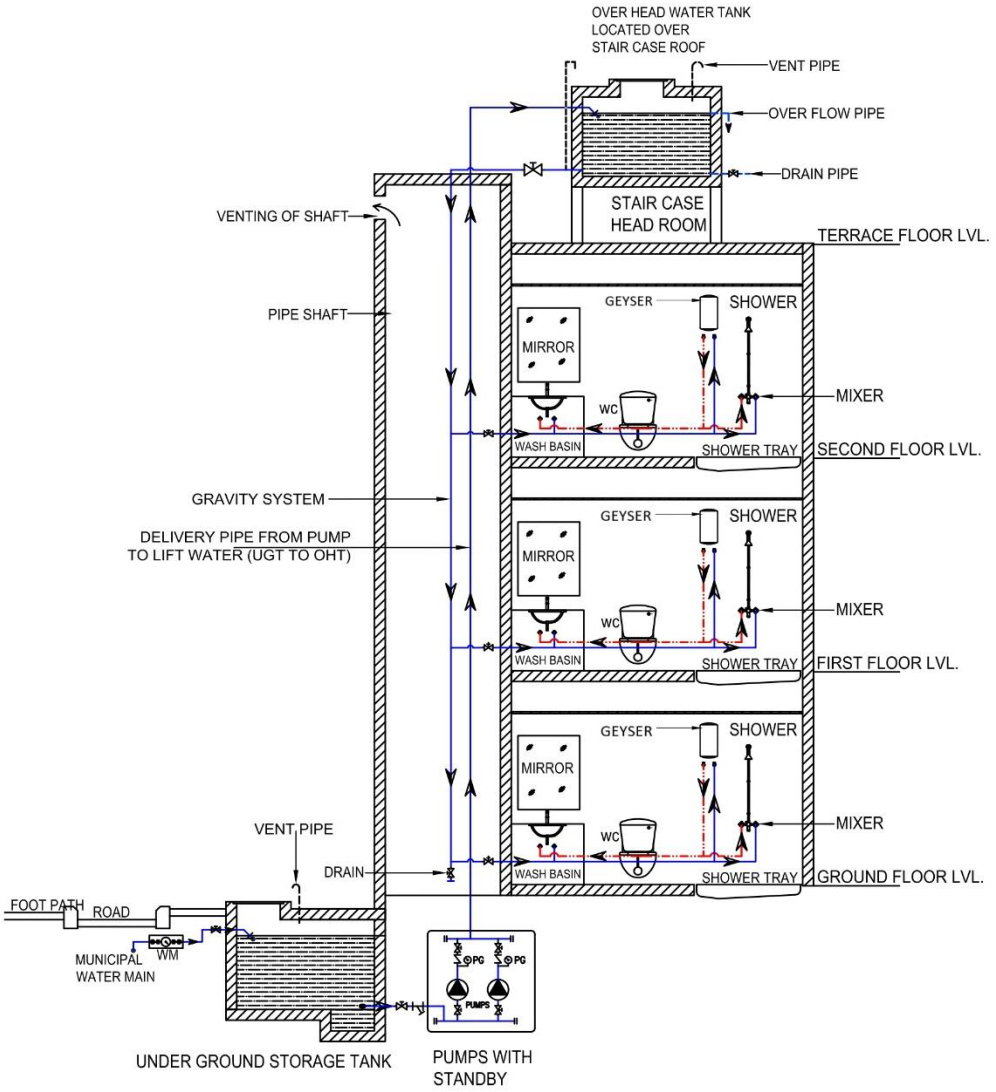
FIG. 3 HYDRO-PNEUMATIC SYSTEM

4.8.5 *Combined Distribution System*

4.8.5.1 In this system, a combination of gravity and pressurized distribution is adopted. A few upper floors are provided with a pressure booster pumping system to achieve the desired residual pressure, while the lower floors are fed by gravity supply.

4.8.5.2 Water collected in the overhead tank is distributed to the various parts of the building. To achieve required residual pressure for top 2 to 4 floors for proper functioning of the fixtures, a pressure booster pumping system is installed on the dedicated outlet from overhead tank with its own distribution piping serving the top 2 to 4 floors. For lower floors, water is distributed by gravity system.

4.8.5.3 Water distribution is accomplished by providing down take pipes in the shaft from the terrace ring mains (*see* Fig. 4).



LEGEND

IV	ISOLATION VALVE
NRV	NON RETURN VALVE
	'Y' TYPE STRAINER
	COLD WATER
	VENT
	HOT WATER
PG	PRESSURE GAUGE
WM	WATER METER
UGT	UNDER GROUND TANK
OHT	OVER HEAD TANK

NOTES

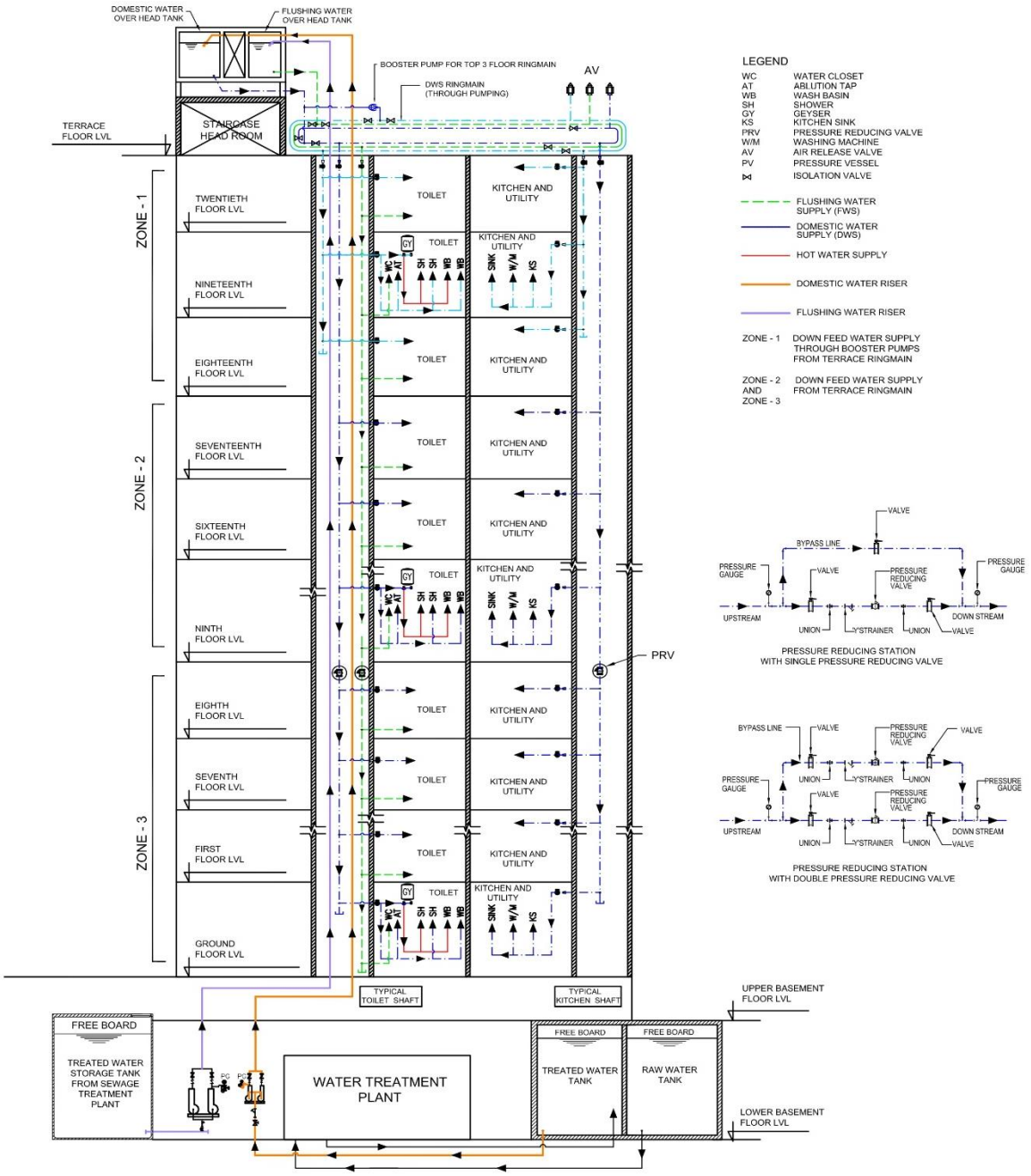
1 Pump operation to be by level controller or air vessel/pressure switch at motorized valve at OHT.
2 Hot water supply to be planned as per requirement by provision of geyser and hot water piping.
3 Flushing water supply from WC to be planned in case of availability of recycled waste water.
4 For large and commercial buildings, water supply to be based on zone-based distribution for domestic and flushing water supply.
5 Presentation of layout and location of fixtures/appliances are only typical in nature.

FIG. 4 OVER HEAD TANK DISTRIBUTION

4.8.6 *Zoning of Distribution Systems*

The zoning of water distribution network may be adopted for 7 to 9 floors, while conforming to the adequate pressure requirements and excessive pressure limitations in the hydraulic design (*see* **4.7.5**). *See* Fig. 5 and Fig. 6 for zoning of gravity distribution system and pressurized distribution system (hydro-pneumatic pumping system), respectively.

The recommended maximum permissible velocity is 2.4 m/s for water distribution. In case of hot water distribution through copper pipes, the velocity is restricted to 1.5 m/s due to concern of erosion of the piping material.

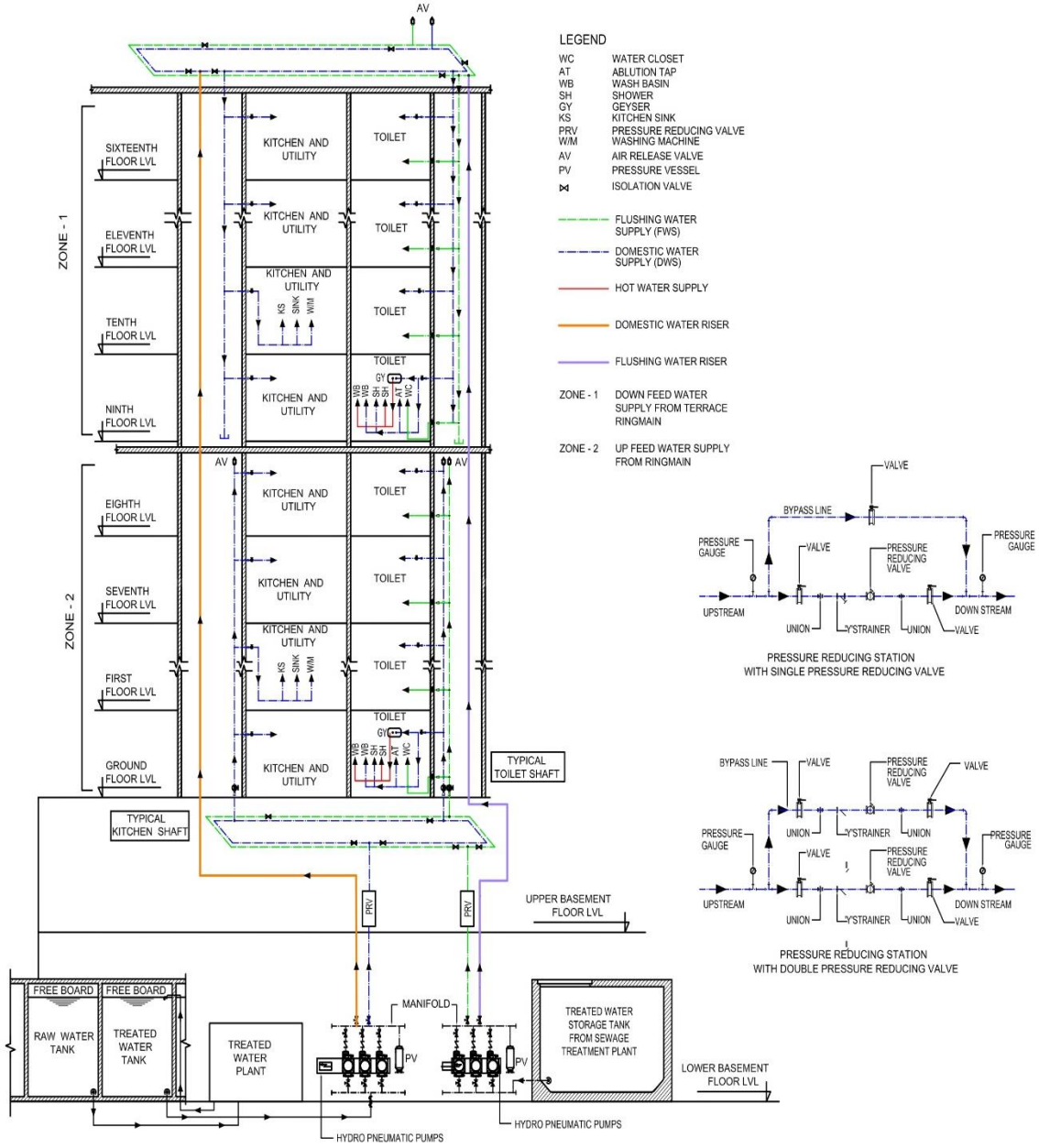


NOTES

1 Appurtenance, such as PRV should be planned in main piping network or branch piping, as required, to restrain pressure to upper limits.

2 Requirements for storage and usage of fire water shall be as per Part 4 'Fire and Life Safety' of the Code.

FIG. 5 SCHEMATIC DIAGRAM SHOWING THE DISTRIBUTION SYSTEM IN RESPECT OF GRAVITY SYSTEM FOR A MULTI-STOREYED BUILDING



NOTES

1 The given example is for 16 stories building with concept of upfeed and down feed ringmains. The choice of ringmain is on designer proposal. For taller building, zones and ringmains shall be planned to meet maximum and minimum pressure requirements. Appurtenance, such as PRV should be planned in main piping network or branch piping, as required, to restrain pressure to upper limits.

2 Requirements for storage and usage of fire water shall be as per Part 4 'Fire and Life Safety' of the Code.

FIG. 6 SCHEMATIC DIAGRAM SHOWING THE DISTRIBUTION SYSTEM IN RESPECT OF HYRDO PNEUMATIC SYSTEM FOR A MULTI-STOREYED BUILDING

4.9 General Requirements for Pipe Work

4.9.1 *Mains*

The following principles shall apply for the mains:

a) Service mains shall be of adequate size to give the required rate of flow.
b) Mains shall be divided into sections by the provisions of sluice valves and other valves so that water may be shut off for repairs.
c) To avoid dead ends, the mains shall be arranged in a grid formation or in a network.
d) Where dead ends are unavoidable, a hydrant shall be provided to act as a wash-out.
e) Wash-out valve shall not discharge directly into a drain or sewer, or into a manhole or chamber directly connected to it; an effectively trapped chamber shall be interposed, into which the wash-out shall discharge.
f) Air valves shall be provided at all summits, and wash-out at low points between summits.
g) Mains need not be laid at unvarying gradients, but may follow the general contour of the ground. They shall, however, fall continuously towards the washout and rise towards the air valves. The gradient shall be such that there shall always be a positive pressure at every point under working conditions.
h) Cover for the mains shall be at least 900 mm under roadways and 750 mm in the case of footpaths. This cover shall be measured from the top of the pipe to the surface of the ground.
j) Mains shall be located sufficiently away from other service lines like electric and telegraph cables to ensure safety and where the mains cannot be located away from such lines, suitable protective measures shall be accorded to the mains. As far as possible, water supply and sewerage mains should be isolated from each other with certain minimum horizontal distance as per good engineering practice.

4.9.2 *Communication Pipes*

a) Every premises that is supplied with water by the Authority shall have its own separate communication pipe. In the case of a group or block of premises belonging to the same owner the same communication pipe may supply water to more than one premises with the prior permission of the Authority.
b) The communication pipe between the water main and the stop-cock at the boundary of the premises shall be laid by the Authority.
c) Connections up to 50 mm diameter may be made on the water main by means of screwed ferrules, provided the size of the connections does not exceed one third the size of the water main. In all other cases, the connection shall be made by a T-branch off the water main.
d) As far as practicable, the communication pipe and the underground service pipe shall be laid at right angles to the main and in approximately straight lines to facilitate location for repairs. It is also recommended that the communication pipe be laid in a pipe in pipe sleeve of larger diameter made of non-corrosive material to protect the communication pipe.
e) Every communication pipe shall have a stop-cock and meter inserted in it. The waterway of each such fitting shall not be less than the internal sectional area of the communication pipe and the fittings shall be located

within the premises at a conspicuous place accessible to the Authority which shall have exclusive control over it.

4.9.3 *Consumer Pipes*

a) No consumer pipe shall be laid in the premises to connect the communication pipe without the approval of the Authority.
b) The consumer pipe within the premises shall be laid underground with a suitable cover to safeguard against damage from traffic and extremes of weather.
c) To control the branch pipe to each separately occupied part of a building supplied by a common service pipe, a stop valve shall be fixed to minimize the interruption of the supply during repairs. All such stop valves shall be fixed in accessible positions and properly protected. To supply water for drinking or for culinary purposes, direct taps shall be provided on the branch pipes connected directly to the consumer pipe. In the case of multi-storeyed buildings, down take taps shall be supplied from overhead tanks.
d) Pumps shall not be allowed on the service pipe, as they cause a drop in pressure on the suction side, thereby affecting the supply to the adjoining properties. In cases where pumping is required, a properly protected storage tank of adequate capacity shall be provided to feed the pump.
e) No direct boosting (by booster pumps) shall be allowed from the service pipes (communication and consumer pipes).
f) Consumer pipes shall be so designed and constructed as to avoid air-locks. Draining taps shall be provided at the lowest points from which the piping shall rise continuously to draw-off taps.
g) Consumer pipes shall be so designed as to reduce the production and transmission of noise as much as possible.
h) Consumer pipes in roof spaces and unventilated air spaces under floors or in basements shall be protected against corrosion.
j) Consumer pipes shall be so located that they are not unduly exposed to accidental damage and shall be fixed in such positions as to facilitate cleaning and avoid accumulations of dirt.
k) All consumer pipes shall be so laid as to permit expansion and contraction or other movements.

4.9.4 *Prohibited Connections*

a) A service pipe shall not be connected into any distribution pipe; such connection may permit the backflow of water from a cistern into the service pipe, in certain circumstances, with consequent danger of contamination and depletion of storage capacity. It might also result in pipes and fittings being subjected to a pressure higher than that for which they are designed, and in flooding from overflowing cisterns.
b) No pipe for conveyance or in connection with water supplied by the Authority shall communicate with any other receptacle used or capable of being used for conveyance other than water supplied by the Authority.
c) Where storage tanks are provided, no person shall connect or be permitted to connect any service pipe with any distributing pipe.

d) No service or supply pipe shall be connected directly to any water-closet or a urinal. All such supplies shall be from flushing cisterns/flush valves which shall be supplied from storage tank.
e) No service or supply pipe shall be connected directly to any hot water system or to any other apparatus used for heating other than through a feed cistern thereof.

4.10 Jointing of Pipes

4.10.1 *Cast Iron Pipes*

Jointing may be done by any of the following methods:

a) Spigot and socket joints, or
b) Flanged joints.

in accordance with good practice [9-1(7)]. Alternative jointing materials which are found to be equally effective, may be used in place of lead joints, with the approval of the Authority.

4.10.2 *Steel Pipes*

Plain-ended steel pipes may be joined by welding. Electrically welded steel pipes shall be jointed in accordance with good practice [9-1(8)].

4.10.3 *Wrought Iron and Steel Screwed Pipes*

Screwed wrought iron or steel piping may be jointed with screwed and socketed joints. Care shall be taken to remove any burr from the end of the pipes after screwing. A jointing compound approved by the Authority and containing no red lead composition shall be used. Screwed wrought iron or steel piping may also be jointed with screwed flanges.

4.10.4 *Asbestos Cement Pipes*

Asbestos cement pipes may be jointed in accordance with good practice [9-1(9)].

4.10.5 *Copper Pipes*

Copper pipes shall be jointed by internal solder ring joint, end-brazing joint or by use of compression fitting. The flux used shall be non-toxic and the solder used shall be lead free. The use of dezincification fittings shall be made in case of jointing of copper pipe and steel pipe. The jointing technology shall be used as per good engineering practice and as per manufacturers recommendations.

4.10.6 *Concrete Pipes*

Concrete pipes shall be jointed in accordance with good practice [9-1(10)].

4.10.7 *Polyethylene and Unplasticized PVC Pipes*

Polyethylene and unplasticized PVC pipes shall be jointed in accordance with good practice[9-1(11)].

4.11 Backflow Prevention

4.11.1 The installation shall be such that water delivered is not liable to become contaminated or that contamination of the public water supply does not occur.

4.11.2 The various types of piping and mechanical devices acceptable for backflow protection are:

a) Barometric loop
b) Air gap
c) Atmosphere vacuum breaker
d) Pressure vacuum breaker
e) Double check valve
f) Reduced pressure backflow device

4.11.3 The installation shall not adversely affect drinking water,

a) by materials in contact with the water being unsuitable for the purpose;
b) as a result of backflow of water from water fittings, or water using appliances into pipework connected to mains or to other fittings and appliances;
c) by cross-connection between pipes conveying water supplied by the water undertaker with pipes conveying water from some other source; and
d) by stagnation, particularly at high temperatures.

4.11.4 No pump or similar apparatus, the purpose of which is to increase the pressure in or rate of flow from a supply pipe or any fitting or appliance connected to a supply pipe, shall be connected unless the prior written permission of the water supplier has been obtained in each instance.

The use of such a pump or similar apparatus is likely to lead to pressure reduction in the upstream pipe work which, if significant, increase the risk of backflow from other fittings.

4.11.5 The water shall not come in contact with unsuitable materials of construction.

4.11.6 No pipe or fitting shall be laid in, on or through land fill, refuse, an ash pit, sewer, drain, cesspool or refuse chute or any manhole connected with them.

4.11.7 No pipe susceptible to deterioration by contact with any substance shall be laid or installed in a place where such deterioration is likely to occur. No pipe that is permeable to any contaminant shall be laid or installed in any position where permeation is likely to occur.

4.11.8 If a liquid (other than water) is used in any type of heating primary circuit, which transfers heat to water for domestic use, the liquid shall be non-toxic and non-corrosive.

4.11.9 A backflow prevention device shall be arranged or connected at or as near as practicable to each point of delivery and use of water. Appliances with built-in backflow prevention shall be capable of passing the test. All backflow prevention devices shall be installed so that they are accessible for examination, repair or replacement. Such devices shall be capable of being tested periodically by the Authority to ensure that the device is functioning efficiently and no backflow is occurring at any time.

4.12 Conveyance and Distribution of Water Within the Premises

4.12.1 *Basic Principles*

Wholesome water supply provided for drinking and culinary purposes shall not be liable to contamination from any less satisfactory water. There shall, therefore, be no cross-connection whatsoever between the distribution system for wholesome water and any pipe or fitting containing unwholesome water, or water liable to contamination, or of uncertain quality, or water which has been used for any other purpose. The provision of reflux or non-return valves or closed and sealed stop valves shall not be construed as a permissible substitute for complete absence of cross-connection.

4.12.2 The design of the pipe work shall be such that there is no possibility of backflow towards the source of supply from any cistern or appliance, whether by siphonage or otherwise. Reflux non-return valves shall not be relied upon to prevent such backflow.

4.12.3 Where a supply of less satisfactory water than wholesome water becomes inevitable as an alternative or is required to be mixed with the latter, it shall be delivered only into a cistern and by a pipe or fitting discharging into the air gap at a height above the top edge of the cistern equal to twice its nominal bore and in no case less than 150 mm. It is necessary to maintain a definite air gap in all appliances or taps used in water-closets.

4.12.4 All pipe work shall be so designed, laid or fixed and maintained as to remain completely water-tight, thereby avoiding wastage, damage to property and the risk of contamination.

4.12.5 No water supply line shall be laid or fixed so as to pass into or through any sewer, scour outlet or drain or any manhole connected therewith, nor through any ash pit or manure pit or any material of such nature that is likely to cause undue deterioration of the pipe.

4.12.5.1 Where the laying of any pipe through corrosive soil or pervious material is unavoidable, the piping shall be properly protected from contact with such soil or material by being carried through an exterior pipe sleeves as approved by the Authority. Any existing piping or fitting laid or fixed, which does not comply with the

above requirements, shall be removed immediately by the consumer and re-laid by him in conformity with the above requirements and to the satisfaction of the Authority.

4.12.5.2 Where lines have to be laid in close proximity to electric cables or in corrosive soils, adequate precautions/protection should be taken to avoid corrosion.

4.12.6 Underground piping shall be laid at such a depth that it is unlikely to be damaged by frost or traffic loads and vibrations. It shall not be laid in ground liable to subsidence, but where such ground cannot be avoided, special precautions shall be taken to avoid damage to the piping. Where piping has to be laid across recently disturbed ground, the ground shall be thoroughly consolidated so as to provide a continuous and even support. In the case of frost conditions, the pipes shall be laid below the frost line with suitable insulation to the pipes.

4.12.7 In designing and planning the layout of the pipe work, due attention shall be given to the maximum rate of discharge required, economy in labour and materials, protection against damage and corrosion, water hammer, protection from frost, if required, and avoidance of airlocks, noise transmission and unsightly arrangement.

4.12.8 To reduce frictional losses, piping shall be as smooth as possible inside. Methods of jointing shall be such as to avoid internal roughness and projection at the joints, whether of the jointing materials or otherwise.

4.12.9 Change in diameter and in direction shall preferably be gradual rather than abrupt to avoid undue loss of head. No bend or curve in piping shall be made which is likely to materially diminish or alter the cross-section.

4.12.10 No boiler for generating steam or closed boilers of any description or any machinery shall be supplied direct from a service or supply pipe. Every such boiler or machinery shall be supplied from a feed cistern.

4.13 Laying of Mains and Pipes on Site

4.13.1 The mains and pipes on site shall be laid in accordance with good practice [9-1(12)]. The pipes laid in buildings situated in seismic zone and across large building expansion joints should be installed with suitable expansion bellows and expansion loops to mitigate expansion of piping system for its intended function without failures.

4.13.2 *Excavation and Refilling*

The bottoms of the trench excavations shall be so prepared that the barrels of the pipes, when laid, are well bedded for their whole length on a firm surface and are true to line and gradient. In the refilling of trenches, the pipes shall be surrounded with fine selected material, well rammed so as to resist subsequent movement of the pipes. No stones shall be in contact with the pipes; when resting on rock, the pipes shall be bedded on fine-selected material or (especially where there is a steep gradient) on a layer of concrete.

4.13.2.1 The pipes shall be carefully cleared of all foreign matter before being laid.

4.13.3 *Laying Underground Mains*

Where there is a gradient, pipe laying shall proceed in 'uphill' direction to facilitate joint making.

4.13.3.1 Anchor blocks shall be provided to withstand the hydraulic thrust.

4.13.4 Iron surface boxes shall be provided to give access to valves and hydrants and shall be supported on concrete or brickwork which shall not be allowed to rest on pipes.

4.13.5 *Laying Service Pipes*

4.3.5.1 Service pipes shall be connected to the mains by means of right-hand screw down ferrule or T-branches. The ferrules shall conform to accepted standards [9-1(13)].

4.13.5.2 Precaution against contamination of the mains shall be taken when making a connection and, where risk exists, the main shall be subsequently disinfected. The underground water service pipe and the building sewer or drain shall be kept at a sufficient distance apart so as to prevent contamination of water. Water service pipes or any underground water pipes shall not be run or laid in the same trench as the drainage pipe. Where this is unavoidable, the following conditions shall be fulfilled:

a) The bottom of the water service pipe, at all points, shall be at least 300 mm above the top of the sewer line at its highest point.

b) The water service pipe shall be placed on a solid shelf excavated on one side of the common trench.

c) The number of joints in the service pipe shall be kept to a minimum.

d) The materials and joints of sewer and water service pipe shall be installed in such a manner and shall possess such necessary strength and durability as to prevent the escape of solids, liquids and gases there from under all known adverse conditions, such as corrosion strains due to temperature changes, settlement, vibrations and superimposed loads.

4.13.5.3 The service pipe shall pass into or beneath the buildings at a depth of not less than 750 mm below the outside ground level and, at its point of entry through the structure, it shall be accommodated in a sleeve which shall have previously been solidly built into the wall of the structure. The space between the pipe and the sleeve shall be filled with bituminous or other suitable material for a minimum length of 150 mm at both ends.

4.13.6 *Pipes Laid through Ducts, Chases, Notches or Holes*

Ducts or chases in walls for piping shall be provided during the building of the walls. If they are cut into existing walls, they shall be finished sufficiently smooth and large enough for fixing the piping.

4.13.6.1 Piping laid in notches or holes shall not be subjected to external pressure.

4.13.7 *Lagging of Pipes*

Where lagged piping outside buildings is attached to walls, it shall be entirely covered all round with water-proof and fire insulating material and shall not be in direct contact with the wall. Where it passes through a wall, the lagging shall be continued throughout the thickness of the wall.

4.14 Hot Water Supply Installations

4.14.1 *Design Consideration*

4.14.1.1 *General*

In electric water heating practice for domestic purposes, the accepted method is to use storage heaters in which water is steadily heated up to a predetermined temperature and stored until required for use. The heating by electricity of a large quantity of water, such as water required for a hot bath, within the time normally taken to run the water into the bath, requires a heater of too high a rating to be practicable in normal domestic premises. It should be ensured that such vents and pipes are above reach/inaccessible during daily use to avoid accidents such as accidental contact and burning.

4.14.1.2 In modern hotels and apartment blocks and service apartments, centralized storage and distribution systems are adopted, where other energy sources such as oil, gas, solar panels, etc, may be used for the generation of hot water as these options prove more economical and convenient in heating large volumes of water for storage.

4.14.1.3 The implementation of a hybrid heating system, integrating solar-based heating with electrical geysers, has demonstrated effectiveness in extreme cold conditions where water freezing occurs, and prolonged use of electric geysers presents challenges. When selecting such hybrid systems, the design shall ensure operational safety during both the heating process and the extraction of hot water.

4.14.1.4 When water supplied to the buildings contain dissolved salts resulting in hardness of water, measures such as installation of water softening plants, etc, shall be taken to avoid formation of scales in the hot water installations.

4.14.2 *Storage Temperature*

4.14.2.1 The design of hot water supply system and its appliances shall be based on the temperatures at which water is normally required for the various uses, namely:

Scalding	:	65°C
Sink	:	60°C
Hot bath	:	43°C as run for use at 41°C
Warm bath	:	37°C
Tepid bath	:	29.5°C

4.14.2.2 In order to minimize the danger of scalding, precipitation of scale from hard water, standing heat losses, risk of steam formation and the possibility of damage to porcelain or other fittings and to surface finishes, a storage temperature of 60°C is recommended. If storage capacity is limited, a higher temperature up to 65°C may be adopted when soft water is used.

4.14.3 *Storage Capacity*

The size of the storage vessel is governed by the maximum short time demand of the domestic premises. Depending on local conditions this shall be 50 ℓ to 75 ℓ at 60°C in a dwelling with a bath tub and 25 ℓ at 60°C for a shower or a tap (for bucket supply). The capacity of the storage vessel shall not be less than 20 percent in excess of the required maximum short time demand. In larger houses where a single hot water heater is intended to supply hot water to more than one bathroom or kitchen or both, the maximum short time demand shall be estimated and the capacity decided accordingly. Small electric or gas storage heaters of 15 ℓ to 25 ℓ capacity may be used to supply one or two points of draw off depending on the use of hot water.

4.14.4 *Rate of Flow*

With storage type installation, the recommended maximum rates of flow for different types of fixtures are given in Table 4.

Table 4 Rate of Hot Water Flow
(*Clause* 4.14.4)

Sl No.	**Fixtures**	**Rate of Flow** litre/min
(1)	(2)	(3)
ii)	Kitchen sink	5
iii)	Wash basin	5
iv)	Shower (spray type)	6.5

4.14.4.1 *Hot water supply systems*

Identification of water supply system is critical for safe functioning and protection of occupants. The first step is correct labelling of various water systems in the building. The requirements of identification/labelling shall be adhered on every installation where different water systems are provided.

While designing centralized hot water systems in major projects, the following points should be considered:

a) Fuel to be used,
b) Location and dimension of boiler house and calorifier chambers,
c) Location and dimension of fuel storage tank,
d) Means of ash disposal (in case of solid fuel),
e) Location and dimension of chimney,
f) Location of cold water points,
g) Drainage facilities during emptying,
h) Quality of water supply, and
j) Provision for air combustion and ventilation.

In laying hot water piping systems, the pressures of hot and cold water should be made equal at each fixture, especially where mixing faucets/thermostatic mixer are to be used. Otherwise, there would be imbalance of pressure where one pressure would be more than the other. These conditions should be avoided by proper design of the system.

Return circulation systems are recommended for energy conservation and user comfort.

In the inverted systems, hot water heaters and tanks are located at the highest point of water supply system and supply and return risers below the level of hot water source.

Environmental and consumer requirements should be considered when planning the installation of a solar hot water system. Factors affecting the performance of a system and decisions about how the system should be installed, include,

1) the climate zone of the site and possibility of,
    i) shading;
    ii) frost and freezing;
    iii) wind;
    iv) dust;
    v) hail; and
    vi) corrosion and scaling.
2) the ambient air temperature.
3) the cold water temperature.
4) the availability of space and pitch of a suitable south-facing roof.
5) the presence and location of an existing hot water service.
6) the available energy sources (for example, gas or electricity).
7) the householder’s hot water usage.

8) the householder's budget.

4.14.5 *Design of Storage Vessel*

Storage tanks shall be oblong or cylindrical in shape and shall be installed, preferably with the long side vertical in order to assist the effective stratification or 'layering' of hot or cold water. The ratio of height to width or diameter shall not be less than 2:1. An inlet baffle should preferably be fitted near the cold inflow pipe in order to spread the incoming cold water.

4.14.6 *Materials for Storage Vessel and Pipes*

4.14.6.1 Under no circumstances shall ungalvanized (black) mild steel pipes and fittings, such as sockets, bushes, etc, be used in any part of domestic hot water installation, including the cold feed pipe and the vent pipe. Materials resistant to the chemical action of water supplied shall be used in construction of vessels and pipes. Each installation shall be restricted to one type of metal only, such as all copper or all galvanized mild steel. When water supplied is known to have appreciable salt content, galvanized iron vessels and pipes shall not be used. However, it is advisable to avoid use of lead pipes in making connection to wash basins. Where required it is also advisable to use vessels lined internally with glass, stainless steel, etc.

4.14.6.2 In general, tinned copper and other metals such as monel metal, etc, are suitable for most types of water. The suitability of galvanized mild steel for storage tanks depends upon the *p*H value of the water and the extent of its temporary hardness. For values of *p*H 7.2 or less, galvanized mild steel should not be used. For values of *p*H 7.3 and above, galvanized mild steel may be used provided the corresponding temporary hardness is not lower than those given below:

*p*H *Value*	*Minimum Temporary Hardness Required* mg/ℓ
7.3	210
7.4	150
7.5	140
7.6	110
7.7	90
7.8	80
7.9 - 8.5	70

4.14.7 *Location of Storage Vessel*

The loss of heat increases in proportion to the length of pipe between the storage vessel and the hot water outlet since each time the water is drawn, the pipe fills with hot water which then cools. The storage vessel shall therefore be so placed that the pipe runs to the most frequently used outlets are as short as possible.

4.14.8 *Immersion Heater Installation*

4.14.8.1 If a domestic storage vessel is to be adopted to electric heating by the provision of an immersion heater and thermostat, the following precautions shall be observed:

a) *Location of immersion heaters* – The immersion heater shall be mounted with its axis horizontal, except in the case of the circulation type which is normally mounted with its axis approximately vertical.

b) In a tank with a flat bottom, a space of not less than 75 mm below the immersion heater and 50 mm below the cold feed connection shall be provided to allow for accumulation of sludge and scale, where it will not affect the working of the immersion heater.

c) In a cylindrical storage vessel with inwardly dished bottom, the inlet pipe shall be so arranged that the incoming cold water is not deflected directly into the hot water zone. The lowest point of the immersion heater shall be 25 mm above the centre line of the cold feed inlet, which, in turn, is usually 100 mm above the cylinder rim.

d) *Location of thermostat* – Where the thermostat does not form an integral part of the immersion heater, it shall be mounted with its axis horizontal, at least 50 mm away from and not lower than the immersion heater.

e) *Dual heater installations* – If desired, the principle of the dual heater may be adopted. In this case, one heater and its thermostat shall be installed at a low level as indicated in (b) and (c). The second heater and its thermostat shall be similarly disposed in the upper half of the cylinder at a level depending on the reserve of hot water desired for ordinary domestic use. The bottom heater shall be under separate switch control.

f) *Clearance around storage vessel* – Adequate clearance shall be provided between the tank and the cupboard, door or walls to allow convenient insertion and adjustment of the immersion heater and thermostat and to give space for thermal insulation.

4.14.8.2 *Rating of immersion heaters*

The rating of an immersion heater shall be determined according to the following factors:

a) Proposed hot water storage capacity (the maximum with cold water as indicated in **4.14.3** shall be taken into account),
b) Rate of utilization (draw off frequency),
c) Permissible recovery period, and
d) Inlet water temperature.

For details regarding rated input of water, refer to good practice [9-1(14)].

4.14.9 *Thermal Insulation*

The hot water storage vessel and pipes shall be adequately insulated, wherever necessary to minimize heat loss. The whole external surface of the storage vessel including the cover to the man hole shall also be duly insulated.

Insulation may be provided by wrapping storage vessel and pipes with fibre glass, mineral wool or closed cell flexible elastomeric foam based materials of desired thickness, covered with cladding for protection from damage or from weather in case of external use.

4.14.10 *Cold Water Supply to Heaters*

4.14.10.1 A storage water heater (pressure type) shall be fed from a cold water storage tank and under no circumstances connected directly to the water main, except the type which incorporates a feed tank with ball valves and overflow pipe arrangement (cistern type heaters) or non-pressure type heaters.

4.14.10.2 *Storage cisterns*

4.14.10.2.1 The storage capacity of a cold water tank shall be at least twicethe capacity of the hot water heater. The capacity of the storage tank may, however, be 1.5 times when the number of heaters connected to one common tank exceeds 10.

4.14.10.2.2 The storage tank for supply of cold water to hot water heaters shall be separate, if practicable. In the case of a common tank which also supplies cold water to the fixtures, this cold water supply connection shall be so arranged that 50 percent of the net capacity, worked out as in **4.14.10.2.1**, shall be available for supply to the hot water heaters.

4.14.10.2.3 In the case of multi-storeyed buildings where a common overhead tank over the stair/lift well is generally installed, it is advisable to have one or more local tanks for supply to the hot water heaters or a compartment in the tank with required storage always available for hot water heater.

4.14.10.2.4 In tall multi-storeyed buildings where the static pressure increases with the height, the total static pressure on the hot water heaters on the lowest floor shall not exceed the rated working pressure of the hot water heater installed. Should the height of the building so require, additional tanks shall be provided on the intermediate floors to restrict the static head to permissible limits or the pressure shall be reduced to working pressure by providing pressure reducing valves.

4.14.10.2.5 As an alternative to the arrangements stated in **4.14.10.2.3** and **4.14.10.2.4**, an individual storage tank in each flat may be provided for supply to hot water heaters.

4.14.11 *Cold Water Feed*

4.14.11.1 The feed pipe connecting cold water tank with the hot water heater shall not be of less than 20 mm bore and it shall leave the cold water tank at a point not

less than 50 mm above the bottom of the tank and shall connect into the hot water heater near its bottom. The feed pipe shall not deliver cold water to any other connection, but into the hot water cylinders only.

4.14.11.2 In the case of multi-storeyed buildings, a common cold water feed pipe may be installed, but each hot water heater shall be provided with a check valve (horizontal type check valve shall be preferred to vertical type for easy maintenance).

4.14.11.3 Care shall be taken in installing the piping to prevent air locks in the piping and negative pressure in the hot water heater. Cold water feed pipe shall not be cross-connected with any other source of supply under pressure.

4.14.12 *Hot Water Piping*

4.14.12.1 *Expansion pipe or vent pipe*

4.14.12.1.1 Each non-pressure type hot water heater or cylinder shall be provided with a vent pipe of not less than 20 mm bore. The vent pipe shall rise above the water line of the cold water tank by at least 150 mm plus 10 mm for every 300 mm height of the water line above the bottom of the heater. The vent shall discharge at a level higher than the cold water tank and preferably in the cold water tank supplying the hot water heaters. Care shall be taken to ensure that any accidental discharge from the vent does not hurt or scald any passerby or persons in the vicinity.

It shall be ensured that such vents and pipes are so located so as not to encroach into the minimum maneuvering space and should be suitably insulated to avoid accidental contact and burns.

NOTE – Pressure type water heaters are very commonly used and non-pressure type is slowly phased out.

4.14.12.1.2 The vent pipe shall be connected to the highest point of the heater vessel and it shall not project downwards inside it, as otherwise air may be trapped inside, resulting in surging and consequent noises.

4.14.12.1.3 At no point, after leaving the vessel, shall the vent pipe dip below the level of its connection with the vessel.

4.14.12.1.4 A vent pipe may, however, be used for supply of hot water to any point between the cold water tank and the hot water heaters.

4.4.12.1.5 The vent pipe shall not be provided with any valve or check valves.

4.4.12.2 *Hot water heaters*

4.4.12.2.1 The common hot water delivery pipe shall leave the hot water heater near its top and shall be of not less than 20 mm bore generally, not less than 25 mm bore if hot water taps are installed on the same floor as that on which the hot water heater is situated.

4.14.12.2.2 Hot water taps shall be of such design as would cause the minimum friction. Alternatively, oversized tap may be provided, such as a 20 mm tap on a 15 mm pipe.

4.14.12.2.3 The hot water distributing system shall be so designed as to ensure that the time lag between opening of the draw-off taps and discharge of hot water is reduced to the minimum to avoid wastage of an undue amount of water which may have cooled while standing in the pipes when the taps are closed. With this end in view, a secondary circulation system with flow and return pipes from the hot water tank shall be used where justified. Whether such a system is used or not, the length of pipe to a hot water draw-off tap, measured along the pipe from the tap to the hot water tank or the secondary circulation pipe, shall not exceed the lengths given in Table 5.

Table 5 Maximum Permissible Lengths of Hot Water Draw-Off Pipes
(*Clause* 4.14.12.2.3)

Sl No.	**Largest Internal Diameter of Pipe**	**Length** m
(1)	(2)	(3)
i)	Not exceeding 20 mm	12
ii)	Exceeding 20 mm but not exceeding 25 mm	7.5
iii)	Exceeding 25 mm	3.0

NOTE – In the case of a composite pipe of different diameters, the largest diameter is to be taken into consideration for the purpose of this table.

4.14.12.2.4 Wherever mixing of hot and cold water is done by a mixing fitting, that is, hot and cold stop-cocks deliver to a common outlet of mixed water (that is, showers, basin or bath supply fittings), the pressure in the cold and hot water systems shall be equal. This can be achieved by connecting the cold water supply from an overhead tank at the same static height as the overhead tank supplying cold water to the hot water heaters. In case this is not possible, hot and cold water should be supplied to the fixtures by separate supply taps.

The hot and cold water thermostatic mixers/diverters/faucets for public use should have ‘hot’ and ‘cold’ clearly marked in the form of colour coding and tactile information. The functioning of hot and cold water from the thermostatic mixer/diverter/faucet should be consistent, for example, a clockwise turn should result in discharge of hot water and counter clockwise for cold. It is recommended that a thermostat be installed to limit the temperature of the hot water to a maximum of 40° C in order to prevent scalding. All faucets/mixers/diverts in public use shall be automatic (sensor operated) or lever type (*see also* **B-7** and **B-9** of Part 3 ‘Development Control Rules and General Building Requirements’ of the Code).

4.14.13 *Types of Hot Water Heaters*

The various types of water heaters used for preparation of hot water are as follows:

a) *Electric storage heaters*:
   1) Non–pressure or open outlet type,
   2) Pressure type,
   3) Cistern type, and
   4) Dual heater type.

b) *Gas water heaters*:
   1) Instantaneous type {*see* accepted standard [9-1(21)]}, and
   2) Storage type.

c) *Solar heating systems*:
   1) Independent roof mounted heating units, and
   2) Centrally banked heated system.

d) *Central hot water system*:
   1) Oil fired,
   2) Gas fired,
   3) Electrical coil type, and
   4) Heat Pump.

4.14.13.1 The quality and construction of the different types of hot water heaters shall be in accordance with good practice [9-1(15)].

4.14.13.2 For solar water heating system and their installation reference shall be made to good practice [9-1(23)].

4.14.13.3 Requirements in regard to inspection and maintenance of hot water supply installations shall be in accordance with **4.15.1** to **4.15.4**.

4.15 Inspection and Testing

4.15.1 *Testing of Mains before Commencing Work*

All pipes, fittings and appliances shall be inspected, before delivery at the site to see whether they conform to accepted standards. All pipes and fittings shall be inspected and tested by the manufacturers at their factory and shall comply with the requirements of this Section. They shall be tested hydraulically under a pressure equal to twice this maximum permissible working pressure or under such greater pressure as may be specified. The pipes and fittings shall be inspected on site before laying and shall be sounded to disclose cracks. Any defective items shall be clearly marked as rejected and forthwith removed from the site.

4.15.2 *Testing of Mains after Laying*

After laying and jointing, the main shall be slowly and carefully charged with water by providing a 25 mm inlet with a stop-cock, so that all air is expelled from the main. The main is then allowed to stand full of water for a few days if time permits, and then tested under pressure. The test pressure shall be 0.5 N/mm^2 or double the maximum working pressure, whichever is greater. The pressure shall be applied by means of a manually operated test pump, or, in the case of long mains or mains of a

large diameter, by a power-driven test pump, provided the pump is not left unattended. In either case, due precaution shall be taken to ensure that the required test pressure is not exceeded. Pressure gauges shall be accurate and shall preferably have been recalibrated before the test. The pump having been stopped, the test pressure shall maintain itself without measurable loss for at least 5 min. The mains shall be tested in sections as the work of laying proceeds; it is an advantage to have the joints exposed for inspection during the testing. The open end of the main may be temporarily closed for testing under moderate pressure by fitting a water-tight expanding plug of which several types are available. The end of the main and the plug shall be secured by struts or otherwise, to resist the end thrust of the water pressure in the mains.

4.15.2.1 If the section of the main tested terminates into a sluice valve, the wedge of the valve shall not be used to retain the water; instead the valve shall be temporarily fitted with a blank flange, or, in the case of a socketed valve, with a plug, and the wedge placed in the open position while testing. End support shall be given as in **4.15.2**.

4.15.3 *Testing of Service Pipes and Fittings*

When the service pipe is complete, it shall be slowly and carefully charged with water, allowing all air to escape, care being taken to avoid all shock or water hammer. The service pipe shall then be inspected under working conditions of pressure and flow. When all draw-offs taps are closed, the service pipe shall be absolutely water-tight. All piping, fittings and appliances shall be checked for satisfactory support, and protection from damage, corrosion and frost. Because of the possibility of damage in transit, cisterns shall be re-tested for water-tightness on arrival at the site, before fixing.

4.15.4 In addition to the provisions given in **4.15.1**, provisions given in **4.15.4.1** to **4.15.4.3** shall also apply to hot water supply installations in regard to inspection and testing.

4.15.4.1 *Testing of the system after installation*

After the hot water system, including the hot water heaters, has been installed, it shall be carefully charged with water, so that all air is expelled from the system. The entire system shall then be hydraulically tested to a pressure of 0.5 N/mm^2 or twice the working pressure, whichever is greater, for a period of at least 30 min after a steady state is reached. The entire installation shall then be inspected visually for leakages, and sweating. All defects found shall be rectified by removing and remaking the particular section. Caulking of threads, hammering and welding of leaking joints shall not be allowed.

4.15.4.2 *Hot water testing*

After the system has been proved water-tight, the hot water heaters shall be commissioned by connecting the same to the electrical supply. The system shall then be observed for leakage in pipes due to expansion or overheating. The

temperature of water at outlets shall be recorded. The thermostats of the appliances shall be checked and adjusted to temperatures specified in **4.14.2.1**.

4.15.4.3 *Electrical connection*

For relevant provisions regarding general and safety requirements for household and similar electrical appliances, reference may be made to good practice [9-1(14)]. The metal work of the water heating appliances and installation other than current carrying parts shall be bonded and earthed in conformity with the good practice [9-1(14)]. It should be noted that screwing of an immersion heater into a tank or cylinder cannot be relied upon to effect a low resistance earth connection, a satisfactory separate earthing of heater should be effected.

4.16 Cleaning and Disinfection of the Supply System

4.16.1 All water mains communications pipes, service pipes and pipes used for distribution of water for domestic purposes shall be thoroughly and efficiently disinfected before being taken into use and also after every major repair. The method of disinfection shall be subject to the approval of the Authority. The pipes shall also be periodically cleaned at intervals, depending upon the quality of water, communication pipes and the storage cisterns shall be thoroughly cleaned at least once every year in order to remove any suspended impurities that may have settled in the pipes or the tanks.

4.16.2 *Disinfection of Storage Tanks and Down Take Distribution Pipes*

The storage tanks and pipes shall first be filled with water and thoroughly flushed out. The storage tank shall then be filled with water again and a disinfecting chemical containing chlorine added gradually while the tanks are being filled, to ensure thorough mixing. Sufficient quantities of chemicals shall be used to give the water a dose of 50 parts of chlorine to one million parts of water. If ordinary bleaching powder is used, the proportions will be 150 g of powder to 1 000 litre of water. The powder shall be mixed with water to a creamy consistency before being added to the water in the storage tank. When the storage tank is full, the supply shall be stopped and all the taps on the distributing pipes opened successively working progressively away from the storage tank. Each tap shall be closed when the water discharged begins to smell of chlorine. The storage tank shall then be topped up with water from the supply pipe and with more disinfecting chemical in the recommended proportions. The storage tank and pipes shall then remain charged for at least 3 h. Finally, the tank and pipes shall be thoroughly flushed out before any water is used for domestic purposes.

4.17 Water Supply Systems in High Altitudes and/or Sub-zero Temperature Regions

4.17.1 *Selection and Source*

In general, the site selected for a water source shall be such as to minimize the length of transmission line so as to reduce the inspection and upkeep. Attempt shall

be made, where feasible, to locate the source near the discharge of waste heat, such as of power plants provided it does not affect the potability of water.

4.17.2 *Pumping Installation*

Pump and pumping machinery shall be housed inside well-insulated chambers. Where necessary, arrangements shall be made for heating the inside of pump houses. Pump houses, as far as possible, should be built directly above the water intake structures.

4.17.3 *Protection of Storage Water and Treatment*

Where ambient temperatures are so low as to cause danger of freezing, proper housing, insulation and protection shall be provided for all processes and equipment. If necessary, means shall be provided for proper heating of the enclosure.

4.17.4 *Transmission and Distribution*

Freezing of the buried pipe may be avoided primarily by laying the pipe below the level of the frost line; well consolidated bedding of clean earth or sand, under, around or over the pipe should be provided. For the efficient operation and design of transmission and distribution work, the available heat in the water shall be economically utilized and controlled. If the heat which is naturally present in water is made equate to satisfy heat losses from the system, the water shall be warmed. Where economically feasible, certain faucets on the distribution system may be kept in a slightly dripping condition so as to keep the fluid in motion and thus prevent is freezing. If found unsuitable for drinking purposes, such water may be used for heating purposes. Heat losses shall be reduced by insulation, if necessary. Any material that will catch, absorb or hold moisture shall not be used for insulation purposes. Adequate number of break pressure water tanks and air release valves shall be provided in the distribution system.

NOTE – The level of frost line is generally found to be between 0.9 m and 1.2 m below ground level in the northern regions of India, wherever freezing occurs.

4.17.4.1 *Materials for pipes*

Distribution pipes shall be made of any of the following materials conforming to Part 5 ‘Building Materials’ of the Code:

a) High density polyethylene pipes,
b) Asbestos cement pipes,
c) Galvanized iron pipes,
d) Cast iron pipes,
e) Copper pipes,
f) Chlorinated PVC pipes,
g) Unplasticized PVC pipes (where it is laid before frost line), and
h) Stainless Steel Pipes.

4.17.4.2 *Materials for insulation of pipes*

Insulation of pipes may be provided by wrapping the pipe with fibre glass, mineral wool or closed cell flexible elastomeric foam based insulation materials of desired thickness covered with cladding for protection from damage or from weather in case of external use/pipes laid in exposed conditions; other materials, like 85 percent magnesia, preformed pipe sections, etc, may also be used.

4.17.4.3 *Distribution methods*

Distribution by barrels or tank trucks shall be employed, where the water requirements are temporary and small. Utmost care shall be exercised for preventing the water from being contaminated by maintaining a residual of disinfecting agent at all times. Hoses, pails and the tank shall be kept free from dust and filth during all period of operation. Where winter temperatures are low, making frost penetration depths greater during the winter and where adequate facilities for heating the water in the distribution system do not exist, the use of tank trucks or barrels for delivery of water shall be considered only for cold weather; during the warm weather, piping system for seasonal use may be supplemented.

4.17.4.4 In the conventional distribution system involving the use of a network of pipelines requiring no auxiliary heat, it is essential that the pipelines are buried well below the frost line. Adequate facilities for draining the pipelines shall be provided where there is a danger of frost.

4.17.4.5 *House service connections*

House service connections shall be kept operative by the use of adequate insulation at exposed places extending below the frost line. Figure 7 shows a typical arrangement for providing insulation for house service connections.

4.17.5 For detailed information on planning and designing water supply system peculiar to high altitudes and/or sub-zero temperature regions of the country, reference may be made to good practice [9-1(16)].

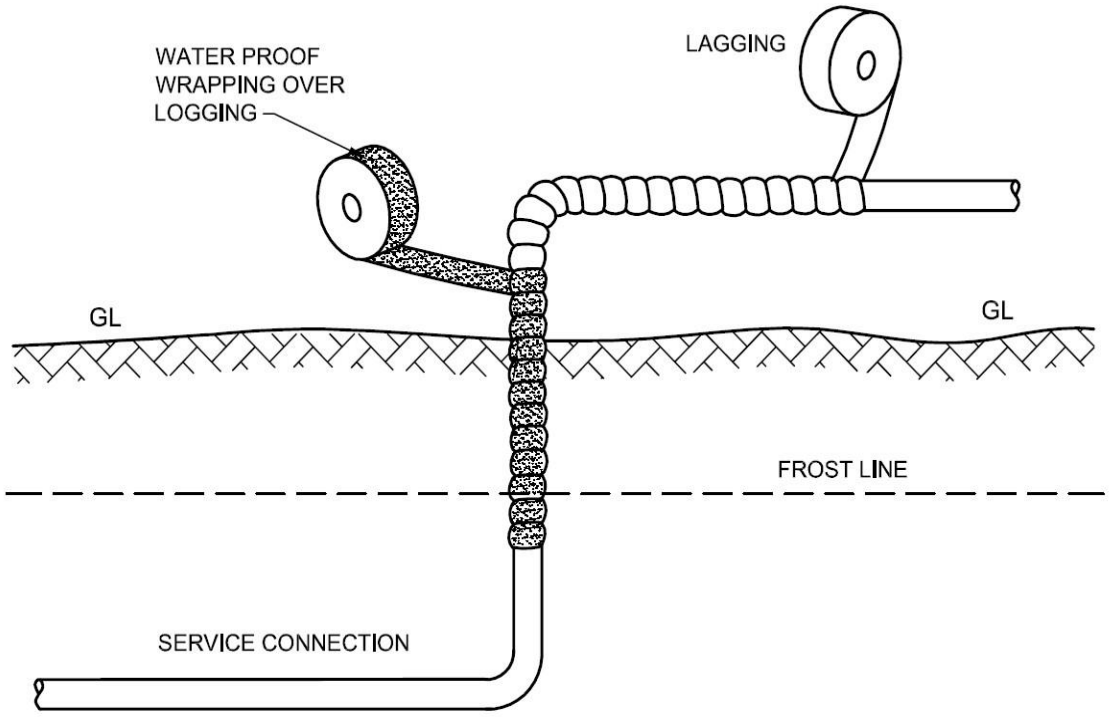


FIG. 7 INSULATION DETAILS AT SERVICE CONNECTION

4.18 Guidelines to Maintenance

4.18.1 Storage tanks shall be regularly inspected and shall be cleaned out periodically, if necessary. Tanks showing signs of corrosion shall be emptied, thoroughly wire brushed to remove loose material (but not scraped), cleaned and coated with suitable bituminous compositions or other suitable anti-corrosive material not liable to impart taste or odour or otherwise contaminate the water. Before cleaning the cistern, the outlets shall be plugged to prevent debris from entering the pipes. Tanks shall be examined for metal wastage and water tightness after cleaning.

4.18.2 Record drawings showing pipe layout and valve positions shall be kept up to date and inspection undertaken to ensure that any maintenance work has not introduced cross-connections or any other undesirable feature. Any addition or alterations to the systems shall be duly recorded from time to time.

4.18.3 Any temporary attachment fixed to a tap or outlet shall never be left in such a position that back-siphonage of polluted water may occur into the supply system.

4.18.4 All valves shall periodically be operated to maintain free movement of the working parts.

4.18.5 All taps and ball valves shall be watertight, glands shall be made good, washers shall be replaced and the mechanism of spring operated taps and ball valves shall be repaired where required.

4.18.6 All overflow pipes shall be examined and kept free from obstructions.

4.18.7 The electrical installation shall be checked for earth continuity and any defects or deficiencies corrected in the case of hot water supply installations.

4.19 Swimming Pools

4.19.1 *General*

A swimming pool is a container that is filled with water to enable swimming or such other leisure activities. Pools can be sunk into the ground or built above ground (as a freestanding construction or as part of a building or other larger structure), and are also a standard feature aboard ocean liners and cruise ships. In-ground pools are most commonly constructed from materials such as concrete, natural stone, metal, plastic or fiberglass, and can be of a custom size and shape or built to a standardized size.

All pools open to public shall take care of the barrier-free design for accessibility and use by persons with disabilities. Reference shall also be made to **13** of Part 3 'Development Control Rules and General building Requirements' of the Code for applicable requirements.

4.19.1.1 Swimming pools shall be of three types, namely:

Type	*Characteristic*
Fill and draw	Clear water of potable quality is retained till it becomes turbid or unfit for use. Thereafter, the pool is drained, cleaned and refilled with clear water. This type is not recommended considering water conservation
Flow through	Clear water of hygienic quality flows continuously. This type requires more water for replenishment and so cautious decision of usage of such pools should be made; it is not recommended considering water conservation
Recirculating	Recirculation system shall be provided to minimize water wastage and disinfection shall be done to ensure hygiene. The recirculation system shall be based on the nature of usage such as private, public, wading and competition pools. The entire pool water should be filtered based on the turnover period for various types of pools.

4.19.1.2 *Turnover rate*

It is the amount of time it would take for the volume of the pool to pass through the filtration system one time. Turnover rate is measured in hours and is expressed as:

Turnover rate, in hours = Pool volume (in litres)/Flow (in litre/h)

NOTE – Pool volume comprises volume of the pool water, balancing tank, overflow gutter and circulation pipe.

Typical turnover rates for the following pools are:

Type of Pool	*Turnover rate* h
Swimming Pool	
a) Private (outdoor)	6
b) Private (indoor)	10
c) Public	6
d) Competition	6
Wading Pool	1
Spa (public)	½
Spa (private)	1

4.19.1.3 *Swimming pool user load*

The maximum load for the pool shall be:

a) For pool depth up to 1m : 2.2 m^2 surface area per user
b) For pool depth up to 1.5m : 2.7 m^2 surface area per user
c) For pool depth more than 1.5m : 4.0 m^2 surface area per user

4.19.1.4 Recommended dimensions of the swimming pools shall be:

a) Half sized olympic pools : 25 m (length) x 12 to 13 m (width) x 1.8 m (depth)
b) Full size olympic pools : 50 m (length) x 25 m (wide) x 2 m (depth)
c) Diving depth : 3.5 m for 1 m spring board; and
5 m for a 10 m platform
d) Maximum depth : *See* **4.19.2.7**
e) Ladders : 2 treads for 1.2 m depth;
3 treads for 1.2 m to 1.5 m depth; and
4 treads for 1.5 m depth
f) Displacement : 60 litre per user for deeper pools; and
45 litre for shallow pools

4.19.2 *Design*

4.19.2.1 The pool should be so designed to withstand all anticipated hydraulic structural loadings for both full and empty conditions. All appurtenances to the pool, such as diving boards and slides, shall be designed to carry the anticipated load. Any obstruction creating a safety hazard shall not extend into or above the pool, or shall not protrude from the floor of the pool. Designers may refer good practice [9-1(17)] for providing the guidance on the procedures and the precautions to be taken during construction of swimming pool to ensure the water tightness of the structure.

4.19.2.2 *Material*

Any suitable material that is non-toxic and provides a rigid watertight shell with a smooth, impervious, light colour finish should be used to construct the pool. The floor of shallow areas shall have a slip-resistant finish. Sand or earth shall not be permitted to use as an interior finish in a swimming pool.

4.19.2.3 *Dimensions*

The shape and size of a pool largely depend on the usage. Shape should be considered from the standpoint of safety and circulation of the pool water.

NOTES

1 A long and rectangular pool may be ideal for sports and exercise as it gives length and breadth, but the shape of a pool for recreation largely depend on the choice of the owners, available space for making the pool and the design of the house.
2 In sports, normally the swimming pools are 50 m long, minimum 21 m wide and 1.8 m overall depth.

4.19.2.4 *Floor slopes*

Slope of the floor of the pool should be made downward toward the main drain. All slopes should be uniform. The slope in shallow areas should not exceed 300 mm vertical in 3.6 m horizontal except for a slope directed downward from a transition point, which shall not exceed 300 mm vertical in 1m horizontal. In portions of the pool with a depth greater than 1.5 m, the front slope of the deep area shall not be steeper than 300 mm in 1 m.

4.19.2.5 *Transition point*

Transition points should be marked with a stripe on the pool floor having a width of at least 100 mm and a colour that contrasts with that of the floor, and with a buoyed safety rope with colour buoys, installed at least 300 mm on the shallow side of the transition point. In other pools having adjoining shallow and deep areas, a safety rope with colour buoys shall be installed where the water depth reaches 1.5 m.

4.19.2.6 *Pool walls*

Where the pool depth is 1 m or less, pool walls shall be vertical to the floor and the junction of the wall with the floor shall consist of a cove with a radius not exceeding 150 mm. Where the pool depth exceeds 1 m, pool walls shall meet one of the following criteria:

a) The wall shall be vertical for a depth of at least 1.5 m below the water level, below which the wall may angle to the floor; or
b) The wall shall be vertical for a depth of at least 1 m below the water level, below which the wall shall form a curve to the floor. The curve shall be tangent to the pool wall.

4.19.2.7 *Water depth*

The depth of a swimming pool depends on the purpose of the pool, and whether it is open to the public or strictly for private use. If it is a private casual, relaxing pool, it may go from 1.0 m to 1.5 m deep. If it is a public pool designed for diving, it may slope from 3.5 m to 5.0 m in the deep end. A children's play pool may be from 0.3 m to 0.6 m deep. Public pools may have differing depths to accommodate different swimmer requirements. Water depths may be clearly marked on the pool walls.

The width between handrails of the pool stairs should be between 500 mm and 600 mm.

4.19.2.8 *Walkways and deck areas*

Pools shall be completely surrounded by a deck that is at least 1.2 m in width and extends completely around and adjacent to the pool. There shall be no obstructions or interruptions of the pool deck within the 1.2 m adjacent to the pool other than necessary structural supports, or appurtenances such as diving boards, slides, perimeter overflow systems, or handrails. A clear, unobstructed walkway at least 1.2 m in width shall be maintained at such obstructions or interruptions. A wheelchair turning space of minimum 1.5m x 1.5 m shall be provided at key places in the walkway.

Structural supports located within the minimum required deck width or within 1.2 m of the swimming pool shall be no closer than 3 m apart measured parallel to the adjacent perimeter of the pool, with the dimension of any single support in a plane parallel to the adjacent pool perimeter not greater than 1 m and the sum of all such support dimensions not greater than 10 percent of the pool perimeter.

The deck between two adjacent swimming pools shall be at least 2.5 m wide. All decks and walkways shall have an unobstructed overhead clearance of at least 2 m.

Synthetic material which meets the following criteria may be installed for deck coverings:

a) Non-fibrous and allows drainage such that it will not remain wet or retain moisture;

b) Inert and will not support bacterial or fungal growth;
c) Durable;
d) Cleanable; and
e) Provides a slip-resistant finish.

The decks and walkways shall have a paved surface. The surface of the pool deck and other surfaces used for foot contact, such as gratings of perimeter overflow systems, shall be slip-resistant.

The outer perimeter of the deck for outdoor pools shall be at least 10 cm higher than the surrounding ground surface except where access is provided to adjacent turf areas.

The pool shall have an accessible entry and exit that is accessible to persons with disabilities. Accessible entry/exit may require provision of a transfer wall or/and a sloped entry with an aquatic chair. Installing a pool lifts may be another option for accessible entry/exit.

The transfer wall should have a minimum clear deck space of 1.5 m x 1.5m, with a slope not steeper than 1:48 at the base of the transfer wall. The height of the transfer wall should be 400mm to 480mm from the deck floor. The transfer wall should be 300 mm to 400 mm wide. The length should be minimum 1.5 m centered on the clear deck space. Surfaces of transfer walls shall not be sharp and shall have rounded edges.

A grab bar should be provided on the transfer wall. Grab bars shall be perpendicular to the pool wall and shall extend the full depth of the transfer wall. The top of the gripping surface shall be 100 mm to 150 mm above transfer walls. Clearance of 610 mm should be available on both sides of the grab bar.

4.19.2.9 *Starting platforms*

Starting platforms may be from 0.50 m to 0.75 m above the surface of water. The maximum height of the platform above the water shall be 0.75 m where the water depth is 1.2 m or greater, and 0.50 m when the water depth is less than 1.2 m. The surface area of each platform shall be 0.5 m x 0.5 m with a maximum slope of not more than 10°. Surface of each block shall be covered with non-slip material and with back stroke hand grip facility.

4.19.3 *Electrical Installation*

4.19.3.1 *Lighting*

Artificial lighting shall be provided at all indoor pools and at all outdoor pools that are open for use after sunset in accordance with one of the following:

a) Underwater lighting of at least 8.35 lumens or 5.5 W per square metre of pool water surface area, located to provide illumination of the entire pool floor; plus area lighting of at least 10 lumens or 6.6 W per square metre of deck area.

b) If underwater lights are not provided, at least 33.5 lumens or 2.2 W per square metre of pool water surface area and deck area.

Where portable electric vacuum cleaning equipment is used, electrical receptacles with ground-fault circuit interrupter protection shall be provided. Separation between receptacles shall be a maximum of 30 m. All receptacles installed in the swimming pool area shall have waterproof covers and ground-fault circuit interrupter protection. Lighting controls should not be accessible to the public.

4.19.3.2 *Ventilation*

Adequate ventilation shall be provided in facilities to prevent objectionable odor.

4.19.3.3 *Shower and bathroom*

Separate shower, dressing booth and sanitary facilities shall be provided for each gender. This may not be applicable for schools and other institutional use where a pool may be open to one gender at a time. The rooms should be well lit, drained, ventilated, and of good construction, using impervious materials. They should be developed and planned to ensure maintenance of good sanitation throughout the building at all times. Floors should have a slip-resistant surface and sufficiently smooth to ensure ease in cleaning.

Each shower and toilet block provided per pool, open for use by public, shall have a unisex accessible shower, dressing-cum-toilet facility for persons with disabilities. Design specifications of this accessible facility shall be as per **13** of Part 3 ‘Development Control Rules and General Building Requirements’ of the Code.

4.19.4 *Water Treatment System*

4.19.4.1 *General*

A water treatment system shall be provided to filter, chemically balance and disinfect the swimming pool water.

4.19.4.2 *Hair and lint strainer*

A hair and lint strainer shall be installed on the suction side of the pump except on vacuum filter systems. The strainer basket shall be easily removable. Valves shall be installed to allow the flow to be shut off during cleaning, switching baskets or inspection.

4.19.4.3 *Inlets*

Inlets for filtered water shall be located and directed suitably to produce uniform circulation of water to facilitate the maintenance of a uniform disinfectant residual throughout the entire pool without the existence of dead spots, and to produce surface flow patterns that effectively assist skimming.

4.19.4.4 *Outlets*

Pools shall be provided with a minimum of two drains (outlets) at the deepest point. Centre-to-centre distance between drains shall not exceed 2.0 m. Drains shall not be more than 3.0 m away from the pool walls. The main drain may be connected to the recirculation system. Openings shall be covered by grating which cannot be removed without the use of tools. Openings of the grating shall be at least four times the area of the main drain pipe or have an open area. The maximum width of grate openings shall not exceed 8 mm. Main drains and all other suction outlets installed in the pool shall be designed to prevent bather entrapment and shall be of anti-vortex type. The velocity at outlet pipe shall not be more than 0.3 m/s.

4.19.4.5 *Velocities*

Maximum permissible velocities for various components of the pools are as follows:

a) Suction pipe: less than 1.5 m/s
b) Return pipe: 1.5 to 2 m/s
c) Return/inlet fittings: 2.4 to 2.75 m/s in private pools and 1.5 to 2 m/s in public pools

4.19.4.6 *Balancing (surge) tank*

Overflow system shall be designed for effective surge capacity. Balancing tank should be provided of capacity to accommodate surge storage and storage for makeup water. The volume of the balancing tank shall be the total of the above with equal proportions.

4.19.4.7 *Make-up water*

Make-up water shall be added through a fixed air gap of at least 150 mm to the pool, surge tank, vacuum filter tank, or other receptacle. When make-up water is added directly to the pool, the fill-spout should be located under a low diving board or immediately adjacent to a ladder rail, grab rail, or fixed lifeguard chair.

4.19.4.8 *Filtration*

The design filtration rate in the particular application in which the filter is utilized shall not exceed the maximum design filtration rate for which the filter was installed. Wash or backwash water from diatomaceous earth filters shall be passed through a separation tank designed for removal of suspended diatomaceous earth and solids, prior to disposal.

NOTE - Filtration rates for various type of filters
a) Low rate filter- 10 $m^3/m^2/h$
b) Medium rate filter- 11 to 30 $m^3/m^2/h$
c) High rate filter- 31 to 50 $m^3/m^2/h$
d) Minimum flow rate for filter backwash - 30 $m^3/m^2/h$

4.19.4.9 *Disinfection*

The pool water shall be continuously disinfected by suitable disinfecting agent that imparts easily measured residual. Gaseous chlorine, chlorine compounds, bromine compounds or other bactericidal agents should be used to maintain the quality parameters of water.

4.19.5 *Water Quality*

4.19.5.1 *Disinfectant residual*

Where chlorine is used as a disinfectant, the chlorine residual shall be maintained between 1.0 and 4.0 ppm as free chlorine residual. A free chlorine residual of at least 2.0 ppm shall be maintained when the pool water temperature exceeds 30ºC.

Where bromine is used as a disinfectant, a bromine residual shall be maintained between 2.0 and 8.0 ppm as total bromine. A bromine residual of at least 4.0 ppm shall be maintained when the pool water temperature exceeds 30ºC.

Where chlorinated cyanurates are used, the cyanuric acid concentration shall not exceed 100 ppm.

Where silver/copper or copper ion generators are used, the concentration of copper shall not exceed 1.3 ppm and the concentration of silver shall not exceed 0.05 ppm.

Where ozone is used, the ambient air ozone concentration shall be less than 0.1 ppm. at all times either in the vicinity of the ozonator or at the pool water surface.

For all other physical, chemical and bacteriological parameters, the quality of water used in swimming pools in continuous circulation type shall conform to good practices [9-1(18)]. For safety aspects related to public swimming pools, the good practice [9-1(19)] shall be referred.

4.20 Allowance for Expansion

4.20.1 The allowances for expansion of the water pipes are recommended as given below:

a) All pipes should be installed at ambient temperature.

b) Pipes carrying hot fluids such as water or steam operate at higher temperatures. It follows that they expand, especially in length, with an increase from ambient to working temperatures. This will create stress upon certain areas within the distribution system, such as pipe joints, which, in the extreme, could cause fracture.

c) The pipe work system shall be sufficiently flexible to accommodate the movements of the components as they expand. In many cases, the flexibility of the pipe work system, due to the length of the pipe and number of bends and supports, means that no undue stresses are imposed. In other

installations, however, it will be necessary to incorporate some means of achieving this required flexibility.

d) The expansion fitting is one method of accommodating expansion. These fittings are placed within a line and are designed to accommodate the expansion without the total length of the line changing. They are commonly called expansion bellows, due to the bellows construction of the expansion sleeve.

e) Other expansion fittings can be made from the pipe work itself. This can be a cheaper way to solve the problem, but more space is needed to accommodate the pipe.

4.20.2 *Full Loop*

a) This is simply one complete turn of the pipe and, on steam pipe work, should preferably be fitted in a horizontal rather than a vertical position to prevent condensate accumulating on the upstream side.
b) The downstream side passes below the upstream side and great care shall be taken that it is not fitted wrong way round, as condensate can accumulate in the bottom. When full loops are to be fitted in a confined space, care shall be taken to specify that wrong-handed loops are not supplied.

c) The full loop does not produce a force in opposition to the expanding pipe work as in some other types, but with steam pressure inside the loop, there is a slight tendency to unwind, which puts an additional stress on the flanges.

4.21 Colour Codes for Different Types of Water Pipes

The following colour codes are recommended for pipes {see also good practice [9-1(20)]}:

Sl No. (1)	*Particulars* (2)	*Ground Colour* (3)	*First Colour Band* (4)	*Second Colour Band* (5)
i)	Cooling water	Sea green	French blue	–
ii)	Boiler feed water	Sea green	Gulf red	–
iii)	Condensate water	Sea green	Light brown	–
iv)	Drinking	Sea green	French blue	Signal red
v)	Treated	Sea green	Light orange	–
vi)	Fire water	Fire red	Crimson red	–
vii)	Water with central heating below 60 °C	Sea Green	Canary Yellow	–
viii)	Water with central heating between 60 to 100 °C	Sea Green	Dark violet	–
ix)	Water with central heating above	Sea Green	Dark Violet	Signal red

	100˚C			
x)	Cold water from storage tanks	Sea green	French blue	Canary yellow
xi)	Domestic, hot water	Sea green	Light grey	–
xii)	Hydraulic power water	Sea green	Black	–
xiii)	Untreated sea/river water	Sea green	white	–
xiv)	Filtered water	Sea green	Light brown	–
xv)	Soft water	Sea green	Light brown	Signal red
xvi)	Warm water	Sea green	Light grey	Canary yellow
xvii)	Chilled water	Sea green	Black	Canary yellow
xviii)	Sprinkler and hydrant water	Sea green	White	Signal red
xix)	Waste water	Sea green	Canary yellow	Signal red

ANNEX A
(*Clause* 3.2.1)

APPLICATION FORM FOR TEMPORARY/PERMANENT SUPPLYOF WATER/FOR ADDITIONS AND/OR ALTERATIONS FORSUPPLY OF WATER

I/We ……..hereby make application to the* …….. for the temporary/permanent supply of water for the following additions and/or alterations to the water supply requirements and water fittings at the premises……. Ward No. ……..Street No. ……Road/Street known as ……for the purpose described below and agreed to pay such charges as the Authority may from time to time be entitled to make and to conform to all their byelaws and regulations……licensed/registered plumber, has been instructed by me/us to carry out the plumbing work.

Description of the premises:…….
Address :……..
Purpose for which water is required…….

……

The connection/connections taken by me/us for temporary use, shall not be used by me/us for permanent supply unless such a permission is granted to me/us in writing by the Authority.

I/We hereby undertake to give the*…….. due notice of any additions or alterations to the above mentioned supply which I/we may desire to make.

My/Our requirements of water supply are as under:

a) I/We request that one connection be granted for the whole of the premises.

b) I/We request that separate connections may be granted for each floor and I/we undertake to pay the cost of the separate connections.

c) My/Our probable requirements for trade purpose are …….litre per day and for domestic purposes are……..litre per day.

d) Our existing supply is ……..litre per day. Our additional requirement of supply is ……..litre per day.

e) The details as regards proposed additions and alterations in fittings are as follows:
……..
……..

Signature of the licensed/registered plumber…….
Name and address of the licensed/registered Plumber…….

Date ……

Signature of the applicant……
Name and address of the Applicant ……

Date ……..

NOTES

1 Please strike out whatever is not applicable.
2 The application should be signed by the owner of the premises or his constituted attorney and shall be countersigned by the licensed/registered plumber.

* Insert here the name of the Authority.

ANNEX B
(*Clause* 3.2.3)

FORM FOR LICENSED/REGISTERED PLUMBER'S COMPLETION CERTIFICATE

Certified that I/we have completed the plumbing work of water connection No……. for the premises as detailed below. This may be inspected and connection given.

Ward No…….. Road/Street……..

Locality……

Block No…… House No……..

Existing water connection No. (if any)…….

Owned by…….

Owner's address…….

Applicant's name…… son of…….

Address……

Situation……...

Size of main…….on…… street

Where main is situated……

Size of service pipe…….

Size of ferrule……

No. of taps…… No. of closets……

No. of other fittings and appliances……..

Road cutting and repairing fee ……

Paid Rs……(Receipt No…….dated……) (receipt enclosed)

Dated ……... Signature of licensed/registered plumber……..
Name and address of the licensed/registered plumber
……

The Authority's Report

Certified that the communication and distribution pipes and all water fittings have been laid, applied and executed in accordance with the provisions of bye-laws, and satisfactory arrangements have been made for draining off waste water.

Connection will be made on……

Date…… The Authority……

ANNEX C
(*Clause* 4.7.4)

NOMOGRAM OF HAZEN AND WILLIAM'S EQUATION

C-1 Examples of the use of nomogram are given below:

Example 1

Find the total friction loss in 25 mm diameter G.I. Pipe discharging 0.25 ℓ/s in a total length of 300 m.

Procedure

Discharge, Q = 0.25 ℓ/s

Pipe diameter = 25 mm

Frictional loss (from nomogram) = 30 m per 1 000 m

Total friction loss in 300 m length

$$= \frac{30}{1\,000} \times 300 = 9 \text{ m}$$

Example 2

Find suitable diameter pipe to carry 15 ℓ/s from service line to overhead tank.
Total length of service main = 200 m
Residual pressure available at the take off point on supply line is 15 m.

Procedure

Available head = 15 m

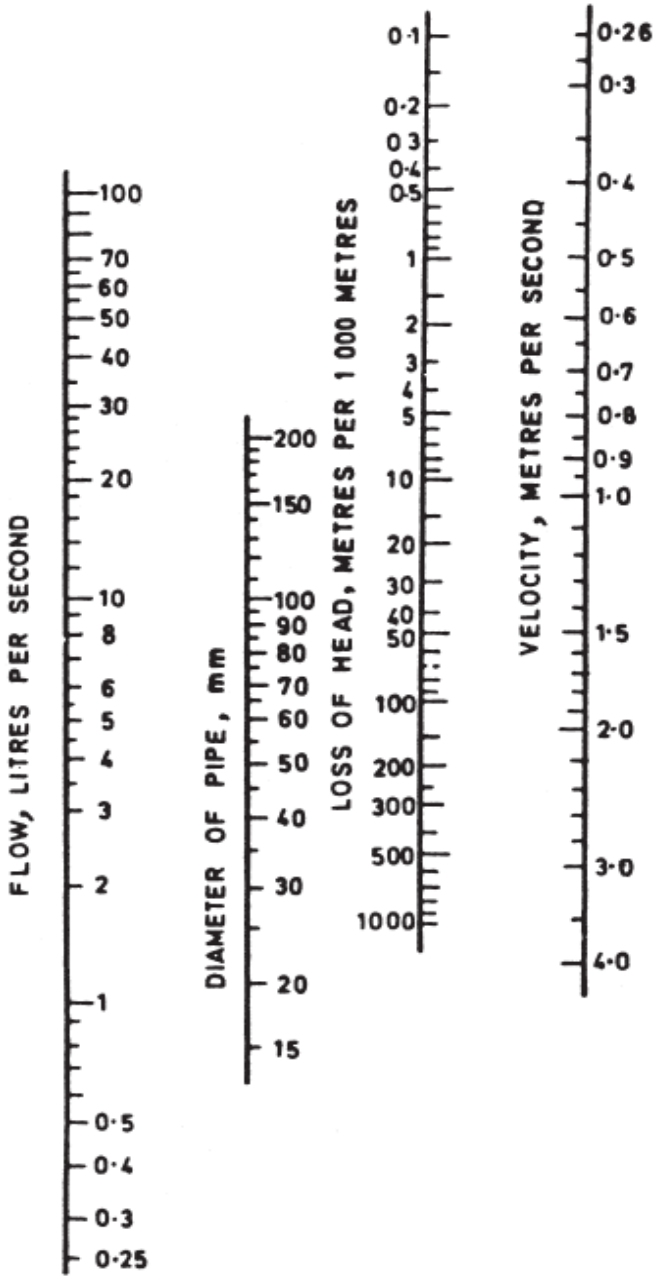
Deduct residual head = 2 m

Deduct 10 percent for losses in bends and specials = 1.3 m

Friction head available for loss in pipe of 1 000 m

$$= \frac{11.7}{200} \times 1\,000 = 58.5 \text{ m per } 1\,000 \text{ m}$$

From the nomogram, for a discharge of 15 ℓ/s and friction loss of 58.5 m per 1 000 m, nearest commercial size (diameter) of pipe is 100 mm.



Nomogram of Hazen & Williams Equation (c = 100)

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.

	IS No.	*Title*
(1)	10446 : 1983	Glossary of terms relating to water supply and sanitation
(2)	11208 :1985	Guidelines for registration of plumbers
(3)	10500 :2012	Specification for drinking water (*second revision*)
(4)	2041 : 2024	Steel plates and strips for pressure vessels used at moderate and low temperature — Specification (*fourth revision*)
	804 : 1967	Specification for rectangular pressed steel tanks (*first revision*)
(5)	4984 : 2016	Polyethylene pipes for water supply — Specification (*fifth revision*)
	4985 : 2021	Unplasticized PVC pipes for water supplies — Specification (*fourth revision*)
	15778 : 2007	Specification for chlorinated polyvinyl chloride (CPVC) pipes for portable hot and cold water distribution supplies
(6)	2065 : 1983	Code of practice for water supply in buildings (*second revision*)
(7)	3114 : 1994	Code of practice for laying of cast iron pipes (*second revision*)
(8)	5822 : 1994	Code of practice for laying of welded steel pipes for water supply (*second revision*)
(9)	6530 : 1972	Code of practice for laying of asbestos cement pressure pipes
(10)	783 : 1985	Code of practice for laying of concrete pipes (*first revision*)
(11)	7634	Code of practice for plastics pipes selection, handling, storage and installation for potable waters supplies
	(Part 1) : 1975	Choice of materials and general recommendations
	(Part 2) : 2012	Laying and jointing of polyethylene (PE) pipes (*first revision*)
	(Part 3) : 2003	Laying and jointing of UPVC pipes (*first revision*)
(12)	783 : 1985	Code of practice for laying of concrete pipes (*first revision*)
	3114 : 1994	Code of practice for laying of cast iron pipes (*second revision*)
	5822 : 1994	Code of practice for laying of welded steel pipes for water supply (*second revision*)

	6530 : 1972	Code of practice for laying of asbestos cement pressure pipes
	7634	Code of practice for plastics pipes selection, handling, storage and installation for potable water supplies
	(Part 1) : 1975	Choice of materials and general recommendations
	(Part 2) : 2012	Laying and jointing of polyethylene (PE) pipes (*first revision*)
	(Part 3) : 2003	Laying and jointing of UPVC pipes (*first revision*)
(13)	2692 : 1989	Specification for ferrules for water services (*second revision*)
(14)	302 (Part 1) : 2024 / IEC 60335-1 : 2020	Household and similar electrical appliances — Safety Part 1 General requirements (*seventh revision*)
	2082 : 2018	Stationary storage type electric water heaters — Specification (*fifth revision*)
(15)	7558 : 1974	Code of practice for domestic hot water installations
	16093 : 2013	Installation of gas based instantaneous water heater — Code of practice
(16)	6295 : 1986	Code of practice for water supply and drainage in high altitudes and/or sub-zero temperature regions (*first revision*)
(17)	6494 : 1988	Code of practice for water-proofing of underground water reservoirs and swimming pools (*first revision*)
(18)	3328 : 1993	Quality tolerances for water for swimming pools
(19)	16508 : 20217	Swimming pool for public – Code of safety
(20)	2379 : 2024	Colour code for pipeline identification — Code of practice (*second revision*)
(21)	17150 : 2019	Mini domestic water heater for use with piped natural gas (PNG) – Specification
(22)	17650 (Part 1) : 2021	Water efficient plumbing products — Requirements Part 1 Sanitaryware
(23)	12976 : 2023	Solar water heating systems — Code of practice (*first revision*)
	17650 (Part 2) : 2021	Water efficient plumbing products — Requirements Part 2 Sanitary fittings

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