

PLUMBING

Edition 2

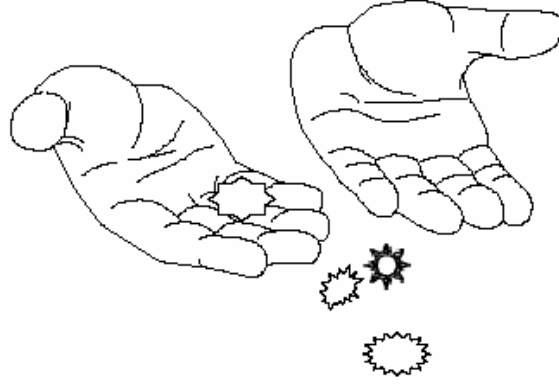
MADE EASY FOR COMMON MAN

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“ THANKS ”

| | अर्पण | |

This book is a dedication to my mother Smt. Savitri Daiya, who has been instrumental to bring in to this world.

My father, Late Shri K. B. Daiya who not only taught me about plumbing but also was a pioneer of the Daiya Empire of Plumbing.

My uncle, Late Shri O. B. Daiya, an engineer of my family was back then a Licensed Plumber and my mentor in this field.

My inspiration, my friend, my guide, my philosopher, Mrs. Mrudula Daiya.

My two sons, Chintan & Heten, who have helped me a lot in compiling this book, with illustrations and articles.

It would be unjust if I left out the name of Shri D.A. Limaye, a wizard of this industry, a retired chief engineer of Bombay Port Trust, a consultant & arbitrator, whose auditing in the previous edition has led to this refined edition.

Moreover, you as a reader deserve a dedication, since your response to the first edition has encouraged me to come up with this new edition.

- Deepak Daiya

I ntroduction to Plumbing

Plumbing is as old as our Indus valley civilisation, the traces of which are available in the valleys of Mohenjodaro & Harrappa, which you must have certainly read in your schooling days. It seems that the consciousness of hygiene is developing amongst us. It would be an endeavour to share my teachings along with you all. It would be better to make you aware of the fact that the profession of plumbing has it's own pros and cons as it is not only defined to new installations for water supply & maintenance, but also has drainage as it's most important subject. Because, in the absence of drainage, water supply will create nothing but puddles of water, an inviting place for mosquitoes to breed, resulting in health hazards.

The drainage: Installation of drainage is a laborious job. Cleaning of drains (removal of chokes) is a job for which you should be mentally prepared, keeping in view the dignity of labour, which is always paying. Even after realising this, if it is yet found interesting then it is very encouraging. It is assured that you will become the best plumber in the vicinity.

The subject which we would start with is **Water supply**. It comprises of all installations right from the water meter, where the plumber / water first enters your premises upto the tap in your house. The plumber's efficiency is measured by water which flows out of the tap in our house.

We have divided this subject into three zones, namely:

1. Water supply from water meter upto your tap i.e. external & internal plumbing including modern concealed fittings.
2. Various kinds of pipes & fittings used for water supply.
3. Internal layouts of Bathrooms & W. C.

Daily requirement of water.

We generally need water for various purposes in the house namely Flushing purposes and Domestic purpose.

To work out the **daily water requirement of the building** following formulae should be used as per the rules of Municipal Corporation Of The Greater Mumbai.

On the basis of carpet area of tenement for **residential** buildings

upto 500 sq. ft (50 sq. m)	7 persons
501 to 750 sq. ft.(51 to 75 sq. m.).....	8 persons
751 to 1000 sq. ft.(76 to 100sq. m)	9 persons
above 1001 sq. ft.(100 sq. m)	10 persons.

For residents the Corporations supplies 40 gallons (180 lit.) per head per day.

Out of which 27.5 gallons (125 lit.) for domestic purpose viz. Bathrooms and kitchens.

12.5 gallons(55 lit.) for flushing purpose viz. For w. c. or urinals.

The capacities of the storage tanks :-

Suction tank viz. Under ground or above ground water storage tanks
= **50% of the total daily requirement.**

Overhead **FLUSHING WATER STORAGE TANK** = **1 x daily flushing requirements**

Overhead **DOMESTIC WATER STORAGE TANK** = **0.75 x total daily domestic requirements**

Please Note:- The corporation as on date supplies 30 gallons of water per head per day, but for determining the capacity of tanks, 40 gallons is yet considered.

For **COMMERCIAL PREMISE OR SHOPS (SELF CONTAINED)**.

2 persons per shop

10 gallons per head per day.

Out of which 5.5. gallons for flushing purposes.(25 litres.)

4.5 gallons for domestic purposes. (20 litres.)

Hospitals :- Upto 100 Beds 75 Gals / bed (340 litres)

Above 100 Beds 100 Gals / bed (450 litres)

Factory :- 25 Persons per W. C.

OR

9 Persons / gala @ 10 Gals/ day / head. (45 litres)

School :- 40 students / class room @ 10 Gals / Student / day. (45 litres)

School with boarding :- 30 Gals/ Student. (135 litres)

Hostel :- 2 Beds / Room @ 30 Gals / Person. (135 litres)

Restaurant, Hotels, Guest House.:- 15 gals / seat / day. (70 litres)

Theatre :- 3 Gals / day / seat (15 litres)

Office :- 10 Gals (45 litres) / day / person; 25 persons/toilet & 10persons/ toilet in case of Toilets for senior staffs

The water requirements for office and factories can also be worked out as following on the basis of number of w. c. s provided.

Plumbing Fixtures Or Fixture Units	Maximum Flow Rate or Quantity
WATERCLOSET	1.6 GALLONS PER FLUSHING CYCLE
URINAL	1.0 GALLON PER FLUSHING CYCLE
SHOWERHEAD	2.5 G.P.M. AT 80 P.S.I.
LAVATORY, PRIVATE	2.2 G.P.M. AT 60 P.S.I.
LAVATORY, PUBLIC	0.5 GALLON AT 80 P.S.I.
LAVATORY, PUBLIC, SELF CLOSING	0.25 GALLONS PER METERING CYCLE
SINK FAUCET	2.2 G.P.M. AT 60 P.S.I.

It is necessary to have metered down take supply for the shopping / commercial premises in the residential building from the over head tank, for the civic authorities to differentiate the billing.

Also there are different ways of working out the daily requirements of the big office and factory buildings, it can also be worked out on the number of actual users .

Some Municipal corporations have a practice of working out the water requirements of the flats (regardless of area of the tenement) on the basis of 5 person per tenement.

Also the water supply per capita per day differs from Civic Authority to Authority

✕ All the water tanks should be fitted with well visible overflow outlets for the inspection of Municipal Inspectors, the same should have mosquito-proof covers and grating on overflow/ warning pipes. As per the Medical Officers Health rules, the tanks should also be fitted with 21” dia covers distance of any cover from the walls of the tanks should not exceed 5’0” (152.4 Cms) & distance between two cover should not exceed 7’0” (213.36 Cms) as illustrated in fig.15..

Hydro-Pneumatic Distribution System

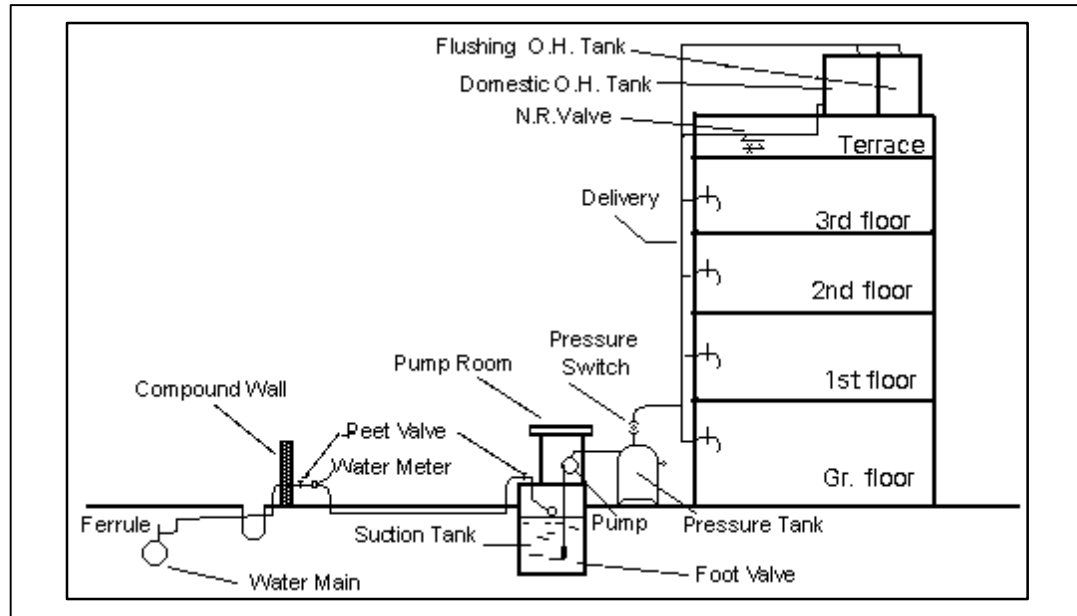


fig.2.

In brief, **Hydro-Pneumatic** system is the system in which water from the suction tank is pumped into the pressure tank having a pressure switch on it, which is capable of controlling water supply at the required pressure in the pressure tank, the pressure switch also activates or deactivates the operation of the pump, in case of drop or rise of pressure in the tank respectively.

Water, as illustrated in fig.2., is first pumped from the suction tank to a pressure tank, which is further pumped directly at the required pressure to the fixtures. One standby overhead tank has to be provided to the to ensure uninterrupted supply to the premises in case of failure of the system or in the case of power failure, which is quiet common.

Designing proper distribution system, can vary from pump to pump & manufacturer to manufacturer. The distribution system can also be obtained from the manufacturers of these type of pumps & also can be derived by applying various formulae. The supply system for the same is as shown in fig.2.

A well designed terrace loop as per the drawings / design of the plumbing engineer or consultants is provided on the terrace for equal and uniform supply to telescopic down takes from the OH water storage tanks which are also shown in figure no. 3.

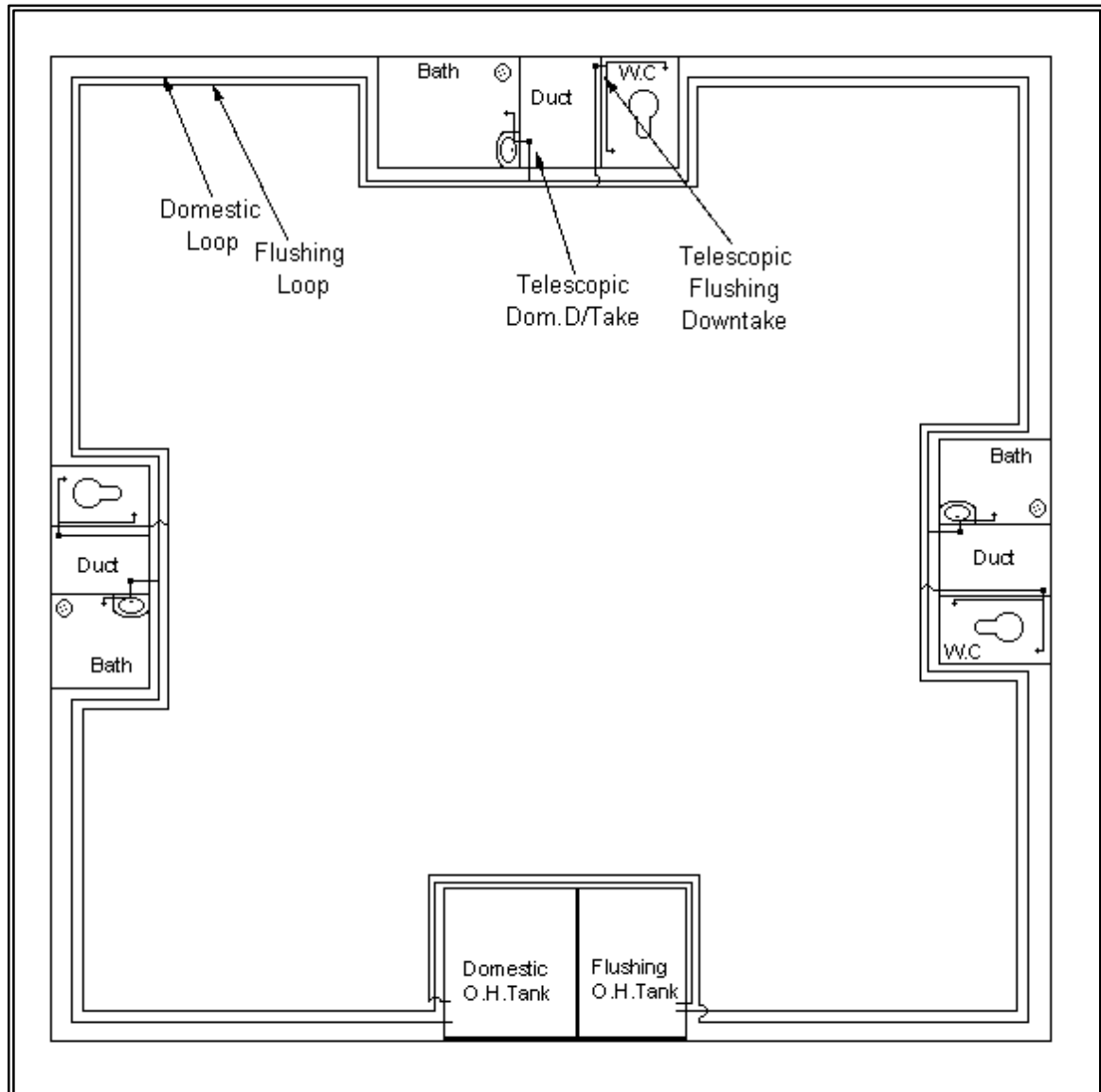


fig.3.

A terrace loop can be worked out by applying some important statistics and simple mathematical formulae as given hereafter.

To work-out the terrace loop, first and foremost factor to be kept in mind is the peak demand factor, Simultaneous demand factor.

Peak Demand For Residential Buildings for *Domestic Purposes*.

Wash Hand Basin --- ½ Gals / Minute.

Shower --- ½ Gals / Minute.

Tap in Bathing Area --- 1 Gal / Minute.

Kitchen --- 1 Gal / Minute

Total 3 Gals / Minute / Flat having only one toilet.

Factor of kitchen may be omitted from the flats having more than one toilets, proportionately.

But the **peak demand** factor as a general practice is **75% of above.**

Peak Demand For Flushing:- Assuming 6 flushes / hour each flush consuming 2 gallons
= 6 x 2 gallons = 12 gallons / hour.

Design calculation for Terrace Loop for a Building, having 4 shops on ground floor, and 7 upper stories having 2 flats of carpet area 475 sq. ft., 2 flats of 695 sq. ft., 1 flat of 935 sq. ft and 1 flat of 1235 sq. ft. having to tal on each floor.

Peak domestic :- 4 kitchens x 7 floors = 28 kit x 1 gal / minute. = 28 G.P.M.
demand 6 W.B. x 7 floor = 42 W.B. x ½ gal / minute = 21 G.P.M.
6 showers x 7 floors = 42 showers x ½ gal / minute = 21 G.P.M.
6 taps x 7 floors = 42 taps x 1 gal / minute = 42 G.P.M.
Peak demand = 112 G.P.M.

Simultaneous demand factor = 0.75 x 112 = 84 x 60 minute = 5040 Gallons / hour

Q = Peak demand in cusecs = cubic feet/seconds

Considering two outlets from the tank Peak demand per outlet = $\frac{5040}{2} = 2520$ [G.P.H.
[per outlet

Therefore cusecs = $\frac{\text{G. P. H.}}{22,500} = \frac{2520}{22,500} = \mathbf{0.112 \text{ Cusecs}}$

L = Length of loop, say 400 ft . Therefore, Length per outlet = $\frac{400}{2} = \mathbf{200 \text{ ft.}}$

H = Effective head = ½ height of the tank + distance from terrace slab to bottom of tank

= (½ x 4) + 6 = 2 + 6 = **8ft**

Now we will be working out the “**K**” Value of the dia of terrace loop. The same can be converted into the actual dia in inches by referring the table 1.

$$K = \frac{H}{Q \times Q \times L}$$

$$K = \frac{8}{0.112 \times 0.112 \times 200} = \frac{8}{2.5088} = 3.1888$$

K VALUE OF 2½ INCH = 2.58
3 INCH = 1.03

Therefore to be on the safer side 2½ dia terrace loop would be ideal .

FLUSHING TERRACE LOOP :-

Q = No. of toilets x 12 gals / hour

$$= 42 \times 12 = 504 \text{ gals / hour} = \frac{504}{22,500} = 0.0224 \text{ cusecs.}$$

Now

$$K = \frac{8}{0.0224 \times 0.0224 \times 200} = \frac{8}{0.100352} = 79.7194$$

Thus **K value** for 1½ = 33.23
for 1¼ = 82.69

Therefore to be on the safer side 1½ sized terrace loop would be ideal

K Value	Dia	K Value	Dia
8076	1/2 inch	7.88	2 inch
1063	3/4 inch	2.58	2 1/2 inch
252	1 inch	1.0347	3 inch
82.69	1 1/4 inch	0.1944	4 inch
33.23	1 1/2 inch	0.0256	6 inch

Now we have entered the bathroom / WC / Kitchen or full fledged toilet. From this point onwards our internal water supply starts, which can be either concealed or exposed plumbing. But prior to starting internal plumbing it is necessary to know the different pipes, taps, valves, fittings etc. being used in plumbing today.

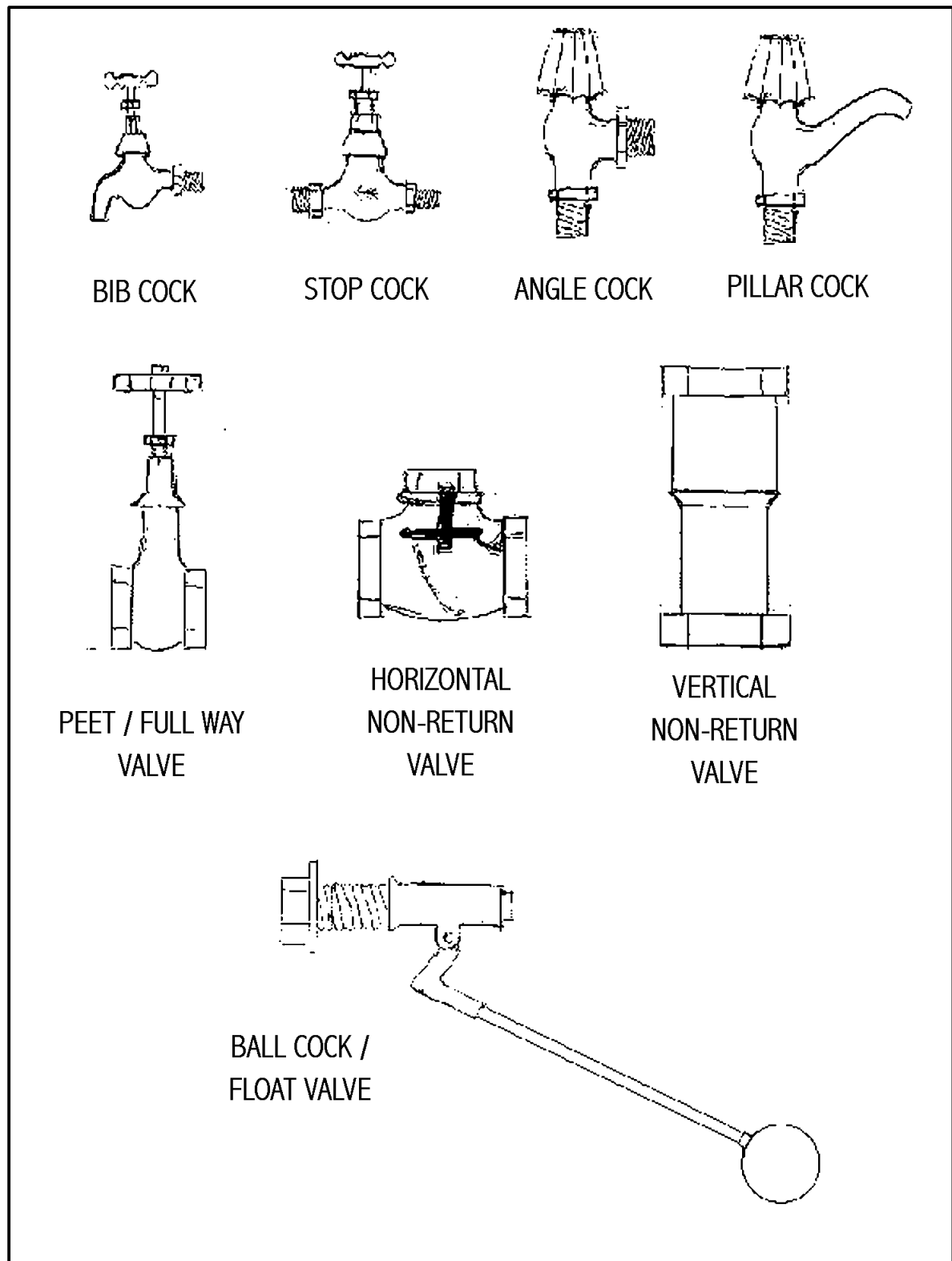


fig.4.

The above figure viz. Fig.4. shows you the different types of taps and valves.

FOLLOWING ARE THE FEW TAPS AND VALVES USED IN DAY TO DAY PLUMBING

BIB TAP :- Most commonly called as ordinary tap or faucet used for drawing and controlling water.

STOP COCK :- Used on the pipe line, having threading on inlet and outlet in one straight line and used for controlling water supply to any apparatus or complete toilet if used as master cock.

ANGLE COCK :- It is nothing but one type of stop cock having inlet and outlet at a right angle. The uses are same as the stop cock.

BALL COCK :- Is a cock connected with a float either of moulded two half rounds of PVC or copper controlling the water supply on the movement of the float. The supply closes when float comes up. This is used for stopping the water supply to the water storage tanks when the tank is full and allows the water fill in the tank when empty.

PEET VALVE :- This is full way valve having female (internal threads) on both inlet and outlet side/ Can be used for controlling on line water supply.

WHEEL VALVE :- This is also one type of control valve but this valve is not full way valve hence it is not being used very commonly, especially where full supply is required.

NON RETURN VALVE :- Non return valve is used where only one way water supply is required. Different valves for horizontal and vertical application are available.

PRESSURE REDUCER VALVES :- These valves are fixed in the high rise buildings having more than 80 feet height . Needs to be fixed below 80 feet from the top of the down takes, to regulate excess gravity pressure due to height as shown in fig.6.

BALL VALVE:- These valves are also full way valve having rotating valve with full passage, having a lever on the top, which is quarter turning.

Different classes of pipes are as following:-

A:- The most common and conventional pipes are Galvanised Iron pipes, which can be divided into three classes, namely 'A' CLASS, 'B' CLASS, and 'C' CLASS. These can be differentiated from the coloured band it has .

Red coloured band indicates that the pipe is of 'C'CLASS, which is heavy quality pipe. It is mainly used for concealed plumbing and underground works. Also, it is necessary to use all the pipes of this class in high rise building having more than 80 feet height. It also bears embossed mark "H" along with the trade name of the manufacturers.

Blue colour and "M" indicates the medium quality pipes of "B" class, which can be used for exposed or open plumbing for the building having height less than 80 feet.

Yellow colour and "L" indicate the light duty pipes which are not used in good plumbing these days.

Joining :- Pipes to be cut to the required length, clean cut the surface, de-burr the same and thread the pipes.(threading to be as per British standard pipe threads. Apply sealant like white zinc, bitumen based sealant, Teflon tape etc. and tighten the fittings using pipe wrench.

Tools required for G.I piping work. :- 1)Hack saw 2) File. 3)Pipe threading die available as different sets of ½ to 1" dia, 1 ¼" to 2" dia and so on. 5). Pipe vice for the pipes of required dia., Pipe wrenches 2 nos. of the required size viz 10 to 12" upto 1" dia pipes and 14" to 18" or 24" upto 2" dia.

Specification for G.I Pipes

SIZE	DIAMETER OF PIPES										
In mm	15	20	25	32	40	50	65	80	100	125	150
In inches	1/2.	3/4.	1	1 1/4.	1 1/2.	2	2 1/2.	3	4	5	6
TYPE	WEIGHT OF G.I.PIPES (kg / metre length)										
Light Class (yellow)	1.01	1.48	2.10	2.72	3.40	4.32	6.10	7.20	10.48	~	~
Medium Class (blue)	1.28	1.65	2.54	3.27	3.76	5.31	6.81	8.85	12.68	17.04	20.20
Heavy Class (red)	1.51	1.97	3.08	3.97	4.58	6.38	8.20	10.51	14.97	18.64	22.20
TYPE	WALL THICKNESS OF G.I.PIPE IN MM										
Light Class (yellow)	2	2.35	2.65	2.65	2.90	2.90	3.25	3.25	3.65		
Medium Class (blue)	2.65	2.65	3.25	3.25	3.25	3.65	3.65	4.05	4.50	4.85	4.85
Heavy Class (red)	3.25	3.25	4.05	4.05	4.05	4.50	4.50	4.85	5.40	5.40	5.40

for the quote of it :

If you re successful, you ll win false friend, & true enemies,
SUCCEED ANYWAY .

Some Important Galvanised Iron Malleable Fittings.

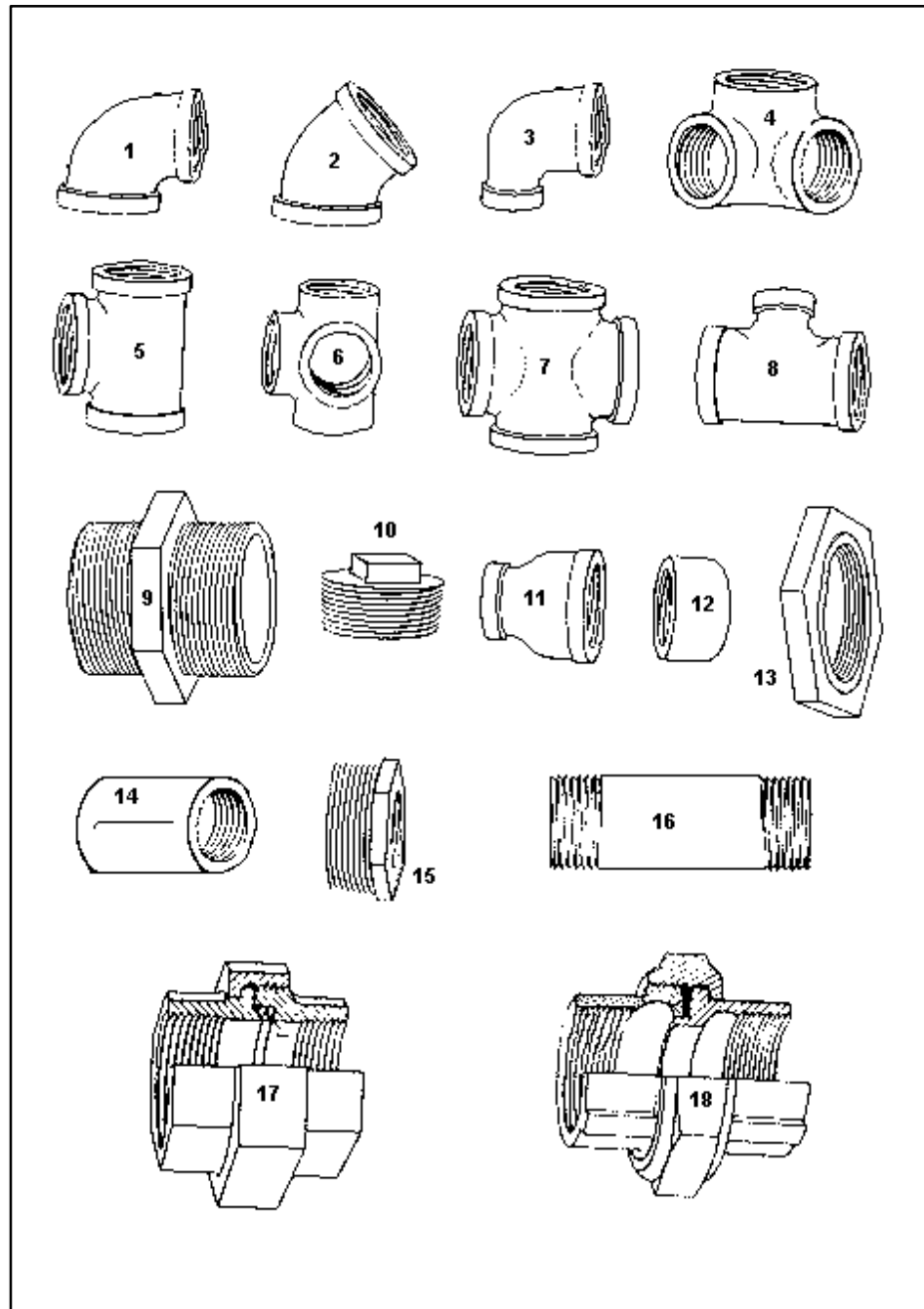


Fig.5.

- | | |
|----------------------------------|----------------------------------|
| 1. Equal Elbow. | 10. Plug. |
| 2. 45° Elbow. | 11. Reducer Coupling. |
| 3. Reducer Elbow. | 12. End Cap. |
| 4. Three Way Elbow / Side Elbow. | 13. Check Nut. |
| 5. Equal tee. | 14. Coupling / Socket. |
| 6. Side Tee / 4 Way Tee. | 15. Bushing. |
| 7. Cross Tee. | 16. Barrel / Pipe Nipple. |
| 8. Reducer Tee. | 17. MS Union with Bronze Seat. |
| 9. Double Nipple. | 18. GI Union with rubber gasket. |

B:- UPVC PIPES:- The name itself is partly self-explanatory as it says unplasticized poly vinyl chloride, the blue coloured plastic pipes in the simplest terminology. These can be threaded like GI pipes.

These pipes are called as ASTM pipes because the same are made as per the American Standard of Testing Materials. Fittings are also available in the same quality, but at some places G. I. Fittings are used in place of moulded fittings for heavier works, since these fittings are moulded are likely to break easily when stress is applied.

These pipes are available in **three qualities**

- 1) Schedule 120 (heavy quality).
- 2) Schedule 80 (medium quality)
- 3) Schedule 40 (light quality)

Joining:- Cutting, threading and joining of this pipes is same as G.I.pipes, avoid using hardening joint sealant where the pipes are required to be re-used..

C:- COPPER PIPES:- These pipes are recently re-introduced in the market for concealed fitting, which is expensive and also because the conventional G. I. PIPES have failed in many instances.

These pipes are also available in mainly three qualities

- 1) **Hard pipes :-** These pipes preferably should be of 20bwg or 0.9mm thickness , but one needs to have elbows at the bending places which increases the joints, joining solders and labour. Although one can use the pipe of 0.7mm or 22 bwg to save the costing
- 2) **Half hard pipes:-** are the pipes which are neither too soft nor too hard. As a result these pipes can be bent with the help of copper pipe benders, which saves cost as there is no elbow and joints. Possibilities of leakage is also reduced.
- 3) **Coiled pipes :-** These pipes are very soft and are available in coil form. These are generally used in Air conditioners where bending is done very often and flexibility is required.

Joining:- These pipes which generally require special type of cutter for better working, can also be cut with ordinary hack saw, clean the area around the cut either with fine emery paper or poly wool, apply flux of prescribed quality and brand. Clean the fitting with poly wool or emery paper from inside, fix the fitting on the pipe or in other words insert the female end of fitting on to the male end of pipe. Heat the ready pipe fittings and touch the lead free solder wire to the fittings in a way that the solder automatically spreads with the help of capillary action. Let the joint come to the temperature of working place.

There are also solder ring fittings available in the market, which are a bit expensive than the end feed fittings, these fittings have got in -built solder at the ends of themselves in a groove, the benefit of using these fittings is, that no solder wire is required for joining.

Some threaded adopters, elbows, tees etc are required to be soldered wherever threaded fittings like showers, taps etc are required to be fixed.

Tools:- Copper pipe cutter, fine file, fine emery paper, poly wool, blow lamp, a pail of water, and clean piece of cloth.

D:- PB & PE PIPES:-

Poly Butylene(PB): These pipes have been very recently introduced in the market in foreign collaboration. These pipes are very versatile. They are only required to be heated to a specific temperature for making joints & they get fused permanently for a lifetime. However, they also happen to be quite expensive. These pipes are grey in colour and can be used for concealed plumbing. It can withstand the high temperature of hot water.

Poly Ethylene(PE): These pipe have also been lately introduced and are black in colour with blue bands on its external wall, length wise. These pipes can be used for external piping, which is exposed to direct sun -light. Ultraviolet rays in the sun -light make pipes brittle, deformed or discoloured and these pipes, unlike UPVC pipes, do not become brittle, deformed or discoloured.

Joining :- Fusion joints are required to be done for these pipes on a special kind of heating, cutting and fixing machine which, as on today is provided by the pipe manufacturers, fittings like tees. Elbows, etc can also be fabricated by using little more skill. In this system also some adopters are required to be fixed wherever joining with threaded fittings is required.

Tools:- Fusion machine having cutting, bevelling, heating facilities in it, Some tissue papers, N.C. thinner for cleaning, special type of pipe cutter for smaller di a pipe or a hack saw. Etc.

E:- MULTI LAYER OR KITEC PIPES : - These pipes are newly introduced in the market. They are bonded, multilayer pipes. Aluminium pipe is covered with plastic, internally as well as externally. These pipes can be joined with the compression fittings supplied by the manufacturers. The only brand name available in the market is 'Kitec' These pipes can be used for transportation of hot water.

Joining:- One of the simplest methods of joining is Kitec pipe joining. Cut the pipe to the required length, de-burr the same, make the pipe perfectly round with the rounding tool, unthread the fitting, remove compression ring from the fitting & insert the same, & tightening the nut on the external wall of the pipe, insert the female end of the pipe of the male end of the fitting & tighten the nut to the male threading of the fitting by using two adjustable screw spanners, & your compression joint is ready for testing.

Tools:- Cutter for cutting Kitec Pipes, de-burring & rounding combination tool, two adjustable pipe screw spanners, etc.

F:- GREY PVC OR AGRICULTURAL PIPES:-

The name of pipes is self explanatory. They are available in various grades right from 4kgf/cm upto 10kgf/cm can be joined with moulded PVC FITTINGS with the help of solvent cement. These pipes are very commonly used in agricultural water supply because it is very easy to work with. It is not advisable to use these pipes for high pressure water transportation.

Joining:- Cut the pipe to the required length with a fine hack saw, clean the internal wall of the fitting, & external wall of pipe with fine emery paper, apply solvent cement, & insert the pipe into the fitting, hold the same for a few seconds & your joint is ready for use. Since these fittings & pipes are not threaded like Kitec, Copper & GI, threaded adapters will be required wherever the threaded fittings are required.

Tools:- One hack saw, Emery Paper & Solvent Cement.

G:- Cast Iron:-

They happen to be of two categories, spun & sand casting pipes. Most common sizes available are 2", 3", 4" & 6" (rain water & soil; varying in wall thickness).

Spun Casting Pipes:- These happen to be the best sort of CI Pipes available, they are centrifugally extruded, they are also of three categories i.e LA, A & B. B is of the best quality, A of the medium quality & LA is of the inferior kind. They are easily toolable, i.e they give a good cut with a plain hacksaw. The process of spinning gives a uniform dense texture to the pipe with closer grain in the metal & greater tensile strength, toughness & elasticity, allowing usage of thinner wall than that of a sand cast pipe of equal strength. Spun pipes are about $\frac{3}{4}$ to $\frac{2}{3}$ of the weight of sand cast pipes of the same class. Spun cast pipes are more compact, free from blow-holes & weight for weight, stronger. Inner surface is also smooth.

Sand Casting Pipes:- These are of the normal mould type pipes, these don't happen to be easily toolable, i.e. they cannot be cut by hacksaws, the cut also obtained is of a very crude type. Though these pipes are not used in places where many cuts are involved, because they are also cheaper than spun pipes. These pipes also have an ISI recognition.

Jointing:- All the Cast Iron pipes can be joined with either rubber ring joints if available, or lead joints or cement joints, after soaking spun yarn into bitumen & filling the joints with cement or lead.

H:- Stone Ware (S.W) & Reinforced Cement Concrete (R.C.C) pipes:-

Stone Ware (S.W): These pipes as the name suggests are made of stone ware or to be precise, they are made of **Earthen Porcelain**. They come in lengths of two feet (2'). The most common sizes available are 4", 6", 9" & 12". They have socketed collars fused on to them. Positioning of pipes should be done as depicted in figure no .6.

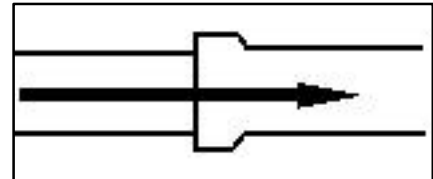


fig.6

Quality Check Of S.W. Pipes

DETAIL	SHOULDN'T BE	SHOULD BE
Pipe Surface	Porous Or visibly cracked	Smooth
Sound	Differing at places	Clear ringing sound
Baking	Burnt at places	Uniformly baked
Wall Thickness	Varying at Places	Min ½ inches throughout

Standard Thickness Of S.W. Pipes

Internal Diameter	Thickness Of Barrel & Socket
100 (4")	12 mm
150 (6")	16 mm
230 (9")	19 mm
300 (12")	25 mm

Test for Stone Ware (S.W) pipes: The breaking weight of the SW pipe should not be less than 770kg applied by means of a flat board of hard wood of the same length as that of the pipe, laid along the top of the pipe through it's length, excluding the socket end. The pipe when subjected to this test, should be supported on a similar flat board underneath the overhanging socket, & a layer of felt laid between the pipe & the boards. SW pipes should not absorb more than 2% of their weight of water when immersed in it for 48 hours.

I:- A.C. pipes are used for soil & waste lines:-

These pipes come in 6 sizes viz. 2", 2 ½", 3", 3 ½", 4" & 6", they are asbestos cement concrete spun pipes which are centrifugally made. They are often clubbed with Cast Iron fittings, the BMC also has a clause in the Bye -Law stating that there should be C.I. pipes at the ground floor level where there are Asbestos Cement pipes.

Jointing:- Can be a cement joint as per the joint of C.I. pipes.

The A. C. & C. I. pipes & fittings are as shown in the figure below.

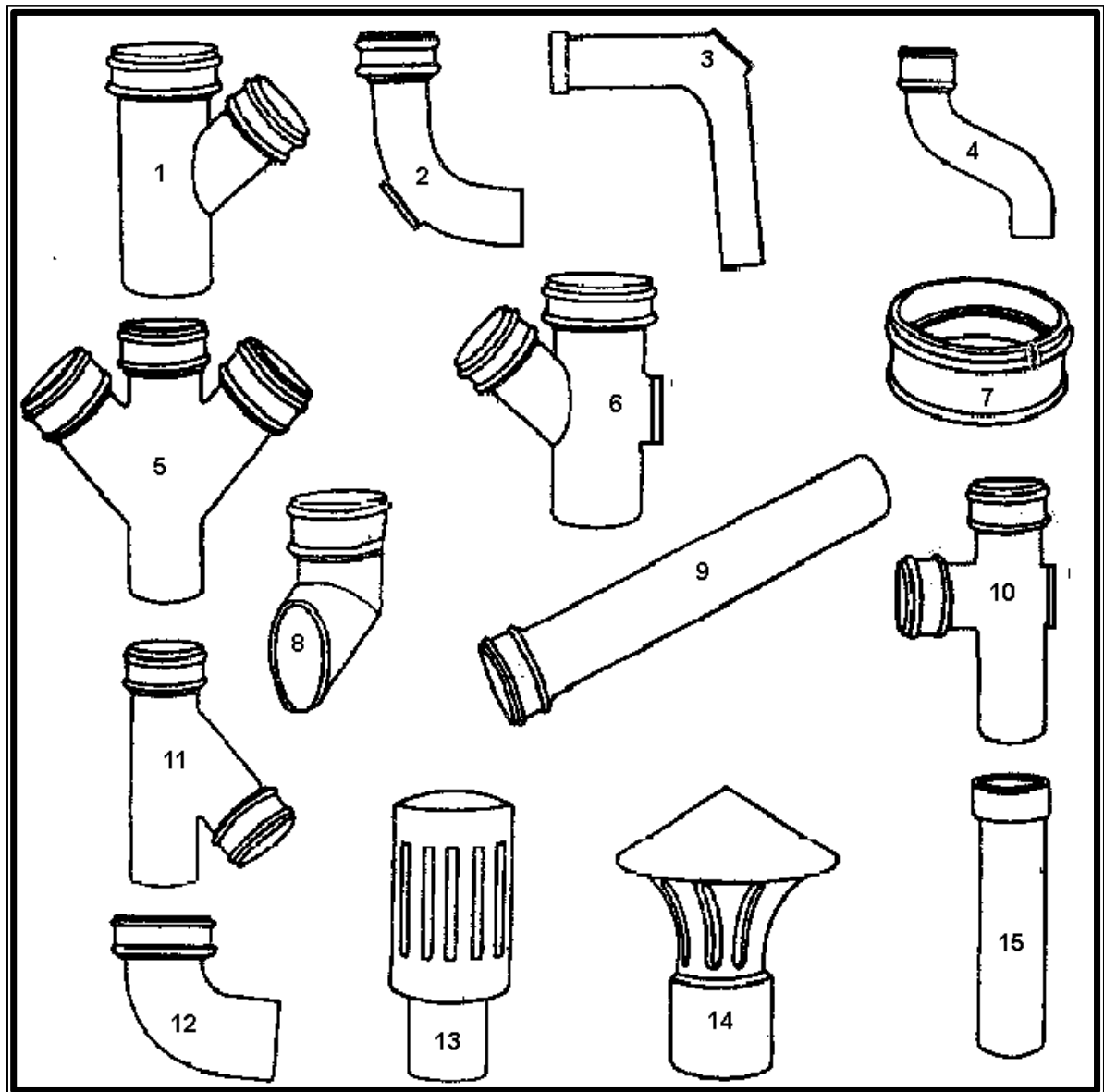


fig.7.

- | | |
|---------------------|-------------------------|
| 1. Single "Y". | 8. Rain Water Shoe. |
| 2. Plug Bend. | 9. Pipe (10', 6' ,4') |
| 3. Long Plug Bend. | 10. Plug Tee. |
| 4. Offset | 11. Invert Single "Y". |
| 5. Double "Y". | 12. Plain Bend. |
| 6. Plug Single "Y". | 13. Vent Cowl |
| 7. Collar | 14. Fancy Vent Cowl |
| | 15. Connector |

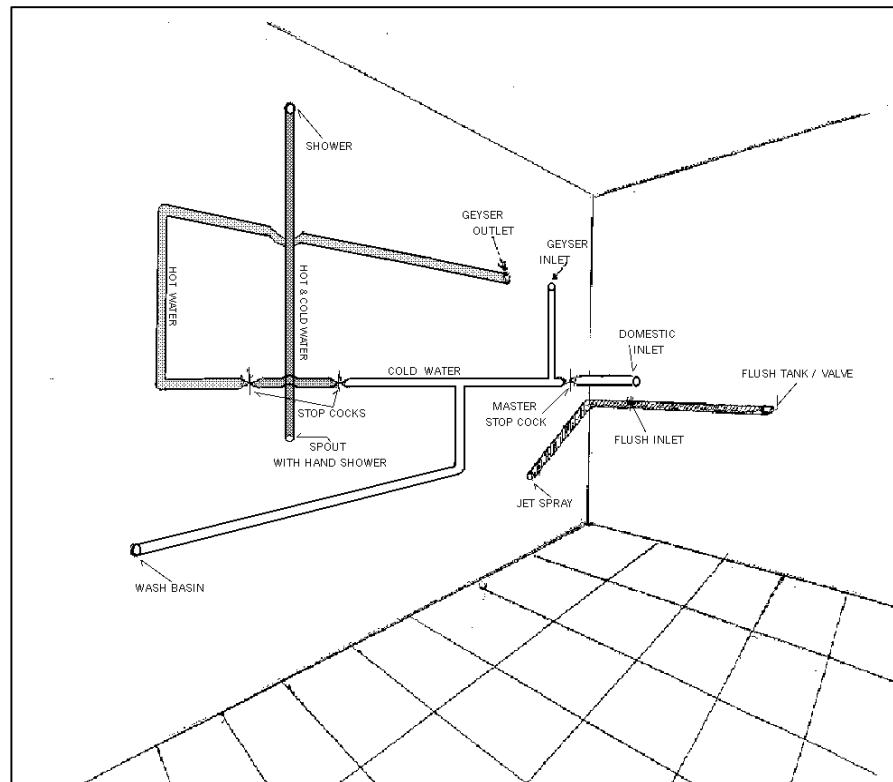
By now you are conversant with external water supply, storage tanks, different types of pipes with their different uses etc.

Now we are starting with the ornamental and ultimate part, viz outlet of all our efforts of the plumbing viz. **Internal water supply.**

The simplest way in internal toilet plumbing is to provide one tap, one shower, one geyser and one cold water tap in wash basin, either open or concealed.

In concealed fittings first and foremost thing to be done is to line-out proposed lines on the walls and start making grooves for the pipe lines to be fixed.

It is advisable to make grooves with the help of electrically driven grinders on both the sides of the groove and chip off the balance mortar with light hammering to



avoid heavy hammering on the single brick or block walls, as heavy hammering on the walls would result in the cracking of walls and plaster. Start fixing pipes of the specified material and quality in the grooves and complete the work.. This work needs testing for leakage as the same is to be concealed and can not be rectified after fixing of tiles or finishing material which is always expensive. **It is highly recommended to have a master stop cock at the entrance of the water system as illustrated in fig.6.**

Testing can be done with the help of hydraulic pressure pump and the pressure should be minimum 100 PSI or 7 kg/cm^2 or 7 bars

Good rust preventive wrapping on the pipes with either conventional material like liquid coal tar (bitumen) and gunny cloth or with non adhesive PVC tape, should be done. Non adhesive tape is highly recommended these days because it does not retain the water unlike gunny cloth (Retaining of which constantly might corrode the pipes very fast.) but it adheres to the surface of pipe and does not allow water to touch the pipes.

Wrapping on cold water pipes can be avoided on any pipes other than G.I. pipes like copper, Kitec, P.E , etc. because these pipes are non corrosive pipes. Any pipes having external surface of material other than metal does not require insulation too.

For metallic pipes, insulation of either Asbestos rope or strap is one of the conventional methods but again Asbestos also retains water. Hence, the new method of wrapping **KINIFOAM** (heatlon) is a better method.

One should also plan locations of fittings like Towel rods, Napkin holders, Mirrors, prior to lining out the concealed fittings as the drilling with the tungsten carbide or diamond tip might damage the pipes.

PLUMBING FOR HIGH RISE BUILDINGS

In metropolitan cities like Mumbai, construction industry has witnessed many changes in last couple of decades, namely different material used for various branches of construction industry like electrification, painting flooring etc. Plumbing is no exception.

The very common factor in all the branches is the types of buildings, like buildings having duplex houses, high rise buildings having penthouses on the top floor etc.

A building having height more than 80 feet is categorised in high -rise building.

The difference in carrying out the plumbing work starts with the supply to suction tank. A separate suction tank for fire fighting is provided. The capacity of the fire fighting tank is provided as per the requirements of Chief Fire Officer's N.O.C. In general case the capacity of the tank is 1,00,000 litres is provided.

Communication pipe from ferrule is extended upto the fire fighting static tank. Water is allowed from the fire-fighting tank to overflow in the tank meant for domestic purposes.

Pump sets specified & approved by C.F.O. are provide and a wet riser is extended upto the Overhead fire fighting tank of 20,000 to 30,000 litres. This wet riser is also connected to the outlet of the tank with the means of Non return valves.

However there are specialised fire-fighting contractors undertaking these jobs, along with the installations of electrification and fire fighting alarm systems , who in turns gets the approvals sanctions etc from the Fire Brigade Department.

Three different methods used in the distribution of down take distribution systems are 1) Pressure reducer valve system. 2) Intermediate tank system 3) break pressure tank system.

Difference in the plumbing form the regular buildings having height less than 80 and high - rise building is that all the water storage tanks should have the water supply after feeding of the fire fighting tanks.(through overflow only.)

Terrace loop :- Terrace loop as per the design calculation is required to be provided same as regular building.

Down takes :- Separate telescopic down takes for flushing and domestic shall be provided for the set of 4 floors as a standard practice, upto 8 floors from the top.

Pressure valves system :-

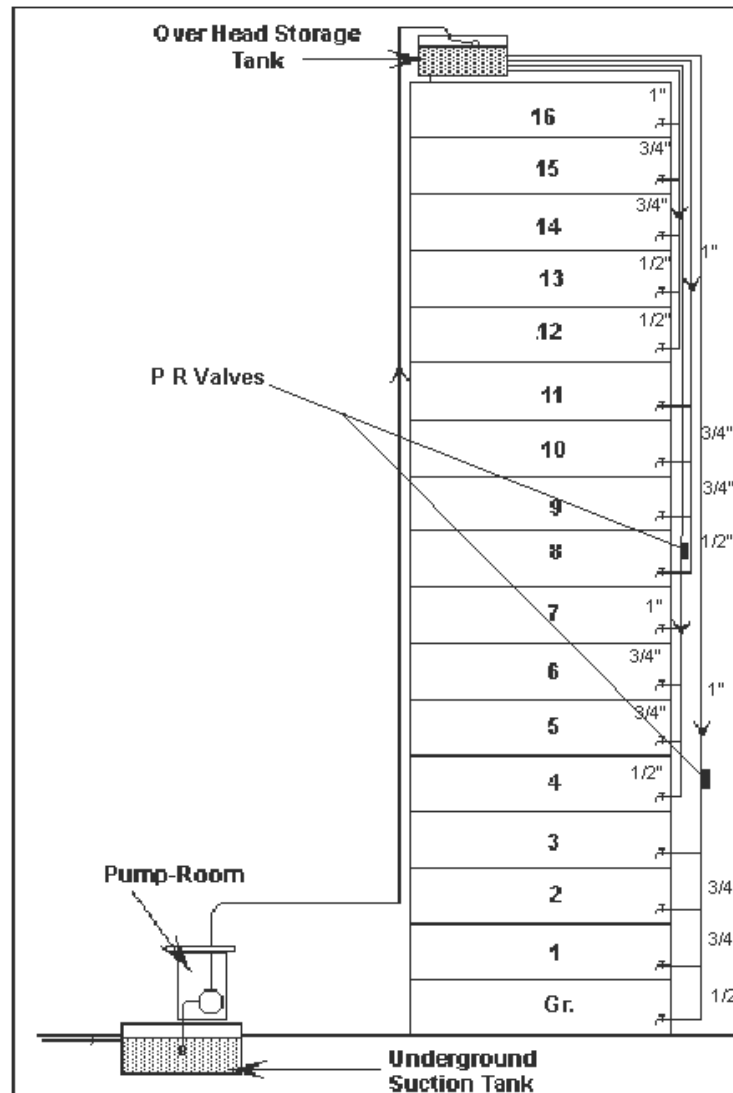
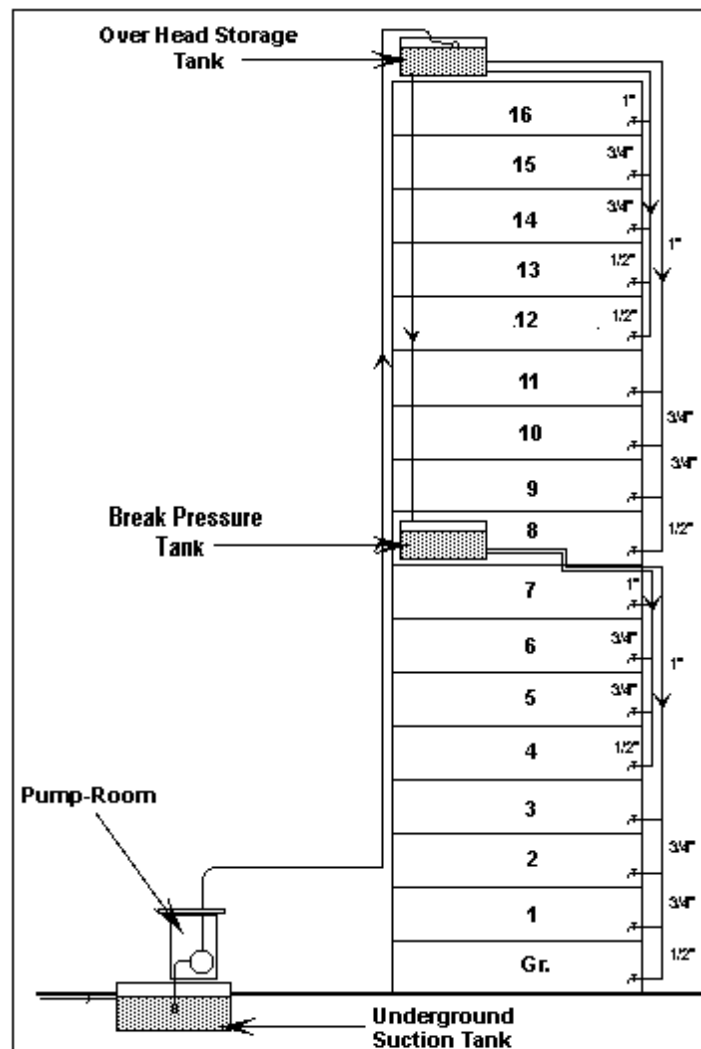


fig.9

A Pressure reducer valve is provided in down take keeping in mind that the gravity pressure in the down take is kept under the control. The maximum distance from the inlet point of toilet and P. R. Valve should not exceed 80 feet. These pressure reducer valves are set in such a way that maximum pressure at the lowest point should not exceed 45 PSI (3 BARS) . It is not a good practise to have a bye-pass to these P. R. Valves to facilitate uninterrupted water supply while servicing repairs or maintenance.

It is also advisable as well as necessary to have means of access to the P. R. Valves.

Break Pressure tank system :-



Distribution Using
Break-Pressure Tanks

fig.10

In this system total water required for the down take supply is pumped to the O.H. Tank installed on the terrace, Intermediate (break pressure) tank is provided on the floor above 8th floor with the float valve. From these two tanks viz. Main O. H. tank and break pressure tank the down take supply is given to the lower floors as per the standard theory as shown in the figure above.

Intermediate Tank System:-

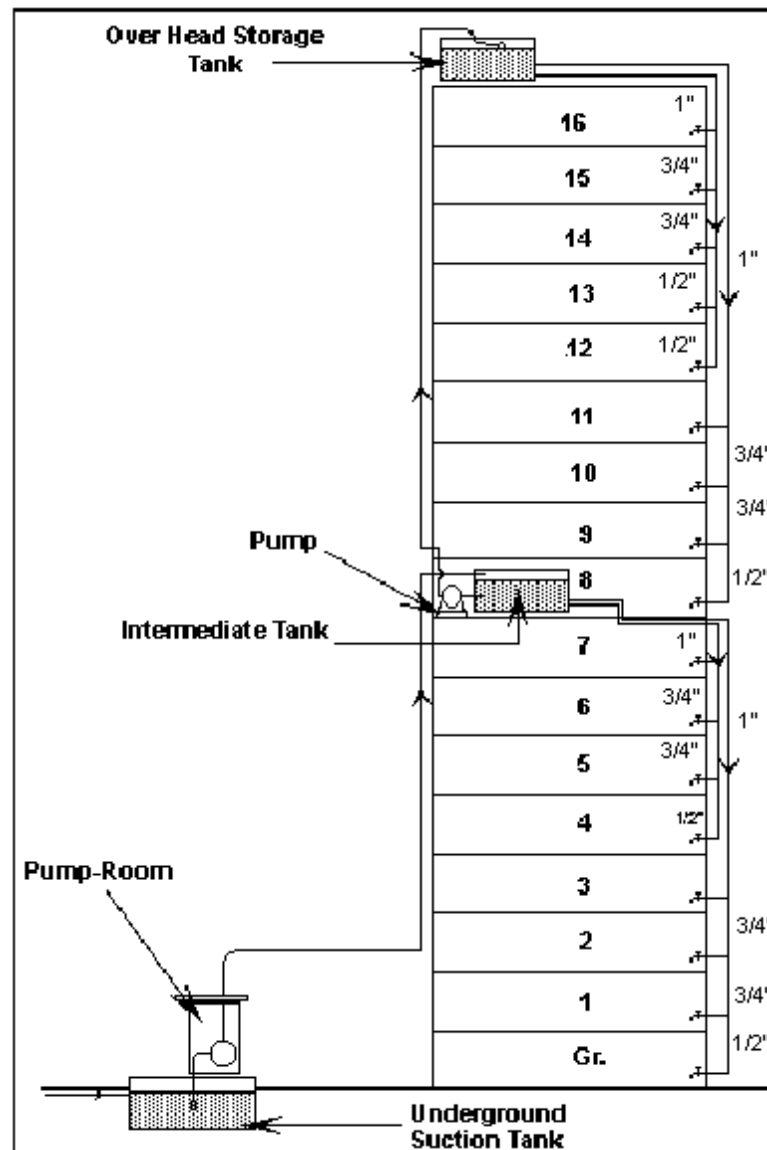


fig.11.

Overhead tank for the set of eight floors is provided on terrace, as well as for one set of upper 8 floors in case of 16 storied building. Water is pumped to the tank provided on first o. h. tank on eighth floor and the stored water is pumped to the tank for upper 8 floors. The down take supply is given from this intermediate tank in the same manner as a regular building as shown in figure above.

In both the above systems the intermediate, by inducing the intermediate tanks the gravity pressure is reduced.

These systems of breaking pressures are used to save the expensive plumbing fixtures malfunctioning due to excessive pressure and also saves the wastage of water.



WORKING OUT HP OF PUMPS



There are two different methods for the working out Horse Power of Water Pumps.

$$1) \quad \text{HP} = \frac{H \times W}{359 \times n}$$

W = Lit/sec.

H = Total Head in ft.

n = Efficiency of pumps generally around 50% (depending on the Pump manufacturers).

$$2) \quad \text{HP} = A \times \frac{H}{C} \times E = \frac{A \times H \times 1.5}{2,000}$$

A = Quantity of Water in G.P.M.

H = Total Head In Feet.

C = Constant = 2,000

E = Efficiency of pump viz. As specified in the manual provided by the Manufactureres.

The Lighter Side

A local doctor called a plumber out in the middle of the night because one of his toilets was blocked.

He insisted that it was urgent & that the plumber attend immediately. Upon arrival the plumber lifted the toilet lid, threw in two aspirins, & said " I f it's still there in the morning, give me another ring ".

DRAINAGE

The whole of plumbing, which is a part of sanitation & hygiene, is totally depending on the quality of drainage work done, because the defective and faulty drainage work cannot be altered or rectified after it is commissioned.

Therefore it is necessary to understand this subject thoroughly.

To start this subject it is very important to know the different types of pipes being used in drainage work.

As soon as you start using water from your tap it turns in to waste water, which needs proper handling and treatment to ensure that no foul gases occur or harmful bacteria are given chance to create health hazards.

We have divided water supply into two different categories mainly domestic and flushing supply.

Similarly the **drainage** is also divided mainly into **three different types 1) waste water 2) soil 3) rain water or storm water. 4) gas or vent pipes (ventilation pipes)**.

1) **Soil pipes :-** These 4" (100 / 110 mm) dia. pipes should be fixed vertically in plumb line generally on the external side of the wall using different types of fittings such as single Y, Double Y, Tee with or without cleaning eye (commonly called as plug) bends etc as shown in the figure 7. These pipes take the discharge from the water closets (w. c.) or urinals upto the branch connection of the underground drainage, but prior to this it is very necessary to have all the traps installed systematically, hence creating conscience about the health and hygiene of the occupants of the building.

It is necessary to fix a trap before fixing Indian style or Orissa type w. c pan (squatting type) having a water seal in it, as illustrated in figure No15, from trap onwards the soil pipes are discharged in to 4" dia branch drain. The upper end is extended to the height beyond the parapet preferably 7' to 8' (215 to 245 cm) above the terrace floor so that a person standing on terrace floor will not be affected with the foul gases

2) **Waste pipe:-** A floor trap known as Nahani trap having 3" (75mm) dia at the outlet point, is fixed in the sunken slab to collect the waste water from bathrooms, wash basins, kitchen sinks, bath tubs etc. These pipes are discharged in to a gully trap provide under the paving and then the same is discharged in the inspection chamber, through this 100mm or 4" dia pipes.

3) **Storm water / Rain water pipe:-**One Pipe of 4" dia upto the terrace floor area of 400 to 600 ft² (40 to 60m²) & 6" (150mm) dia pipe for 1000 ft² (100m²) is provided from the roof or terrace of the building and are discharged on the paving / compound or are discharged in the storm water under ground drainage as the case may be.

4 a) Anti Syphonage Pipes:- These pipes of 2 ½ (63mm) dia. start from the top of the trap of W. C. of the first floor above the terrace parapet of the terrace like soil and waste lines, to avoid water seal of trap getting siphoned and allowing foul gases entrance to the premises.

4 b) Vent Pipes :- These pipes are provided from the first and last chambers of the building are also extended above the parapet height of the building. dia of the pipes can be 2 ½ or 3".

All these pipes collect the waste water from all the draining points like kitchen, bath tubs, wash basins, w. c., urinals, etc upto the ground level.

Note:-1) **Never ever forget to fix vent cowls** of the material same as the material and the size of pipe on the top of the pipe to allow the gases to escape and prevent birds dropping foreign particles in the vertical stacks which might create choke ups.

2) **Never use** or allow to use **any acids in the toilets** because the A. C. Pipes, C. I. Pipes, flooring tiles as these pipes & water proofing material can not resist the acids.

Here starts the **UNDER GROUND DRAINAGE** which ends at the chamber of street sewer or septic tank/soak pit.

Main under ground drainage, very widely called as house drainage is divided into two zones.

1. Branch pipes
2. Main drain

Branch pipes:- Bottom most end of all the vertical stacks, such as soil, waste, and vent pipes are connected to Inspection chambers through 4" dia s.w.pipes.

At the bottom of **waste pipe** one **stone ware gully trap** is provided, which not only converts the 3" dia waste pipe into 4" dia branch pipes, but also gives an additional trapping. This trapping will prevent foul gases and bad smells entering into the vertical stack.

Similarly **soil pipe** is connected to the Inspection Chamber directly by providing 4" dia **s. w. bend**.

All the under ground drainage is laid to the slope the thumb rule for the slopes in various sizes of pipes are as follows.

4" dia pipes	@	1 : 40 to 60	viz 1 foot slope in 40 feet length
6" dia pipes	@	1 : 60 to 80	
9" dia pipes	@	1 : 90 to 135	
12" dia pipes	@	1 : 120 to 200	

and so on....

These gradients are given keeping in mind that it carries liquids & solid contents to the destination by the velocity of the sewage. Which is called as **self cleansing velocity** which should not be less than **3.5 ft/second (1m/sec approx)** in India.

Main Drain :- From first branch connection onwards and Inspection chamber, the main drain starts. Main drain is generally provided of 6" dia S.W. pipes laid to the specified slope in the excavated trench. It is very necessary to have Inspection chamber at every junction wherever branch connection are required to be made or the under ground drainage needs turning.

Method of laying under ground drainage & giving the slopes:- It is advisable to chalk out the whole drainage system on the plan & transfer the same on site with the help of dry marking powder.

Mark out centres of the manholes / inspection chambers preferably with wooden pegs & the trench to be excavated. Width of the trench should be equal to outer diameter of the pipe plus 25cm on both the sides of the pipe. e.g. for 150mm dia pipe, width should not be less than 65cm.

After keeping clearance for dumping excavated earth on both sides of the trench, square wooden members should be inserted in earth in perfect plumb line at both the ends of the trench. A horizontal wooden member at an assumed & constant level (say 1 to 1.5 mtrs above the plinth level) on all the vertical members.

A tee shaped wooden member is also required to be made with the different level markings indicating invert levels of various manholes.

Pipes at the starting & terminating point of the drain should be positioned & firmly placed in the excavated trench at the required difference in level so as to give specified gradients. Insert longer wooden pegs in the centre of the pipes diameter wise before starting point & after terminating point. The pegs thus inserted should be firm enough in the soil. A thin but strong nylon string from the top & sides of the first pipe should be extended upto the last pipe thus forming a grid in which the intermediate pipes should be laid.

After filling the joints (refer to the '**Jointing**' section which has been of the medium of pipe being used) adequate time should be given to let the joint get firm enough before back filling the trench.

Transferring of levels can be done either with the help of dumpy level & theodolite or level tube.

Inspection Chamber :- Size of the Inspection Chamber should not be less than 3'6" x 1'6" internally, constructed with 9" thick brick masonry in 1: 4 Cement, sand Mortar. Plastered from inside and outside with rich cement sand mortar and finished with the coat of Neat and smooth cement. Depth of Inspection chamber should not exceed 5'0" or 1.5m. This Inspection chamber should be constructed on 6" thick plain cement concrete of 1 : 2 : 4 (Cement, sand, metal)

Manholes:- Beyond the depth of 5'0" a round conical chamber having 5'0" clear internal diameter at the bottom & 21" at the top should be constructed with the above specifications. It is necessary to fix Cast Iron foot steps in staggering manner to facilitate maintenance.

Last manhole :- or Inspection chamber prior to connection to the street sewer or septic tank should house a Sewer trap/ Intercepting trap and the same chamber should be called as either intercepting trap chamber or sewer trap chamber. The diagram of this chamber is also given for the ready reference.

Sewage disposal the absence of street sewer :- It is a common and simplest practice to have a septic tank and soak pit preferably for the buildings in the remote areas of the city, where there is no street sewers. This system is generally constructed by the civil contractors on the basis of proper designing by a competent consultant or as per the approval given by the local civic authorities.

The internal cut sections and the plans of the **septic tanks and soak pit** are shown in the **diagram following herewith** .

Standard method of designing septic tank.

A. Fixture units.

1. W. C.....	=	1	x
2. URINALS.....	=	½	x
3. SINKS.....	=	½	x
4. WASH BASIN.....	=	½	x
5. BIB TAPS.....	=	½	x
6. SHOWERS.....	=	½	x

Total fixture = Nos.

B. Simultaneously used fixture units

(60% to 70%)..... = Nos.

C. Required 'Q' in litres/ minute

(9 lit / min / fixture unit)... .. = lit. / min.

D. Area required (0.92 sq. mtr /10 lit/min)

= sq. mtr

E. Population (should not be more than 300)

= Nos.

F. Volume

i) Volume for sludge digestion

0.033cu. mtr per capita. = cu. mtr

ii) Volume for sedimentation

0.25 to 0.30m x D (area). = cu. mtr

iii) Volume for sludge storage

a. for one year cleaning

0.00021 x 365 x Capita. = cu. mtr

OR

for two years' cleaning

0.00021 x 365 x 2 x capita. = cu. mtr

Grand Total = cu. mtr

G. Depth required F / D

mtrs

H. Depth Provided

mtrs

I. Area Provided F / H

sq. mtrs

J. Size of the Tank (length x breadth x depth [liquid])

K. Volume Provided

L. Volume of Anaerobic filter

M. Size of Anaerobic filter (length x breadth X depth)

FEW TABLES TO MAKE YOU RURAL PLUMBING EASIER

No Of Users	Houses	Fixture Units	Peak Discharge
50	10	20	108
100	20	40	216
150	30	60	324
200	40	80	432
300	60	120	648

As a general practice the tentative peak discharge which should be 60% considering 5 persons per house.

STANDARD READY RECKNOR TABLES FOR THE CAPCITY OF S E P T I C T A N K FOR VILLAS, COTTAGES, BUNGALOWS

No.Of Users	Length (mtrs)	Breadth (mtrs)	Effluent Cleaning	Depth (mtrs) 2 yrs
5	1.50	0.75	1.00	1.05
10	2.00	0.90	1.00	1.40
15	2.00	0.90	1.30	2.00
20	2.30	1.10	1.30	1.80

However capacity of the septic tank can be reduced by doing two separate drainage, for soil & waste water, Effluent form WCs only should be discharged in septic tank & effluent form waste water drain can be discharged directly into the soak pit as it doesn't require treating. This can only be done if the rules of civic Authorities permit.

Back Down In Time ...

Plumbing in Egyptian Pyramids

Egypt's pyramid-temples, which have withstood thousands of years of time, attest to the skill of the ancient construction workers. The earliest pyramids were built from 2660-2500 BC. By 2500 BC the Egyptians were pretty adept with drainage construction, accentuated by the significance that that water played in their priestly rituals of purification & those affecting burial of the kings. According to their religion, to die was simply to pass from one state of life to other. If the living required food, clothing & other necessities, then so did the dead.

Found within a pyramid built by king Tutankhamen's father-in-law at Abusir was a **Brass Drain Pipe** running from the upper temple along the connecting masonry causeway to the outer temple on the river.

Excavators have discovered a tomb that supposedly contains the body of Osiris before he became a god. It contains the dividing line between life & death, i.e. a deep moat containing water that surrounds all sides of the figure of the god on the throne. After 5,000 years, water still finds the canal through underground pipes from the river Nile.

DIAGRAM OF SEPTIC TANK, SOAK PIT

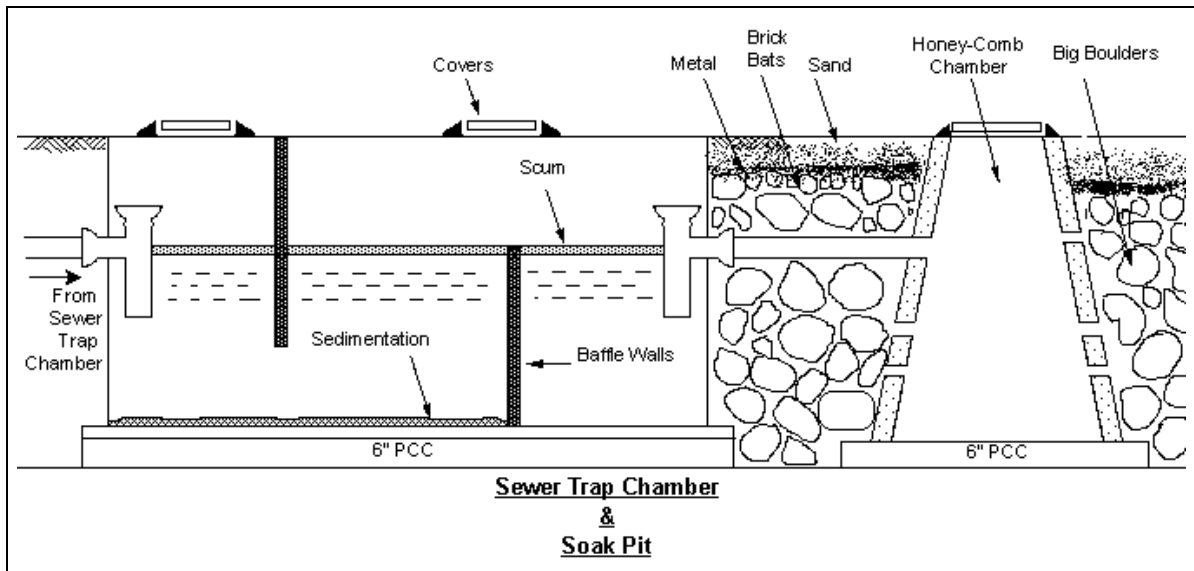


fig.12.

SCHEMATIC DIAGRAM OF A TYPICAL HOUSE DRAINAGE

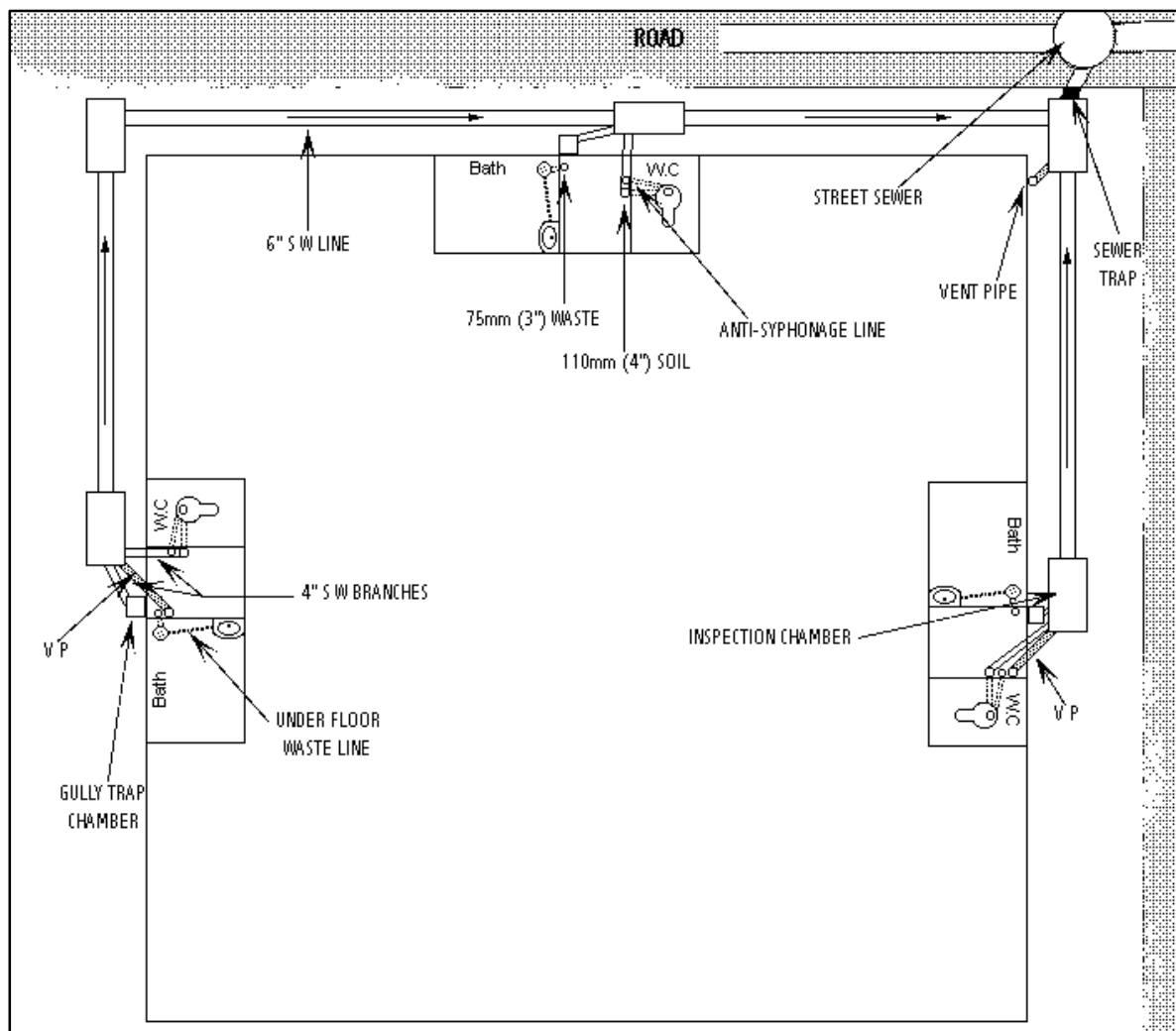
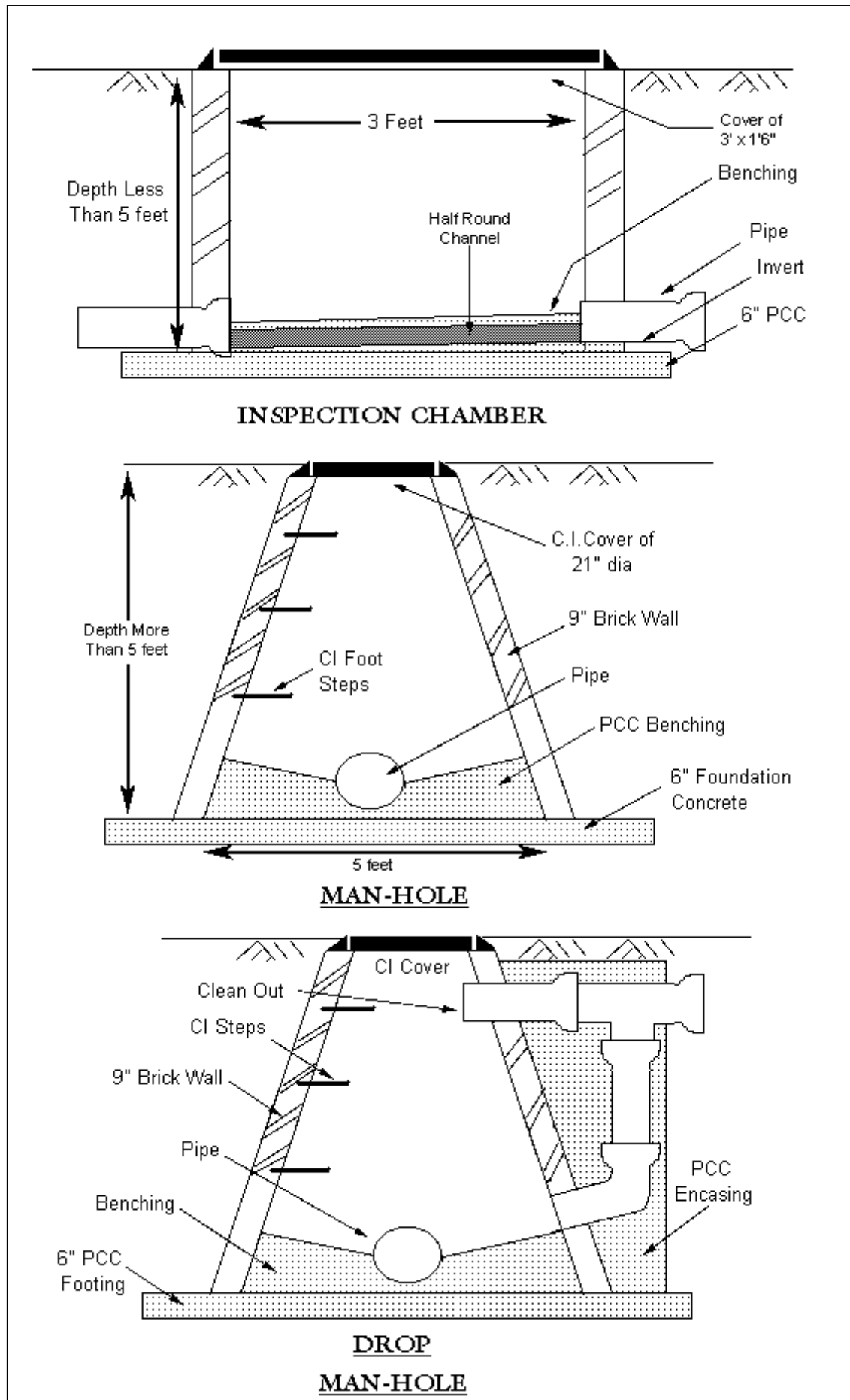


fig.13.

Different Type Of Chambers. (fig.14.)



Some Widely used traps:-

By now you are conversant with the theory of traps. The water remaining and creating barrier to the foul gases is called as Water Seal. Some of them are as shown in diagram no.15.

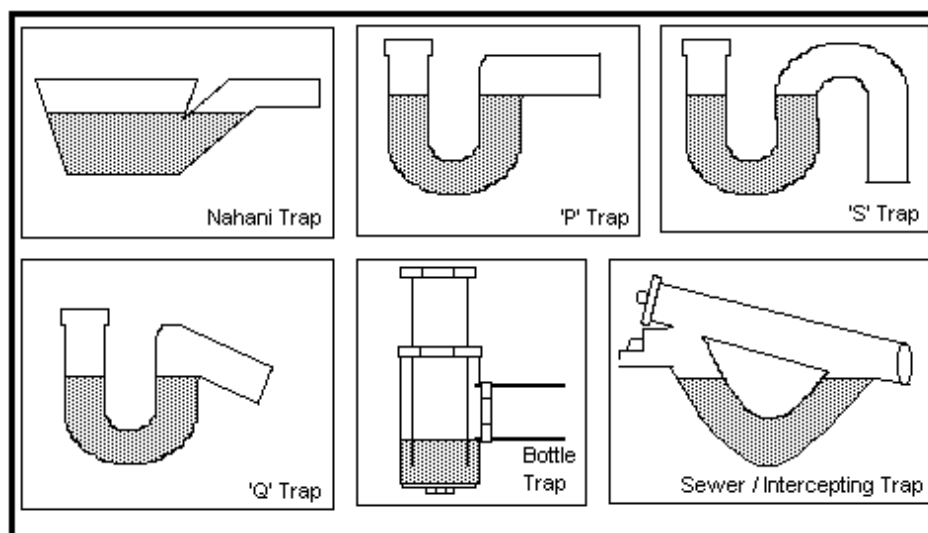


fig.15

Nahani Trap or Floor trap.

Material:	Cast Iron or PVC
Colour:	Black painted in CI, and grey PVC
Sizes:	Inlet point mainly 6" dia & outlet point 2", 2 ½, 3" (right size 3")
Application:	Under the floor of washing or bathing area.
Purpose:	To collect the waste water from surface of floor, outlet from wash basins or sink & discharge into vertical waste. (water waste)

Gully Trap.

Material:	Salt glazed earthen ware (stone ware)
Colour:	Brown when baked properly (uniform colour & clear ringing sound)
Sizes:	For Branches pipes 6"x 6" on the top square side & 4" dia on outlet side.
Application:	Collects the discharge from waste water vertical drain & discharge in the branch pipes of the under ground drainage.
Purpose:	Avoids foul gases of under ground drainage entering into the waste water vertical stack. It also acts as a checking point at the time when there is a choke in either vertical stack or branch drain.

P, Q & S Trap.

Material:	White glazed earthen ware (porcelain)
Colour:	White or enamelled to the shade of choice.
Sizes:	Generally 4" dia.
Application:	Underneath Indian WC or squatting type or for urinals.
Purpose:	Avoid foul gases entering from soil vertical either through squatting type WC or urinals with the open channel.

Sewer (Intercepting Trap).

Material:	Salt glazed earthen ware (stone ware)
Colour:	Brown when baked properly (uniform colour & clear ringing sound)
Sizes:	As per the size of the main drains , available in sizes as in SW pipes.
Application:	Collects the discharge from the underground house drain & discharges into the street sewer or septic tank / soak pit in the last inspection chamber or manhole on outlet point.
Purpose:	Avoid foul gases of street sewer or septic tank to enter into the house drainage

Bottle Trap.

Material:	Chrome-plated Brass / PVC / Chrome -plated Plastic / Powder Coated
Colour:	As required.
Sizes:	1¼", 1½ & 2" in special cases.
Application:	Fixed Wash Basins, Sinks, Urinals.
Purpose:	To prevent foul gases emitted from the traps upto the apparatus.

DOs & DON'Ts

- 1) Proper water proofing base coat should always be done prior to fixing of Nahani trap or Indian style W. C. pans & the same should not be disturbed while carrying out any under floor plumbing.
- 2) Water tightness of the joints of all the pipe fittings should be checked prior to concealing the entire work.
- 3) Minimise the number of joints.
- 4) Use right material & method of joining as prescribed by the manufacturer of respective material or the joints approved by the local civic Authorities.
- 5) Never use objectionable Acids for washing bathing Areas, as it can damage the flooring, lining or joints of drainage system.
- 6) Water tightness check should be done prior to starting fixing of flooring and wall tiling work.
- 7) Testing of water supply piping should not be done at less than 100lbs/in² (15kgs/cm²)
- 8) Use specified material for insulation to hot water piping & proper rust preventive material in case of steel pipes.
- 9) Proper alignment of water supply fittings in concealing as well as in exposed plumbing, which will enhance the quality of workmanship.
- 10) Do not over tighten the fittings.
- 11) Use proper safety gears.
- 12) Never use any objectionable petroleum lubricants or rust removers which can contaminate water.
- 13) Keep your working area well lighted, ventilated, clean and free from hazards.
- 14) Do not insist on carrying out with the work in fatigue.
- 15) Use only drinking/ cooking purpose water for the specific purpose. Use untreated water (allowable) for any uses other than potable purposes.
- 16) Do not inter mix the drainages, like soil, waste, storm water unless allowed or designed for the load.
- 17) Do not mix potable & non-potable water.

Some important

INTERNATIONAL PLUMBING CODE 1995

CHAPTER 6

WATER SUPPLY AND DISTRIBUTION.

SECTION 601

601.1 Scope This chapter shall govern the materials, design and installation of water supply systems, both hot and cold for utilisation in connection with human occupancy and habitation and shall govern the installation of individual water supply systems.

601.2 Solar energy utilisation . Solar energy used for heating potable water or using an independent medium for heating potable water shall comply with the applicable requirements of this code. The use of solar energy shall not compromise the requirements for cross connection or protection for the potable water supply system required by this code.

601.3 Existing piping used for the grounding. Existing metallic water service piping used for electrical grounding shall not be replaced with non-metallic pipe for tubing until other approved means of grounding are approved.

Section 602 DEFINITIONS

602.1 General. The following words and terms shall, for the purpose of this chapter and shall as stated elsewhere in this code, have the meanings shown herein. Refers to Chapter 2 for general definitions

AIR GAP (WATER DISTRIBUTION SYSTEM). The unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to a tank, plumbing fixtures or other device and the flood level rim of the receptacle.

BACKFLOW

Back pressure. Pressure created by any means in the water distribution system, which by being in excess of the pressure in the water supply mains causes a potential backflow conditions.

Backsiphonage. The backflow of potentially contaminated water into the potable water system as a result of the pressure in the potable water system falling below atmospheric pressure of the plumbing fixtures, pools, tanks, vats, connected to the potable water distribution piping.

Water supply system. The flow of water or other liquids, mixtures or substances into the distribution pipes of a potable water supply from any source except the independent source.

BACKFLOW CONNECTION. Any arrangement whereby backflow is possible.

BACKFLOW PREVENTER. A device or means to prevent backflow.

CISTERN. A small covered tank for storing water for home or farm. Generally, this tank stores rainwater to be utilised for purposes other than in the potable water supply, and such tank is placed underground in the most cases.

CONTAMINATION. An impairment of the quality of the potable water which creates an actual hazards to the public health through poisoning or through the spread of disease by sewage, industrial fluids or waste.

CRITICAL LEVEL (C. L.). An elevation (height) reference point that determines the minimum height at which a backflow preventer or vacuum breaker is installed above the flood level rim of the fixture of receptor served by the device. The critical level is the elevation level below which there is a potential for backflow to occur. If the critical level marking is not indicated on the device, the bottom of the device shall constitute the critical level.

CROSS CONNECTION. Any physical connection or arrangement between two otherwise separate systems, one of which contains potable water and the other either water of unknown or questionable safety of steam, gas or chemical whereby there exists the possibility for flow from one system to the other, with the direction of flow depending on the pressure differential between two systems (see backflow).

EFFECTIVE OPENING. The minimum cross sectional area of the point of water supply discharge, measured or expressed in terms of the dia. Of a circle or equivalent cross -sectional area. For faucets and similar fittings, the effective opening shall be measured at the smallest orifice in the fitting body or in the supply piping to the fitting.

ESSENTIALLY NONTOXIC TRANSFER FLUIDS. Fluids having Gosselin rating of 1, including propylene glycol; mineral oil; polydimethylsiloxane; hydrochlorocarbon refrigerants; and FDA approved boiler water additives for steam boilers.

ESSENTIALLY TOXIC TRANSFER FLUIDS. Soil, waste or grey water fluids having a Gosselin rating of 2 or more including ethylene glycol, hydrocarbon oils, ammonia refrigerants and hydrazine.

FIXTURE SUPPLY. The water supply pipe connecting a fixture to a branch water supply pipe or directly to a main water supply pipe.

FLOOD LEVEL RIM. The edge of the receptacle from which water overflows.

FLOW PRESSURE. The pressure in the water supply pipe near the faucet or water outlet while the faucet or the water outlet is wide open and flowing.

HOT WATER. Water at a temperature greater than or equal to 120 °f (49 °c).

INDIVIDUAL WATER SUPPLY. A water supply except an approved public water supply that serves one or more families.

NONPOTABLE WATER. Water not safe for drinking, personal or culinary utilisation.

POLLUTION. an impairment of quality of the potable water to a degree which does not create a hazard to the public health but which does not adversely and unreasonably affect the aesthetic qualities of such potable waters for domestic use.

POTABLE WATER. Water free from impurities present in the amounts sufficient to cause disease or harmful physiological effects and confirming in bacteriological and chemical qualities to the requirements of the Public Health Service Drinking Water Standards or the regulations of the public health authority having jurisdiction.

QUICK CLOSING VALVE. A valve or faucet which closes automatically when released manually, or which is controlled by a mechanical means for fast -action closing.

REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTER. A backflow prevention device consisting of two independently acting check valves, initially force loaded to a normally closed position and separated by an intermediate chamber (or zone) in which there is an automatic release means of venting to atmosphere. Internally loaded to a normally open position between two tightly closing shutoff valves with means for testing of the checks and opening of relief means.

RELIEF VALVES.

Pressure relief valves. A pressure actuated valve held closed by a spring or other means and designed to relieve pressure automatically at the pressure at which valve is set.

Temperature and pressure (T&P) valve. A combination of relief valve designed function as both temperature relief and pressure relief valve.

Temperature relief valve. A temperature-actuated valve designed to discharge automatically at the temperature at which such valve is set.

RIM. An unobstructed open edge of a fixture.

TEMPERED WATER. Water ranging in temperature from 85°F. (29°C.) TO 120°F.(49°C.).

VACUUM BREAKER. A type of backflow preventer installed on an opening subject to normal atmospheric pressure and which prevents backflow by admitting atmospheric pressure surge through ports to the discharge side of the device.

WATER HAMMER ARRESTOR. A device utilised to absorb the pressure surge (water hammer) that occurs when water flow is suddenly stopped in a water supply system.

WATER OUTLET. A discharge opening through which water is supplied to a fixture, into the atmosphere (except into an open tank that is part of the water supply system), to boiler or a heating system, or to any device or equipment requiring water to operate but which are not part of the plumbing system.

WATER PIPE.

Riser. A water supply pipe that extends one full story or more to convey water to branches or to a group of fixtures.

Water distribution pipe. A pipe within the structure or on the premises which conveys water from the water service pipe, or from the meter when the meter is at the structure, to the point of utilisation.

Water service pipe. The pipe from the water main or other source of potable water supply, or from the meter when the meter is at the public right of way, to the water distribution system of the building served.

WATER SUPPLY SYSTEM. The water service pipe, water distribution pipe, and the necessary connecting pipes, fittings, control valves and all appurtenances in or adjacent to the structure or premises.

WELL.

Bored. A well constructed by boring a hole in the ground with an auger, and installing a casing.

Drilled. A well constructed by making a hole in the ground with a drilling machine of any type, and installing casing and screen.

Driven. A well constructed by driving a pipe in the ground. The drive pipe is usually fitted with a well point and screen.

Dug. A well constructed by excavating a large diameter shaft and installing a casing.

SECTION 603.

WATER REQUIREMENT.

603.1 Structures. Every structure equipped with plumbing fixtures and utilised for human occupancy or habitation shall be provided with a potable supply of cold water in the amounts and at the pressure specified in this chapter. Hot water shall be provided for permanent residences and hot or tempered water shall be provided for structures in which people are employed.

603.2 Potable water required. Only potable water shall be supplied to plumbing fixtures that provide water for drinking, bathing or culinary purposes, or for the processing of food, medical or pharmaceutical products. Unless otherwise provided in this code, potable water shall be supplied to all plumbing fixtures.

603.3 Individual water supply. Where a potable public water supply is not available, individual sources of potable water supply shall be utilised/

603.3.1 Sources. Dependent upon geological and soil conditions and the amount of rain fall, individual water supplies are of the following type: drilled well, driven well, dug well, bored well, spring, stream or cistern. Surface bodies of water and land cisterns shall not be sources of individual water supply, unless properly treated by approved means to contamination.

603.3.2 Minimum quantity. The combined capacity of the source and storage in an individual water supply system shall supply the fixtures with water at rate and pressure as required by this chapter.

603.3.3 Water quality. Water from an individual water supply shall be approved as potable by the authority having jurisdiction prior to connection to the plumbing system.

603.3.4 Disinfection of system. After construction or major repair, the individual water supply system shall be purged of deleterious matter and disinfected in accordance with section 611.

603.3.5 Pumps. Pumps in an individual water supply system shall be constructed and installed so as to prevent contamination from entering a potable water supply through the pump units. Pumps shall be sealed to the well casing or with a watertight seal. Pump shall be designed to maintain a prime and installed such that ready access is provided to the pump parts of the entire assembly for repairs.

603.3.5.1 Pump enclosure. The pump room or enclosure around a well pump shall be drained and protected from freezing by heating or other approved means. Where pumps are installed in basements, such pumps shall be mounted on a block or shelf not less than 18 inches(457 mm) above the basement floor. Well pits shall be prohibited.

SECTION 604.

WATER SERVICE

604.1.Size of water service pipe. The water service pipe shall be sized to supply water to the structure in the quantities and at the pressures required in this code. The minimum dia of water service pipe shall be $\frac{3}{4}$ inch (19.1mm).

604.2 Separation of water service and building sewer/ drain. Water service pipe and the building sewer shall be separated by 10feet (3048mm) of a undisturbed or compacted earth.

Exception: The required separation distance shall not apply where the bottom the water service pipe within 10 feet (3048mm) of the sewer is a minimum of 12 inches (305mm) above the top of the highest point of the sewer and the pipe materials conform to section 704.1

604.2.1. Water service near sources of pollution. Potable water service pipe shall not be located in, under or above cesspools, septic tanks, septic tank drainage fields or seepage pits(see section 606.2 for soil and ground water conditions).

SECTION 605

DESIGN OF BUILDING WATER DISTRIBUTION SYSTEM

605.1 General. The design of the water distribution system shall conform to accepted engineering practice. Methods utilised to determine pipe sizes shall be approved.

605.2 System interconnection. At the points of interconnection between the hot and cold water supply piping system and the individual fixtures, appliances or devices, provisions shall be made to prevent flow between such piping systems.

605.3 Water distribution system design criteria. The water distribution system shall be designed and pipe sizes shall be selected such that under conditions of peak demand and the capacities at the fixture supply pipe outlets shall not be less than shown in table 605.3.

TABLE 605.3
WATER DISTRIBUTION SYSTEM DESIGN CRITERIA
REQUIRED CAPACITIES AT FIXTURE SUPPLY PIPE OUTLETS

FIXTURE SUPPLY OUTLET SERVING	FLOW RATE(gpm)	FLOW PRESSURE(psi)
BATH TUB	4	8
BIDET	2	4
COMBINATION FIXTURES	4	8
DISH WASHER, RESIDENTIAL	2.75	8
DRINKING FOUNTAIN	0.75	8
LAUNDRY TRAY	4	8
LAVATORY	2	8
SHOWER	3	8
SHOWER, TEMPERATURE CONTROLLED	3	20
SILLCOCK, HOSE BIBB	5	8
SINK, RESIDENTIAL	2.5	8
SINK, SERVICE	3	8
URINAL, VALVE	15	15
W.C., BLOWOUT, FLUSHOMETER VALVE	35	25
W.C., FLUSHOMETER TANK.	1.6	8
W.C., TANK, CLOSED COUPLED	3	8
W.C., TANK ONE PIECE	6	20
W.C., SIPHONIC, FLUSHOMETER VALVE	25	15

605.4. Maximum flow and water consumption. The maximum water consumption flow rates and quantities for all plumbing fixtures and fixture fittings shall be in accordance with table 605.4. Water consumption for water closets listed in the following exceptions shall not be greater than 4 gallons (15L) per flushing cycle. Water consumption for urinals listed in the following exceptions shall not be greater than 1.5 gallons (5.7L) per flushing cycle.

EXCEPTIONS:

1. Blow-out design fixtures.
2. Penalware.
3. Clinical sinks.
4. Service Sinks.
5. Emergency showers.
6. Water closets provided for the public in theatre, night clubs, restaurants, halls, coliseums, arenas, churches stadiums, and similar occupancies.
7. Water closets provided for patients in hospitals, nursing homes, sanitariums, and similar occupancies.
8. Water closets provided for inmates and residents in prisons, reformatories, and similar occupancies.

Table 605.4

MAXIMUM FLOW RATES AND CONSUMPTION FOR PLUMBING FIXTURES AND FIXTURE FITTINGS

FOR SI: 1 GALLON = 3.787 L, 1 GPM = 3.785 L/m, 1 psi = 6.895 kPa

605.5 Size of fixture supply. The minimum size of a fixture supply pipe shall be as shown in table 605.5. The fixture supply pipe shall not determine more than 30 inches (762mm) from the point of connection to the fixture. A reduced size flexible connector installed between the supply pipe and the fixture shall be of an approved type. The supply shall extend too the floor or wall adjacent to the fixture. The minimum size of individual distribution lines utilised in parallel water distribution systems shall be shown in Table 605.5.

605.6 Variable street pressures. Where street water main pressures fluctuate, the building water distribution system shall be designed for minimum pressure available.

605.7 Inadequate water pressure. Wherever water pressure from the street main or the other sources of supply is insufficient to provide the flow pressure at fixture outlets as required under section 605.3, a booster pump and pressure tank, or other approved means, shall be installed on the building water supply system.

605.8 Water pressure reducing valve or regulator. Where water pressure within a building exceeds 80psi (552kPa) static, an approved water pressure reducing valve conforming to ASSE 1003 with strainer shall be installed to reduce the pressure in the building water distribution piping to 80psi (552kPa) static or less. Exceptions to this requirement are service lines to sill cocks and outside hydrants, and main supply risers where pressure from the mains is reduced to 80psi (552kPa) or less at individual fixture.

605.8.1. Valve design. The valve shall be designed to remain open to permit uninterrupted water flow in the case of valve failure.



TABLE 605.5

MINIMUM SIZES OF FIXTURE WATER SUPPLY PIPES

FIXTURE	MINIMUM PIPE SIZE
Bathtubs (60"x32" and smaller)	1/2
Bathtubs (larger than 60"x32")	1/2
Bidet	3/8
Combination sink and tray	1/2
Dishwasher ,domestic ^a	1/2
Drinking fountain	3/8
Hose bibs	1/2
Kitchen sink ^a	1/2
Laundry, 1,2 or 3 compartments ^a	1/2
Lavatory	3/8
Shower, single head ^a	1/2
Sinks, flushing rim	3/4
Sinks, service	1/2
Urinal, flush tank	1/2
Urinal, flush valve	3/4
Wall hydrant	1/2
Water closet, flushometer tank	3/8
Water closet, flush tank	3/8
Water closet, flush valve	1
Water closet, one piece ^a	1/2

For SI: 1inch = 25.4mm, 1foot =304.8mm, 1psi =6.895kPa.

^a Where the developed length of the distribution line is 60 feet or less, and the available pressure at the meter is a minimum of 35psi, the minimum size of an individual distribution line supplied from a manifold and installed as part of a parallel water distribution system shall be one nominal tube size smaller than the sizes indicated.

605.8.2 Repair and Removal. All water pressure reducing valves, regulators & strainers shall be so constructed & installed as to permit repair or removal of parts without breaking a pipeline or removing the valve and strainer from the pipe line.

605.9 Water Hammer. The flow velocity of the water distribution shall be controlled to reduce the possibility of water hammer . A water-hammer arrestor shall be installed where quick closing valves are utilised, unless otherwise approved. The arrestor shall be located within an effective range of the quick closing valve. Water hammer arrestor confirm to ASME A 112.26.1 or ASSE 1010. Access shall be provided to water hammer arrestors

605.10. Parallel water distribution system manifolds. Hot water and cold water manifolds installed with parallel connected individual distribution lines to each fixture or fixture fitting shall be designed in accordance with sections 605.10.1 through 605.10.3.

605.10.1. Manifold sizing. Hot water and cold water manifold shall be size in accordance with table 605.10.1. The total gallons per minute is the demand of all outlet supply

TABLE 605.10.1

MANIFOLD SIZING.

Nominal Size Internal Dia	Maximum Demand (gpm)	
	Velocity at 4 ft/second	Velocity at 8 ft/second
½	2	5
¾	6	11
1	10	20
1 ¼	15	31
1 ½	22	44

For SI: 1 inch = 25.4 mm, 1 gpm = 3.785 L/m, 1 ft / second = 0.305 m/s.

605.10.2. Valves. Individual fixture shutoff valves installed at the manifold shall be identified as to the fixture being supplied.

605.10.3. Access. Access shall be provided to manifolds.

Section 606

Materials, Joints & Connections

606.1. Water Compatibility. Water service pipe & water distribution pipe shall be resistant to corrosive action & degradation action from the portable water supplied by the water purveyor or individual water supply system.

606.2. Soil & Ground Water. The installation of a water service pipe shall be prohibited in soil & ground water which are contaminated with solvents, fuels, organic compounds & other detrimental materials causing permeation, corrosion, degradation or structural failure of the piping material. Where detrimental conditions are suspected, a chemical analysis of the soil & ground water conditions shall be required for to ascertain the acceptability of the water service material for the specific installation. Where detrimental conditions exist, approved alternative materials or routing shall be supplied.

606.3. Lead-Free water supply pipe & fittings. Pipe & pipe fittings, including valves & faucets, utilised in the water supply system shall have a maximum of **8 %** lead content

606.4. Water distribution pipe. Water service pipe shall confirm to NSF 61 & shall confirm to one of the standards listed in Table 606.4. All water service pipe or tubing, installed underground & outside of the structure, shall have a minimum working pressure rating of 160 psi (1100 kPa) at 73.4° (23°C). Where the water pressure exceeds 160 psi (1100 kPa), piping material shall have a minimum rated working pressure equal to the highest available pressure. Plastic water service piping shall terminate within 5 feet (1524mm) inside the point of entry into a building.

606.5. Water Distribution Pipe. Water distribution pipe shall confirm to NSF 61 & shall confirm to one of the standards stated in table 606.5. All hot water distribution pipe & tubing shall have a minimum pressure rating of 100 psi (690 kPa) at 180°F (82°C).

Table 606.4
Water Service Pipe

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) Plastic pipe	ASTM D 1527, ASTM D 2282
Brass pipe	ASTM B 43
Copper or copper alloy pipe	ASTM B 42; ASTM B 302
Copper or copper alloy tubing (Type K, WK, L, WL, M or WM)	ASTM B 75, ASTM B 88; ASTM B 251, ASTM B 447
Chlorinated Polyvinyl Chloride (CPVC) pipe	ASTM D 2846; ASTM F 441 ASTM F 442; CSA B 137.6
Ductile Iron Water Pipe	AWWA C 151
Galvanised Steel Pipe	ASTM A 53
Polybutylene (PB) plastic pipe & tubing	ASTM D 2662; ASTM D 2666 ASTM D 3309; CSA CAN/CSA-B137.8
Polyethylene (PE) Plastic pipe	ASTM D 2239; CSA CAN/CSA-B137.1
Polyethylene (PE) Plastic tubing	ASTM D 2737; CSA CAN/CSA-B137.10
Cross Linked Polyethylene	ASTM F 876; ASTM F 877 CSA CAN/CSA-B137.5
Cross Linked Polyethylene/ Aluminium / cross linked polyethylene (PE-AL-PE) pipe	ASTM F 1281; CSA CAN/CSA B 137.10
Polythene / Aluminium / Polythene pipe (PE-AL-PE) pipe	ASTM F 1282; CSA CAN/CSA-B137.9
Polyvinyl Chloride (PVC) plastic pipe	ASTM D 1785; ASTM D 2241; ASTM D 2672; CSA CAN/CSA-B137.3

TABLE 605. 5
WATER DISTRIBUTION PIPE

MATERIAL	STANDARD
Brass pipe	ASTM B 43
Chlorinated polyvinyl chloride (CPVC) plastic pipe & tubing	ASTM D 2846; ASTM F 441 ASTM F 442; CSA B 137.6
Copper or Copper alloy pipe	ASTM B 42; ASTM B 302
Copper or Copper alloy tubing (TYPE K, WK, L, WL, M or WM)	ASTM B 75; ASTM B 88; ASTM B 251; ASTM B 447
Cross linked Polyethylene (PEX) plastic tubing	ASTM F 887; CSA CAN/CSA-B137.5
Cross linked Polyethylene/Aluminium/cross linked polyethylene (PEX-AL-PEX) pipe	ASTM F 1281; CSA CAN/CSA-B 137.10
Galvanised Steel pipe	ASTM A 53
Polybutylene (PB) plastic pipe tubing.	ASTM D 3309; CSA CAN 3-B137.8

606.6 Fittings. Pipe fitting shall be approved for installation with the piping material installed, and shall conform to the respective pipe standards or one of the standards listed in Table 606.6. All pipe

fittings utilised in water supply system shall also conform to NSF 61. The fittings shall not have ledges, shoulders or reductions which are capable of retarding or obstructing flow in the piping

**TABLE 606.6
PIPE FITTINGS**

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic	ASTM D 2486
Cast Iron	ASME B 16.4 ;ASME B 16.12
Chlorinated Polyvinyl Chloride (CPVC) plastic	ASTM F 437; ASTM F 438; ASTM F 439
Copper or Copper Alloy.	ASME B 16.15; ASME B 16.18; ASME 16.23; ASME B 16.26; ASME 16.29 ASME B16.32
Gray iron or Ductile iron	AWWA C 110
Malleable Iron	ASME B 16.3
Polyethylene chloride plastic (PVC) plastic	ASTM D 2464; ASTM D 2466; ASTM D 2467; CSA; CAN/CSA-B 137.28
Polyethylene (PE) plastic	ASTM DC 2609
Steel	ASME B 16.9; ASME B 16.11; ASME 16.28

606.7. Valves. All valves shall be of the approved type, and compatible with type of piping material installed in the system.

606.8. Manufactured pipe nipples. Manufactured pipe nipples shall conform to one of the standards listed in Table 606.8

**TABLE 606.8
MANUFACTURED PIPE NIPPLES**

MATERIAL	STANDARD
Steel	ASTM A 737
Brass; copper; chromium plated	ASTM B 687

606.9. Prohibited joints and connections. The following types of joints and connections shall be prohibited:

1. Cement concrete joints.
2. Joints made with fittings not approved for the specific installations
3. Solvent-cement joints between different type of plastic pipe.
4. Saddle type fitting.

606.10.ABS Plastic. Joints between ABS plastic pipe or fittings shall comply with section 606.10.1 through 606.10.3

606.10.1.Mechanical joints. Mechanical joints on water pipes shall be made with an elastomeric seal conforming to ASTM D 3139. Mechanical joints shall only be installed in underground systems, unless otherwise approved. Joints shall be installed with manufacturer's instructions.

606.10.2. Solvent cementing. Joint surfaces shall be clean and free from moisture. Solvent cement that conforms to ASTM D 2235 shall be applied to all joint surfaces. The joint shall be made while the cement is wet. Joints shall be made in accordance with ASTM D 2235. Solvent -cement joints shall be permitted above or below ground.

606.21.3. Threaded joints. Threads shall conform to ASME B1.20.1 Schedule 80 or heavier pipes shall be permitted to be threaded with dies specifically designed for plastic pipe. Approved thread lubricant or tape shall be applied on the male threads only.

606.11 Asbestos Cement. Joints between asbestos-cement pipe fittings shall be made with sleeve coupling of the same composition as the pipe, sealed with elastomeric ring conforming to ASTM D 1869.

606.12 Brass. Joints between brass pipes or fittings shall comply with sections 606.12.1. through 606.12.4.

606.12.1. Brazed Joints. All joint surfaces shall be cleaned. A flux of approved make shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8.

606.12.2. Mechanical Joints. Mechanical joints shall be installed in accordance with manufacturer's instructions.

606.12.3. Threaded Joints. Threads shall conform to ASME B 1.20.1. Pipe-joint compound or tape shall be applied on the male threads only.

606.12.4. Welded Joints. All joint surfaces shall be cleaned. The joint shall be welded with an approved filler metal.

606.13. Cast - Iron Caulked Joints. Joints for bell & spigot cast-iron pipe shall be firmly packed with clean, sound asbestos rope or treated paper rope. Molten lead shall be poured in one operation to depth indicated in the table 606.13. The lead shall be caulked tight.

Table 606 .13
Lead Depth For Caulked Cast- Iron Pipes

Pipe Size (inches)	Depth of Lead (inches)
Upto 20	2 ¼
24, 30, 36	2 ½
Larger than 36	3

for SI: 1inch = 25.4 mm.

606.14. Copper Pipe. Joints between copper or copper-alloy pipes or fitting shall comply with sections 606.14.1. through 606.14.5.

606.14.1. Brazed Joints. All joints surfaces shall be cleaned. An approved flux shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8.

606.14.2. Mechanical Joints. Mechanical joints shall be installed in accordance with manufacturer's instructions.

606.14.3. Soldered Joints. Solder joints shall be made in accordance with the methods of ASTM B 828. All cut tube end shall be reamed to the full inside diameter of the tube end. All joint surfaces shall be cleaned. A flux conforming to ASTM B 813 shall be applied. The joints shall be soldered with a solder conforming to ASTM B 32. The joining of water supply piping shall be made with a lead- free solder & fluxes. "Lead-Free" shall mean a chemical composition equal to or less than 0.2 % lead.

606.14.4. Threaded Joints. Threaded joints shall conform to ASME B1.20.1. Pipe-joint compound shall be applied on the male thread only.

606.14.5. Welded joints. All joints surfaces shall be cleaned. The joints shall be welded with an approved filler metal.

606.15. Copper tubing. Joints between copper and copper-alloy tubing or fittings shall comply with section 606.15.1 through 606.15.4.

606.15.1. Brazed joints. All joint surfaces shall be cleaned. An approved flux shall be applied where required. The joint shall be brazed with filler metal conforming to AWS A5.8

606.15.2. Flared joints. Flared joints for water pipe shall be made by a tool designed for that operation.

606.15.3. Mechanical joint. Mechanical joints shall be installed in accordance with the manufacturer's instructions.

606.15.1. Soldered joints. Soldered joints shall be made in accordance with the methods of ASTM B 828. All cut tube shall be reamed to the full inside diameter of the tube end. All joint surfaces shall be cleaned. A flux conforming to ASTM B 813 shall be applied. The joint shall be soldered with a solder conforming to ASTM B 32. The joining of water supply piping shall be made with the lead-free solder and fluxes. "Lead free" shall mean a chemical composition equal to or less than 0.2 percent lead.

606.16. CPVC plastic. Joints between CPVC plastic pipe or fittings shall comply with section 606.16.1 through 606.16.3.

606.16.1. Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's instructions.

606.16.2 Solvent cementing. Joint surface shall be clean and free from moisture, and an approved primer shall be applied. Solvent cement orange in colour and conforming to ASTM F 493, shall be applied to the joint surfaces. The joints shall be made while the cement is wet, and in accordance with ASTM D 2846 or ASTM F 493. Solvent-cement joints shall be permitted above or below ground.

606.16.3 Threaded joints. Threads shall be of ASME B1.20.1. Schedule 80 or heavier pipe shall be permitted to be threaded with the dies specifically designed for plastic pipe, but the pressure rating of the pipes shall be reduced by 50%. Thread by socket moulded fittings shall be permitted. Approved thread lubricant or tape shall be applied on the male threads only.

606.17. Steel. Joints between galvanised steel pipes or fittings shall comply with sections 606.17.1. & 606.17.2.

606.17.1 Threaded Joints. Threads shall conform to ASME B1.20.1. Pipe-joint compound or tape shall be applied on the male threads only.

606.17.2. Mechanical Joints. Joints shall be made by an approved elastomeric seal. Mechanical Joints shall be installed in accordance with the manufacturer's instructions.

606.18. Polybutylene Plastic. Joints between polybutylene pipe & tubing or fittings shall comply with sections 606.19.1. through 606.19.4.

606.18.1. Flared Joints. Flared pipe ends shall be made by a tool designed for that operation.

606.18.2. Heat-Fusion Joints. Joints shall be of the socket-fusion or butt-fusion type. Joint surfaces shall be clean & free from moisture. All joint surfaces shall be heated to melt temperature & joined. The joint shall be undisturbed until cool. Joints shall be made in accordance with the ASTM D 2657, ASTM D 3309 or CSA CAN3-B 137.8.

606.18.3. Mechanical Joints. Mechanical joints shall be fixed in accordance with the manufacturer's instructions. Metallic lock rings employed with insert fittings as described in ASTM D 3309 or CSA CAN3-B 137.8. shall be installed in accordance with the manufacturer's instructions.

606.19. Polyethylene Plastic. Joints between polyethylene plastic pipe & tubing or fittings shall comply with sections 606.19.1 through 606.19.4.

606.19.1. Flared Joints. Flared joints shall be permitted where so indicated by the pipe manufacturer. Flared joint shall be made by a tool designed for that operation.

606.19.2. Heat-Fusion Joints. Joints shall be clean & free from moisture. All joint surfaces shall be heated to melt temperature & joined. The joint shall be undisturbed until cool. Joints shall be made in accordance with ASTM D 2657.

606.19.3. Mechanical Joints. Mechanical Joints shall be installed in accordance with the manufacturer's instructions.

606.19.4. Installation. Polyethylene pipe shall be cut square, with a cutter designed for plastic pipe. Except where joined by heat fusion, pipe shall be chamfered to remove sharp edges. Kinked pipe shall not be installed. The minimum pipe bending radius shall not be less than 30 pipe diameters, or the minimum coil radius, whichever is greater. Piping shall not be bent beyond straightening of the curvature of the coil. Bend shall not be permitted within 10 pipe diameters of any fitting or valve. Stiffener inserts installed with compression-type couplings & fittings shall not extend beyond the clamp or nut of the coupling or fitting.

606.20. PVC plastic. Joints between PVC plastic pipe or fittings shall comply with sections 606.20.1/ through 606.20.3.

606.20.1. Mechanical joints. Mechanical joints on water pipe shall be made with an elastomeric seal conforming to ASTM D 3139. Mechanical joints shall not be installed in above-ground systems, unless otherwise approved. Joints shall be installed in accordance with the manufacturer's instructions.

606.20.2. Solvent Cementing. Joint surface shall be clean and free from moisture. A purple primer that conforms to ASTM F 656 shall be applied. Solvent cement not in purple in colour and conforming to ASTM D 2564 or CSA/CAN/CSA-B 137.3 shall be applied to joint surfaces. The joint shall be made while the cement is wet, and shall be in accordance with ASTM D 2855. Solvent-cement joint shall be permitted above or below ground.

606.20.3. Threaded joints. threads shall conform to ASME.B.1.20.1 Schedule 80 or heavier pipe shall be permitted to be threaded with dies specifically designed for plastic pipe, but the pressure rating of the pipes shall be reduced to 50%. Approved thread lubricant or tape shall be applied on the male threads only.

606.21. Joints between different materials. joints between different piping materials shall be made with a mechanical joints of the compression or mechanical - sealing type, or as permitted in section 606.21.1. and 606.21.2. Connectors or adapters shall have an elastomeric seal conforming to ASTM D 1869 OR ASTM F 447. Joints shall be installed in accordance with the manufacturer's instructions.

606.21.1. Copper or copper alloy tubing or galvanised steel pipe. Joints between copper and copper alloy tubing and galvanised steel pipe shall be made with a brass converter fitting dielectric fitting. The copper tubing shall be soldered to the fitting in an approved manner, the fitting shall be screwed to the threaded pipe.

606.21.2. Plastic pipe or tubing to other piping material. Joints between different grades of plastic pipe or between plastic pipe and other piping material shall be made with an approved adapter fitting. Joints between plastic pipe and cast iron hub pipe shall be made by a caulked joint or a mechanical compression joint.

SECTION 607.

INSTALLATION OF THE BUILDING WATER DISTRIBUTION SYSTEM.

607.1 Location of full open valves. Full open valves shall be installed in the following locations :

1. On the building water service pipe from public water supply near the curb.
2. On the water distribution supply pipe at the entrance into the structure.
3. On the discharge side of every water meter.
4. On the base of every water riser pipe in occupancies other than the multiple family residential occupancies which are two stories or less in height and in one and two family residential occupancies.
5. On the top of every water down-feed pipe in occupancies other than one and two-family occupancies
6. On the entrance to every water supply pipe to dwelling unit, except where supplying a single fixture equipped with individual stops.
7. On the water supply pipe to gravity or pressurised water tank.
8. On the water supply pipe to every water heater.

607.2 Location of shutoff valves. Shutoff valves shall be installed in following locations:

1. On the fixture supply to each plumbing fixture in other than one and two-family residential occupancies, and other than in individual guest rooms that are provided with unit shutoff valves in hotels, motels, boarding houses and similar occupancies.
2. On the water supply pipe to each sill cock.
3. On the water supply pipe to each appliance or mechanical equipment.

607.3 Access to valves. Access shall be provided to all required full open and shutoff valves.

607.4 Valve identification. Service and hose bibs valves shall be identified. All other valves installed in locations that are not adjacent to the fixture appliance shall be identified, indicating the fixture or appliance served.

607.1 Water pressure booster systems. Water pressure booster systems shall be provided as required by sections 607.5.1 through 607.5.11.

607.5.1 Water pressure booster systems required. Where the water pressure in the public water supply or individual water supply system is insufficient to supply the minimum pressure and the quantities specified in this code, the supply shall be supplemented by an elevated water tank, hydro-pneumatic pressure booster system or a water pressure booster pump installed in accordance with section 607.5.5.

607.5.2 Support. All water supply tank shall be supported in accordance with the building code.

607.5.3 Covers. All water supply tanks shall be covered to keep out unauthorized persons, dirt and vermin. The covers of gravity tanks shall be vented with a return bend vent pipe with an area not less than the area of the down-feed riser pipe, and the vent shall be screened with a corrosion-resistant screen of not less than 16x20 mesh per inch (630x787 mesh per m).

607.5.4 Overflows for water supply tanks. Each gravity or suction water supply tank shall be provided with an overflow with a diameter not less than that shown in table 607.5.4. The overflow shall discharge above and within not less than 6 inches (152 mm) of a roof or roof drain, the floor of floor drain or over an open water supply fixture. The overflow outlet shall be covered with a corrosion resistant screen of not less than 16 x 20 mesh per inch (630x787 mesh per m) and by 1/4 inch (6.4 mm) hardware cloth or shall terminate in horizontal angle seat check valve. Drainage from overflow pipes shall be directed so as not to freeze on roof walks.

TABLE 607.5.4.

SIZES FOR OVERFLOW PIPES FOR WATER SUPPLY TANKS

Maximum Capacity of Water Supply Line to Tank (gpm)	Diameter of overflow Pipe. (inches)
0 - 50	2
50 - 150	2 1/2
150 - 200	3
200 - 400	4
400 - 700	5
700 - 1000	6
OVER 1000	8

For SI : 1 inch = 25.4 mm, 1 gpm = 3.785 lpm

607.5.5 Low pressure cut off required on booster pumps. Low pressure cut-off shall be installed on all booster pumps in a water pressure booster system to prevent creation of vacuum or negative pressure on the suction side of the pump when in positive pressure of 10 psi (68.94 kpa) or less occurs on the suction side of the pump.

607.5.6 Potable water inlet control and location. Potable water inlets to gravity tanks shall be controlled by a ball cock or other automatic supply valve installed so as to prevent the tank from overflowing. The inlet shall be terminated so as to provide an air gap not less than 4 inches (102 mm) above the overflow.

607.5.7 Tank drain pipe. A valved pipe shall be provided at the lowest point of each tank to permit emptying of the tank. The tank drain pipe shall discharge as required for overflow pipe and shall not be smaller in size than specified in table 607.5.7.

TABLE 607.5.7
SIZES OF DRAIN PIPE FOR WATER TANKS

TANK CAPACITY (gallons)	DRAIN PIPES (Inches)
Upto 750	1
751 to 1500	1 ½
1501 to 3000	2
3001 to 5000	2 ½
5001 to 7500	3
Over 7500	4

For SI: 1 gallon = 3.785 litres, 1 inch = 25.4 mm.

607.5.8 Prohibited location of potable supply tanks. Potable water gravity tanks or manholes of potable water pressure tanks shall not be located directly under any soil or waste piping or any source of contamination.

607.5.9 Pressure tanks, vacuum relief. All water pressure tanks shall be provided with a vacuum relief valve at the top of the tank which will operate upto a maximum water pressure of 200 psi (1380 kpa) and upto a maximum temperature 200 °F (93°C). The maximum size of such vacuum relief valve should be ½ inch (12.7 mm).

607.5.10 Pressure relief for tanks. Every pressure tank in a hydropneumatic pressure booster system shall be protected with a pressure relief valve. The pressure relief valve shall be set at a maximum pressure equal to the rating of the tank. The relief valve shall be installed on the supply pipe to the tank or on the tank. The relief valve shall discharge by gravity to a safe place of disposal.

607.5.11 Pumps and other appliances. Water pumps, filters, softeners, tanks and all other appliances and devices which handle or treat potable water shall be protected against contamination in accordance with section 609.

607.6 Water supply system test. Upon completion of a section of or the entire water supply system, the system, or portion completed, shall be tested in accordance with section 313.

SECTION 608

HOT WATER SUPPLY SYSTEM

608.1 Where required. In occupied structures, hot water shall be supplied to all plumbing fixtures and equipment's utilised for bathing, washing, culinary purposes, cleansing, laundry or building maintenance.

Exception: In non-residential occupancies, hot water or tempered water shall be supplied for bathing and washing purposes.

608.2 Hot water supply and temperature maintenance. Where the developed length of hot water piping from the source of hot water supply to the farthest fixture exceeds 100 feet (30480 mm), the hot water supply system shall be provided with a method of maintaining the temperature of hot water to within 100 feet (30480 mm) of the fixtures. The methods of maintaining the temperature shall not expend more energy than required by re-circulation system.

608.2.1 Piping insulation. Piping in required return circulation systems shall be insulated to provided a thermal resistance, R , excluding film resistance's, of

$$R = \left[\frac{t_i - t_a}{25} (\text{hr.})(\text{ft}^2)^{\circ}\text{F} \right] / \text{Btu}$$

$$\text{for SI : } R = \left[t_i - t_a \text{ o.0304} \right] \text{ K} \cdot \text{m}^2 / \text{W}$$

where $t_i - t_a$ is design temperature differential between the water in the pipe and the surrounding air in °F. Exception : Pipe insulation is not required where $t_i - t_a$ is 25°F. (14°C) or less.

608.2.2 Pump operation. Where a circulating pump is installed on a return circulation hot water system, the pump shall be arranged to shut off automatically or to allow manual shut off when the hot water system is not in operation.

608.3 Thermal expansion control. A means of controlling increased pressure caused by thermal expansion shall be provided where required in accordance with section 608.3.1. and 608.3.2.

608.3.1 Pressure reducing valve. For water service system size up to and including 2 inches (51 mm), a device for controlling pressure shall be installed where because of thermal expansion, the pressure on the downstream side of pressure reducing valve exceeds the main supply pressure. A pressure reducing valve with an integral bypass check valve or other device shall be installed to satisfy this requirement.

608.3.2 Back flow prevention device or check valve. Where a back flow prevention device, check valve or other device is installed on a water supply system utilising storage water heating equipment such that thermal expansion causes an increase in pressure, a device for controlling pressure shall be installed.

608.4 Hot water supply to fixtures. The hot water supply to any fixture requiring hot water shall be installed on the left of the fixtures.

SECTION 609 PROTECTION OF POTABLE WATER SUPPLY

General. A potable 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 potable water supplied through cross-connections or any other piping connections to the system. Back-flow preventer applications shall conform to table 609.1.

Plumbing fixtures. The supply lines or fittings for every plumbing fixture shall be installed so as to prevent back flow.

**Always
Protect
Hands &
Eyes.**

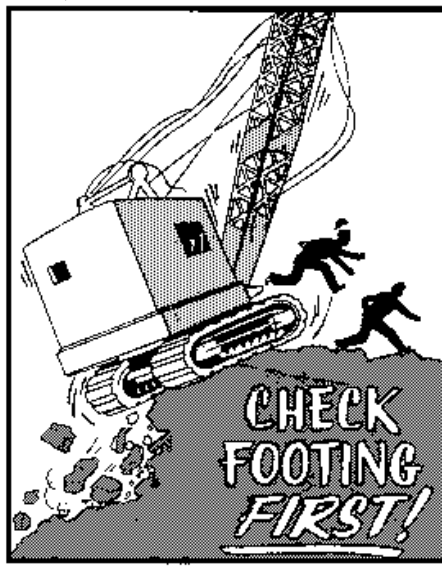


TABLE 609.1
APPLICATION FOR BACK FLOW PREVENTER

DEVICE	DEGREE OF HAZARDS*	APPLICATION*	APPLICABLE STANDARDS
Air Gap	High or low	Backsiphonage or backpressure	ASME A112.1.2
Antisiphon type WC flush tank ballcock	Low	Backsiphonage only.	ASSE1002, CSA CAN/CSAB125
Reduced pressure principle back flow preventer	High or low	Back pressure or backsiphonage sizes: 3/8 inches-16 inches	ASSE1013, AWWA C511, CSA CAN/CSA B64.4
Reduced pressure detector assembly back flow preventer	High or Low	Backsiphonage or back pressure (fire sprinkler systems)	ASSE1047
Double check back flow prevention assembly	Low	Back pressure or backsiphonage sizes: 3/8 - 16 inches	ASSE1015, AWWA C510
Double check detector assembly back flow preventer	Low	Back pressure or backsiphonage (fire sprinkler systems)sizes:1 1/2 -16"	ASSE1048
Dual check valve type back flow preventer	Low	Back pressure or backsiphonage size: 1/4 inch - 1 inch	ASSE1024
Back flow preventer with immediate atmospheric vents	Low	Back pressure or backsiphonage sizes: 1/4 inch - 3/4 inch	ASSE1012, CSA.CAN/CSA B64.3.
Dual check valve type back flow preventer for carbonated beverage dispensers/post- mix type	Low	Back pressure or backsiphonage sizes: 1/4 inch - 3/4 inch	ASSE1032
Pipe applied atmospheric type vacuum breaker	High or Low	Backsiphonage only sizes: 1/4 inch - 4 inches	ASSE1001, CSA.CAN/CSA B64.1.1
Pressure vacuum breaker assembly	High or Low	Backsiphonage only. Sizes: 1/2 inch - 2 inches	ASSE1020
Hose connection vacuum breaker	High or Low	Low head back pressure or back siphonage sizes: 1/2 ", 3/4", 1"	ASSE1011, CSA.CAN/CSA B64.2
Vacuum wall hydrants, frost resistance, automatic draining type	High or Low	Low head back pressure or back siphonage sizes: 3/4 ", 1"	ASSE1019, CSA.CAN/CSA B64.2.2.
Laboratory faucet back flow preventer	High or Low	Low head back pressure and back siphonage	ASSE1035, CSA.CAN/CSA B64.7.
Hose connection back flow preventer	High or Low	Low head back pressure and back siphonage size: 1/2 " - 1"	ASSE1052.

For SI : 1" = 25.4 mm

- a) Low Hazard - See Pollution (Section 602).
High Hazard - See Contamination (Section 602).
- b) See Back pressure (Section 602).
See Back siphonage (Section 602).



SOME IMPORTANT WATER BYE-LAWS OF MUNICIPAL CORPORATION OF GREATER BOMBAY

An introduction:- **1.** These water bye-laws were framed by the Bombay Municipal Corporation in year 1924 and were approved by the then State Government in 1925. And were enforced from 1.10.1928, under section 461 (a) & (b) of Municipal Act.

Bye-Laws covers almost all the items like definitions of the terms used in the bye-laws, right from word commissioner to communication pipe, supply pipes, different types of pipes and valves allowed to be used. It also had the specimens of the different forms to be used for obtaining permissions, notices being served by the corporation in case of breach of conditions of the bye-laws, diagrams showing different taps and valves allowed by the corporation vide these bye-laws.

To be in little more details:- **Schedule “A”** shows the application form on which the application for the water connection is being made. **Schedule “B”** Material, sizes and quality wise description of the pipes and fittings to be used for water connections and the pipes and fittings prohibited to be used.

2. Definitions

Consumer :- Shall mean and refer to any corporate body, person or persons applied or applying to be supplied with, or any person or persons otherwise liable for the payment of water tax or water charges.

Communication pipe :- shall mean and refer to the pipe which extends from the municipal stop cock upto the ball cock of the storage tank, if any and any consumer pipe subject to water pressure from the Municipal main.

Distribution pipe :- Any consumer pipe which is not subject to water pressure from Municipal main.

Municipal stop cock :- The stop cock on the communication pipe nearest the Municipal main, controlling the supply of water from Municipal water work to any premises charged or chargeable separately with the water tax or water charges.

Consumer's pip & fitting :- All pipes and fittings used in connection with the supply of water from any Municipal water work, which are not property of Corporation.

Commissioner :- The Municipal commissioner for the city of Greater Bombay and include such other duly authorised officer as he may appoint for the purpose of these bye-laws.

Act:- The city of Bombay Municipal Act, 1888, as modified to date.

So far may be reasonably consistent with the definition given, terms used in these bye-laws shall have the same meaning as the same terms have, when used in the Bombay Municipal Act.

3 Application for supply:- Before commencing the laying, the laying alteration or extension of any consumer's pipe or otherwise, on applying to the corporation to provide a supply of water to any premises, intending consumer shall fill-up, sign and deliver to the Head Office of the water department of the Corporation an application in the form prescribed in Schedule “A” attached to the bye-laws.

4. Connection to mains :- All consumer pipes & fittings shall be provided and laid in accordance with Sections 272, 273A, AND 274(2) of the Act and these with these bye-laws, and be perfectly sound and water tight before the water laid. Water will not be supplied to any remises so long as such non-compliance remains.

5. Alterations/Removal of consumers' pipe:- No consumer's pipe shall be removed, altered or extended except in accordance with section 274(2), 279, and 284 of the Act and in accordance with these bye-laws.

6. Provision relating to the prevention of wastage of water etc. section 279 284 & 278(1) of the Act provided to prevent the wastage, contamination and misuse of the water. It also authorises the Commissioner to have an access to the Consumer's premises, pipes and fittings.

7. Corporation to lay or remove communication pipe:- The communication pipes & fittings shall be provided & laid by the corporation and shall be maintained or removed at the expenses of the Corporation.
8. size of the communication pipe:- Water supplied to any premises for which water tax is payable, shall be supplied through a ferrule & communication pipe of the size specified in the schedule "B" OF these Bye-laws.
9. Testing & stamping of Consumer's fittings : Consumer' pipes and fittings whatever kind, shall conform to the particulars prescribed and specified in Schedule "B" of the Bye-laws or to such further standards as may from time to time be prescribed by the Commissioner under Section 274(2) of the Act, & whether so specified or not shall be submitted for approval to Commissioner before being fixed. All such fittings shall be maintained, repaired & renewed at the Consumer's expenses to the satisfaction of the Commissioner. All consumer's fittings or apparatus used in connection with the water supply of the Corporation, shall be tested stamped by the Corporation or shall bear the test mark or stamp approved by the Commissioner as guaranteeing conformity with the Act & these Bye-laws.
10. Consumer's pipes & fittings:- All consumer's pipes & fittings shall be provided and laid at the Consumer's cost and Consumer shall be entitled to supply of water unless & until such pipes & fittings laid & fixed are approved by the Commissioner as complying with the Act and these Bye-laws and unless proper drainage arrangements have been made for the disposal of waste water & approval of Commissioner obtained.
11. Erection of W. Cs to be approved :- No connection will be granted for the supply of water to any W.C Latrine or urinals unless its erection is approved by the Commissioner, and unless sufficient storage is provided.
12. Materials of Communication pipes :- All consumer's pipes & fittings shall be of lead, galvanised Iron, Brass or copper and shall conform in every respect to the particulars prescribed in & specifications given in the Schedule "B" attached to these Bye-laws. No pipes, except such existing pipes as shall be sound & do not permit waste, or except when and as otherwise authorised by these rules, shall be laid, used or fixed in or about any premises for conveyance of or on connection with the water supplied by the Corporation unless such pipe be as hereafter prescribed.
13. joints :- Whenever lead pipes are used, every lead joint thereof shall be of the kind called a plumbing or wiped joint, except such existing joints as shall be sound and do not permit waste. All connections with lead and iron pipe shall be made with brass union.
14. Method of laying consumer's pipes:- All Consumer's pipes shall be laid in the ground & not less than 45.72 cms below the surface unless laid inside a building and all consumer opines shall be so laid or fixed as not to be exposed to the nor shall any consumer's pipes & fittings be laid in any position or manner which would involve risk or injury to the pipe or fitting, or waste or contamination of water. All Consumer's pipes hereafter laid or fixed inside any building shall be accessible and not embedded in plaster, stone, or brick work of any wall. In every case Consumer shall carry-out reasonable requirements of the Commissioner to this end. The position at which the connection of the supply pipe to the communication pipe shall be made be fixed by the Commissioner.
14. No pipe to be laid trough the drains etc.:- No pipes shall be used for the conveyance of or in connection with water supplied by the Corporation which is laid or fixed through, or into any drain or any place where the water conveyed through such pipe may be liable to become fouled, or where pipe may become unsound, except where such use is unavoidable. In every such unavoidable case, such pipe shall be passed through an exterior air-tight pipe or jacket of Cast iron or other material approved by the Commissioner of sufficient length & strength and such construction as to afford due protection to the water pipe to the satisfaction of the Commissioner so as to bring any leakage therefrom within any observation. Any existing pipe or pipes laid or affixed which do not comply with this rule, shall be removed unless the written consent of the commissioner be obtained for its retention.
15. Premises not to be supplied through more than one communication pipe:- No premise shall be supplied with the water of the Corporation by more than one communication pipe except as provided in Schedule "B" attached to these Bye-laws.
16. Separate communication pipe to every premise:- Every premises supplies with the water by the corporation shall have its own separate communication pipe & no communication pipe shall be used to supply eater to more than one premises. Provided that in case of group or block of premises, the water tax of which is paid by one owner, the said owner may at his option have one communication pipe sufficient for such group of blocks.

17. Position of stop cock on communication pipe:- The stop cock with the guard box on the communication pipe shall be placed in a position to be selected by the Commissioner. The Corporation shall have exclusive control of the stop cock, and to this end require that it will be with crutch or spindle head of special design to suit a key kept by the Commissioner.
18. consumer' tap not to be fixed in certain place:- No consumer's taps shall be fixed in any court yard, passage, or outside any premises, so as to be available for use by the public, without special permission in writing from the Commissioner; nor shall any tap be fixed in close proximity to privies open drains, or places where injurious gases are likely to be produced; nor shall any taps, cocks or connections to any tank or reservoir be fixed so as to permit of any part of the contents of the said tank or reservoir to siphon back into the consumer's pipes.
- If, in the judgement of the Commissioner, any such tap, either direct or indirectly conduce to, or be used or dealt with as to cause waste or nuisance of the water of the Corporation, such taps shall be removed by the consumer within 14 days of the receipt of a written order to that effect from the Commissioner.
19. Prohibited connections of Consumer's pipe:- No Consumer's pipe shall be connected to any cistern or other receptacle used for the storage of rain or well water or water other than from the mains of the corporation, and no supply pipe shall be connected to any water closet, urinals, steam boiler, or any hot water system or any apparatus used for heating for trade purposes of any closed vessel otherwise than through the supply cistern thereof; and any pipes so connected shall be disconnected within 14 days of the receipt of a written order from the Commissioner.
20. Character of cistern and ball cocks:- Every existing cistern, if not sound or efficient, or is such as causes waste or is such as can not be efficiently repaired and every cistern, reservoir, or storage tank shall be of prescribed kind and shall be at all times maintained water tight and shall be properly covered with a close fitting dust-light mosquitoes proof lid fitted with an approved lock and key & shall be provided with a sound and suitable ball cock of prescribed kind securely fixed to the cistern independently of the supply pipe and so set that the ball will not become submerged, when the level of the water in the cistern is below the warning pipe or allow the water rise to within 1 inch of the lower side of the overflow or warning pipe. A stop cock shall be provided on the out let pipe of all cistern and fixed as near the cistern as poss.
21. No cistern be buried :- No cistern, reservoir or storage tank, buried or excavated in the ground shall be used for the storage or reception of water for domestic purposes supplied by the Corporation unless the use of such be allowed in writing by the Commissioner, the necessary permission not to be withheld by the Commissioner except on engineering or sanitary grounds.
22. wooden cistern prohibited:- No wooden receptacle without a proper zinc, lead or other approved metallic lining shall hereafter be used for the storage of any water supplied by the Corporation for domestic purpose.
23. Cisterns to be accessible:- Every cistern, reservoir or storage tank hereafter used or fixed in connection with water supplied by the Corporation must be easily accessible & placed in such position as to admit of thorough inspection & cleaning, & if placed within the house or building shall have a clear space of not less than 2 feet between its top and any ceiling, rafter or roof. No cistern, reservoir or storage tank except those supplying closets, latrines and urinals only, shall be fixed in any water closets, latrines or urinal or any place in which injurious gases are likely to be produced and as far as practicable shall not be placed immediately over any water closet, latrine or urinal.
24. Cisterns to have warning pipes:- Every cistern, reservoir or storage tank whether existing or future, shall be provided with an efficient and mosquito-proof warning pipe & the materials & construction of such cistern, reservoir or storage tank, shall be as prescribed.
- No overflow or wastage pipes other than a " Warning pipe" shall be attached to any cistern, reservoir or any storage tank supplied with water by the Corporation. And all such existing pipes when these rules come into operation shall be removed or converted into an efficient "warning pipe "within two calendar months next after the Commissioner shall have given to the owner of the premises in which such cistern, reservoir or storage tank is situated, a

notice in writing requiring such alteration to be made, and if the said notice be not complied with the Commissioner shall be at liberty to make the alteration at the cost of the owner without further notice.

- 25 Arrangements of warning pipes:- The outlet of every "Warning pipe" shall be in such situation outside the house as will admit of the discharge of the water from such "warning pipe" being readily seen by the officers of the Corporation without entering the house. And the position of such "warning pipe" shall not be changed without seven day's previous notice in writing to and approval of the Commissioner. The outlet of every warning pipe shall not be less than 2 feet above any drain, sink or gully over which the same may be fixed. No overflow or waste pipes shall be allowed to be connected to any drain or sewer, nor shall it discharge on any street. All warning pipe unions shall not be less than 19.05 mm bore screwed to British Standard pipe threads, so fixed that the bottom of the pipe will be 1" above top water level.
- 26 Water - closets, etc. to have flushing cisterns :- Every water closets, latrine & urinal to which water supplied by the Corporation is laid on shall be supplied from a flushing cistern, & shall not have any direct communication with the pipes of the Corporation and every such water-closet, latrine & urinal now existing & having direct communication shall be altered so as to conform with this rule. Any apparatus by which water may be allowed to flow continuously is prohibited.
- 27 water- closets flushing apparatus :- Every flushing cistern for single seated water-closet, (excepting such as are on the "intermediate system") hereafter fitted or fixed in which water supplied by the Corporation is to be used, shall have an efficient waste preventing apparatus so constructed of maintain as to prevent the discharge of more than three gallons of water at each flush, or a continuous flow of water, and shall not be automatic. Every flushing cistern to which water supplied by the Corporation is at present laid on which at any time shall become unsound or inefficient or shall waste water, shall be altered to conform with these Bye-laws.
- 28 Water-closets valves to be self closing :- All valves, cocks, taps or other fittings used in water closets, latrines & urinals for the purpose of admitting water to the pans or basins of such closets shall be self closing ; and any such valve, cock, taps or other fittings which are not self closing shall be removed & other substituted so as to conform with these bye-laws.
- 29 Urinal cistern apparatus:- Every urinal system in which water supplied by the Corporation is used (other than public urinal cistern) shall have an efficient waste preventing apparatus, so constructed as to prevent the discharge of more than one gallon of water to each stall, basin or compartment at each flush.
30. Automatic apparatus prohibited :- No apparatus capable of discharging automatically shall be fitted or fixed except by special permission of the Commissioner. If automatic flushing cistern are not supplied through a meter, the supply shall be taken by means of a small pet cock, or a small cistern fed through a bull cock, from which the water shall be supplied to the automatic cistern through a hole in a gun metal plate, or other approved fitting, regulated to fill the tank not more than one in 20 minute.
1. Hot water apparatus :- The distributing pipe between any supply cistern & any hot water apparatus shall be connected to the supply cistern at a point not more than 50.80 mm (2") above the bottom of such cistern & shall not be connected to any other distributing pipe.
No supply pipe shall be connected to any steam boiler, or any close vessel otherwise than through the supply cistern thereof or to any hot water system or apparatus.
Where any hot water apparatus is connected with the supply cistern, any distributing pipe which is used or intended to be used for conveying or delivering cold water for any other purpose shall be connected to the supply cistern at a point not below one half the depth of such cistern. (continued)
Hot water pipes must be arranged with sufficient room for expansion, & for the escape of air, & if of lead must be supported by continuous ledge falling toward the boiler. All hot water systems shall be provided with safety valves.
- 32 Bath apparatus:- In every bath hereafter fitted or fixed the outlet shall be distinct from & unconnected with the inlet or inlets which must be placed so that the orifice or orifices shall be atleast 50.80mm (2") above the overflow pipe or the top of the bath, & the outlet of every bath shall have a perfectly water-tight plug valves or cock & any existing outlet not provide with such plug, valve or cock shall be altered so as to conform to this Bye-laws.
- 33 Alteration of fittings :- No alteration shall be made in any pipes or fittings in connection with the supply of water by the Corporation without the consent of the Commissioner for which 2 working days previous notice in writing must be given & such altered pipes & fittings shall be in accordance with these Bye-laws.

- 34 Supply by meter measurement :-** Except with the special consent in writing of the Commissioner no water supplied by the Corporation, for which water tax under section 141 of The Act or a compounded sum under Rules II of the Water Charges Rules is chargeable, shall be used for operating lifts or hydraulic engines, nor shall such water be drawn from any hose, movable pipe, hydrant, fountain, or automatic sprinkler or used for any purpose specially provided for in Rule I of The Water Charges Rules unless such water be passed through a meter and paid for by meter measurement.
- 35 Private cattle troughs :-** Watering troughs for the use of horses or cattle supplied with the water of the Corporation shall be of cast Iron or other material approved by the Commissioner & fitted with a ball cock as specified in Schedule "B" attached to these Bye-laws, such ball cock to be enclosed in a covered box & with the pipe supplying the same properly & completely protected from damage to the satisfaction of the Commissioner.
- 36 List of Licensed Plumbers :-** The corporation shall publish from time to time a list of Licensed Plumbers & require under the Act that all work carried out by the consumer in connection with the supply or use of the water of the Corporation shall be executed by one or other of the plumbers named in the list of their workman.
- 37. Work to be done by the Licensed Plumbers:-** All work which is required to be done under any of the provisions of these Bye-laws, shall only be executed by a Licensed plumbers; and every person who employs a Licensed Plumber to execute any such work, shall when so required, furnish to the Commissioner the name of such Plumber.
- 38 Penalty for the infringement of Bye-laws :-** In the event of infringement of any or either of these Bye-laws the offender shall be liable to a fine which may extend to Rs. 20 & in the case of a continuing breach to a fine which may extend to Rs. 10 for every day during which the breach continues same provided under Section 462 of the Act.

STANDARD SPECIMEN of SCHEDULE "A"

Application for supply of water

..... the undersigned, hereby, make application to the Corporation of Bombay to be supplied with water at premises and for the purpose described below & agree to pay such charges as the corporation may from time to time be entitled to make & conform to Bombay Municipal Act, & all Bye-laws & regulations made thereunder.

..... licensed plumber have been instructed by

to carry out the plumbing work. Description of premises.....

Address.....

Purpose for which water connection is required..... and.....
hereby undertake to give the Corporation due notice of any additions or alterations to the above mentioned supply which..... may desire to make.

Applicant & owner of premises

Dated.....19..

SCHEDULE 'B'

Specification & description of pipes & fittings prescribed by the Municipal Corporation for the purpose of these Bye-laws.

Under section 274(2) & 274(3) OF THE Bombay Municipal Act No. III OF 1888 as modified to date, the Commissioner, hereby prescribes the size, material, quality, description & position of communication, consumer's, distributing & supply pipes & fittings, & no connection or communication shall be made by any person with a municipal water works except in the manner hereby prescribed.

M. C. 's sanction No. M.H.E. 7551 of 27-12-62 for clause Nos.1 to 1 (f) & sanction No. M.H.E. 7833 of 7-1-63 for clause No.1. (g):---

1. Size of communication pipe for domestic & flushing use & capacity of storage tanks :-

The size of communication pipe shall be calculated on the basis of population of each floor & aggregate population of a building to be served which shall be determined on the following basis

CARPET AREA OF A TENAMENT	POPULATION (PERSONS)
Area upto 50 sq. meters (500 sq. ft.)	7
51 to 75 sq. meters (501 sq.ft to 750 sq.ft.)	8
76 sq. meters to 100 sq. meters (751 sq.ft to 1000 sq.ft.)	9
Above 101 sq. meters (Above 1001 sq.ft.)	10

-- For servant's quarters which are not self contained units with nahanis, kitchens, etc, two persons per unit shall be counted.

A servant's room within the flat itself shall be ignored.

Garages shall be ignored.

For shops, where water for trade is not required, two persons per shops shall be counted.

1 (a) The quantity of water to be supplied per person shall be taken at 40 gallons (180 litre) per day, of which 12.5 gallons (55 litres) shall be for flushing purposes and 27.5 gallons (125 litres) for domestic purposes.

1 (b) Direct supply :- Only one connection shall be granted for the whole building to deliver the total requirement of the day in suction tank and the whole supply shall be down take from the over head tans.

But the municipal Hydraulic Engineer may consider on request to grant separate connection or connections for direct supply upto 3rd floor, provided the pressures are permissible. The quantity allowed for the direct supply shall be deducted from the total requirement of the building. the direct supply upto the 3rd floor when permitted shall be as under :-

FLOORS	QNTTY OF DIRECT SUPPLY
GROUND FLOOR	45 LITRES (10 GALLONS) PER PERSON
FIRST FLOOR	45 LITRES (10 GALLONS) PER PERSON
SECOND FLOOR	45 LITRES (10 GALLONS) PER PERSON
THIRD FLOOR	45 LITRES (10 GALLONS) PER PERSON

1(c). **Storages** :- Storage tanks shall be provided for the total daily quantity of the requirements of the whole building worked out on the basis of 180 litres (40 gallons) per head of the population of the building after deducting the quantity allowed for the direct supply & this whole quantity shall be pumped to over head tank.

1 (d). **Capacity of the storage tanks :-**

- (i) **Suction tank** :- The capacity of suction tank shall be equal to 50 % of the total quantity mentioned 1(c) above.
- (ii) **Overhead storage tanks :-**
 - (a) **Flushing Storage Tanks** :-The capacity shall be for the full daily requirement on the basis of 55 litres (12.5 gals) per head of the population of the building.
 - (b) **Domestic Storage Tank** :- The capacity shall be for 75 % of the total daily requirement worked out after deducting total flushing requirement & direct supply requirements upto 3rd floor.

1.(g) Quantity of water to be supplied to factory & office quantity of water will be taken as 45 litres (10 gals) per head per day, out of which 25 litres (5.5 gals) shall be for flushing purpose and 20 litres (4.5 gals) for other domestic purposes.

The number of persons shall be determined according to the provision of sanitary arrangement on the following basis :-

Factories :

NO OF WATER CLOSETS	NO. OF WORKERS
1	15
2	35
3	65
4	100
5	133
6	166
7	200
8	240 & ONWARD; 40 WORKERS PER TOILET

(ii) **Offices** :-The number of persons per water closet shall be determined on the basis of 25 persons per water closets

(iii) In case of lavatory units for superior staff, the number of persons per unit shall be taken as 10 in both the cases of factory & offices.

This will be in addition to water required for processing in factories.

(2). Size of taps : No taps either direct or dountake on the ground floor shall exceed 9.53mm (3/8") dia in bore & those on the second floor & above shall not exceed 12.7mm (1/2") dia in bore except where specially permitted by the commissioner. The taps on the ground floor shall be provided with orifices of the suitable size at the direction of the Commissioner.

(3).No. of taps in chawls : In case of single room Chawls where the area of each room is not less than 100 sq.mt. (100 sq.ft.) & is not more than 24 sq.mt. (240 sq.ft.) a direct or down take tap may be provided in each room & a direct or down take tap shall be provided in the general washing place for every 50 sq.mt. (500 sq.ft.) of the floor area excluding the area of the rooms where the taps are allowed.

In case of chawls where the area of the tenement exceeds 24 sq.mt. (240 sq.ft.) two taps either direct or downtake may at the discretion of the Commissioner be provided in each tenement. In the general washing place for every 50 sq.mt (500 sq.ft.) of the floor area of the rooms where the taps are not allowed one direct or downtake tap shall be provided.

Provided that the minimum number of taps in the general washing place in a chawl shall be two taps either direct or downtake or one direct & one downtake, irrespective of the floor area.

(3A) No. of taps in houses with self contained flats : In case of self contained flats for first 24 sq.mt. (240 sq.ft.) of the floor area, one direct or one downtake tap shall be provided. A maximum no. of two taps, either direct or downtake or one direct & one downtake may be allowed.

For every additional 15sq.mt (150 sq.ft.)of floor area either one direct or downtake tap may be provided..

(3B) No. of showers in self contained flats : Showers as per requirements may be allowed in case of self contained flats & shall be connected to the downtake supply.

(3B-1) Geysers or heaters :Geysers or heaters as per requirements may be allowed in case of self contained flats & shall be connected to downtake supply only.

(3C) No. of taps in shops, offices, etc. :In shops, offices, pedhies, garages, and godowns with area under 15 sq.mt (150 sq.ft.), no taps shall be allowed. Shops, offices etc with area more than 15 sq.mt. (150 sq.ft.)but less than 24 sq.mt. (240 sq.ft.), may be provided with one downtake tap and for every 24 sq.mt. (240 sq.ft.), an additional direct or downtake tap may be allowed.

(3D) No of taps in bakeries, restaurants etc: For bakeries, restaurants, milk shops, meat shops, hair cutting saloons, clinics, dispensaries, medical consulting rooms, & chemist's shops, one direct tap shall be allowed upto 24 sq.mt (240 sq.ft.)of floor area, & for every additional 24 sq.mt, one direct tap may be allowed. The downtake taps shall be allowed as per requirements at the direction of the Hydraulic Engineer.

(3E) No. of taps on metered supply : In case where the supply is metered direct or downtake taps may be allowed as per requirement at the direction of Commissioner.

(4) Position of taps :Every tap fixed in mori, washing place, nahani, or a bath room shall not be higher than 0.91mt (3')above the floor unless a written sanction of the Commissioner is first obtained. Such moris, nahanis, washing places or bathroom shall be properly constructed & drained as required by the Building Regulations & Bye-laws.

(5) Taps in water closets : A 9.53 mm (3/8")self closing taps approved by the Commissioner may be allowed *in water closet*, provided the water supply to the tap is taken from the storage tanks *meant for flushing purposes*.

(6) position where self closing taps are permissible: Self closing taps & other special fittings of makes approved by the Commissioner may be permitted to be used on direct pipes & *distributing* pipe from the cisterns.

(7A) Testing & stamping of water pipes & fittings : All pipes & fittings shall bear the standardisation marks of the makers when subject to pressure, shall be capable of resisting a force 14.6 kgs/cm² (200 lbs/in²) for five minutes without leaking . They shall be tested & approved by the Commissioner & shall bear the Municipal test mark thereon in token of their being approved by the Commissioner. The commissioner shall make reasonable charges for testing any water pipes or fittings suitable for such purposes. The Commissioner or the authorised officer will not be responsible for any breakage or injury that may occur, to pipes & fittings in the process of testing & stamping.

(7B) Pipes & fittings bearing ISI MARK : Pipes & fittings bearing ISI Mark shall be exempted from the test prescribed under (7A)

(8) Water way fittings: No fittings used in the course of any communication pipe of the Corporation upto & through the stop cock shall in any part to be less in area than that of the ferrule and no ferrule shall be of less than 12.7mm (1/2") bore in its course.

Position of stop cock : Every Communication pipe shall have inserted in it, in such position as the Commissioner may determine, stop cock of the prescribed kind having an area of water-way atleast equal to the internal sectional area of Communication pipe. If the Commissioner orders the position of the existing stop cock to be removed or altered the, the work shall be done at the expense of the Corporation.

(9) fittings to be as approved : No fittings shall be used or fixed by the Consumer which is **not tested** by the Commissioner & which does not bear the approved Municipal test mark thereon, & all fittings not tested as prescribed above shall be removed. Provided always that any existing pipe or fittings or apparatus not tested as prescribed above or lawfully existing & lawful use in any premises immediately before the date when these regulations apply to such premises may be allowed to remain in use so long as it is sound & efficient & does not cause wastage of water, undue consumption, misuse, erroneous measurements contamination to the water supplies by the Corporation. In the event of it becoming unsound, inefficient or causing wastage of water or becoming defective in any of the senses previously described, it shall be removed & replaced with the approved fittings.

"Provide further that whenever an Indian Standard is available, it shall supersede the specification prescribed in the schedule.

(14D) Brass & copper pipes & tubes : All brass & copper tubes (if allowed to be used) shall be solid drawn & as regards the quality, thickness of metal & form of screw threads shall comply with the tables No. 2 & 3 of British Standard Specifications No. 61 for copper tubes & their screwed threads. The Commissioner may permit the use of tubes of light gauge & coupling of an approved type as an alternative to the above table for screwed tubing.



Helmet or Hell mate.

PLUMBING MADE EASY FOR COMMON MAN

2nd Edition

Specimen of Application for water connection

BRIHANMUMBAI MAHANAGARPALIKA

No:xxxxxx

Water Department

Application form for supply of water for (a) Construction Purpose, (b) Domestic purpose for newly constructed building

(To be filled in by an applicant & returned to Local Ward Office.)

I/we hereby make an application to the Corporation for a supply of water required by me/us for construction/Domestic purposes as per the details mentioned below and I/We hereby agree to pay to the Corporation such taxes, Charges, fees, premiums, rents, etc. for the water connections and for the supply of water as the Corporation is entitled to charge, levy or collect from time to time.

*(1) I/We hereby agree to conform to the Municipal Act, & to all rules, bye -laws, regulations as shall be in force from time to time.

(2) I/We hereby agree to the said temporary water connection being cut -off on completion of construction work unless otherwise permitted to be retained by the Corporation.

*(3) I/We hereby declare that the wa ter supplied shall be used only for the domestic purposes & undertake to inform the Corporation of any change in the user of water supplied on the premises & undertake to carry -out or permit to be carried -out any changes. Additions or alteration in the wa ter fittings on the premises without the written order & consent of the Corporation .

I/We enclose copy of the sanctioned plans.

DETAILS

1. Ward-----	2. Ward No.-----	3. Street* Plot No.-----	4. Name of Road.-----
5. Name of the Applicant.-----		6. Name of the Owner.-----	
7. Name of the Architect/Engineer.-----		8. Name of Licensed Plumber-----	
9. Sanctioned Plan no. & Date.-----		10. Description of premises floorwise-----	
11. Size of water connections required-----			
12. Storage Intended to be provided-----			
13. Is there a well in the compound-----		14. Can well water be used for construction/flushing-----	

FITTINGS REQUIRED

Flr.	Direct Tap		Downtake Taps			Down take Branches to				Wash Hand Basins	Sinks	Shower	Bath Tubs	Geyser
	Rooms	Wash- -ing places	Rooms	Bath- -rooms	Wash- -ing places	Flushing Systems		Push Taps						
						Urinal	WC	Urinal	WC					
Ground														
First														
Second														
Third														
Fourth														
Fifth														
Sixth														
Seventh														
Eighth														
Ninth														
Tenth														
Elventh														

Please attach separate list for additional floors.

Abstracts Of Important Sections of the Act.

- Section 263:** The commissioner may enter any land in the vicinity of water works & carry all the materials through such land required in connection with water works. While carrying out the works, if any damage is one or caused the commissioner shall pay the compensation for the same.
- Section 268:** No new structures, streets or railways shall be constructed over the water mains without a written permission from the commissioner. In the event of any work being constructed as above, the commissioner with approval of the standing committee shall remove them & the expense in doing so shall be borne by the party.
- Section 269(3):** Water from public fountains, tanks reservoirs, cistern, etc vesting in the corporation shall be used for the domestic purposes only, but shall not be sold or carried away in a cask, cart or pakhal without obtaining a permission from the commissioner.
- Section 270:** The water from public fountains, stand pipes etc., shall be used for the purpose it is assigned for & set apart by the commissioner. No person shall use the water from such fountains, for a purpose other than assigned.
- Section 271(2):** If any building in the city is not provided with adequate water, the commissioner shall require the owner, by a written notice, to obtain a supply from the municipal water works, adequate to the requirements of the inmates.
- Section 272:** (1) The municipal officer or the servant shall give a connection for a premises with the municipal water works. Water connection shall not be made until certificate from the commissioner is obtained.
- (2) The commissioner shall pay the cost of the works in connection with giving new connections or renewal of connection including ferrule on supply pipe upto the stopcock of the communication pipe.
- (3) The works referred to the section 272 (2) shall vest in the corporation & shall be maintained at municipal cost.
- Section 273 A:** The commissioner may change the position of an existing connection or a consumer's pipe or fitting & remove all such works. In that event the expenses shall be borne by the Municipality & the connection pipe or fitting shall vest in the corporation shall be maintained at municipal cost.
- Section 274:** (1) The commissioner may by a written notice require the owner of a building to provide cisterns & or fittings of specified description.
- (2) The commissioner shall prescribe the size, material, quality & description of the pipes, taps, cocks , etc., to be used for the connection with Municipal water works.
- Section 275 (2):** When the occupier is served with a notice under section 278(2) he may execute such works mentioned in the notice & recover the actual amount of the works from the rent to paid to the owner after giving a 3 days notice to the owner.
- Section 278:** The commissioner may inspect the premises to which the water supply is furnished by the corporation in order to remove, test, examine the water meters , communication pipes, taps, cocks, storage tanks ,etc. & see if there is any waste of water. The commissioner may by written notice require the owner or the occupier to remedy any defect in or clean any meter, pipe or fitting which causes waste of water.
- Section 279:** The commissioner may cut off water supply of any premises in certain specified cases as enumerated in the section.
- Section 280 A:** The commissioner shall have the powers for carrying, removing, & repairing private water main pipes & ducts.
- Section 281:** The pipes shall not be laid in a drain open channel house gully lose to the cess-pool, or in a place where the pipe is likely to be injured.
- Section 282(2):** A person who does not reside on premises in respect of which water tax is paid shall not be allowed to carry away water from the premises to which water supply is furnished. If the supply is charged by measurement he does so with the permission of the person to whom such a supply is furnished.
- Section 283:** No person shall alter the index of any meter or prevent it from registering draw of meter. The use of artificial means to cause alteration, prevention, destruction ,etc shall be evidence that the consumer has fraudulently effected the same.
- Section 284:** No person shall injure any meter or fitting belonging to the corporation; break, injure or open any lock, cock, valve , pipe, etc., pertaining to the Municipal water works; do any act so as to cause waste of water; obstruct, divert or alter any water main.
- Section 285:** Any person, who contravenes the provisions of sections 283, 284 shall pay compensation to the corporation.

Section 287B: No person other than a License Plumber shall carry out the water works. A person who employs a licensed plumber to execute such works, shall furnish the name of the Licensed Plumber. If a person who executes the work in connection with water supply in contravention of section 287B(1), he shall be in addition to the penalty provided, not get water connection until such defects are removed to the satisfaction of the commissioner.

Section 287A: The commissioner may execute any water works through municipal or other agency without giving an option to the person responsible.
The expense of such work shall be paid by the above person unless corporation sanctions the charge being met out of the Municipal fund.

Amendment to Water Bye-Laws approved by the Corporation & confirmed by the State Government.

Bye-Law No. 2 (hh)(a) 1.

- "Meter" means a measuring device for recording consumption of water fitted with strainer, sluice valve, wiper & meter chamber. & of such size, material & description as Municipal Commissioner approved.
- "Quota" of water means the maximum quantity of water fixed by the municipal commissioner on the basis of the average of the "monthly consumption" for a period of successive 12 months less 10 per cent. The period of 12 months for this period will be decided by the municipal commissioner & shall be applied to the industries of a particular category.
- The "Monthly consumption" mentioned in 2(b) above means the quantity of water charged to the consumer by the corporation is the actual meter bill issued in his name.
- In case there is any extension to the existing industry the additional quota may be fixed by the Municipal Commissioner on suitable basis.

Bye-Law 34-A Municipal Commissioner may fix "quotas" of water.

- After assessing the requirement, Municipal Commissioner may by order, fix the maximum quantity of water of any consumer or class of consumers shall be entitled to receive per day, per week or per month or per quarter, or otherwise periodically, Provided that, having regard to the availability of water, Municipal Commissioner may from time to time amend the order fixing the quota of water & no compensation shall be payable for any reduction in the quota.

No consumer to whom an order made under this bye-law applied shall consume water in excess of the maximum quantity permissible under this Bye-law.

Bye-Law 34-B Municipal Commissioner may insist on provision of meter.

- Municipal Commissioner may, whenever it shall appear to him to be necessary, by a written notice require the owner or occupier of any premises furnished by a water supply, to provide for premises within reasonable period (which shall be specified in the notice) a meter to place it in such a position either in Municipal road or the private premises the staff subordinate to Municipal Commissioner can have an easy means of access thereto.
- It shall be the duty of such owner or occupier to maintain the meter & keep it in proper order for correctly registering the supply of water. Any failure or defect in working of the meter shall be reported by such owner or occupier to the Municipal Commissioner within 24 hours & remedied within two days or such longer time as the Municipal Commissioner may grant.
- Municipal Commissioner or any officer authorised by him may, with a view to consider whether any premises be provided with a meter or where a meter to be provided with a view to examine the meter, enter & inspect the premises at all reasonable hours & see if there is any waste or misuse of water, if the meter is provided or not, whether the meter requires cleaning, repair or replacement or whether there is any defect in any supply or distributing pipe cistern lock or fitting & give suitable directions to the owner or occupier, who shall comply with such directions.

Bye-Law 34-B Municipal Commissioner may insist on provision of meter

If any person contravenes any of the provisions of this bye-law Municipal Commissioner may, by order, take action under all or any, of the following paragraphs, namely :-

- To charge such person penal water rates for water drawn in excess of the maximum quantity permissible under the bye-law, at rates not exceeding 20 times the normal, as he may deem fit.
- To reduce supply of water to such person by such quantity & for a period as he may determine.
- To discontinue supply of water to such person for such a period as he may determine.

SOME IMPORTANT DRAINAGE BYE-LAWS OF MUNICIPAL CORPORATION OF GREATER BOMBAY

Drainage Bye-Laws were framed under section 461 a, b, c, e, f, g, h, n of the Municipal Act especially for the matter pertaining to the drainage.

As a general practice these bye-laws also gives the definitions of the terms used in the bye-laws. Some of them are as following:-

- 3.3 Antisiphonage vent or back vent:-** Shall mean any vent pipe from an individual trap to the open air or to main or branch vent pipe, having for the prevention or breakage of water seal in the trap.
- 3.5 Bedding :-** A layer of concrete or the other suitable material on the trench floor to provide continuous support for the pipes.
- 3.6. Benching :-** The sloped floor of a Manhole or an Inspection Chamber on both side and above the top of the channel.
- 3.8. Chair :-** A bed of concrete or other suitable material on the trench floor to provide a support to for the pipes at intervals.
- 3.9 Channel:-** The open waterway through which sewage, storm water or other liquid wastes flow at the invert of a Manhole or an Inspection Chamber.
- 3.10. Cleaning Eye :-** An access opening having a removable cover to enable obstruction to be removed / cleared by means of a drain rod.
- 3.11. Combined Waste Pipe :-** Shall mean any pipe which receives the discharge from both soil and waste fixtures and conveys the same directly to the drain and which is used only in the connection with one pipe / single stack system.
- 3.14. Depth of Manhole :-** The vertical distance from the top of the Manhole cover to the outgoing invert of the main drain channel.
- 3.15. Diameter or Bore or Size :-** The reference to any pipe shall the nominal internal diameter thereof.
- 3.16 Drain :-** Shall mean a line of pipes including all fittings and equipment such as manholes, traps, gullies and floor traps used for drainage of a building / number of buildings or yards appurtenant to the buildings, within the same premises. This shall also include open or buried channels used for conveying surface water.
- 3.16.1. Sub soil water drain:-** Shall mean a drain conveying sub- soil water.
- 3.16.2 .Surface water drain :-** Shall mean a drain conveying surface water including storm water.
- 3.16.3. Sewer :-** Shall mean a closed drain carrying night soil and other water borne-waste.
- 3.17 Drainage :-** The removal of any liquid by a system constructed for the purpose.

- 3.18. Drainage Work :-** The design and construction of a system of drainage.
- 3.19. Drop Connection :-** A branch drain of which the last length of piping of the incoming drain is vertical before connection to the drain.
- 3.20. Drop Manhole:-** A manhole incorporating a vertical drop for the purpose of connecting a sewer or drain at high level to one at the lower level.
- 3.23. Fixture unit:-** Shall be quantity in terms of which the load producing effect on the plumbing system, of different kinds of plumbing fixtures, on some arbitrarily chosen scale is evaluated.
- 3.26. Haunching:-** Concrete bedding with additional concrete at the side of the pipe.
- 3.27. House Gully:-** Shall mean a passage common to a group of premises which is used for laying common drain for the premises.
- 3.28. Invert :-** Shall mean the lowest point of the interior of a sewer or drain at any cross section. In a manhole or inspection chamber, it is the lowest point of the channel in the floor.
- 3.30. Licensed Plumber :-** Shall mean a person licensed by the Corporation to carry out plumbing works U/s 355 of the B.M.C.ACT.
- 3.31. Manhole or Inspection Chamber :-** A built up opening by which a man may enter or leave a drain, a sewer or other close structure for inspection, cleaning and maintenance of a sewer line.
- 3.32. Municipal sewer :-** Shall include all sewers and sewerage works which forms the sewerage system vested in Corporation.
- 3.34. PH :-** (Potential of Hydrogen ions) Shall mean the reciprocal of Hydrogen ion concentration. It signifies the amount of weight of Hydrogen ion in ion form in grams per litre of solution, as determined by procedure / outlines in "standard Methods".
- 3.38. Sewer trap or Intercepting Trap :-** Shall mean a trap situated in the last Chamber or Manhole between the Municipal Sewer and the House Drain, within the property of the owner, for the purpose of preventing the passage of air or gases from the municipal sewer into house drain and equipped with fresh air inlet on the upstream side of the trap.
- 3.39. Soakway :-** A pit suitably prepared to receive soil waste water or partially treated sewage for seepage into the surrounding ground.
- 3.40. Soffit / Overt. :-** The highest portion of the interior of a sewer or drain at any cross section.
- 3.41. Soil pipe :-** Shall mean the pipe which receives the discharge from soil fitments, such as Water Closets, Urinals, slop sinks etc.
- 3.42. Soil Waste:-** The discharge from the Water Closets, Urinals, slop sinks, suitable for cowshed gullies and similar appliances.
- 3.43. Stack:-** Means any vertical line of soil, waste, combined waste or vent piping with its offsets if any.
- 3.46.1. Combined system :-** Shall mean a system in which foul water and surface water are conveyed by separate sewers and drains.
- Separate system :-** Shall mean a system in which foul water and surface water are conveyed by separate sewers and drains.

3.46.3. Partially Separate system :- A modification of the separate system in which part of the surface water is conveyed by the sewers.

3.47.1. Two pipe system :- The system of plumbing in which soil and waste pipes are distinct and separate, the soil pipes being connected to the house drain direct and waste pipes through trapped gully. Traps of all appliances are completely ventilated in this system.

3.47.2. One pipe system:- One pipe system of plumbing in which the waste connections from sinks, baths and wash basins and soil pipe branches are all collected into one main pipe, which is connected directly to the drainage system. Gully trap of water closets, basins etc. are completely ventilated to preserve the water seal.

3.46.3. Single stack system :- One pipe system without trap ventilation pipe work. The traps of water closets, sinks, basins etc. are directly connected to the single stack. Single stack system shall comply with following :-

- a. The vertical distance between the waste branch (from floor trap to the individual appliance) and the soil branch shall not be less than 20 cms
- b. If appliances like wash basins and sinks are directly connected to the stacks, they shall have a 7.5 cm deep water seal trap. However, if they are connected through floor trap to the stack, the individual appliances need not have water seal trap. The floor trap shall have atleast 35mm water seal. The conventional 50mm water seal of w. c. are satisfactory. The branches from W. C. s and Floor trap shall be 100mm and 75mm respectively.
- c. The branch pipe from all appliances shall fall gradually and continuously in the direction of flow and shall have a slope of 1:10 to 1: 50.

Additional requirements :- The pipes shall be laid in straight lines as far as possible in both the vertical and horizontal planes. Anything that is likely to cause irregularity of flow, such as abrupt change of direction shall be avoided. No bends & junctions whatsoever shall be permitted in the sewers except at Manholes & Inspection Chambers.

3.47.4. One pipe system partially ventilated:- A via media between one pipe system and single stack system. There is one soil pipe into which all water closets, baths sinks and basins discharge. In addition, There is a relief vent which ventilates only the traps of water closets.

3.48. THD :- Levels of various works under the jurisdiction of the corporation are with reference to Bombay Town Hall Datum (THD) which is 24.46M or 80.257 ft. below the mean sea level (MSL). The town hall bench mark is fixed on the north side of the main entrance and is marked as G.T.S.O.B.M. Its value is 30.48m or 100 ft above THD.

3.49. Trade effluent :- Discharge or liquid waste from any trade or other process other than domestic sewer.

3.50. Trap :- Shall mean any fitting designed to retain a quantity of water for the purpose of preventing the passage of air or gases through such fittings.

3.50.1. Gully trap :- Shall mean a trap used in the two pipes system for isolating or disconnecting waste pipe from the drain and for providing inlet ventilation to the waste pipe discharging into it. This fitting also facilitates removal of accumulated grit.

3.50.2. Grease trap :- It is a trap which is used to intercept grease present in the discharge, before it enter drain pipe.

3.50.3. Nahani trap :- It is trap provided at the outlet of the sanitary fittings in baths, sinks, etc. which retains sufficient water to prevent smell or gases from the waste pipes or drain from escaping and entering the home.

3.51. Waste pipe :- Shall mean any pipe which conveys the discharge from any fixtures, other than water closets, slop sinks, urinals, mortuaries, or operation theatres, to the trap gullies in case of separate pipe system and directly to the drain in case of combined pipe system.

3.51.1. Combined waste pipe :- Shall mean any pipe which receives the discharge from both soil and waste fixtures and conveys the same directly to the drain and which is used only in connection with the one pipe system / single stack system.

3.52. Waste / sullage water :- Spent water from baths, wash basins, sinks and similar appliances, which contain human or animal excreta.

3.53. Water seal / trap seal :- shall mean the vertical distance between the soffit of the dip and the crown of the weir of a trap.

3.54. Vent pipe :- A pipe line installed to provide flow of air to or from a drainage system or to provide a circulation of air within such system to protect trap seal from syphonage and backflow.

3.54. Ventilating pipe :- Shall mean the pipe which provides a safe outlet into the atmosphere for the foul gases in the drain or sewer.

PERMISSION REQUIRED, APPLICATION ETC.:

- 4.1. The owner or occupier should first obtain a permission before executing any work,
- 4.2. The work should be carried out through the agency of a **Licensed Plumber** and shall forward three sets of plans for approval.
- 4.3. The authorities may demand any information, if required.
- 4.4. If wilful misrepresentation has been made while obtaining the approval, the same may be cancelled by the Authorities.
- 4.5. Alteration, if any, should be got approved.

CONDITIONS OF PERMISSION :

- 5.1.1. The work shall be executed in accordance with plans approved and conditions mentioned thereunder and shall be in accordance of the B. M. C. Act and these bye-laws.
- 5.1.2. That no person other than a **Licensed Plumber** should be employed to execute such work.
- 5.1.3. If the license of such a plumber is suspended, such a person shall not continue to execute the work, until the restoration / renewal of his license.
- 5.2. On violation of any of the conditions, the Authorities may withdraw the permission previously granted.
- 5.3. The work shall be carried out within the premises owned by the applicant and shall not trespass in any other property without proper consent.
6. **Penalty :-** if any person whether he is or is not holder of a plumber's license of the corporation, alters, removes or in any way, interferes with any drain, fittings, pipes, bends, traps, or other things without obtaining prior permission of the commissioner, shall be guilty of breach of these bye-laws and shall be liable of not less than Rs. 200/=

PLANS REQUIRED :

7.1. The application for permission shall be accompanied by three or more sets of plans.

7.2. Design Consideration :- The drainage system for individual building or housing colony shall be designed so that self cleansing velocity is developed and which will help in rapid and efficient removal of waste. Measure shall be taken for preventing access of foul gases to the building and provision for their escape shall be made. The system shall not be such as to develop air locks, siphone proneness to obstruction, deposit and damage. The layout shall be compact with proper grouping of horizontal and vertical fitments.

7.2.1. Layout :- In the layout the rain water shall be drained separately from sewage and sullage, Sewage and sullage shall be connected to a sewer, if existing within 30 RM. from the boundary of the plot. Otherwise, arrangements such as septic tank and other units as directed by the commissioner shall be provided.

7.3. Plans of drainage :- Plans of drainage submitted for approval by the owner through the Licensed Plumber shall be neatly and accurately drawn to scale not smaller than 1:500 and shall set out clearly the following informations:-

7.3.1. Positions of all the buildings and other structures including pump house etc. in relation to the boundry of the property.

7.3.2. Position and direction of flow of the municipal manhole to which the drain is proposed to be connected, marked in red (full) together with the invert level and road level in THD of the Municipal manhole.

7.3.3. The position, direction of flow, ground level and invert levels in THD of all existing manholes, chambers, sewer trap chambers, drains marked in black. The proposed work should be shown in red dotted.

7.3.4. The adjoining plots streets with their names.

7.3.5. Alignments, sizes of all drains and also surface drains, if any.

7.4.0. Plans of plumbing :- The plans shall be neatly drawn to a scale of 1:500 and details to a scale of 1:100, if required.

7.4.1. Plans for each floor, including the ground floor, and basement, if any shall show the position of fixtures, pipes with size, gradient and proposed depth of manholes of all drains, upon such plans. Fixtures shall be designated by the symbols set out in the appendix and various pipe lines shall be designated in colours as follows :-.

10.1. No trade waste shall be discharged directly or indirectly into any sewer without special permission of the corporation.

19.3 Size of drain :- Main house drain shall be minimum 150mm dia or as approved. In case of large layouts, minimum size of 230 mm. Dia. Shall be laid on internal roads.

19.3 .1 Choice of materials :- S. W. Pipes for 100MM / 150MM / 230MM & 300MM DIA. Larger size may be of R. C. pipe only.

19.6. Maximum distance between two manholes on road is 30 meters (dia of 230mm minimum) and between inspection chambers (150mm dia pipe) 23 meters. The distance between gully trap chamber and inspection chamber shall not exceed 6 meters.

20. Basement and celler Drainage. :- The consent of Commissioner in writing is required for installing and connecting sinks, water closets, urinals etc in basements.

20.3. Risk of backflow :- When there is a risk of backflow, the sewage from backflow the sewage from all fixtures therein shall be lifted by pumps or ejectors to a height decided by the authority and discharged into the sewers as directed.

20.7. GRADIENTS :- All drains shall be laid to a gradient which will impart the velocity of 1 m/ sec (3.5ft/sec) at peak flow when the sewer runs to the designed depth of flow which will be running half full. The minimum gradient shall be as stated below

DIAMETER OF PIPES	MINIMUM GRADIENT
100MM (4")	1 IN 40
150MM (6")	1IN 80
230MM (9")	1 IN 135
300MM (12")	1 IN 200

Note :- Gradient giving velocity of flow greater than 2.4.m/second shall not be employed. In such an event cast iron pipes shall be laid or drop arrangements shall be provided.

23. Drains under the buildings :-

23.1 Every drain, as far as possible, shall be so constructed as not to pass under the buildings or outhouse.

23.2. However in special cases, shall the Commissioner may permit laying a drain under building or outhouse.

23.2.1. In such case the drain shall be laid straight, and shall have approved means of access.

23.2.2. The pipes shall be cast Iron socket and spigot pipes.

23.2.3. In any case in which drain passes through or under walls, a space of approx. 10cm shall be left over the pipes.

23.3. In between the pipes, if chambers are required, they shall be constructed in brick masonry with cast iron airtight covers.

24. Joints:- All soil pipes, waste pipes, ventilating pipes, and other such pipes above ground shall be airtight. All sewers and drains laid below the grounds shall be watertight. Jointing shall be done as following.

24.1 Stoneware pipes joints :- Spun yarn soaked 80-100 bitumen, caulked in the joint in one length. Alternately the spun yarn shall be soaked in Cement paste. The join should be filled with 1:1 Cement and Sand mortar,

24.2.1.R. C. Pipes :- With collar joints, Cement and sand joints 1:1 mortar joints with caulking of spun yarn.

24.2.2 R. C. Pipes with rubber ring joints :- Lubricated rubber rings.

24.3. Cast iron pipes :- Filled with approved gasket and caulked with lead. Lead shall be soft and 99% pure. The rubber ring joint also is permitted

24.4. Flanged joints :- The facing of the flanges may be painted with the bitumastic paint and 5mm tick rubber packing may be used.

25. Traps :-

25.1. Every inlet to any drainage or any plumbing system other than the inlets for ventilation, shall be provided with an approved trap.

25.2. Water seal :- Every drainage trap shall have a water seal of not less than 5 Cms in depth.

25.3. Intercepting / sewer trap :- The owner of the property is required to fix at the lower most end of the drain at the downstream side of the manhole or inspection chamber an intercepting trap with lid within the boundaries of the property.

26. Grease, petrol, and oil traps :-

26.1. Wastes from the following fixtures or the areas shall first discharge into an approved apparatus for retaining objectionable matters, that is to say :-

26.1.1. Every fixtures or areas from which petrol, benzene, or other inflammable or explosive substance, or greasy or oily matter is likely to be discharged or conveyed into waste, combined system into drains.

26. 1.2. Every sink in all food packaging houses, butcher's shop lard rendering establishments, hotels, restaurants, boarding houses and such other places.

26.2 Construction and maintenance of grease traps:-

26.2.1. Grease trap shall be fixed outside buildings/out houses wherever practicable. If its is inside the building, it shall have proper access for removal and disposal of greases or a potable one

Non Portable type :- Shall be of glazed stoneware, brick masonry and portable one of copper or other approved material. The outlet from any grease trap shall be connected to the disconnect trap. The same shall be properly cleaned periodically and maintained. It shall be provided with ventilation on inlet and outlet ends, if so directed.

26.3.1 Size of grease trap :- The capacity of grease trap shall be not less than the total capacity of the sinks or dish washers served.

26.3.2 The depth from top of grease trap to invert level of the invert of the outlet shall not be less than half the depth of the trap below the invert of the outlet.

26.3.3. The difference in level between invert of inlet and invert of outlet shall not be less than one eighth of the depth of the below invert of the outlet. The capacity of a sink shall be measured to the overflow level or in the event of their being the overflow, to the top of the sink.

26.4. Outlets pipe from grease trap shall not be less than 75mm dia.

27.1.1. Every drain in a building shall be ventilated at its upper end and intercepting sewer trap fixed there on shall be ventilated at its lower end.

27.3. Vent shafts shall be provided at the heads of all sewers and on straight lengths at a distance not more than 200meters.

28.1. Soil pipes :- These pipes shall be provided to carry discharge of soil water from closets, urinals, bed pans, sinks and other water containing faecal matter including discharge from operating theatres and mortuaries. These pipes shall be of 100 mm dia. These shall be extended 2 RM above the highest point of the roof.

28.2 The size of the soil pipes in multi-storied buildings shall be in accordance with the code of practice framed by the ISI or the NATIONAL BUILDING CODE OF INDIA.

28.3 Waste water pipes :- These pipes are provided to carry separate discharge from bathrooms, washing places, nahanis, wash basins. Sinks and water trough. The pipe shall be 75mm dia.

28.4 Anti- Syphonage Pipes:- Loss of water seal in 'P' or 'S' traps or any other shall avoided by providing 60 to 70mm pipes. In case where there is a tier of water closets one above the other, the anti- syphonage pipe shall be taken from each other closet & carried from 2 meters above the topmost portion of the roof.

28.5 Rain Water Pipes:- These pipe shall only carry rain water. The minimum diameter shall be 100mm. One 100mm dia, pipe shall serve an area of not more than 40 sq.mts. The rain water pipes shall not be connected to any soil, waste lines or to any inspection chamber. However separately. (The approval has to be obtained by SWD department).

29.1 Combined pipe system shall be got approved by giving details of sizes & arrangements of soil, waste combined waste & vent pipes.

30.1 Concealment of pipes:- All pipes & traps shall be reasonably accessible at all times for inspection & convenience of repairing.

30.3.1 In buildings the ducts should be of a minimum size of 1 sq.meter with a width of 600mm.

48. Septic Tanks:- Where discharge into a public sewer is not possible, the same can be connected to a septic tank / soak pit system.

48.2 The septic tank shall be water tight, discharge from soil pipes & waste pipes shall be connected to this tank. The effluent from the septic tank, after secondary treatment shall be allowed to be discharged into SWD or nalla.

48.3 Septic tank shall have a minimum width of 75cm, minimum depth of 100cm, below the water level. The length of the tank shall be 2 to 4 times the width.

48.5 Every septic tank shall be provided with a vent pipe of not less than 50mm dia.

48.8.1 Soak pit in the soil with an absorption capacity of atleast 50ltrs / mtr. square / day below the outlet pipes shall be provided when the sub-soil water is 1m below the outlet of the effluent pipe. The soak pit shall not be less than 100cm. In depth below the invert level of the inlet pipe.

48.8.3 If the area is rocky, the effluent shall be treated by filters. The quantity of filter media to be provided shall be at least 0.20 cu. m./ capita. The minimum depth of filter shall be 1.3 metres.

If the gravity flow is not possible, then up flow filters should be provided.

48.9.2 The septic tank shall be filled with water & seeded with small quantity of digested sludge from a nearby septic tank or digested cow dung.

48.10 Maintenance & proper operation of septic tanks shall be carried out periodically.

Completion Certificate:- At the completion of the plumbing installation work, the licensed plumber shall give a completion certificate in the prescribed form.

Ideal Water Storage Tank

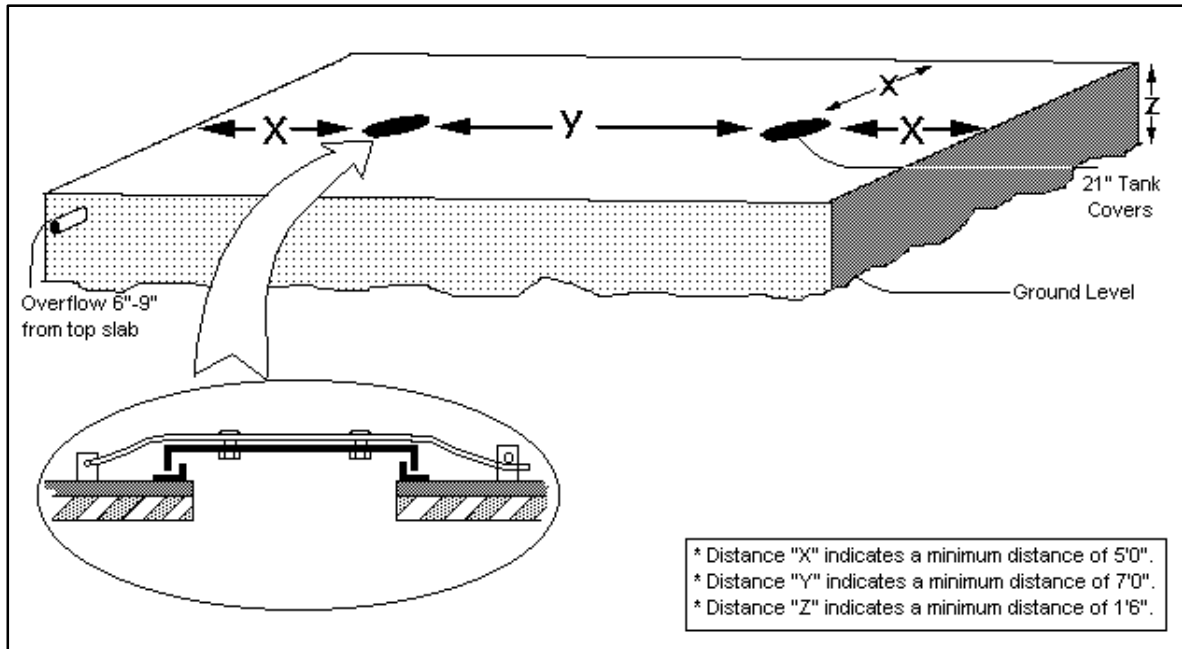
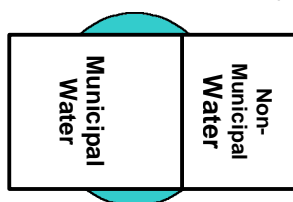


Fig.15

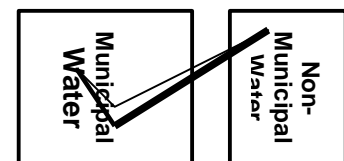
The above figure viz.fig.no.15 shows an ideal storage tank as per the rules laid down by the Municipal Corporation.

As per the new norms of the Municipal Corporation of Mumbai, it is essential to use Well water / Tube Well water (to be precise non-municipal water) for flushing purposes.

It thus becomes essential to store well water into a separate suction at or below ground level, so as to reduce the Horse power of the pumps installed, to transport the same water, subsequently it



also becomes essential to elevate the same to the overhead flushing tank. Though the further procedure remains the same as discussed in the "Terrace Loop" section before.



In this case, it is not advisable, to separate out the water storage tanks meant for storing the municipal water & the non-municipal one by the means of a single partition wall, as it is quiet likely that these different propertied waters (both chemically as well as biologically different) might mix, after the partition wall develops cracks, & let these waters seep into each other, thus compromising the hygiene of the inhabitants of the same building.

Hence it becomes imminent to separate out these tanks physically & bodily, having no common walls in between. In short, both the tanks should have all the six walls of their own.



Discharge Capacities of Connections at municipal stop tap for different lengths & connections.

Length of Loop	Pressure at ferrule in lbs/sq.in	Discharges for different sizes in GPH at Municipal Stop Tap							
		1/2 "	3/4 "	1"	1 1/4 "	1 1/2 "	2"	3"	4"
100	10	100	280	680	1170	1860	4000	10600	21700
	15	120	350	720	1430	2210	4750	13000	26500
	20	130	410	830	1670	2640	5600	15000	31000
	25	160	450	930	1875	2950	6200	16800	34600
	30	170	600	1020	2060	3230	6800	18200	37600
200	10	70	200	410	830	1320	3000	7100	15500
	15	85	250	500	1020	1620	3600	9000	18800
	20	100	280	580	1110	1860	4000	10600	21700
	25	110	320	650	1300	2070	4500	11800	23200
	30	120	350	730	1430	2240	4700	12800	25000
300	10	55	150	410	680	1100	2500	6000	12400
	15	70	200	470	830	1320	3000	7100	15500
	20	80	230	530	970	1530	3500	8400	18000
	25	90	260	580	1075	1700	3900	9600	20000
	30	100	280	680	1170	1860	4000	10800	21700
400	10	48	140	280	600	940	2100	5000	10800
	15	60	170	350	700	1130	2500	6200	12500
	20	70	200	410	830	1320	3000	7100	15500
	25	76	225	460	930	1480	3150	8200	17400
	30	82	240	500	1000	1620	3500	8700	18200
500	10	42	120	250	530	830	2000	4500	9460
	15	55	150	320	650	1030	2200	5500	11600
	20	62	180	370	750	1200	2600	6500	13800
	25	70	200	410	860	1320	3000	7100	15500
	30	75	230	500	920	1450	3250	8000	17000
750	10	34	100	200	440	700	1500	3600	7500
	15	42	120	250	530	830	2000	4600	9400
	20	50	145	300	625	975	2200	5100	11100
	25	55	160	330	680	1180	2500	6000	12400
	30	62	180	370	750	1200	2600	6500	13800

Discharging Capacities of Connections at Consumers Tap For Different Floor Levels For Different Lengths Of Communication Pipe.

Fl. Level	Length of Communication Pipe	Pressure at ferrule in lbs/sq.in	Discharges for different sizes in GPH at Consumer's Tap					
			½ "	¾ "	1"	1¼ "	1½ "	2"
Ground Floor Direct Suction Tank 5'0" Height	100	10	68	200	400	820	1300	3000
		15	95	280	570	1150	1820	4000
		20	115	350	700	1400	2220	4700
		25	135	400	830	1620	2575	5500
		30	150	450	930	1830	2880	6000
	200	10	48	140	280	600	980	2000
		15	68	200	410	825	1325	3000
		20	84	245	500	1000	1600	3600
		25	95	280	575	1160	1850	4000
		30	108	320	650	1300	2050	4400
	300	10	38	110	220	490	750	1900
		15	55	150	330	680	1075	2300
		20	68	200	410	825	1325	3000
		25	80	230	475	970	1525	3400
		30	88	250	530	1070	1880	3800
1st Floor Direct Supply 16'0" Height.	100	10	--	--	--	--	--	--
		15	65	190	380	775	1250	2700
		20	90	270	540	1100	1725	4000
		25	110	350	660	1330	2000	4500
		30	125	370	760	1550	2440	5000
	200	10	--	--	--	--	--	--
		15	46	130	270	575	900	2000
		20	67	190	400	800	1280	2900
		25	83	240	500	1000	1600	3600
		30	94	275	560	1125	1770	4000
	300	10	--	--	--	--	--	--
		15	35	100	215	475	730	1800
		20	55	150	330	670	1075	2300
		25	69	200	410	840	1325	3000
		30	78	225	460	950	1500	3300
2nd Floor Direct Supply upto 38'0" Height	100	10	--	--	--	--	--	--
		15	--	--	--	--	--	--
		20	60	175	360	750	1200	2500
		25	85	250	500	1050	1650	3750
		30	105	310	640	1250	2020	4300
	200	10	--	--	--	--	--	--
		15	--	--	--	--	--	--
		20	45	125	260	560	900	2000
		25	65	200	400	780	1260	2800
		30	80	230	475	570	1525	3400
	300	10	--	--	--	--	--	--
		15	--	--	--	--	--	--
		20	30	100	210	470	725	1700
		25	55	150	325	660	1050	2200
		30	66	190	390	800	1280	2800

Slopes & Discharges for Various Diameters & Velocities for Circular Sewers, Running Full.

Diameter		Area		VELOCITIES											
				2ft / sec = 0.609 mt / sec				2.5 ft / sec = 0.76 mt / sec				3.0 ft / sec = 0.91 mt / sec			
				Slope 1 in	Discharge			Slope 1 in	Discharge			Slope 1 in	Discharge		
					In cusecs	In MGD	In Lit/sec		in cusecs	In MGD	In Lit/sec		In cusecs	In MGD	In Lit/sec
mm	Inch	In ft ²	In mt ²												
230	9"	0.44	0.0415	410	0.689	0.37	19.55	265	1.10	0.59	31.21	180	1.34	0.72	38.02
300	12"	0.785	0.071	610	1.565	0.84	44.4	390	1.95	1.05	55.33	270	2.35	1.26	66.68
350	14"	1.032	0.096	740	2.15	1.16	61.0	475	2.66	1.43	75.47	330	3.22	1.73	91.36
400	16"	1.40	0.126	890	2.80	1.50	79.45	570	3.5	1.88	99.31	395	4.20	2.26	119.1
450	18"	1.76	0.159	1050	3.52	1.89	99.88	670	4.4	2.36	124.8	460	5.31	2.86	150.6
500	20"	2.19	0.196	1200	4.35	2.34	123.4	770	5.4	2.9	153.2	530	6.55	3.52	185.8
600	24"	3.14	0.283	1500	6.33	3.4	179.6	970	7.9	4.25	224.1	680	9.40	5.05	266.7
700	28"	4.28	0.385	1800	7.92	4.25	224.7	1150	9.9	5.32	280.9	790	11.95	6.43	339.0
800	32"	5.59	0.50	2350	11.83	6.36	335.6	1500	14.8	7.96	419.9	1050	17.70	9.5	502.2
900	36"	7.09	0.635	2600	14.2	7.65	402.9	1700	17.55	9.44	497.9	1150	21.70	11.7	615.7
1000	40"	8.74	0.785	2900	16.63	8.94	471.8	1900	20.55	11.00	583.1	1300	24.85	13.4	705.1
1100	44"	10.6	0.950	3500	22.2	11.93	629.9	2250	27.70	14.90	785.9	1550	33.32	17.9	945.4
1200	48"	12.6	1.13					2450	31.5	16.90	893.8	1700	37.80	20.3	1072
1400	56"	18.0	1.54					3100	44.25	23.40	1255.0	2150	53.13	28.6	1564
1600	64"	22.4	2.00					3500	54.4	29.30	1543.0	2450	65.0	35.0	1844
1800	72"	28.3	2.55									2900	85.30	45.9	2420

Diameter		Area		VELOCITIES											
				3.5 ft / sec = 0.06 mt / sec				4 ft / sec = 1.24 mt / sec				4.5 ft / sec = 1.37 mt / sec			
				Slope 1 in	Discharge			Slope 1 in	Discharge			Slope 1 in	Discharge		
					In cusecs	In MGD	In Lit/sec		in cusecs	In MGD	In Lit/sec		In cusecs	In MGD	In Lit/sec
mm	Inch	In ft ²	In mt ²												
230	9"	0.44	0.0415	135	1.545	0.83	43.84	100	1.8	0.97	51.07	80	2.0	1.08	56.75
300	12"	0.785	0.071	200	2.73	1.47	77.46	150	3.15	1.69	89.38	120	3.53	1.90	100.1
350	14"	1.032	0.096	240	3.77	2.03	106.9	185	4.3	2.31	112.0	145	4.83	2.60	137.05
400	16"	1.40	0.126	290	4.55	2.45	129.1	220	5.62	3.02	159.4	175	6.30	3.40	178.7
450	18"	1.76	0.159	340	6.20	3.34	175.9	260	7.07	3.80	200.6	205	7.93	4.25	225.0
500	20"	2.19	0.196	390	7.95	4.26	225.5	300	8.72	4.70	247.4	235	9.85	5.25	279.4
600	24"	3.14	0.283	500	10.97	5.90	311.2	380	12.58	6.76	356.9	300	14.20	7.62	402.9
700	28"	4.28	0.385	590	13.83	7.44	392.4	450	15.83	8.50	449.1	350	17.95	9.68	509.3
800	32"	5.59	0.50	760	20.82	11.20	590.7	580	22.15	11.9	628.5	460	26.75	14.4	759.0
900	36"	7.09	0.635	860	24.70	13.30	700.8	660	28.20	15.2	800.1	520	31.73	17.1	900.3
1000	40"	8.74	0.785	950	29.07	15.60	824.8	730	33.15	17.8	940.6	570	37.52	20.2	1064.6
1100	44"	10.6	0.950	1150	38.70	20.80	1098.1	880	44.20	23.8	1254	700	49.59	26.6	1407.1
1200	48"	12.6	1.13	1250	44.07	23.60	1250	960	50.30	27.0	1427	760	56.52	30.4	1603.7
1400	56"	18.0	1.54	1600	61.60	33.10	1747.9	1200	71.13	38.2	2018	950	79.62	42.6	2259.2
1600	64"	22.4	2.00	1800	75.85	40.70	2152.9	1400	86.00	46.2	2440	1100	97.02	52.0	2752.9
1800	72"	28.3	2.55	2150	99.10	53.20	2811.9	1650	113.10	60.6	3209	1300	127.4	68.5	3614.9

SOME IMPORTANT KNOWHOW

WEIGHT, MELTING POINT & SPECIFIC HEAT OF METALS

(The following tables are ready reckoners only, apply appropriate formulae for accuracy)

<u>METAL</u>	<u>WEIGHT</u> <u>LBS/FT³</u>	<u>MELTING POINT</u> <u>F⁰</u>	<u>SPECIFIC HEAT</u>
ALUMINIUM	167	1,210	0.219
BRASS	537	1,850	0.092
BRONZE	532	1,675	-
CAST IRON	450	2,200	0.144
COPPER	554	1,940	0.0936
LEAD	709	620	0.305
NICKLE	540	2,600	0.109
STEEL	490	2500	0.116
TIN	455	446	0.0553
ZINC	428	785	0.0935

METRIC CONVERSION TABLE

GALLONS IN TO LITRES	LBS IN TO KGs	MILES IN TO K.MITRES
0.22 1 4.55	2.205 1 0.454	0.621
0.44 2 9.09	4.409 2 0.907	1.242
0.66 3 13.64	6.614 3 1.361	1.863
0.88 4 18.18	8.819 4 1.814	2.494
1.10 5 22.73	11.023 5 2.268	3.115
1.32 6 27.28	13.228 6 2.722	3.536
1.54 7 31.39	14.432 7 3.175	4.357
1.76 8 36.37	17.637 8 3.629	4.978
1.98 9 40.91	19.842 9 4.082	5.599
2.20 10 45.46	22.046 10 4.536	6.2110

VOLUME CONVERSION TABLE

LITRE	TO	GALLON	LITRE	TO	GALLON
15	-	3.3	26	-	5.72
16	-	3.52	27	-	5.94
17	-	3.74	28	-	6.16
18	-	3.96	29	-	6.38
19	-	4.18	30	-	6.6
20	-	4.4	31	-	6.82
21	-	4.62	32	-	7.04
22	-	4.84	33	-	7.26
23	-	5.06	35	-	7.48
24	-	5.28	35	-	7.7
25	-	5.5			

Squares, Cubes, Square Roots & Cube Roots.

Fluid Memoranda

Gallon of Water = 10 lb.
 Crude Petroleum = 8 1/4 lb.
 1 cubic feet of water = 6 1/4 Gals (approx)
 62 1/4 lbs = 7.48 U. S. Gals
 1 U. S. Gal = 231 in³ = 0.1307 ft.³
 1 lb. water at 62° F = 0.016 ft.³.
 B. I. Gal. = 217.418 in³
 1 cwt of water = 1.8 ft³. = 11.2 gals.
 British Gallon = 1.2009 U. S. Gallons.
 1 ton of water = 35.9 ft³. = 224 gals.
 1 inch of Rainfall = 22622 gals/acre = 100 tons (app)

Mercury	125.9 lb. / gal
Sprem Oil	8.8 lb. / gal
Kerosene	3.0 lb. / gal
Sulphuric Acid	18.5 lb. / gal
Hydrochloric Acid	12.1 lb. / gal
Turpentine	8.7 lb. / gal
Alcohol	8.0 lb. / gal
Petrol	7.5 lb. / gal
Nitric Acid	16.3 lb. / gal
Acetic Acid	10.4 lb. / gal

X	X ²	X ³	√X	∛X
1/8	.015	.0019	.353	.5
1/4	.062	.156	.500	.629
3/8	.140	.527	.612	.721
1/2	.256	.1250	.707	.793
5/8	.390	.244	.790	.855
3/4	.562	.421	.866	.908
7/8	.765	.670	.835	.956
1	1	1	1	1
1 1/2	2.25	3.375	1.224	1.14
2	4	8	1.414	1.26
2 1/2	6.250	15.625	1.581	1.35
3	9	27	1.732	1.44
3 1/2	12.250	42.875	1.87	1.51
4	16	64	2	1.68
4 1/2	20.250	91.125	1.121	1.66
5	25	125	2.236	1.71
5 1/2	30.250	166.375	2.345	1.76
6	36	216	2.449	1.81
6 1/2	42.250	274.625	2.549	1.86
7	49	343	2.645	1.91
7 1/2	56.250	421.875	2.738	1.95
8	64	512	8.828	2
8 1/2	72.250	614.125	2.915	2.04
9	81	729	3	2.08
9 1/2	90.250	857.575	3.082	2.11
10	100	1000	3.162	2.15
10 1/2	110.250	1157.625	3.240	2.18
11	121	1331	3.316	2.22
11 1/2	132.250	1520.875	3.391	2.25
12	144	1728	3.364	2.29

Lbs into Kilos

Lbs.	KGs.	Lbs.	KGs.	Lbs.	KGs.	Lbs.	KGs.
1	0.454	16	7.957	31	14.061	50	22.679
2	0.907	17	7.711	32	14.514	55	24.946
3	1.361	18	8.164	33	14.968	60	27.214
4	1.814	19	8.618	34	15.421	65	29.482
5	2.268	20	9.071	35	15.875	70	31.75
6	2.721	21	9.525	36	16.329	75	34.016
7	3.175	22	9.979	37	16.782	80	36.288
8	3.629	23	10.432	38	17.236	85	38.554
9	4.082	24	10.886	39	17.689	90	40.82
10	4.536	25	11.339	40	18.143	95	43.089
11	4.989	26	11.793	41	18.596	100	45.357
12	5.443	27	12.246	42	19.05		
13	5.896	28	12.7	43	19.504		
14	6.35	29	13.154	44	19.957		
15	6.804	30	13.607	45	20.411		

CONVERSION TABLE

GENERAL

Multiply By	To Convert	To		Multiply By	To Convert	To	
2.54	Inches	Cms	0.3937	1.215	Tons / Yd ²	Tons / M ³	0.823
30.48	Feet	Cms	0.3228	1.329	Tons / Yd ³	Tons / M ²	0.752
9.14	Yards	Meters	1.094	0.01426	Grains/gal	Gm / Lit	70.12
1,609.30	Mile	Meters	0.000621	48.905	Gals / Ft ²	Lit / M ²	0.0204
1,853.27	Nauti. Mile	Metres	0.000539	25.8	Inches tons	K'gmmeter	0.0287
6.45	Inch ²	Cm ²	0.155	0.477	Lb. /HP	Kg / cheval	2.235
0.93	feet ²	Meter ²	10.764	0.0916	Ft ² /HP	M ² / Cheval	10.913
0.836	Yards ²	Meters	1.196	0.0279	Ft ³ /HP	M ³ /Cheval	35.806
16.39	Inch ³	Cm ³	0.061	2.713	Heat unit/HP	Calories/M ²	0.369
28.3	Feet ³	Litres	0.0353	4.546	Gals	Litres	0.22
6.24	Feet ³	Gallons	0.1602	10	Gals Water	Lbs	0.1
765	Yards ³	Metres ³	1.308	0.454	Lbs Water	Litres	2.202
0.3732	Lbs (Troy)	KGs	2.68	70.3	Lbs /In ²	Gm / Cm ²	0.0142
31.1	Oz (Troy)	Grams	0.032216	2.3	" "	Head of water (ft)	0.434
45.36	Lbs (Avoir)	KGs	2.2046	0.7	" "	Head of water (m)	1.4285
7,000	Lbs (Avoir)	Grams	0.000148	0.068	" "	Atmosphere	14.7
28.35	Oz (Avoir)	Grams	0.0353	1.575	Tons /In ²	KGs / MM ²	0.635
0.065	Grains	Grams	15.38	4.883	Lb. / Ft ²	Kg / M ²	0.205
50.8	Cwt.	KGs.	0.0968	0.593	Lb. / Yd ³	Kg / M ³	1.686
0.9	Ger.Candles	Eng.Candles	1.1111	16.02	Lb/Ft ³	" "	0.062
9.55	Cercels	Candles	0.1074	0.0998	Lb. / Gal	Kg. M	10.02
0.737	Joules	Ft. Lb.	1.375	0.1833	Foot Lb.	Kg / M	7.23
88	Miles/hour	Ft / Min	0.01134	0.33	Ft Tons	Ton M	3
179	Meters / sec	Ft /Min	0.00508	1.014	HP	force de cheval	0.9861
1.8	C.H.U.	BTU	0.5555	746	"	watts	0.00134
0.0000208	Centipoles	LB force sec/ft ²	4.8	33,000	"	ft.lbs/mm	---
1.4888	LB. / ft	Kg /meter	0.672	0.76	"	Kg. M /Sec.	0.01316
0.496	LB. / Yd	" "	2.016	0.44	Watts	Ft. LB. / min	0.327
3,333.33	Tons / Ft	" "	0.0003	0.1	Watts	Kg. M / Sec	10
1,111.11	Tons / Yd	" "	0.0009	0.252	Heat Unit	Calories	3.97
0.2818	LB. / Mile	Kg / Km	3.548	14.7	Atmosphere	Lbs/ In ²	0.068
10.936	Tons / Ft2	Tones / M ³	0.0914		TO OBTAIN	FROM	Multiply By above

SOME MORE IMPORTANT CONVERSIONS:--

- 1) Imperial Gallon = 1.2 U. S. Gallon.
- 2) 1 Foot. = 12 Inches = 0.305 Meters.
- 3) 1 Meter = 3.28 feet = 39.37 Inches.
- 4) 1 ft³ = 6.25 Gals = 28.2 Litres = 0.0283 M³.
- 5) 1 M³ = 1000 Litres = 220 Gals = 35.32 Ft³.
- 6) 1 Gallon = 277.27 Inches³ = 16 Ft³ = 4.543 Litres = 0.004543 Inch³.
- 7) 1 Litres = .001 M³ x 0.035 Ft³ = 0.22 Gallons.
- 8) 1 mtr³ of water = 2205 Lbs = 220.5 Imperial Gallons.
- 9) 1 Gallon of water = 10 Lbs.
- 10) 1 Gallon Petroleum = 82 Lbs.
- 11) 1 Ton water = 35.2 Ft³ = 220 Imp. Gals = 1000 Litres.
- 12) 1 Ton petroleum = 275 Imp Gallons.
- 13) 1 Litre of water = 1Kg = 2,204 Lbs.
- 14) Density of water = 62.4Lb/Ft³ = 1Gm / Cm³

MATERIAL REQUIRED TO PLASTER 100 FT² OF SURFACE WITH DIFFERENT THICKNESS OF MORTAR

MIX THICKNESS	1:1		1: 1 1/2..		1:2		1:2 1/2		1:3		1:4		1:6		1:8	
	C.	F.A.	C.	F.A.	C.	F.A.	C.	F.A.	C.	F.A.	C.	F.A.	C.	F.A.	C.	F.A.
3/8."	1.8	2.2	1.5	2.6	1.3	2.9	1.0	3.1	0.9	3.3	1.0	3.4	0.5	3.0	0.4	3.8
1/2".	2.4	2.9	1.9	3.5	1.7	3.9	1.4	4.2	1.2	4.4	1.0	4.6	0.7	4.9	0.5	5.1
3/8"	3.6	4.3	2.9	5.3	2.5	5.9	2.1	6.3	1.8	6.6	1.4	6.9	1.0	7.4	0.8	7.7
1"	4.8	5.8	3.9	7.0	3.3	7.8	2.8	8.4	2.4	8.8	1.2	9.2	1.4	9.8	1.1	1.2
1 1/4"	6.0	7.2	4.8	8.8	4.1	9.8	3.5	10.4	3.0	11.0	2.3	11.5	1.7	12.3	1.3	12.7
1 1/2"	7.2	8.7	5.8	10.5	4.9	11.8	4.2	12.5	3.6	13.1	2.9	13.8	2.0	14.8	1.6	15.3
2"	9.6	11.5	7.8	14.0	6.6	15.7	5.6	16.7	4.8	17.5	3.8	18.3	2.7	19.7	2.1	10.4

Wastage is not considered in this table.

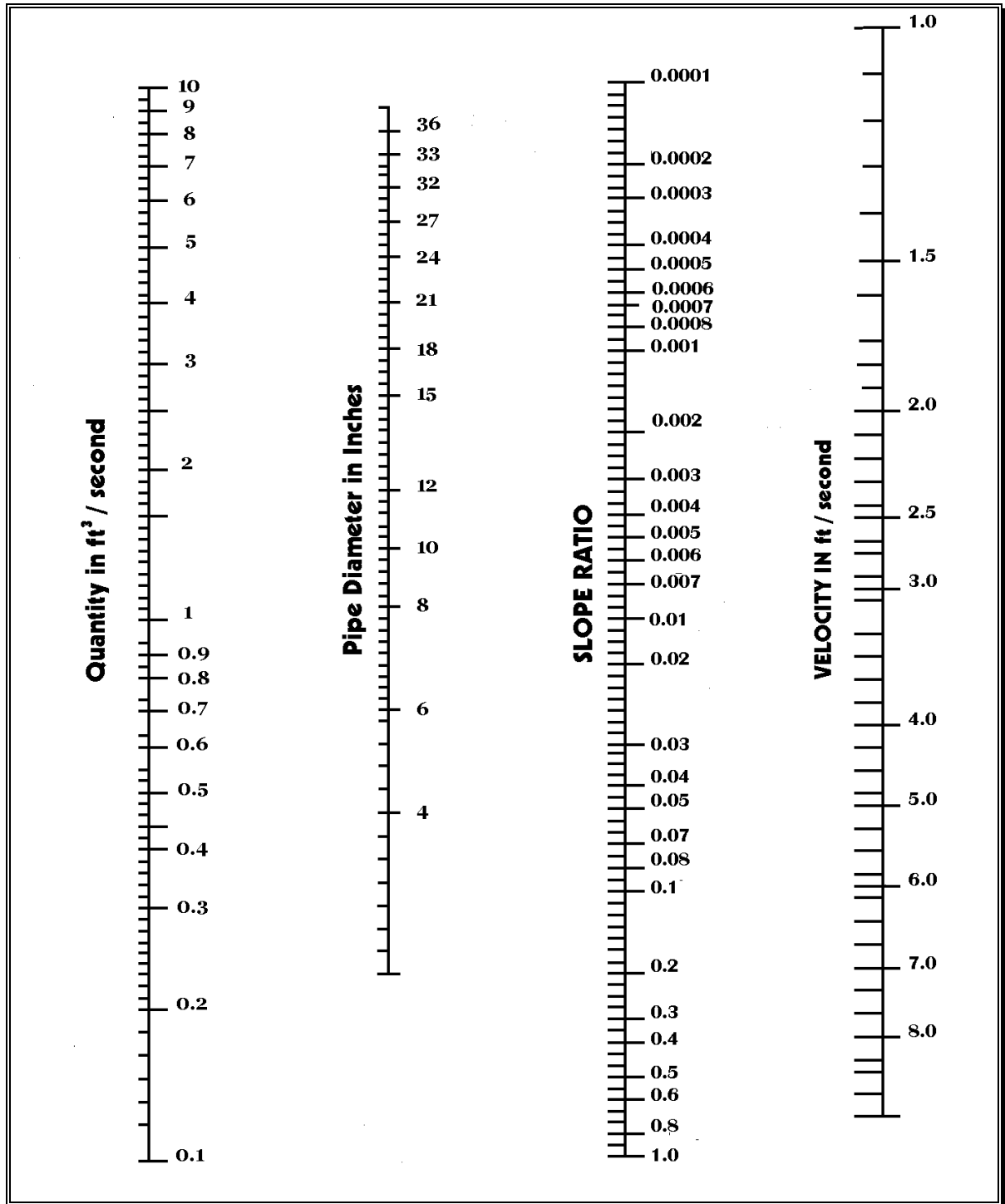


Nominal Mix	Material	Thickness In Inches											
		2"	2 1/2"	3"	3 1/2"	4"	4 1/2"	5"	6"	8"	9"	10"	12"
1:1:3	C.	3.8	8.4	5.7	6.7	7.6	8.6	9.6	11.5	15.3	17.2	19.1	22.9
	F.A.	6.9	8.6	10.3	12.0	13.7	15.5	17.2	20.6	27.5	30.9	34.3	41.2
	C.A.	13.8	17.2	20.6	24.0	27.4	31.0	34.4	41.2	55.0	61.8	68.7	82.4
1:2:3	C.	3.4	4.3	5.1	6.0	6.8	7.7	8.5	10.3	13.7	15.4	17.1	20.5
	F.A.	8.2	10.3	12.3	14.3	16.4	18.5	20.5	24.6	32.8	36.9	41.0	49.2
	C.A.	12.3	15.4	18.5	21.5	24.6	27.7	30.8	37.0	49.3	55.4	61.5	73.8
1:2:2:4 or 1: 1.67 : 3.33	C.	8.4	4.3	5.1	6.0	6.8	7.0	8.6	10.3	13.7	15.4	17.1	20.6
	F.A.	6.9	8.6	10.3	12.0	13.7	15.7	17.2	20.6	27.5	31.0	34.3	41.2
	C.A.	13.8	17.2	20.6	24.0	27.4	31.0	34.4	41.2	55.0	62.0	68.5	82.4
1:2:4	C.	3.0	3.7	4.4	5.2	5.9	6.7	7.4	8.9	11.8	13.3	14.8	17.75
	F.A.	7.1	8.9	10.7	12.5	14.2	16.0	17.8	21.4	28.5	32.0	35.6	42.7
	C.A.	14.2	17.8	21.4	25.0	28.4	32.0	35.6	42.8	57.0	64.0	71.2	85.4
1: 2.5 : 5	C.	2.5	3.1	3.7	4.3	4.9	5.5	6.1	7.4	9.8	11.0	12.2	14.7
	F.A.	7.3	9.2	11.0	12.8	14.7	16.5	18.3	22.0	29.4	33.0	36.7	44.0
	C.A.	14.6	18.4	22.0	25.6	29.4	33.0	36.6	44.0	58.8	66.0	73.4	88.0
1:3:5	C.	2.2	2.8	3.3	3.9	4.5	5.0	5.6	6.7	8.0	10.0	11.2	13.25
	F.A.	8.3	10.4	12.4	14.5	16.5	16.5	20.7	24.8	33.1	37.2	41.4	49.6
	C.A.	13.8	17.2	20.6	24.1	27.5	33.0	34.4	41.0	25.0	62.0	68.8	81.6
1:3:6	C.	2.1	2.6	3.1	3.6	4.2	4.7	5.2	6.3	8.3	9.4	11.4	12.5
	F.A.	7.5	9.4	11.2	13.1	14.9	16.8	18.7	22.4	29.9	33.6	37.4	44.9
	C.A.	15.0	18.8	22.4	26.2	29.8	33.6	33.4	44.8	59.8	67.2	74.8	89.8
1:4:8	C.	1.6	2.0	2.4	2.8	3.2	3.6	4.0	4.8	6.4	7.2	8.0	9.6
	F.A.	7.7	9.6	11.5	13.5	15.4	17.3	19.2	23.3	30.7	34.6	38.4	46.1
	C.A.	15.4	19.2	23.0	27.0	30.8	34.6	38.4	46.0	61.4	69.2	76.8	92.2

Note :- “C” stands for Cement.

“C. A.” Stands for Coarse Aggregate (metal).

“F. A.” stands for Fine Aggregate (sand).



DRAINAGE NOMOGRAM

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*Thank
You*