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CODE OF PRACTICE FOR PLUMBING IN MULTI-STOREYED BUILDINGS

PART 1 WATER SUPPLY

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BUREAU OF INDIAN STANDARDS
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Indian Standard

CODE OF PRACTICE FOR PLUMBING IN MULTI-STOREYED BUILDINGS

PART 1 WATER SUPPLY

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CODE OF PRACTICE FOR PLUMBING IN MULTI-STOREYED BUILDINGS

PART 1 WATER SUPPLY

0. FOREWORD

0.1 This Indian Standard was adopted by the Bureau of Indian Standards on 30 July 1987, after the draft finalized by the Water Supply and Sanitation Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Many administrative authorities controlling water supply have their own sets of bye-laws, rules and regulations for water supply to suit local conditions. These should be strictly conformed to before operations are commenced for laying pipe lines or plumbing systems which are to be connected to public water supply. This code is intended to give the necessary guidance on good practices of plumbing.

0.3 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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1. SCOPE

1.1 This code deals with water supply in multi-storeyed buildings and covers general requirements and regulations, design considerations, plumbing systems, distribution system, storage of water and inspection for water supply in multi-storeyed buildings.

1.2 Requirements of water piping, fittings and appliances, inspection, and maintenance covered in IS : 2065-1983† shall be applicable for multi-storeyed buildings also.

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*Rules for rounding off numerical values (*revised*).

†Code of practice for water supply in buildings (*second revision*).

2. EXCHANGE OF INFORMATION

2.1 Full coordination at the planning stage between the architects, owners, civil engineer, contractor and electrical contractor is essential. Provision for spaces for pipe runs, ducts, tanks, pumping systems and other elements shall be made in advance so as to prevent any overlapping with other services of the building.

2.2 All pipe runs, apprutenances and valves shall be located in a manner to provide easy access for maintenance and repair.

2.3 All information regarding additional load on structures for water tanks etc, shall be given to the structural engineer for incorporation in the structural design.

2.4 Data for designing the electrical and mechanical system shall be given to the concerned engineer.

2.5 Installation plans for record purposes shall be provided on completion of the installation.

3. ESTIMATION OF WATER SUPPLY DEMAND

3.1 Demand of water supply in each type building is not accurately determinable due to various factors, for example, type of building, usage, economic conditions of users, hours of supply and climatic conditions.

3.2 The requirement of water for different types of buildings is given in IS : 1172-1983* These requirements are minimum recommended and care should be taken to study each project in accordance with circumstances applicable and the requirement of water estimated accordingly.

3.3 Provision shall be made for additional quantities of water required for special uses, for example, air-conditioning system, gardening, for process or laboratory use. For requirements regarding water supply for fire fighting reference may be made to IS : 9668-1980†.

3.4 Provision for additional water supply for any future expansion in the building shall be made.

3.5 Population Projection — 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) Residence	5 persons per dwelling unit area
b) Offices	1 person/10 to 15 m^2 of plinth area

*Code of basic requirements for water supply, drainage and sanitation (*third revision*).

†Code of practice for provision and maintenance of water supplies for fire fighting.

c) Schools	Strength of the school plus teaching and other staff
d) Hostels	Number of beds plus 4·5 × warden's residence plus staff
e) Hotels	Number of beds plus staff plus requirement of restaurant seats
f) Hospitals	Number of beds plus staff (residential requirement, if any, should also be added)

Five to 15 percent additional population depending on the usage of the building shall be added for visitors and floating population likely to use the building facilities.

4. DESIGN CONSIDERATION

4.1 Piping systems shall be designed to cater for various types of fixtures as given in Table 1.

TABLE 1 RATE OF FLOW AND FIXTURE UNITS

	Rate of Flow litres/second	Fixture Units		School/Industrial Buildings
		Residential	Offices	
W. C. with flushing cistern	0·12	2	2	2
Wash basin	0·15	1·5 3*	1·5	3
Wash basin with spray taps	0·04	2	2	2
Bath tub (private)	0·30	10	—	—
Bath tub (public)	0·60	—	—	22
Shower (with nozzle)	0·12	3	—	—
Sink with 15 mm tap	0·20	3	3	3
Sink with 20 mm tap	0·30	4	4	4
Sink with 35 mm tap	0·40	5	5	5

*Concentrated use.

4.2 For ease of designing and working out the probable simultaneous demand (*see* **4.4**), each fixtures has been given a fixture unit (FU). Fixture units have no precise unit in terms of litres/second but are based on the rate of flow for each unit and average time of use for each fixture.

4.3 The fixture units are based on and used on a piping system which has a common down take.

4.4 Simultaneous Demand

4.4.1 The probability of all taps being open simultaneously except in a small group of fixtures is remote. In order to work out the probable demand, a study of each work shall be made to ascertain the type of building, periods of water usage, etc.

4.4.2 Where water is supplied 24 hours a day without interruption, the probable demand would be minimum. It would be maximum, if the hours of supply are least.

4.4.3 Simultaneous demand could be 100 percent of the gross demand in certain cases, for example, showers and toilets in stadium, gymnasiums, swimming pool, students' hostels, industrial and office wash rooms and similar other establishments where the water usage could be concentrated during a short period.

4.4.4 Probable simultaneous demand may also be worked out by the relation:

$$m = \sqrt{n}$$

where m is the probable number of appliances in use and n is the total number of appliances installed.

4.4.5 Figure 1 gives a chart from which the probable demand in litres per second may be worked out by adding the number of fixture units installed on each line.

4.4.6 Certain type of fixtures and connections, for example, urinals or connections to cooling tower of air-conditioning systems required a continuous flow of water throughout their period of use. Load of this type of use should be added after the probable demand in a line has been calculated.

4.5 Outlet Pressure — Pressure at each outlet shall be enough to overcome the frictional losses through the fixture and provide the desire flow. (*see* IS : 2065-1983*),

5. SOURCE OF SUPPLY

5.1 Before planning the water supply system source(s) of water supply should be identified and established.

5.2 The source of supply may be any one or more of the following:

a) Municipal filtered water supply from mains running near the premises.

b) Sub-soil sources such as open well and tubewells.

c) Surface such as lakes, rivers or canals.

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*Code of practice for water supply in buildings (*first revision*).

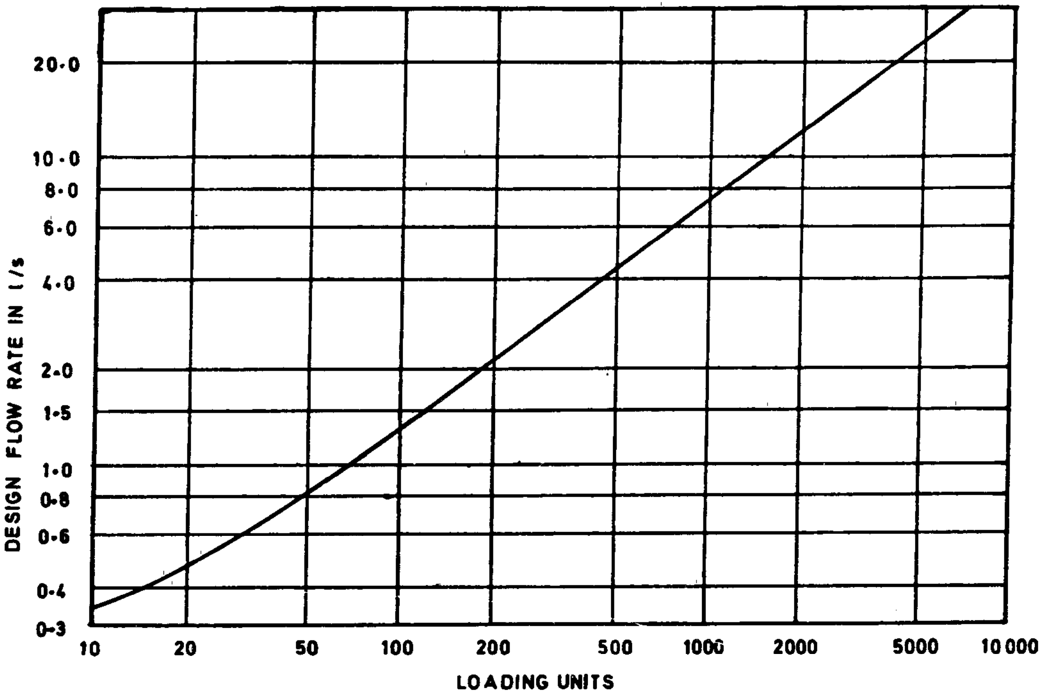


Fig. 1 Loading Units and Design Flow Rate

5.3 Municipal Supply — Before tapping municipal supply, permission from concerned authority shall be obtained to draw water from the source. Information regarding size of main, location of tapping, pressure available and hours of supply shalll be obtained.

5.4 Sub-Soil Sources — When water is obtained from a sub-soil source, information regarding the sub-soil water table (high and low), quantity available, quality and potability of water shall be ascertained. Use of sub-soil water source shall be determined with or without subsequent treatment on the basis of above analysis. Licence for taping sub-soil sources, if required under the prevalent rules in any town/municipality, should be obtained from the Authority.

5.5 Surface Sources — When water is obtained from water of any surface source, information regarding the location, high and low water levels, flooding conditions. method of pumping, chemical and bacteriological quality of water in different seasons, and turbidity shall be obtained. Desirability and method of treatment shall be based on information so obtained.

6. DISTRIBUTION SYSTEM

6.1 There are four basic methods of distribution of water to a multi-storeyed buildings.

6.1.1 Direct supply from mains to ablutionary taps and kitchen with WCs and urinals supplied by overhead tanks.

6.1.2 *Direct Pumping Systems*

6.1.3 *Hydro-pneumatic Systems*

6.1.4 *Overhead Tanks Distribution*

6.2 Direct Supply System — This system is adopted when adequate pressure is available round the clock 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. This system is covered in IS : 2065-1983*.

6.3 Direct Pumping

6.3.1 Water is pumped directly into the distribution system without the aid of any overhead tank, except for flushing purposes. The pumps are controlled by a pressure switch installed on the line. Normally a jockey pump of smaller capacity installed which meets the demand of water

*Code of practice for water supply in buildings (*second revision*).

during low consumption and the main pump starts when the demand is greater. The start and stop operations are accomplished by a set if pressure switches are installed directly on the line. In some installation, a timer switch is installed to restrict the operating cycle of the pump.

6.3.2 Direct pumping systems are suitable for buildings where a certain amount of constant use of water is always occurring. These buildings are all centrally air-conditioned buildings for which a constant make up supply for air-conditioning cooling towers is required.

6.3.3 The system depends on a constant and reliable supply of power. Any failure in the power system would result in a breakdown in the water supply system.

6.3.4 The system eliminates the requirements of overhead tanks for domestic purposes (except for flushing) and requires minimum space (*see* Fig. 2).

6.4 Hydro-pneumatic Systems

6.4.1 Hydro-pneumatic system is a variation of direct pumping system. An air-tight pressure vessel is installed on the line to regulate the operation of the pumps. The vessel is arranged to consist of approximately half the capacity of water. As pumps operate, the incoming water in the vessel, compresses the air on top. When a predetermined pressure is reached in the vessel, a pressure switch installed on the vessel switches off the pumps. As water is drawn into the system, pressure falls into the vessel starting the pump at preset pressure. The air in the pressure tank slowly reduces in volume due to dissolution in water and leakages from pipe lines. An air compressor is also necessary to feed air into the vessel so as to maintain the required air-water ratio.

6.4.2 There are various types of system available in the market and the designers has to select the system according to the needs of each application.

6.4.3 Hydro-pneumatic system generally eliminates the need for an over head tank and may supply water at a much higher pressure than available from overhead tanks particularly on the upper floors, resulting in even distribution of water at all floors (*see* Fig. 3).

6.5 Overhead Tank Distribution

6.5.1 This is the most common of the distribution systems adopted by various type of buildings.

6.5.2 The system comprises pumping water to one or more overhead tanks placed at the top most location of the hydraulic zone.

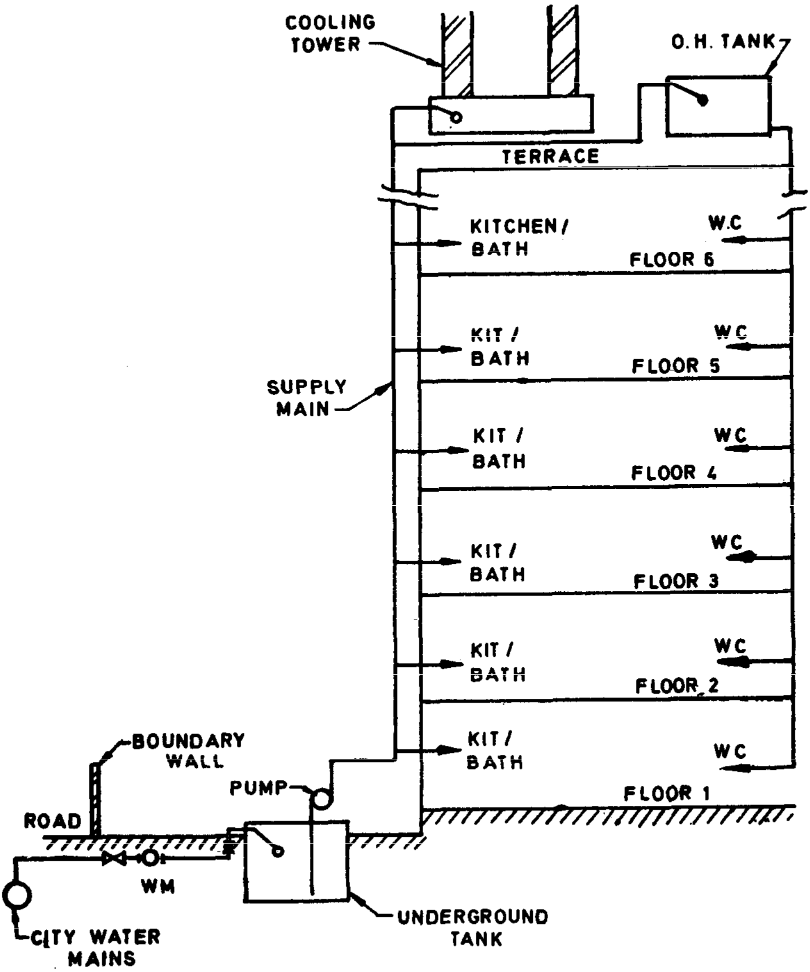


Fig. 2 Direct Pumping System Applicable Where There is Continuous Demand on System

6.5.3 Water collected in the overhead tank is distributed to the various parts of the building by a set of pipes located generally on the terrace.

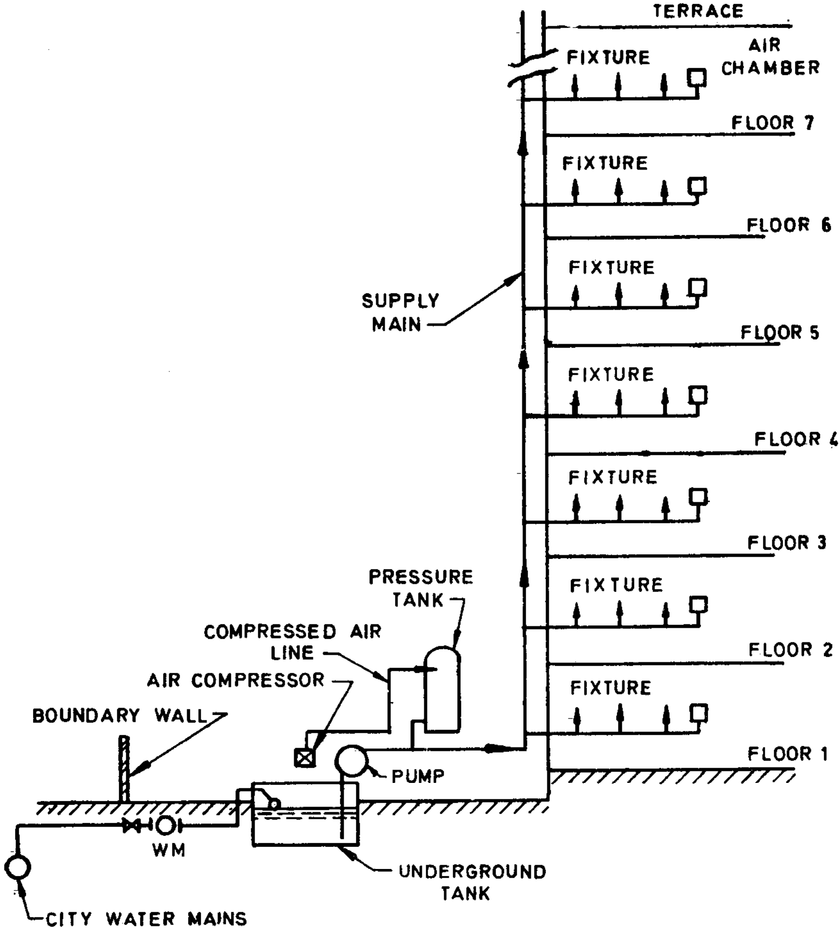


FIG. 3 HYDRO-PNEUMATIC SYSTEM

6.5.4 Distribution is accomplished by providing down takes to various fixtures (*see* Fig. 4).

7. DESIGN OF DISTRIBUTION SYSTEM

7.1 Distribution system in a multi-storeyed building should be designed to provide (as far as practically possible) equitable flow and pressure at all the floors.

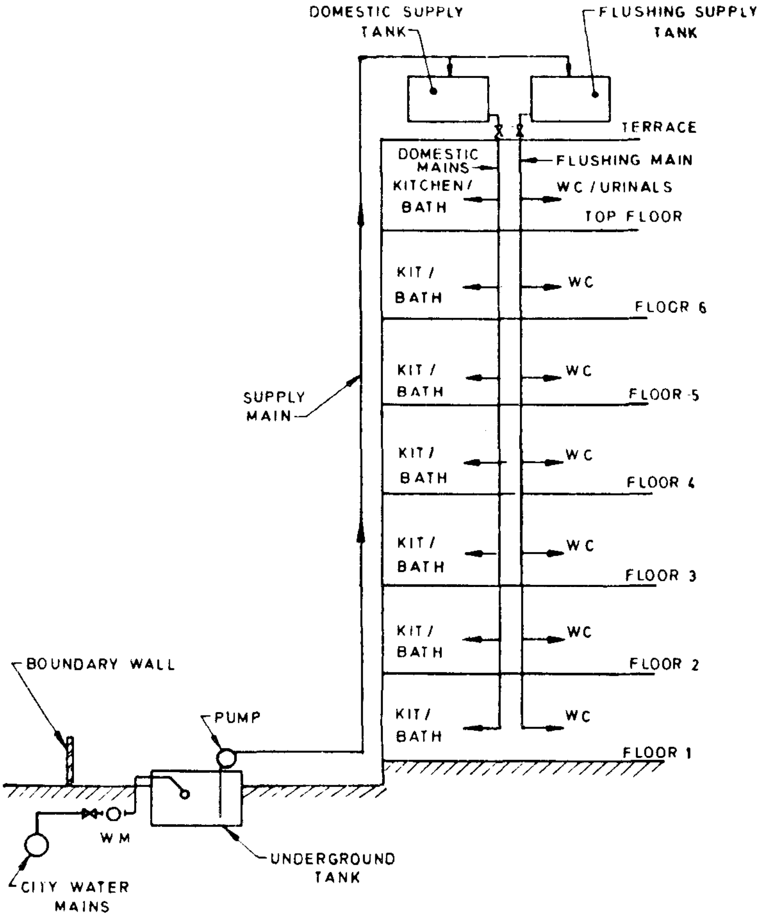


Fig. 4 Overhead Tank Distribution

7.2 Care should be taken to obtain the flow required for the minimum pressure at all parts in the building.

7.3 Excessively high pressure should be avoided on every floor.

7.4 In tall buildings, the building should be divided in vertical hydraulic zones so that the static pressure in any zone does not exceed 24-30 m (*see* Fig. 5).

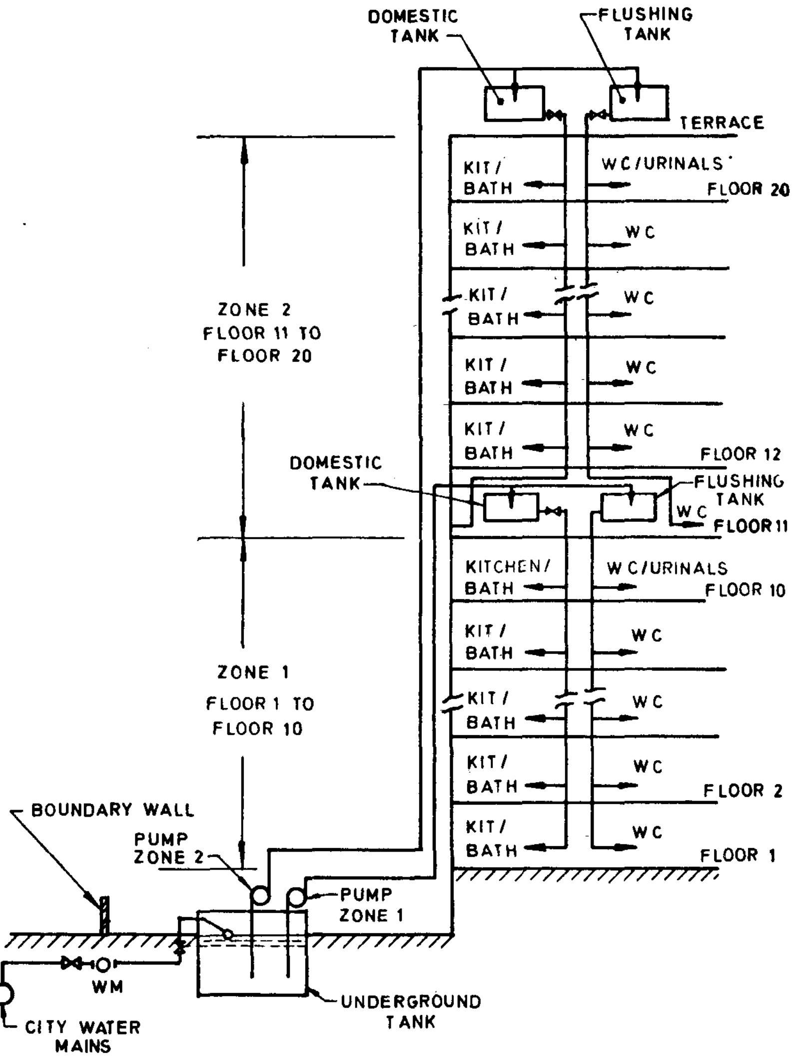


FIG. 5 HYDRAULIC ZONES FOR TALL BUILDING

7.5 Wherever static zones are necessary, water shall be supplied to each zone from an overhead tank located at least 3 m above the zone.

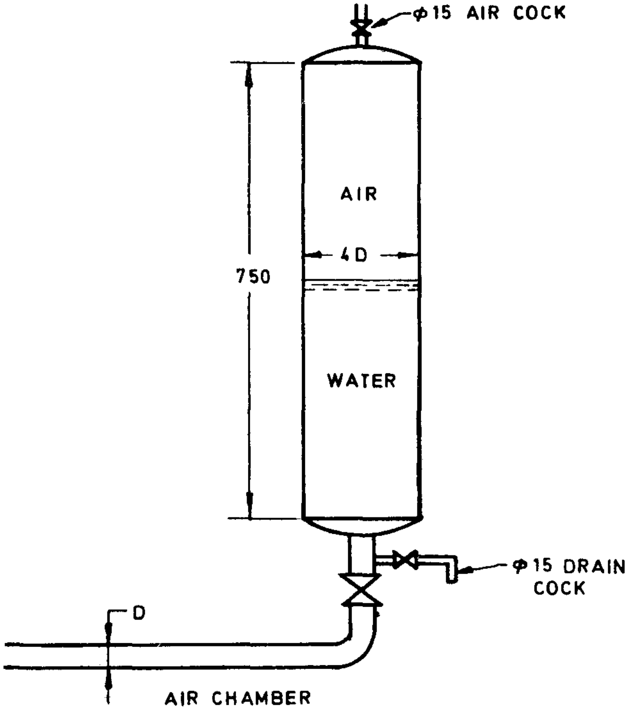
7.6 In buildings where division of the building in vertical zones is not practical or possible, supply from each riser or drop should be restricted to a maximum of 8-10 floors so as to restrict the maximum static head to 30 m. Alternatively, pressure in the lower floors may be restricted by use of pressure reducing values, orifice flanges or other similar devices.

7.7 Designing of the Piping System

7.7.1 Designing of the piping systèm should be done by considering the pressure loss at each level and head available at that level for the required flow.

7.7.2 It is recommended that the velocity of water in pipes should be restricted to 2·0 m/s to avoid noise problem.

7.7.3 Systems connected to hydro-pneumatic or direct pumping systems should be provided with suitable air chambers for protection against water hammer and noise problems (*see* Fig. 6).



All dimensions in millimetres.

FIG. 6 TO BE INSTALLED ON HYDRO-PNEUMATIC SYSTEM AT THE END OF EACH BRANCH LINE FOR CONTROL OF WATER HAMMER

7.7.4 Adequate anchorage and support to pipes below and above floors or at ceiling level should be provided.

7.7.5 Provision for expansion in pipe lines in the building structure should be made.

7.7.6 Pipes should be designed to withstand the additional pressure due to water hammer.

8. STORAGE CAPACITIES

8.1 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 tanks (in case of direct supply systems) or underground storage reserviors;

b) Frequency of replenishment of overhead tank during 24 hours;

c) Rate and regularity of supply; and

d) Consequences of exhausting the storage, particularly in buildings like hospitals.

8.2 When a single supply is provided, it is not necessary for health reasons to have separate storage for flushing and domestic requirements. The storage tank shall, however, not be connected directly with the supply pipe of the authority.

8.3 Dual Supply

a) Wherever two separate types of supply are being used, for example, municipal supply and tubewell supply, it is advisable to have their pumping and rising main system separate and independent of each other.

c) Wherever systems using recycled treated water is used in a building for flushing or air-conditioning purposes, the entire system of storage, pumping, rising main and distribution system shall be separate and independent of the domestic supply system.

8.4 Underground Storage — The storage capacity of water for a building should be provided for one day requirement of water and the storage capacity of underground tanks should be 50 percent of overhead tanks.

Where direct pump or hydro-pneumatic systems are provided to avoid the overhead tanks, the capacity of the underground tanks should be for 24 hours requirement.

8.5 The requirement for flushing may be taken as one-third of the total requirement and two-third for domestic requirement.

8.6 The above requirement of storage do not include requirements of water for air-conditioning systems or fire fighting.

8.7 Underground/Suction Tanks

8.7.1 *General*

a) Any pumping system adopted should be accomplished through a suction tank located near the pumps.

b) As far as possible, flooded suction conditions are desirable as it improves the working conditions of the pumps.

c) Wherever suction conditions are negative, care should be taken to provide access to foot valves for maintenance and repairs, and maintain its priming.

8.7.2 Underground storage tanks should be construted to meet the following requirements:

a) Tanks should be watertight.

b) Care should be taken to prevent ingress of sub-soil water into the tanks.

c) Adequate precautions should be taken to prevent surface water from finding its way into the tanks.

d) Care should be taken to avoid any backflow of surface waters or drains into the tanks through overflow pipes.

e) Tanks should be provided with suitable scour pipe of adequate size where it is possible to empty the same under gravity flow conditions or emptying of tank should be done by means of pumping.

f) Tanks should be provided with at least one vent pipe for area not exceeding 20 m^2.

g) Each tanks should be provided with adequate number of water-tight and lockable manholes. All inlets, outlets and control connections should be provided near manholes for easy access and repair. Suitable rust proof steps or ladders should be provided under manholes for access.

h) Tank slab should designed for any additional loads of vehicles that may be encountered. Top of slab should be provided with slopes to drain out any surface water.

j) Underground tanks should not be located in low lying areas near septic tanks, soak pits, oil tanks, parking lots areas where there is a risk of water being polluted.

8.8 Overhead Storage

8.8.1 Overhead tank should be constructed to meet the following requirements:

a) The structure should be designed to carry the load of tank and water.

b) The tank should be at least 600 mm above the terrace level.

c) In case mild steel tanks or G. I. sheet tanks are used, care should be taken to prevent cathodic action and consequent corrosion. A sacrificial magnesium anode may be provided. Tanks should be painted inside with suitable anti-corrosive non-toxic paint. Tanks may by painted from out side with enamel or ready mix paint. Galvanized tank need not be painted.

d) A suitable ladder should be provided for access to manholes.

e) Adequate fencing or parapet should be provided for security.

f) Suitable lightening arrestors should be provided for the tanks, where necessary.

9. PUMPING SYSTEM

9.1 Wherever direct pumping or hydro-pneumatic systems are provided (*see* **6.3** and **6.4**), the pumping systems are provided to meet the designed peak flow in the system by one or more pumps. The systems should be arranged so that, if the first pumps fails to meet the demand, the second pump will go in operation until the demand is met. One additional stand by pump shall always be provided.

9.2 Where overhead tank supply system is adopted and adequate overhead tank capacity is available, the pumping rate should be 1·5 times the average requirement.

9.3 In areas with power supply available in limited hours, the pumping rate may be correspondingly increased. Wherever emergency power supply is available, it may be advisable to connect the pumping sets to such a source of power.

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