

Chapter 14

Drainage And Sewerage

14.0. TERMINOLOGY

Benching (Fig. 14.10) : The sloped floor of a manhole or an inspection chamber on both sides and above the top of the channel for the purpose of conforming the flow of sewage.

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

Cleaning Eye (Fig. 14.10) : An access opening having a removable cover to enable obstructions to be cleared by means of a drain rod.

Connections : The junction of a foul water drain, surface water drain with public sewer, cesspool, soakway or other water courses.

Curb, Kerb : The stone margin of a side walk.

Dispersion Trench : A trench in which open jointed pipes surrounded by coarse aggregate media and overlaid by fine aggregate, are laid. The effluent from septic tank gets dispersed through the open joints and is absorbed in the surrounding soil.

Depth of Manhole : The vertical distance from the top of the manhole to the outgoing invert of the main drain channel.

Drain : A line of pipes including all fittings and equipment, such as manholes traps, gullies and floor traps used for the drainage of a building, or a number of buildings or yards appurtenant to the buildings, within the same cartilage. Drain shall also include open channels used for conveying surface water.

Drainage : The removal of any liquid by a system constructed for the purpose.

Drop connection (Fig. 14.10) : A branch drain of which the last length of piping of the incoming drain, before connection to the sewer, is vertical.

Drop Manhole (Fig. 14.10) : A manhole incorporating a vertical drop for the purpose of connecting a sewer or drain at high level to one at lower level.

Effluents

a) Tank effluent: The supernatant liquid discharge from a septic tank.

b) Filter effluent: The liquid discharged from a biological filter.

Gully Chamber (Fig. 14.4) : The chamber built of masonry around a gully trap, for housing the same.

Gully Trap (Fig. 14.4) : A trap water seal provided in a drainage system in a suitable position to collect waste water from the scullery, kitchen sink, wash basins, baths and rain water pipes.

Haunching (Fig. 14.14) : Concrete bedding with additional concrete at the sides of the pipe.

Junction pipe : A pipe incorporating one or more branches.

Invert : The lowest point of the interior of a sewer or drain at any cross action.

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

Interceptor Manhole (interceptor chamber) : A manhole incorporating an intercepting trap, and providing means of access thereto and equipped with a fresh air inlet on the upstream side of the trap.

Manhole (Manhole Chamber) : Any chamber constructed on a drain or sewer so as to provide access thereto for inspection testing or the clearance of obstruction.

Rest Bend (Duck Foot Bend) : A bend supported in a vertical position by a foot formed at its base.

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

Soffit : The highest portion of the interior of a sewer or drain at any cross-section.

Soil waste: The discharge from water closets, urinals, slope sinks, stable or cowshed gullies and similar appliances.

Soil pipe: Which receives the discharges from soil fitments, such as water closets urinals, and slope sinks.

Sullage Waste Water: Spent water from baths, wash basins kitchen sinks, and similar appliances which does not contain human or animal excreta.

Sewer: A closed drain carrying night soil and other water borne waste.

Surface Water Drain : A drain conveying surface water including storm water.

Surface Water: The run off from precipitation, other water that flows over surface of the ground.

Sub Soil Water : Water occurring naturally below the surface of the ground.

Sludge : The settled solid matter in semi solid condition

Soak Pit (seepage pit soakway) (Fig. 14.17) : A pit through which effluent is allowed to seep or leach into the surrounding soil.

Septic Tank : A water tight single storeyed tank in which sewage is retained sufficiently long to permit sedimentation of suspended solids and partial digestion of settled sludge by anaerobic bacteria.

Scum : The greasy and other substances floating on the surface of sewage.

Vent Pipe : A pipe line installed to provide flow of air to or from a drainage system or to provide circulation of air within such system to protect trap seals from siphonage and back flow.

Waste Water : The discharge from wash basins, sinks and similar appliance, which does not contain human excreta.

14.1. GENERAL REQUIREMENTS - For Details IS 1742 -1988 Code of Practice for Building Drainage may be referred to. Extracts of some important clauses of this code are given at **ANNEXURE 14.1**.

14.1.1. Design of Drainage system: In designing a drainage system for building(s), the aim shall be to provide self cleansing conduits for the conveyance of soil, waste, surface or subsurface waters, and the removal of such wastes speedily and

efficiently to a sewer or other outlet, without risk of nuisance and hazard to health.

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

14.1.3. Self cleaning velocity: Normally, the sewer shall be designed for discharging three times the dry weather flow flowing half-full with a minimum self cleansing velocity of 0.75 metre per second. The approximate gradients which give this velocity for the sizes of pipes likely to be used in building drainage, and the corresponding discharges when flowing half-full are given in **Table 14.1**. The sizes and slopes shall conform to Local Municipal Bye Laws.

14.1.4. Minimum velocity of flow: In cases, where it is practically not possible to conform to the minimum gradients, a flatter gradient may be used but the minimum velocity in such cases shall on no account be less than 0.61 metres per second.

14.1.5. Maximum velocity of flow: On the other hand, it is undesirable to employ gradients giving velocity of flow greater than 2.4 metres per second. Where it is unavoidable, cast iron pipes shall be used. The approximate gradients which give a velocity of 2.4 metres per second for the various sizes of pipes and the corresponding discharge when flowing half-full are given in **Table 14.1**.

TABLE 14.1
GRADIENTS FOR SEWERS

Diameter	Minimum Gradient		Maximum Gradient	
	<i>Gradients</i>	<i>Discharge</i>	<i>Gradients</i>	<i>Discharge</i>
<i>mm</i>		cum/Min.		<i>cum/Min.</i>
100	1 in 57	0.18	1 in 5.6	0.59
150	1 in 100	0.42	1 in 9.7	1.32
200	1 in 145	0.73	1 in 14	2.4
230	1 in 175	0.93	1 in 17	2.98
250	1 in 195	1.10	1 in 19	3.60
300	1 in 250	1.70	1 in 24.5	5.30

14.1.6 Design of pipes: Subject to the minimum size of 100mm, the sizes of pipes, shall be decided in relation to the estimated quantity of flow and the available gradient.

14.1.7 Cast Iron Soil pipes, waste pipes and vent pipes

14.1.7.0 Material: All cast iron soil, waste and vent pipes shall conform to the relevant IS Specification in force. The pipes as well as specials shall have spigot and socket ends with bends on spigot ends. They shall be of heavy grade and distinguished from light cast iron rain water pipes by their larger thickness and weight. All C.I. pipes and specials used shall be coated with an approved anti-corrosive treatment at the factory itself.

14.1.7.1 Soil pipes: The minimum internal diameter for soil pipes shall not be less than 100mm. Soil pipes shall be situated outside the building or in a suitably designed open shaft. The work of the soil pipe shall be carried down truly vertical, but where unavoidable, they may be laid at an inclination of not less than $22\frac{1}{2}^{\circ}$ to Horizontal. Soil pipes below ground shall

be cast iron. Above ground asbestos cement soil pipes may also be used in exceptional case.

14.1.7.2 Vent pipes: The soil or waste pipe above the highest inlet connection shall be continued upwards either to the full diameter or to a reduced diameter of not less than 80mm for water closets, and 50 mm for other fixtures to serve as a ventilating pipe. The vent pipe shall be carried to a height of at least 60 cm above the outer covering of roof (near the cover) of the building. In the case of flat roof with access provided the height shall be at least 120 cm above the parapet, and 2 meters above the roof level. The top of the pipe shall also not be less than 2 metres above the head of any window within a horizontal distance of 3 metres from it. The top of the vent pipe shall be fitted with a hard cast iron / GI or copper wire dome.

14.1.7.3 Waste pipes: The main outside waste stacks from wash basins, sinks, baths, floor traps, etc shall be as indicated below :

Type of fitting	No. connected to the waste stack	Minimum dia. of waste stack
Wash basin	One	4 cm lead or 2 in (5 cm) H.C.I
Do	More than one	2 in (5 cm) H.C.I.
Baths or sinks	Any number	Do
Floor traps	Do	3 in (7.5 cm) H.C.I

Waste Pipes shall be fixed and jointed in the same manner as soil pipes. Branch waste pipes from fittings to the main waste stack shall ordinarily be of lead and these shall be connected to the fittings through an efficient syphon trap.

14.1.7.4 Antisiphon pipes: Where more than one water closet or sink discharge with the same soil pipe, the traps of such fittings shall be ventilated from a point not less than 7.5cm or more than 30 cm from their highest part and on the side nearest to the soil pipe by providing Anti-syphon pipes. These Antisiphon pipes shall be lead pipes or cast iron pipes of not less than 50mm internal diameter. The antisiphon pipe may either be connected with a separate vent pipe and continued upwards to terminate in a wire dome as for vent pipes, or be connected to the main vent pipe itself through a 45° branch not less than 1.2 meters above the topmost inlet connection in the soil or waste pipe.

14.1.7.5 Discharge: All soil pipes, after passing vertically below ground level shall be led by an easy bend into the adjoining home service manhole if provided or be connected direct to a sewer pipe. No soil pipe shall discharge into a gully trap or open drain. All waste pipes shall discharge into open gully traps, provided with square C.I. gratings. A waste pipe shall not be connected directly to a manhole or soil pipe or sewer.

14.1.7.6 Access Door: On waste traps, soil pipe junctions and bends, wherever clogging of pipes is likely to occur, access door shall be provided to facilitate cleaning. Doors shall be provided with 3 mm rubber insertion packing. When closed and bolted they shall be watertight.

14.1.7.7 Rain Water Drain Pipe: If a separate underground drainage system is provided for surface water rainwater down pipes shall discharge in the open air over un trapped gullies. Otherwise they shall

discharge in the open air into surface drains.

14.1.7.8 Traps: All traps shall be set perfectly true and level. No fixture shall have more than one trap. The trapped waste from a fixture shall not connect with the inlet or house side of the trap of an adjoining fixture. The size of trap is as follows :

Water closets	80 - 100 mm
Slop sinks	80 mm
Kitchen sinks	50 mm
Wash tubes	50 mm
Urinals	50 mm
Wash basins & pantry sinks	40mm

14.1.7.9 Tests: All soil, waste pipes, laid above ground, shall be subjected to a smoke test, at the expense of the contractor, after fixing in position preferably with the use of a smoke machine. Smoke shall be pumped in from the lower end and all joints and traps carefully examined for any leakage of smoke. In case of pipes laid below ground, they shall be subject to a static head of water of 60 cm above the crown at the top most point following the same method as for glazed earthenware pipes.

14.1.8 Asbestos cement, soil, waste & vent pipes

14.1.8.1 The specification shall be the same as per cast iron pipes vide para 14.1.7 above except the material and the manner of fixing them shall be as for rain

water pipes of asbestos cement. The use of AC pipes should be restricted as far as possible since these are liable to crack and are damaged easily.

14.1.8.2 Asbestos cement building pipes shall not be used for soil or waste pipes to be laid below ground level.

14.1.9 Glazed Half round Earthen ware pipes

14.1.9.1 These pipes shall correspond to IS 771 (1962). The diameter referred to shall be the inside diameter.

14.1.9.2 These pipes shall be laid over the bed of a lime concrete or cement concrete as specified. The joints of the pipes shall be made up of cement mortar 1:2 and cured well.

14.1.10 Fixing of soil waste and vent pipes

14.1.10.1 a) The pipes shall be fixed to the wall of the building at intervals as laid down in Table below. Except where eared pipes are employed this fixing shall be done by means of holderbat clamps of approved pattern. A holderbat clamp is a bracket made in two halves so as to securely grip the pipe being held therein. Alternately the holder bats may contain a bracket for fixing the same to the wall and this bracket shall be fastened to the wall by wrought iron nails, which shall be driven into wooden plugs into the walls at the points required and held clear of the wall by wooden blocks or bobbins.

MAXIMUM SPACING OF PIPE FIXINGS

Item	Material of pipe	Dia of pipe	Max. spacing of pipe fixing	
			vertical Runs	horizontal Runs
1	Cast Iron *	All sizes	3.00 m	1.50 m
2	Cement Asbestos *	All sizes	3.00 m	1.50 m
3.	Wrought iron or Mild steel	20 mm	2.75 m	2.10 m
		25 mm	3.00 m	2.40 m
		32 mm to 50 mm	3.65 m	3.00 m
		65 mm to 80 mm	4.55 m	3.65 m

* Note: One fixing must be provided for each fittings.

b) The eared pipes shall be fastened to the wall in a similar way.

c) The clearance between the surface of the pipe and the surface of the wall should not be less than 32 mm.

d) All fixing shall be carefully aligned and spaced so as to support the runs of pipe in

correct straight alignment. All soil pipe shall be carried up above the roof and shall have HCI terminal guard.

14.1.10.2 Connection between main pipe and branch pipe shall be made by using proper branches and bends with access doors for cleaning.

14.1.10.3 a) Joints: Both cement asbestos and cast iron soil and ventilating pipes shall

have joints made with gasket of tarred yarn caulked to a depth of 25 millimetres. The joint shall then be filled with molten lead / lead wool which shall be caulked after cooling so as to make a secure water tight joint.

b) For cement asbestos pipes if approved by the Engineer a layer of approved bituminous compound may be used in place of the caulked lead joint.

c) The caulked lead or the bituminous compound shall be followed by fittings with neat cement mortar which shall be brought up to the edge of the socket and neatly trowelled off around the joint.

14.1.10.4 The lead shall be rendered thoroughly fluid and each joint filled in one pouring. Before caulking, the projecting lead shall be removed by flat chisels and then the joint caulked round with proper caulking tools and a hammer of 1 kg. Being well set up, the joint is to be left flush, neat and even with socket. The caulked lead shall be followed by filling with neat cement mortar which shall be brought up to the edge of the socket and neatly trowelled off around the joint.

14.2. MATERIALS

14.2.1. Flushing Tank (Refer Fig. 14.1)

14.2.1.1. C.I. Cover : C.I. Cover shall be of 560 mm dia and shall be medium duty or heavy duty depending upon the locations of the tank. It shall conform in all respects to IS: 1726 (Part IV and Part II) respectively. Weight of cover and frame shall conform to IS: 1726.

14.2.1.2. Syphon shall be automatic syphon made of cast iron with trapped outlet for flushing. The syphon for flushing a sewer line shall be as 65 mm, 80 mm or 100 mm dia as specified.

14.2.2. Manholes – Covers and Foot rests

14.2.2.1. C.I. Covers : The covers and frames shall conform to IS: 1726 and shall be generally of the following grades and types. The basic performance requirement of manhole covers and frames are given in **Table 14.2**. The use of Cast Iron covers

should be restricted to the minimum and only at places where chances of theft are negligible. Normally precast RCC covers should be used if possible.

a) Heavy duty: These shall be denoted by the letters HD circular solid type for use under heavy vehicular traffic condition and shall conform to IS : 1726 (Part-II).

b) Medium duty: These shall be denoted by the letters MD circular or rectangular solid *type* for use under light traffic condition such as foot paths, carriage drives and cycle tracks. These shall conform to IS: 1726 (Part IV&V).

c) Light duty: These shall be denoted by the letter LD of rectangular size for use in domestic premises or where they are not subjected to wheeled traffic loads. These shall conform to IS: 1726 (PartVI)-Square types shall conform to IS: 1726 (Part-VII). The covers and frames shall be cleanly cast and they shall be free from air and sand holes and from cold shuts. They shall be neatly dressed and carefully trimmed. All castings shall be free from voids whether due to shrinkage, gas inclusion or other causes. Covers shall have a raised chequered design on the top surface to provide an adequate non-slip grip.

The cover shall be capable of easy opening and closing and it shall be fitted in the frame in workmanship like manner. The cover shall be gas tight and water tight. The covers used in manholes in sewer lines shall invariably bear the word, 'SEWER' on the top and those used for storm water drains shall bear the word 'STORM'. These markings shall be done during casting of the covers. The sizes of covers specified shall be taken as the clear internal dimensions of the frame. The approximate weights of the various types of manhole covers and frames shall be as per IS: 1726.

Covers and frames shall be coated with a black bituminous composition. The coating shall be smooth and tenacious. It shall not flow when exposed to a temperature of 63 degree centigrade and shall not be brittle as to chip off at temperature of 0 degree centigrade.

Table 14.2

BASIC AND PERFORMANCE REQUIREMENTS OF MANHOLE COVERS & FRAMES

Grade Designation	Type/shape of cover	Clear opening of frame mm	Frame		Test Load Tonnes
			Depth fd mm	Seating S mm	
LD-2.5	Rectangular	450x600	35	50	2.5
	Square	450x450	30	50	
		400x400	30	50	
	Circular	370(dia)	45	40	
		350(dia)	45	40	
MD-10	Circular	450(dia)	60	40	10
		480(dia)	70	40	
		500(dia)	80	50	
	Rectangular	450x600	80	50	
HD-20	Circular	500 (dia)	100	50	20
		560(dia)	110	60	
		600(dia)	110	75	
	Lamphole cover	350(dia)	130	25*	
	Square	560x560	110	75	
	Rectangular (scraper manhole)	450x900	100	60	
EHD-35	Circular	560(dia)	130	60	35
		600 (dia)	140	75	
	Square	560x560	130	60	
	Rectangular (scraper manhole)	600x900	120	70	

Note: The depth and seating in the frame for the respective test loads may vary depending upon the design of the frame (inside) and the corresponding matching cover.

* This seating at 25mm is in case of tapered designs of the frame (inside) as also the matching cover.

14.2.2.2. Precast concrete manhole covers & frames

Precast reinforced cement concrete manhole covers intended for use in sewerage and water works shall generally conform to IS: 12592 (Part 1 & 2). Detailed specifications are as under. In case the ready made covers are procured from approved manufacturer test certificate should be submitted by the agency before use at site.

14.2.2.2.1. Grades: Types & Uses

Manhole covers and frames shall be of the following four grades and types :

Grades	Grade Designation	Type/shape of cover
Light Duty	LD - 2.5	Rectangular, Square, circular
Medium Duty	MD - 10	Rectangular, Circular
Heavy Duty	HD - 20	Circular-Square, Rectangular, (Scraper Manhole)
Extra Heavy Duty	EHD - 35	Circular, Square, Rectangular, (Scraper Manhole)

14.2.2.2.2. The different grades and types of manhole covers may be used as follows :

a) LD-2.5 Rectangular, Square or Circular types:- These are suitable for use within residential and institutional complexes/ areas with pedestrian but occasional LMV traffic. These covers may also be used for Inspection chambers.

b) MD-10- These are suitable for use in service lanes/roads, car parking areas etc.

c) MD-20- Suitable for use in institutional/ commercial areas/carriage ways with heavy duty vehicular traffic like buses, trucks, etc.

d) EHD-35- Circular, square, or rectangular (scraper manhole) types - These are suitable for use on carriage way in

commercial industrial/port areas/near warehouses/ godowns/Goods shed where frequent loading and unloading of trucks/trailers are common, with slow to fast moving vehicular traffic of the types having wheel loads upto 11.5 tonnes, irrespective of the location of the manhole chambers.

14.2.2.2.3. Materials

Cement : Cement used for the manufacture of precast concrete manhole covers shall be portland cement conforming to IS : 269 or 1489 (part 1 & 2) or IS : 8041 or IS : 8043 - or IS : 8112 or IS : 155.

Aggregates : The aggregates used shall be clean and free from deleterious matter and shall conform to the requirements of IS : 383. The aggregates shall be well graded and the nominal maximum size of coarse aggregate shall not exceed 20 mm.

Concrete : The mix proportions of concrete shall be determined by the manufacturer and shall be such as will produce a dense concrete without voids, honey combing etc. The minimum cement content in the concrete shall be 360 kg/m³ with a maximum water cement ratio of 0.45. Concrete weaker than grade M30 (design mix) shall not be used. Compaction of concrete shall be done by machine vibration.

Reinforcement

a) The reinforcement steel shall conform to IS : 226 or IS : 432 (Part I) or IS : 832

(part 2) or IS : 1566 or IS : 1786 as specified.

Reinforcement shall be clean and free from loose mill scale, loose rust, and mud, oil, grease or any other coating which may reduce or destroy the bond between the concrete and steel. A light film of rust may not be regarded as harmful but steel shall not be visibly pitted by rust.

b) **Fibres steel**: In addition to the main steel bar reinforcement, steel fibres of appropriate types and forms may also be used as secondary reinforcement (minimum upto 0.5% by volume of concrete). The diameter/equivalent diameter of steel fibres shall not be greater than 0.75mm. The aspect ratio of the fibres (ratio of length of fibre to its dia / equivalent dia) shall be in the range of 50-80.

c) **Plastics** : Plastics fibres of polypropylene fibrillated film of suitable type and form (0.25% by weight of cement) may also be used as reinforcement in line of steel reinforcement.

14.2.2.2.4. Shapes and Dimensions

Shapes : The shapes of precast concrete manhole covers shall be square, rectangular or circular as specified.

Dimensions : Dimensions of precast concrete manhole covers shall be as given in **Table 14.3**, the minimum clearance at top between the frame and cover shall be 5 mm

TABLE 14.3

SL	Description	Heavy/Extra Heavy duty HD/EHD	Medium duty MD	Light duty LD
1.	Clear opening matching the top opening of manhole	560mm dia or 600mm dia or square or 560mm	450mm dia 480mm dia 500mm dia or square	600x450mm (rectangular) 450mm dia or 350mm dia or square
2.	Precast slab with integral frame (D/T)	900mm dia x 180mm or square corners cut/1000mm dia x200mm or square corner cut	800mm dia x 130mm/800mm dia x150mm	850mmx700mmx100mm/625mm dia x100mm or 575 mm dia x100 mm or square
3.	Thickness of cover depth of frame (T1)	100mm or 110/120mm	70/80mm	50mm
4.	Matching manhole cover (B)	685/660mm or 735/710mm dia or square	585mm dia or 645 mm dia or square	685x535mm/515mm dia or square 435mm dia or square
5.	Edge protection of covers/lifting facility	Precast manhole covers are designed and provided with MS rims of 2.5mm thickness welded around with provision of two lifting hooks welded at appropriate locations.		

6.	Chequered pattern on operative surface	The MS rims along with the edges of precast manhole covers and their operative surface are suitably coated/finished using corrosion resistant paint.
7.	Marking on the covers	Precast manhole covers/precast slabs are suitably marked on the operative surface with the following letters, unless specified otherwise. Name of the department/Sewer or SWD/Grade/Date of MFR/Trade Name etc.
8.	Performance requirements Test Load	When tested for ultimate braking load using 300mm dia block as per the method described in IS 12592 (Part I) manhole covers shall be within the following range. Light-duty 2.5 tonnes(LD 2.5) Heavy duty – 20 tonnes (HD-20) Medium duty- 10tonnes (MD-10 Extra heavy duty 35 tonnes (EHD-35)

14.2.2.2.5. Lifting Device : The minimum diameter of mild steel rod used as lifting device shall be 10 mm for light and 12 mm for medium duty covers and 16 mm for heavy and extra heavy duty covers. The lifting device shall be protected from corrosion by not galvanising or epoxy coating or any other suitable.

14.2.2.2.6. Finishing & Coating : To prevent any possible damage from corrosion of steel the underside of the covers shall be treated with anticorrosive paint. The top surface of the covers shall be given a chequered finish.

In order to protect the edges of the covers from possible damage at the time of lifting and handling it is necessary that the manhole covers shall be cast with a protective mild steel sheet of minimum 2.5

mm thickness around the periphery of the covers. Exposed surface of mild steel sheet shall be given suitable treatment with anticorrosive paint or coating.

14.2.2.2.7. Physical Requirements

a) **General :** All units shall be sound and free from cracks and other defects which interface with the proper placing of the unit or impair the strength or performance of the units. Minor chipping at the edge/surface resulting from the customary methods of handling during delivery shall not be deemed for rejecting.

b) **Load Test :** The breaking load of individual units when tested in accordance with the method described in IS: 12592 shall be not less than the values specified in **Table 14.4.**

TABLE 14.4

Grade of cover	Type	Load in Tonnes	Diameter of Blocks in mm
EHD-35	Circular, square or rectangular	35	300
HD-20	Circular, square or rectangular	20	300
MD-10	Circular or rectangular	10	300
LD-2.5	Rectangular , square or circular	2.5	300

14.2.2.2.8. Fixing : The frames of manhole shall be firmly embedded to correct alignment and level in RCC slab or plain concrete as the case may be on the top of masonry which shall be paid as extra unless specified otherwise.

14.2.2.2.9. Measurements : The manhole covers shall be enumerated under relevant items.

14.2.2.2.10. Rates : The rate shall include the cost of materials and labour involved in all the operation described above except fixing of frames and covers which shall be paid as extra unless specified otherwise in the item.

14.2.2.3. Foot Rests : Foot rests shall be of 20 mm M.S. square or round bars as specified.

14.2.3. Pipes and Specials

14.2.3.1. Cast iron (centrifugally cast) pipes and specials shall conform to the specifications described in 13.2.12.

14.2.3.2. Cement Concrete Pipes (with and without Reinforcement)

For details of different classes of pipes **Table 14.5** below may be referred to. The pipes shall be with or without reinforcement as required and shall be of, the specified class. These shall conform to IS: 458. The reinforced cement concrete pipes shall be

manufactured by centrifugal (or spun) process while un-reinforced cement concrete pipes by spun or pressure process. All pipes shall be true to shape, straight, perfectly sound and free from cracks and flaws. The external and internal surface of the pipes shall be smooth and hard. The pipes shall be free from defects resulting from imperfect grading of the aggregate mixing or moulding. Concrete used for the manufacture of unreinforced and reinforced concrete pipes and collars shall not be leaner than 1:2:4 (1 cement: 2 coarse sand: 4 graded stone

aggregate). The maximum size of aggregate should not exceed one third of the thickness of the pipe or 20 mm whichever is smaller. The reinforcement in the reinforced concrete pipes shall extend throughout the length of the pipe. The circumferential and longitudinal reinforcements shall be adequate to withstand the specified hydrostatic pressure and further bending stresses due to the weight of water when running full across a span equal to the length of pipe plus three times its own weight.

TABLE 14.5 CONCRETE PIPES

Class	Description	Test pressure (Hydrostatic)	Conditions where normally used
NP1	Un-reinforced concrete non pressure pipes	0.7 kg/sq.cm (7 meter head)	For drainage and irrigation use, above ground or in shallow trenches
NP2	Reinforced concrete light duty, non-pressure pipes	0.7 kg/sq.cm (7 meter head)	For drainage and irrigation use, for culverts carrying light traffic.
NP3	Reinforced concrete, medium-duty non-pressure pipes	0.7 kg/sq.cm (7 meter head)	For drainage and irrigation use for culverts, carrying heavy traffic
NP4	Reinforced concrete, heavy duty non-pressure pipes	0.7 kg/sq.cm (7 meter head)	For drainage and irrigation use for culverts carrying very heavy traffic, such as railway loading.
P1	Reinforced concrete pressure pipes	2.0 kg/sq.cm (20 metre head)	For use on gravity mains, the design pressure not exceeding two-third of the test pressure
P2	Reinforced concrete pressure pipes	4.0 kg/sq.cm (40 metre head)	For use on pumping mains, the design pressure not exceeding half of the test pressure.
P3	Reinforced concrete pressure pipes	6.0 kg/sq.cm (60 metre head)	-do-

The dimensional requirements of concrete pipes are given in **Annexure 14.2**. The minimum cover for reinforcement of spun pipes and for all other pipes shall be as given in **Table 14.6**.

TABLE 14.6

Pipe thickness	Cover for	
	Spun pipes mm	Other than spun pipe mm
Less than 30mm	9	12
30mm to 75mm	12	16
75mm and over	18	18

14.2.4. Road Gully Grating (Fig 14.2 and 14.3)

14.2.4.1. Horizontal Gully Grating : The casting of the grating and frames shall be the same as that of manhole covers described in 14.2.2.1. The gully grating cover shall be hinged to the frame to facilitate its opening for cleaning and repairs. A typical grating is shown in **Fig. 14.2 & 14.3** The weight of grating shown in Figure shall be minimum 75 Kg. In case of R.C.C. horizontal gully grating it shall be in cement

concrete 1:1:2 (1 cement: 1 coarse sand: 2 graded stone aggregate 20 mm nominal size) as shown in **Fig. 14.2**

14.2.4.2. Vertical Gully Grating : The chamber shall be of brick masonry, 12mm dia, round bar shall be fixed in cement concrete block at the bottom. The bars at the top shall be welded or riveted to Mild Steel flat 40x6 mm as shown in **Fig. 14.3**

14.2.4.3. Horizontal and vertical Gully Grating : The details of typical road gully chamber of brick masonry with horizontal

and vertical grating shall be as given in **Fig. 14.3**

14.2.5. Stone Ware Pipes and Fittings : All pipes with spigot and socket ends and fittings shall conform to IS: 651. These shall be sound, free from visible defects such as fire cracks or hair cracks. The glaze of the

pipes shall be free from crazing. The pipes shall give a sharp clear tone when struck with a light hammer. There shall be no broken blisters. The thickness of pipes shall be as given in the **Table 14.7**

TABLE 14.7
STONEWARE PIPES

Internal diameter mm	Thickness of the barrel and socket mm
100	12
150	16
200	17
230	19
250	20
300	25
350	30
400	35
450	38

The length of pipes shall be 60, 75, 90 cm exclusive of the internal depth of the socket. The pipes shall be handled with sufficient care to avoid damage to them.

14.2.6. S.W. Gully Trap (Fig. 14.4) : Gully traps shall conform to IS: 651. These shall be sound, free from visible defects such as fire cracks, or hair cracks. The glaze of the traps shall be free from crazing. They shall give a sharp clear tone when struck with light hammer. There shall be no broken blisters.

Each gully trap shall have one C.I. grating of square size corresponding to the dimensions of inlet of gully trap. It will also have a water tight C.I. cover with frame inside dimensions 300 x 300 mm the cover weighing not less than 4.50 Kg and the frame not less than 2.70 Kg. The grating, cover and frame shall be of sound and good casting and shall have truly square machined seating faces.

14.3. CONSTRUCTING FLUSHING TANK (FIG. 14.1)

For details, refer to IS 4111-1986 Code of Practice for ancillary structure to sewage system Part 2 Flushing tanks. Where it is not practicable to obtain gradients in the sewers, steep enough to give a self cleansing velocity of not less than 75 cm per second, it is necessary to provide flushing water tanks at suitable points in a sewer line to help the flow of sewage. For pipes under 600-mm dia the quantity of flushing water should be sufficient to fill the sewer at least half bore over the whole length of sewer to be flushed or from one flush point to the next. The head at which the flush is discharged should give an initial velocity much higher than the self cleansing velocity so as to ensure that solids already deposited will be removed. The approximate quantity of flushing water per flush over a length of 75 m to 90 m is given in **Table 14.8**.

TABLE 14.8
WATER REQUIRED PER FLUSH

Diameter of pipe mm	Quantity of water litres
250	1400 to 1700
350	1700 to 2700
400	2700 to 3600
450	3600 to 4500

14.4. CONSTRUCTION OF MANHOLES (FIG. 14.5 to 14.10)

14.4.0. General: At every change of alignment, gradient or diameter of a drain, there shall be a manhole or inspection

chamber. Bends and junctions in the drains shall be grouped together in manhole as far as possible. The maximum distance between manholes shall be 30 m. IS 4111-1986 Codes of Practice for ancillary structures in sewage system Part 1 may be referred to for further details.

Manholes of different types and sizes as specified shall be constructed in the sewer line at such places and to such levels and dimensions as shown in the drawings or as directed by the Engineer-in-charge. The size specified shall indicate the inside dimensions between brick faces of the manholes.

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

Sewers of unequal sectional area shall not be jointed at the same invert in a manhole. The invert of the smaller sewer at its junction with main shall be at least $\frac{2}{3}$ the diameter of the main above the invert of the main. The branch sewers shall deliver sewage in the manhole in the direction of main flow and the junction must be made with care so that flow in main is not impeded.

No drain from house fittings, e.g. gully trap or soil pipe, etc to manhole shall normally exceed a length of 6 m unless it is unavoidable.

Manholes 90 x 80 cm are generally constructed within compound for house drainage only and near the buildings for house drainage normally for depth of 1 m or less. Manholes 1.2 m x 90. cm are generally constructed for main drainage work for depths less than 1.5 m.

Manhole - 1.4 m x 90 cm are of the arched type and are generally constructed for main drainage works where depth is 1.50 m or more. The width of manholes shall be increased more than 90 cm on bends or junctions or pipes with diameter greater than 450 mm and that the benching width on either side of the channel is minimum 20 cm.

Manholes of circular type of 1.4 m internal diameter are generally constructed for main drainage works where depth is 2.45 m or more as an alternative to manholes of arch type. The diameter shall be increased suitably, for pipes with diameter greater than

450 mm in the same manner as in the case of rectangular manholes.

Before deciding size of manholes, Local Municipal Bye Laws shall be consulted. As a general guide some typical type designs of manholes generally followed have been shown in Fig. 14.6 to 14.9. When manholes are constructed on foot path, these shall be provided with cover of medium duty casting and when built within the width of tie road under vehicular traffic, these shall be provided with cover of heavy duty casting.

14.4.1. Excavation : The excavation for manhole shall be true to dimensions and levels shown on the plans or as directed by the Engineer.

14.4.2. Bed concrete : The manhole shall be built on a bed of cement concrete 1:4:8 (1 cement: 4 coarse sand: 8 graded stone aggregate 40 mm nominal size) unless otherwise stipulated by local authorities. The thickness of the bed concrete shall be 20 cm for manholes up to 4.25 m depth and 30 cm for depths beyond 4.25 m unless otherwise specified or directed by the Engineer. In bad ground, special foundations as suitable shall be provided.

14.4.3. Brick Work : The brick work shall be with class 7.5 bricks in cement mortar 1:4 (1 cement: 4 coarse sand). The external joints of the brick masonry shall be finished smooth, and the joints of the pipes with the masonry shall be made perfectly leak proof. For arched type and circular manholes, brick masonry in arches and arching over the pipes shall be in cement mortar 1:3 (1 cement: 3 fine sand). In the case of manholes of circular type the excess shaft shall be corbelled inwardly on three sides at the top to reduce its size to the cover frame to be fitted.

The walls shall be built of one brick thickness for depths up to 4.25 m. Below a depth of 4.25 m in ordinary subsoil the wall thickness shall be increased to one and half brick and at 9.75 m below ground two brick thick walls shall be built.

14.4.4. Plaster and Pointing: The walls of the manholes shall be plastered inside with 12 mm thick cement plaster 1:3 (1 cement: 3 coarse sand) finished smooth. In the case of arched type manhole the walls of the manhole shall be plastered inside all around only upto the crown level, and flush pointed for the shaft with cement mortar 1:2 (1 cement: 2 fine sand). Where the saturated soil is met with, also the external surface of the walls of the manhole shall be plastered with 12 mm thick cement plaster 1:3 (1

cement: 3, coarse sand) finished smooth upto 30 cm above the highest sub-soil water level with the approval of the Engineer. The plaster shall further be water proofed with addition of approved water proofing compound in a quantity as per manufacturer's specifications. In case Local Authorities/Bye Laws specify richer specifications, the same shall be adopted.

For earth work excavation, bed concrete brick work, plaster and pointing, R.C.C. work

and refilling of earth, respective specifications shall be followed.

14.4.5. Benching : The channels and benching shall be done in cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) and rendered smooth with neat cement. The depth of channels and benching shall be as given in **Table 14.9**.

TABLE 14.9

Sizes of drain mm	Top of channel at the centre above bed concrete cm	Depth of benching at side walls above bed concrete cm
100	15	20
150	20	30
200	25	35
250	30	40
300	35	45
350	40	50
400	45	55
450	50	60

14.4.6. Foot Rests (Fig. 14.10) : All manholes deeper than 0.8 m shall be provided with M.S. foot rests. These shall be embedded 20 cm deep in 20x20x10 cm blocks of cement concrete 1:2:4 (1 cement: 2 coarse sand 4 graded stone aggregate 20 mm nominal size). The concrete block with M.S. foot rest placed in its centre shall be cast in situ along with the masonry and surface finished with 12 mm thick cement plaster 1:3 (1 cement: 3 coarse sand) finished smooth.

Foot rests which shall be of 20x20 Sq. M.S. bars as shown in **Fig. 14.10** shall be fixed 40 cm apart vertically and staggered laterally and shall project 10 cm beyond the surface of the wall. The top foot rest shall be 45 cm below the manhole cover.

Foot rests shall be painted with coal tar, the portion embedded in the cement concrete block being painted with thick cement slurry before fixing.

14.4.7. Manhole covers and Frames : The frame of manhole shall be firmly embedded to correct alignment and levels in R.C.C. slab or plain concrete as the case may be on the top of the masonry. After completion of the work, manhole covers shall be sealed by means of thick grease.

14.4.8. Measurements : Manholes shall be enumerated under relevant items. The depth of the manhole shall be reckoned from the top level of C.I. cover to the invert level of channel. The depth shall be measured correct to a cm. The extra depth shall be measured and paid as extra over the specified depth.

14.4.9. Rate : The rate shall include the cost of materials and labour involved in all the operations described above but exclude the cost of (i) excavation, (ii) M.S. foot rests and (iii) 12 mm thick cement plaster with water proofing material applied at the external surface of the manhole if required. These items shall be paid for separately under relevant items of work:

Payment for extra depths of manholes shall be made separately under relevant items of work.

14.4.10 Reinforced Cement Concrete Man holes (Refer IS 4111- 1986 for further details)

14.4.10.1 Reinforced Cement Concrete Manholes : Where sewers are to be laid in high sub-soil water conditions, manholes may be constructed in reinforced cement concrete of Grade M 20 or 1:1 ½ : 3 mix (see

IS 456-1978). The manholes in this type of construction shall be preferably circular type.

14.4.10.2 Walls may be constructed of brick masonry above the sub-soil water level. A typical illustration of a reinforced cement concrete manhole with brick masonry above the sub-soil, water level is shown in **Figure 14.11**

14.4.11 **Safety Measures:** (Refer IS 4111-1986 for further details).

14.4.11.1 In deep manholes enlarged rest chambers should be made at about 6m intervals, each provided with a landing platform in the form of a grating incorporating a hinged trap-door immediately under the ladder.

14.4.11.2 All the manholes on sewers of 1m diameter and over should be provided with provision for fixing safety chains (galvanized wrought iron closelink, 6 or 10mm) for placing across the mouth of the sewer on the downstream side when men are at work; galvanized pipe handrail (nominal 38mm bore) should be provided on the edges of all benchings, platforms etc, to prevent possibility of a man falling into the sewer.

14.4.11.3 If ground conditions are such as to give rise to excessive risk of settlement and consequential damage to the manhole or sewer a concrete slab shall be provided at the top of the shaft to receive the cover frame. This should be independent of the shaft in order to avoid transmitting traffic shocks to the manhole. Any subsidence of the back filling on which the slab rests, shall be brought to the required road level without disturbing or damaging the pipe or the shaft.

14.4.11.4 No manhole shall be permitted inside a building or in any passage therein

14.4.11.5 In cascades and ramps, handrails and chains should be provided for the safety of workmen.

14.4.11.6 For further details IS 11972 -1987 "Code of Practice for Safety precautions to be taken where entering a sewage system" may be referred to.

14.5. **CONSTRUCTING DROP CONNECTION (FIG. 14.10)**

14.5.0. **General:-** In cases where branch pipe sewer enters the manhole of main pipe sewer at a higher level than the main sewer, a drop connection shall be provided. The work shall be carried out as per **Fig. 14.10** S.C.I. pipes and special conforming to IS: 1729 shall be of the same size as that of the branch pipe sewer.

For 150 and 250 mm main line, if the difference in level between the water line (peak flow level) and the invert level of the branch line is less than 60 cm, a drop connection may be provided within the manhole by giving suitable ramp. If the difference in level is more than 60 cm, the drop shall be provided externally.

The main lines upto 350 mm dia, are designed for half depth of flow, from 350 mm to 900 mm for 2/3 depth of flow and beyond 900 mm for 3/4 depth of flow.

14.5.1. **Excavation :** The excavation shall be done for the drop connection at the place where the branch line meets the manhole the excavation shall be carried upto the bed concrete of the manhole and to the full width of the branch line.

14.5.2. **Laying :** At the end of branch sewer line S.C.I. cross shall be fixed to the line which shall be extended through the wall of the manhole by a horizontal piece of S.C.I. pipe to form an inspection or cleaning eye. The open end shall be provided with chain and lid. The S.C.I. drop pipe shall be connected to the cross at the top and to the S.C.I. bend at the bottom. The bend shall be extended through the wall of the manhole by a piece of C.I. pipe which shall discharge into the channel. Necessary channel shall be made with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) and finished smooth to connect the main channel. The joint between S.C.I. pipe and fittings shall be lead caulked as described in para 13.5.3. The joint between S.C.I. cross and S.W. branch line shall be made with cement mortar 1:1 (1 cement : 1 fine sand). The exposed portion of the drop connection shall be encased all around with minimum 15 cm thick concrete 1:3:6 (1 cement: 3 fine sand: 6 graded stone aggregate 40 mm nominal size) and cured. For encasing the concrete around the drop connection, the necessary centering and shuttering shall be provided. The holes made in the walls of the manhole shall be made good with brick work in cement mortar 1:4 (1 cement: 4 coarse sand) and plastered with cement mortar 1:3 (1 cement: 3 coarse sand) on the inside of the manhole wall. The excavated earth shall be back filled in the trench in level with the original ground level.

14.5.3. **Measurements :** Drop connection shall be enumerated. The depths beyond 60 cm shall be measured in running metres correct to a cm under relevant items.

14.5.4. **Rate :** The rate shall include the cost of labour and materials involved in all the

operations described above but excluding the cost of excavations and refilling.

14.6. LAYING AND JOINTING CEMENT CONCRETE PIPES AND SPECIALS

14.6.0 General:- The pipes shall be as described in para 14.2.3.2

14.6.1. Trenches : Trenches shall be as described in para 13.3.4. Where the pipes are to be bedded directly on soil, the bed shall be suitably rounded to fit the lower part of the pipe, the cost for this operation being included in the rate for laying the pipe itself.

14.6.2. Laying

14.6.2.1. Loading, transporting and unloading of concrete pipes is to be done with care. Handling shall be such as to avoid impact. Gradual unloading by inclined plane or by chain pulley block is recommended. All pipe sections and connections shall be inspected carefully before being laid. Broken or defective pipes or connections shall not be used. Pipes shall be lowered into the trenches carefully. Mechanical appliances may be used. Pipes shall be laid true to line and grade as specified. Laying of pipes shall proceed upgrade of a slope.

14.6.2.2. If the pipes have spigot and socket joints, the socket ends shall face upstream. In the case of pipes with joints to be made with loose collars, the collars shall be slipped on before, the next pipe is laid. Adequate and proper expansion joints shall be provided where directed.

14.6.2.3. In case where foundation conditions are unusual such as in the proximity of trees or holes, under existing or proposed tracks manholes etc. the pipe shall be encased all-around in 15 cm thick cement concrete 1:3:6 (1 cement : 3 fine sand : 6 graded stone aggregate 40 mm nominal size) or compacted sand or gravel.

14.6.2.4. In cases where the natural foundation is inadequate the pipes shall be laid either in concrete cradle supported on proper foundations or on any other suitably designed structure. If a concrete cradle bedding is used the depth of concrete below the bottom of the pipe shall be at least 1/4th of the internal dia of the pipe subject to the min. of 10 cm and a maximum of 30 cm. The concrete shall extend up the sides of the pipe at least to a distance of 1 /4th of the outside diameter of pipes 300 mm and over in dia. The pipe shall be laid in this concrete bedding before the concrete has set.- Pipes laid in trenches in earth shall be bedded evenly and firmly and as far up the haunches

of the pipe as to safely transmit the load expected from the backfill through the pipe to the bed. This shall be done either by excavating the bottom of the trench to fit the curve of the pipe or by compacting the earth under / around the curve of the pipe to form an even bed. Necessary provision shall be made for joints wherever required.

14.6.2.5. When the pipe is laid in a trench in rock hard clay, shale or other hard material the space below the pipe shall be excavated and replaced with an equalising bed of concrete, sand or compacted earth. In no place shall pipe be laid directly on such hard material.

14.6.2.6. The method of bedding and laying the pipes under different conditions are illustrated in **Fig. 14.12**

14.6.2.7. When the pipes are laid completely above the ground the foundations shall be made even and sufficiently compacted to support the pipe line without any material settlement. Alternatively the pipe line shall be supported on rigid foundations at intervals. Suitable arrangements shall be made to retain the pipe line in the proper alignment, such as by shaping the top of the supports to fit the lower part of the pipe. The distance between the supports shall in no case exceed the length of the pipe. The pipe shall be supported as far as possible close to the joints. In no case shall the joints come in the centre of the span. Care shall be taken to see that super imposed ' loads greater than the total load equivalent to the weight of the pipe when running full shall not be permitted.

Suitably designed anchor blocks at change of direction and grades for pressure lines shall be provided where required.

14.6.3. Jointing

14.6.3.0. Joints are generally of rigid type. Where specified flexible type joints may also be provided.

14.6.3.1. Rigid Spigot and Socket Joint (Fig. 14.13) : The spigot of each pipe shall be slipped home well into the socket of the pipe previously laid and adjusted in the correct position. The opening of the joint shall be filled with stiff mixture of cement mortar in the proportion of 1:2 (1 cement: 2 fine sand) which shall be rammed with caulking tool. After a day's work any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured.

14.6.3.2. Rigid Collar Joint (Fig. 14.13) : The two adjoining pipes shall be butted against each other and adjusted in correct

position. The collar shall then be slipped over the joint, covering equally both the pipes. The annular space shall be filled with stiff mixture of cement mortar 1:2 (1 cement: 2 fine sand) which shall be rammed with caulking tool. After a day's work any extraneous materials shall be removed from the inside of the pipe and the newly made joint shall be cured.

14.6.3.3. Semi flexible spigot and socket Joint (Fig. 14.13) : The joint is composed of specially shaped spigot and socket ends on the concrete pipes. A rubber ring shall be placed on the spigot which shall be forced into the socket of the pipe previously laid. This compresses the rubber ring as it rolls into the annular space formed between the two surfaces of the spigot and the socket, stiff mixture of cement mortar 1:2 (1 cement: 2 fine sand) shall then be filled into the remaining annular space and rammed with a caulking tool. After day's work any extraneous materials shall be removed from the inside of the pipe and the newly made joint shall be cured.

14.6.3.4. Semi Flexible Collar Joint : This is made up of a loose collar which covers two specially shaped pipe ends as shown in the Fig. 14.13. Each end shall be fitted with a rubber ring which when compressed between the spigot and the collar, seal the joint. Stiff mixture of cement mortar 1:2 (1 cement: 2 fine sand), shall then be filled into the remaining annular space and rammed with a caulking tool. After day's work, any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured.

14.6.3.5. Internal. Flush Joint (Fig. 14.13) : This joint is generally used for culvert pipe of 60 cm dia and over. The ends of the pipe are specially shaped to form a self centering joint with an internal jointing space 1 -3 cm wide the finished joint is flush with both inside and outside with the pipe wall as shown in Fig. 14.13. The jointing space is filled with cement mortar 1:2 (1 cement: 2 fine sand) mixed sufficiently dry to remain in position when forced with a trowel or rammer. After day's work, any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured.

14.6.3.6. External Flush Joint : This joint is suitable for pipes which are too small for jointing from inside. This joint is composed of specially shaped pipe ends as shown in Fig. 14.13. Each end shall be butted against each other and adjusted in correct position. The jointing space shall then be filled with

cement mortar 1:2 (1 cement: 2 fine sand) sufficiently dry and finished off flush. Great care shall be taken to ensure that the projecting ends are not damaged as no repairs can be readily affected from inside the pipe.

14.6.3.7. In all pressure pipe lines the recess at the end of the pipe line shall be filled with jute braiding dipped in hot bitumen or other suitable approved compound. Pipes shall be so jointed that the bitumen ring of one pipe shall set into the recess of the next pipe. The ring shall be thoroughly compressed by jacking or by any other suitable method.

The number of pipes that shall be jacked together at a time shall depend on the diameter of the pipes and the bearing capacity of the soil, for small pipes upto 25 cm diameter, six pipes can be jacked together at a time.

The quantity of jute and bitumen in the ring shall be just sufficient to fill the recess in the pipe when pressed hard by jacking or by any other suitable method. Before and during jacking care shall be taken to see that there is no offset at the joint.

14.6.4. Testing : For pressure pipes, the completed pipeline shall be tested for pressure (Known as site test pressure) which shall not be less than the maximum pipeline operating pressure plus the calculated surge pressure, but in no case shall it exceed the hydrostatic test pressure. For non-pressure pipes the joints shall be tested as per procedure laid down under para 14.7.4.

14.6.5. Refilling of Trenches : The specification described in para 13.3.7 shall apply. In case where pipes are not bedded on concrete special care shall be taken in refilling, trenches to prevent the displacement and subsequent settlement at the surface resulting in uneven street surfaces and dangers to foundations etc. The backfilling materials shall be packed by hand under and around the pipe and rammed with a shovel and light tamper. This method of filling will be continued upto the top of pipe. The refilling shall rise evenly on both sides of the pipe continued upto 60 cm above the top of pipe so as not to disturb the pipe. No tamping shall be done within 15 cm of the top of pipe. The tamping shall become progressively heavier as the depth of the backfill increases.

14.6.6. Measurements : The lengths of pipes shall be measured in running metres nearest to a cm as laid or fixed, -from inside of one manhole to the inside of the other manhole. The length shall be taken along the

centre line of the pipes over all fittings such as bends, collars, junctions, etc. which shall not be measured separately.

Excavation, refilling, shoring and timbering in trenches, and cement concreting wherever required shall be measured separately under relevant items of work.

14.6.7. Rate : The rate shall include the cost of materials and labour involved in all the operations described above.

14.7. LAYING AND JOINTING STONE WARE PIPES

14.7.0. General: For all sewers and drains, glazed stoneware pipes shall be used as far as possible in preference to other types of pipes. These are suitable, particularly where acid effluents or acid sub-soil conditions are likely to be encountered. Stone ware pipes and specials shall conform to Grade A of the Indian Standards Specification No. IS: 651-1980. All pipes shall be new and perfectly sound, free from fire cracks and imperfections of glazing, cylindrical and straight. They shall be made of hard burnt stoneware and thoroughly salt-glazed inside and outside. They shall be got approved from the Engineer, before use. For details refer to IS 4127-1983 – Code of practice for laying glazed stone ware pipes.

14.7.1. Trenches

14.7.1.1. Specifications described in 14.6.1 shall apply, as far as possible.

14.7.1.2. The trench shall be so dug that the pipe can be laid to the required alignment and at the required depth. When the pipe line is under a roadway, a minimum cover of 90 cm is recommended for adoption, but it may be modified to suit local conditions. The trench shall be excavated only so far in advance of pipe laying as specified by the Engineer. The trench shall be so shored and drained that the workmen may work therein safely and efficiently. The discharge of the trench dewatering pumps shall be conveyed either to drainage channels or to natural drains.

14.7.1.3. The excavation shall be carried out with manual labour or with suitable mechanical equipment as approved by the Engineer.

14.7.1.4. Unless otherwise specified by the Engineer-in-charge, the width at bottom of trenches for different diameters of pipes laid at different depths shall be as given below:-

a) For all diameters, upto an average depth of 120 cm, width of trench in cm shall be equal to External diameter of pipe + 30 cm.

b) For all diameters for depths above 120 cm, width of trench in cm shall be equal to External diameter of pipe + 40 cm.

c) Notwithstanding (a) and (b) the total width of trench shall not be less than 75 cm for depths exceeding 90 cm.

The width of trench in the upper reaches shall be increased as directed by the Engineer.

14.7.2. Laying (Fig. 14.14)

14.7.2.1. All pipes shall be laid on a bed of cement concrete with thickness and mix as specified, projecting on each side of the pipe to the specified width of the trench. The pipes with their crown level at 1.20 m depth and less from ground shall be covered with 15 cm thick. Concrete above the crown of the pipe and sloped off to meet the outer edges of the concrete, to give a minimum thickness of 15 cm all around the pipe (**Fig. 14.14**). Pipes laid at a depth greater than 1.20 m at crown shall be concreted at the sides upto the level of the centre of the pipe and sloped off from the edges to meet the pipe tangentially (**Fig. 14.14**). Concreting shall be paid for separately, but nothing extra shall be paid for rounding or sloping of the concrete surface.

14.7.2.2. The pipe shall be carefully laid to the alignments, levels and gradients shown on the plans and sections. Great care shall be taken to prevent sand etc. from entering the pipes. The pipes between two manholes shall be laid truly in a straight line without vertical or horizontal undulation. All junctions and changes in directions and diameter shall be made inside manholes by means of curves/tapered channels formed in cement concrete finished smooth and benched on both sides. The pipes shall be laid with socket up the gradient. The body of the pipe shall for its entire length rest on an even bed of concrete and places shall be excavated in the concrete to receive the socket of the pipe. The pipes shall be laid socket up the gradient.

14.7.2.3. Where pipes are not bedded on concrete, the trench floor shall be left slightly high and carefully bottomed up as pipe laying proceeds, so that the pipe barrels rest on firm and undisturbed ground. If the excavation has been carried too low due to negligence by the contractor the desired levels shall be made up with concrete 1:5:10 (1 cement: 5 fine sand: 10 graded stone

aggregate 40 mm nominal size) for which no extra payment shall be made.

14.7.2.4. If the floor of the trench consists of rock or very hard ground that cannot easily be excavated to smooth surface the pipe shall be laid on a levelling course of concrete.

14.7.2.5. When S.W. pipes are used for storm water drainage, no concreting will normally be necessary. The cement mortar for jointing will be 1:3 (1 cement: 3 fine sand). Testing of joints will also not be done, and no recovery made on this account

14.7.3. Jointing

14.7.3.1. Tarred gasket of hemp yarn soaked in thick cement slurry shall first be placed round the spigot of each pipe and the spigot shall then be slipped home well into the socket of the pipe previously laid. The pipe shall then be adjusted and fixed in the correct position and the gasket caulked tightly home so as to fill not more than 1/4th of the total depth of the Socket or 1-3cm in depth.

14.7.3.2. The remainder of the socket shall be filled with stiff mixture of cement mortar in the proportion of 1:1 (1 cement: 1 fine sand). When the socket is filled, a fillet shall be formed round the joint with a trowel forming an angle of 45 degree with the barrel of the pipe.

14.7.3.3. After a day's work any extraneous material shall be removed from the inside of the pipe. The newly made joints shall be cured for at least seven days.

14.7.3.4. Mortar shall be mixed as required for immediate use and no mortar shall be beaten up and used after it has begun to set.

14.7.3.5 **Curing:-** Newly made joints shall be protected, until set, from the sun, drying winds, rain or frost. Sacking or other suitable materials, which shall be kept damp, may be used for the purpose. Cement mortar joints shall be cured for atleast 7 days.

14.7.4. Testing of joints.

14.7.4.1. Stoneware pipes used for sewers shall be subjected to a test pressure of 2.5 m head of water at the highest point of the section under test. The test shall be carried out by suitably plugging the lower end of the drain and the ends of the connection if any and filling the system with water. A knuckle bend shall be temporarily jointed in at the top end and a sufficient length of vertical pipe jointed to it so as to provide the required test head, or the top may be plugged with a connection to a hose ending in a funnel

which could be raised or lowered till the required head is obtained and fixed suitable for observation. The test will be for an hour or such longer period as may be decided upon by the Engineer. If the water level in the funnel during the test period does not fall more than 1 cm in a length of 175m of the sewer, the joint may be considered satisfactory.

14.7.4.2. If any leakage is visible, the defective part of the work shall be cut out and made good. A slight amount of sweating which is uniform may be overlooked, but excessive sweating from a particular pipe or joint shall be watched for and taken as indicating a defect to be made good.

14.7.4.3. Any joint found leaking or sweating, shall be rectified or embedded into 15 cm layer of cement concrete (1:2:4) 30 cm in length and the section retested.

14.7.5. **Tests for straightness and Obstruction:** These tests shall be carried out:-

a) by inserting at the high end of the sewer or drain, a smooth ball of a diameter 15mm less than the pipe bore. In the absence of obstruction, such as yarn or mortar projecting through the joints, the ball should roll down the invert of the pipe and emerge at the lower end; and

b) by means of a mirror at one end of the line and lamp at the other. If the pipe line is straight, the full circle of light can be observed. If the pipe line is not straight, this will be apparent. The mirror will also indicate obstructions in the barrel.

14.7.6. **Refilling :** In cases where pipes are not bedded on concrete special care shall be taken in refilling trenches to prevent the displacement and subsequent settlement at the surface resulting in uneven street surfaces and dangers to foundations etc. The backfilling materials shall be packed by hand under and around the pipe, and rammed with a shovel and light tamper. This method of filling will be continued upto the top of pipe. The refilling shall rise evenly on both sides of the pipe continued upto 60 cm above the top of pipe so as not to disturb the pipe. No tamping should be done within 15 cm of the top of pipe. Filling shall continue in layer not exceeding 15cm in thickness both layer being watered as well and well rammed)

14.7.7 Precautions

(a) All pipes, water mains, cables, etc met within the course of excavation shall be

carefully protected and supported by timbers and / or chains or rope slings. Care shall be taken not to disturb the electrical and communication cables, removal of which, if necessary, shall be arranged by the Engineer.

(b) The contractor shall be responsible for providing the requisite fencing, watchmen and red light during night to guard against any accident.

(c) To avoid clogging of drains, both ends shall be kept plugged until the construction of manholes is completed in every respect. On completion, care shall be taken that each plug is removed and the face of the drain made smooth.

14.7.8. Measurements : The lengths of pipes shall be measured in running metres nearest to a cm as laid or fixed, from inside of one manhole to the inside of the other manhole. The length shall be taken along the centre line of the pipes over all fittings such as bends, junctions, etc. which shall not be measured separately. Excavation, refilling, shoring and timbering in trenches, and cement concreting wherever required shall be measured separately under relevant items of work.

14.7.9. Rate : The rate shall include the cost of materials and labour involved in all the operations described above excluding the cost of Excavation, refilling, shoring, timbering in trenches and concrete which shall be paid for separately.

14.8. FIXING S.W. GULLY TRAP (FIG. 14.15A TO 14.15D)

14.8.1. Excavation : The excavation for gully traps shall be done true to dimensions and levels as indicated on plans or as directed by the Engineer.

14.8.2. Fixing : The gully traps shall be fixed on cement concrete foundation 70 cm square and not less than 10 cm thick. The mix for the concrete will be 1:5:10 (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size). The jointing of gully outlet to the branch drain shall be done similar to jointing of S.W. pipes described in para 14.7.3.

14.8.3. Brick Masonry Chamber : (Fig. 14.15 A and C) After fixing and testing gully and branch drain, a brick masonry chamber 300 x 300 mm (inside) in brick work of specified class in cement mortar 1:6 (1 cement: 6 fine sand) shall be built with a half brick thick brick work round the gully trap from the top of the bed concrete upto ground level. The space between the chamber walls

and the trap shall be filled in with cement concrete 1:5:10 (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size). The upper portion of the chamber i.e. above the top level of the trap shall be plastered inside with cement mortar 1:3 (1 cement: 3 coarse sand), finished with a floating coat of neat cement. The corners and bottom of the chamber shall be rounded off so as, to slope towards the grating.

C.I. cover with frame 300 x 300 mm (inside) shall then be fixed on the top of the brick masonry with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) and rendered smooth. The finished top of cover shall be left about 4 cm above the adjoining ground level so as to exclude the surface water from entering the gully trap.

14.8.4 : Random rubble stone masonry chamber: Instead of brick masonry chamber as shown in **Figure 14.15A** for 10 cm S.W. Gully Trap and **Figure 14.15C** for 15cm S.W. Gully trap. Random Rubble Stone Masonry can also be used where convenient. They are shown in **Figure 14.15B** for 10cm S.W. Gully trap and **Fig. 14.15D** for 15cm S.W. Gully Trap.

14.8.5. Measurements : The work shall be enumerated. Excavation shall be measured separately under relevant item of earth work.

14.8.6. Rate : The rate shall include the cost of materials and labour involved in all the operations described above, except earthwork which shall be paid for separately.

14.9. CONSTRUCTING ROAD GULLY CHAMBER WITH GRATING

14.9.1. Road Gully chamber with Horizontal Grating (Fig. 14.2 & 14.3) : The chamber shall be of brick masonry of specified class and shall have a C.I. grating with frame fixed in 15 cm thick cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) at the top. The size of the chamber shall be taken as the clear internal dimensions of the C.I. frame. The chamber shall have a connection pipe, the length of which in metre between the road gully chamber and the manhole of the drain shall not be less than one by forty (1 /40) times the nominal diameter of pipe in mm (i.e. for 150 mm connection pipe, length shall not be less than 3.7 m and for 250 mm connection pipe length shall not be less than 6.25 m). The chamber shall be built at the location fixed by the Engineer-in-Charge. Generally

the spacing of the chambers shall be 18 to 36 m depending upon the grading of the road channel and the area of the drainage. R.C.C. gully grating shall be fixed in cement mortar 1:2 (1 cement: 2 coarse sand) as shown in **Fig. 14.2**. For details refer to IS 7740-1985 –Code of practice for Construction and Maintenance of Road Gullies.

14.9.2. Road Gully Chamber with Vertical Grating (Fig. 14.3) : The chamber shall be of brick masonry 12 mm dia round bar shall be fixed in cement concrete block at the bottom. The bars at the top shall be welded or riveted to M.S. flat 40 x 6 mm as shown in **Fig. 14.3**. The specifications shall be same as described in para 14.10.1.

14.9.3. Road Gully Chamber with Horizontal and Vertical Grating : The details of typical road gully chamber of brick masonry shall be same as shown in **Fig. 14.3**

14.9.4. Measurements Road gully chambers shall be enumerated.

14.9.5. Rate : The rate shall include the cost of materials and labour involved in all the operations described above except the cost of excavation and connection pipes.

14.10. CONSTRUCTING BRICK MASONRY GREASE TRAP (FIG. 14.17)

14.10.0. General: The internal size of the trap shall be 80 x 40 x 46 cm. The height shall be measured from the top of the floor to the top of the cover. 40 mm thick stone baffles / RCC precast slabs shall be fixed 50 mm deep in masonry with cement mortar 1:4 (1 cement: 4 fine sand), as shown in the **Fig. 14.17**. The connection of open surface, drain with a soak pit shall be invariably through a grease trap. It should be covered with stone slab / RCC precast slab.

14.10.1. Measurements : Grease traps shall be enumerated.

14.10.2. Rate : The rate shall include the cost of labour and materials required for all the operations described above.

14.11. CONSTRUCTION OF SEPTIC TANK - (FIG. 14.18)

14.11.0. General: In unsewered area, every house shall have arrangements for its sewage being treated in septic tank, effluent from which should be given secondary treatment either in a biological filter or on the land, or in a sub-surface disposal system.

For details IS 2470-1985 Code of Practice for installation of septic tank may be referred.

Surface and sub-soil water should be excluded from finding way into the septic tank. Waste water may be passed into the septic tank provided the tank and the means for effluent disposal are designed to cope up with this extra liquid. Depending on the location of the water table and the nature of the strata, the type of disposal for the effluent from the septic tank shall be decided.

14.11.1. Dimensions : Septic tanks shall have minimum width of 75 cm, minimum depth of one metre below water level and a minimum liquid capacity of the one cubic metre. Length of tanks shall be 2 to 4 times the width. Suitable sizes of septic tanks for use of 5, 10, 15, 20 and 50 persons based on certain assumptions are given in **Annexure 14.3**.

14.11.2. Cover and Frame : Every septic tank shall be provided with C.I. cover of adequate strength. The cover and frames shall be 500 mm dia. (M.D.) minimum or 610 mm x 455 mm (LD). The specification for frames and cover given in para 14.2.2 shall apply. As an alternate RCC slabs may be permitted in lieu of CI covers.

14.11.3. Ventilating Pipe : Every septic tank shall be provided with C.I. ventilating pipe of at least 50 mm diameter. The top of the pipe shall be provided with a suitable cage of mosquito proof wire mesh.

The ventilating pipe shall extend to a height which would cause no smell nuisance to any building in the area. Generally the ventilating pipe may extend to a height of about 2 m, when the septic tank is at least 15 m away from the nearest building and to a height of 2 m. above the top of the building when it is located closer than 15 metres. The ventilating pipe may also be connected to the normal soil ventilating system of the building where so desired.

14.11.4. Disposal of Sludge : The sludge from septic tanks may be delivered into covered pit or into a suitable vehicle for removal from the site. Spreading of sludge on the ground in the vicinity shall not be allowed.

14.11.5. Testing : Before the tank is commissioned for use, it shall be tested for water-tightness by filling it with water and allowing it to stand for 24 hours. It shall then be topped up, if necessary, and allowed to stand for a further period of 24 hours during

which time the fall in the level of the water shall not be more than 1.5 cm.

14.11.6. Commissioning of Septic Tank.

The tank shall be filled with water to its outlet level before the sewage is let into the tank. It shall, preferably, be seeded with small quantities of well digested sludge obtained from septic tanks or sludge digestion tanks. In the absence of digested sludge a small quantity of decaying organic matter, such as digested cow dung, may be introduced.

14.11.7. Sub-surface Absorption System :

The effluent from septic tank shall be disposed of by soak pit or dispersion trench depending on the position of the sub-soil water level, soil and sub-soil conditions and the size of the installation.

14.11.8. Measurements : All the relevant items may be paid separately under the relevant item as excavation, brick masonry, flooring, plaster, CC, pre cast RCC, CI cover, ventilation pipes, water proofing compound cowls etc,

14.11.9 Rate: Rate shall include cost of materials and labour involved in relevant items.

14.12. SOAK PIT – 2.5M DIA x 3 M DEEP (FIG. 14.19)

14.12.1. Construction : The earth excavation shall be carried out to the exact dimensions as shown in the figure. In the soak pit shall be constructed a honey-comb dry brick shaft 45x45 cm and 292.5 cm high. Round the shaft and within the radius of 60 cm shall be placed. well burnt brick bats. Brick ballast of, size from 50 to 80 mm nominal size shall be packed round the brick bats upto the radius of 90 cm. The remaining portion shall be filled with brick ballast of 40 mm nominal size. The construction of shaft and filling of the bats and the ballast shall progress simultaneously.

14.12.2. Cover and Drain : Over the filling shall be placed a single matting which shall be covered with minimum-layer of 7.5 cm earth. The shaft shall be covered with 7.5 cm thick stone or. R.C.C. slab, 11 cm wide and 15 cm deep brick edging with bricks of class designation 75 shall be provided round the pit. The connection of the open surface drain to the soak pit shall be made by means of 100 mm diameter S.W. pipe with open joints.

14.12.3. Measurements : Soak pit shall be enumerated if constructed as per SOR item otherwise various items may be paid separately under the relevant items.

14.12.4. Rate : Rate shall include the cost of labour and material involved in all the operations / separate different items described above.

14.13. DESLUDGING OF SEPTIC TANKS

Septic tanks shall be de-sludged periodically, the intervals of de-sludging, depending upon the design of the septic tanks and the capacity in relation to its users. De-sludging may be done when the sludge level reaches a predetermined level. A portion of the sludge may be left in the tank to seed the fresh deposits. De-sludging shall preferably be carried out by hydrostatic head or by using a portable pump. Manual handling of sludge shall be discouraged.

14.14 VENT SHAFT

14.14.1 Vent shaft Location : Vent shaft shall be provided at the starting point of the main sewer and at such points where the flow is distributed e.g. at falls, siphons etc. As far as possible, the location shall be at such a place where it receives sun rays for the maximum period of the day.

14.14.2 Design : Vent shaft shall be of S.C.I. pipe or of RCC manufactured by centrifugal spun process. RCC vent shaft shall be provided as per **Figure 14.21**.

ANNEXURE 14.1**IS 1748:1988 – CODE OF PRACTICE FOR
BUILDING DRAINAGE – SOME
IMPORTANT CLAUSES****4.0 Design consideration**

4.1 Aim: In designing a drainage system for individual building (s), the aim shall be to provide a system of self-cleansing conduits for the conveyance of soil, waste, surface or sub-surface waters and for the removal of such wastes speedily and efficiently to a sewer or other outlet without risk of nuisance and hazard to health.

4.3.4 Additional requirements: The pipes shall be laid in straight lines as far as possible and with uniform gradients. Anything that is likely to cause irregularity of flow, such as, abrupt changes of directions shall be avoided. No bends and junctions whatsoever shall be permitted in sewers except for manholes and inspection chambers.

4.3.4.1 Where it is not possible to avoid a change of direction in the case of drains, access shall be provided through manholes and inspection chambers. Necessary terminal bends at junctions shall be 1/8 or preferably 1/16 bends.

4.3.4.2 All junctions shall be oblique and the contained angle shall not be more than 60 deg.

4.3.4.3 Drains may be laid under the buildings only when unavoidable and when it is not possible to obtain otherwise a sufficient fall in the drain.

4.3.4.4 Where it is necessary to lay a drain under a building or exposed locations within the building, the following conditions shall be observed:

- a. Pipes shall be of cast iron (see IS 1536-1976 and IS: 1537-1976)
- b. The drains shall be laid in a straight line and at a uniform gradient;
- c. Means of access in the form of manholes/inspection chambers shall be provided at each end, immediately outside the building.
- d. In case the pipe or any part of it is laid above the natural surface of the ground, it shall be laid on concrete supports the bottom of which goes at least 150mm below the ground surface.

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

4.3.4.5 Surcharge of sewers (precautions): Where there is a risk of the sewer becoming surcharged under storm conditions all gullies and sanitary fittings shall be located above the level of maximum surcharge of the sewer. Where this is not practicable, an anti-flood valve shall be provided in the manhole nearest to the junction of the drain and sewer. Parts exposed to wear in anti-flood valves shall be of non-corrodable metal and easily accessible. The cross-sectional area of flow through the valve shall not be less than that of the pipe connected. In extreme cases, pumping may have to be considered.

4.3.4.6 The distance between inspection chamber and gully chamber shall not exceed 6 m.

4.7 CHOICE OF MATERIALS

4.7.1 Salt glazed stoneware Pipes: For all sewers and drains in all soils, except where supports are required as in made-up ground, glazed stoneware pipe shall be used as far as possible in preference to other type of pipes; they are particularly suitable where acid effluents or acid subsoil conditions are likely to be encountered. Salt glazed stoneware pipes shall conform to IS 651-1980 or IS:3006-1979.

4.7.2 Cement Concrete pipes: When properly ventilated, cement concrete pipes with spigot and socket or collar joints present as alternative to glazed stoneware sewers over 150mm diameter. These shall not be used to carry acid effluents or sewage under condition favourable for the production of hydrogen sulphide and shall not be laid in those sub-soils which are likely to affect adversely the quality or strength of concrete. Cement concrete pipes may be used for surface water drains in all diameters. These pipes shall conform to IS 458-1971. Where so desired the life of cement concrete pipe may be increased by lining inside of the pipe by suitable coatings like epoxy/polyester resin, etc

4.7.3 Cast Iron Pipes: Cast iron pipes (see IS : 1536-1976 and IS:1537-1976) shall be used in the following situations.

- (a) In bad or unstable ground where soil movement is expected.
- (b) In made-up or tipped ground
- (c) To provide for increased strength where a sewer is laid at insufficient depth,

where it is exposed or where it has to be carried on piers or above ground.

(d) Under buildings and where pipes are suspended in basements and like situations.

(e) In reaches where the velocity is more than 2.4m/sec and

(f) For crossings of water courses.

4.7.3.1 It shall be noted that cast iron pipes even when given as protective paints are liable to severe external corrosion in certain soils. Among such soils are

(a) Soils permeated by peaty waters and

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

4.7.4 **Asbestos cement pipes:** Asbestos cement pipes are commonly used for house drainage systems and they shall conform to the requirements specified in IS:1626 (Part I)-1980. They are not recommended for underground situations. However, asbestos cement pressure pipes conforming to the requirements specified in IS:1592-1980 may be used in underground situations also provided they are not subjected to heavy superimposed loads. These shall not be used to carry acid effluents or sewage under conditions favourable for the production of hydrogen sulphide and shall not be laid in those sub-soils which are likely to affect adversely the quality or strength of asbestos cement pipes. Where so desired, the life of asbestos cement pipes may be increased by lining inside of the pipe by suitable coatings like epoxy/polyester resins, etc

4.7.5 **Lead pipes:** Branch soil pipes from fittings to main soil pipes and branch waste pipes from fittings to main stack and branch antisiphonage pipes may be of lead and shall conform to IS :404 (Part I) 1977.

4.7.8 **PVC pipes:** Unplasticized PVC pipes may be used for drainage purposes; however, where hot water discharge is anticipated, the wall thickness should be at least 3mm irrespective of the size and flow load, UPVC pipe shall conform to IS 1985-1981.

Note: Where possible, high density polyethylene pipes (HDPE) and UPVC pipes may be used for drainage and sanitation purposes, depending upon suitability. HDPE pipes shall conform to IS 4984-1978.

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

4.8.1 Where soil and ventilating pipes are accommodated in ducts, access to cleaning eyes shall be provided. Any connection to a drain shall be through a gully with scaled cover to guard against ingress of sewer gas, vermin or backflow. Trenches and subway shall be ventilated, preferably to the open air.

4.8.2 All vertical soil, waste, ventilating and anti-siphonage pipes shall be covered on top with a copper or heavily galvanized iron wire dome or cast iron terminal guards. All cast iron pipes which are to be painted periodically shall be fixed suitably to the wall to give a minimum clearance of 50mm.

Note: Asbestos Cement cowls may be used in case asbestos cement pipes are used as soil pipe.

4.8.3 Drainage pipes shall be carried to a height above the buildings as specified for ventilating pipe (see IS 5329-1983).

5. CONSTRUCTIONS RELATING TO CONVEYANCE OF SANITARY WASTES

5.1 **Pipe Lines and jointing:** All soil pipes, waste pipes, ventilating pipes and all other pipes, when above ground, shall be gas tight. All sewers and drains laid below ground shall be water tight.

5.2 **Jointing Lead and Iron Pipes:** Where any lead waste pipe, ventilating pipe or trap is connected with an iron pipe or drain communicating with a sewer these shall be inserted between such lead waste pipe and such iron pipe or drain an ordinary thimble of copper or brass, which shall be connected to such lead waste pipe by means of a wiped joint. The thimble shall be connected with such cast iron pipe by means of a joint made with molten lead, properly caulked, a sufficient quantity lead being melted at a time to finish each joint at one pouring. (Note: For figure see IS 1742:1988)

5.3 **Jointing stoneware with Lead pipes:** Where any stoneware or semi-vitrified ware trap or pipe is connected with a lead soil pipe, waste pipe or trap communicating with a sewer, these shall be inserted between such stoneware or semi-vitrified ware trap or pipe and such lead soil pipe, waste pipe, or trap a socket of copper, cast brass or other

suitable alloy, which shall be connected with such stone-ware or semi-vitrified-ware trap or pipe by means of a joint made with mortar consisting of one part of cement and one part of coarse sand with the lead soil pipe, waste pipe or trap by means of wiped metallic joint. (Note:- For Figure see IS 1742:1988).

5.4 Jointing Cast Iron pipes with stoneware pipes: Where any cast iron soil pipe, waste pipe, ventilating pipe or trap is connected with a stone ware or semi-vitrified waste pipe or drain communicating with a sewer, the beaded spigot end of such cast iron soil pipe, waste pipe, ventilating pipe, or trap shall be inserted into a socket of such stoneware of semi-vitrified ware pipe or drain

and the joint made with mortar consisting of one part of cement and one part of clean coarse sand after placing a tarred gasket or hemp yam soaked in neat cement slurry round the joint and inserted in it by means of a caulking tool. (Note:- For Figure see IS 1742:1988).

5.4.1 Jointing stoneware with cast iron pipes: Where any water closet pan or earthenware trap connected to such pan is to be jointed with a cast iron soil pipe, the joint between the stoneware spigot and the cast iron socket shall always be of a flexible (non-rigid) nature. Such joint shall be made preferably with a mixture of bitumen and chopped asbestos fibre.(not dust.)

ANNEXURE 14.2

DIMENSIONAL REQUIREMENTS OF CONCRETE PIPES

A. CLASS NP-1 – UNREINFORCED NON-PRESSURE PIPES

Internal diameter of pipes mm	Barrel wall thickness mm	Collar Dimensions		
		Minimum Caulking mm	Minimum Thickness mm	Minimum Length mm
80	25	13	25	150
100	25	13	25	150
150	25	13	25	150
200	25	13	25	150
225	25	13	25	150
250	25	13	25	150
300	30	16	30	150
350	32	16	32	150
400	32	16	32	150
450	35	19	35	200

B. CLASS NP2- REINFORCED CONCRETE LIGHT DUTY, NON PRESSURE PIPES

Internal diameter of pipes Nominal mm	Barrel wall thickness mm	Collar Dimensions		
		Minimum Caulking mm	Minimum Thickness mm	Minimum Length mm
80	25	13	25	150
100	25	13	25	150
150	25	13	25	150
200	25	13	25	150
225	25	13	25	150
250	25	13	25	150
300	30	16	30	150
350	32	16	32	150
400	32	16	32	150

450	35	19	35	200
500	35	19	35	200
600	45	19	40	200
700	50	19	40	200
800	50	19	45	200
900	55	19	50	200
1000	60	19	55	200
1100	65	19	60	200
1200	70	19	65	200
1400	75	19	75	200
1600	80	19	80	200
1800	90	19	90	200
2000	100	19	100	200
2200	110	19	110	200

Note : 1. The effective length of barrel shall be 2m upto 250mm nominal diameter pipes and 2.5, 3.0, 3.5 or 4.0 m for pipes above 250mm

2. The actual internal diameter is to be declared by the manufacture and the

tolerance is to be applied on the declared diameter.

3. Minimum thickness and minimum length of collars shall be the same as that for the next higher size available in NP2 class pipes corresponding to the calculated.

C. CLASS NP3- REINFORCED CONCRETE, MEDIUM DUTY, NON PRESSURE PIPES

Internal diameter of pipes mm	Barrel Wall thickness mm
80	25
100	25
150	25
200	30
225	30
250	30
300	40
350	75
400	75
450	75
500	75
600	85
700	85
800	95
900	100
1000	115
1100	115
1200	120
1400	135
1600	140
1800	150
2000	170
2200	185
2400	200
2600	215

D. REINFORCED CONCRETE PRESSURE PIPES CLASS P1 TESTED TO TO 20M HEAD, CLASS P2 TESTED TO 40M HEAD AND CLASS P3 TESTED TO 60M HEAD

Internal diameter of pipes mm	Barrel Dimensions		
	Minimum Caulking mm	Minimum Thickness mm	Minimum Length mm
80	25	25	25
100	25	25	25
150	25	25	25
200	25	30	35
225	25	30	35
250	25	30	35
300	30	40	45
350	32	45	55
400	32	50	60
450	35	50	70
500	35	55	75
600	40	65	90
700	40	70	105
800	45	80	120
900	50	90	-
1000	55	100	-
1100	60	-	-
1200	65	-	-

Note: Collar dimensions will be same as operated for class NP2 pipe.

ANNEUXRE 14.3

**RECOMMENDED SIZES OF SEPTIC TANKS
RECOMMENDED SIZES OF SEPTIC TANKS FOR 20 USERS**

No. of users	Length m	Breadth m	Liquid depth (cleaning interval of	
			1 year m	2 year m
5	1.5	0.75	1.0	1.05
10	2.0	0.90	1.0	1.40
15	2.0	0.90	1.3	2.00
20	2.3	1.10	1.3	1.80

Note: 1. The capacities are recommended on the assumption that discharge from only WC will be treated in the septic tank.

2. A provision of 300mm should be made for free board

3. The sizes of septic tanks are based on certain assumptions, while choosing the size of septic tank exact calculation shall be made

RECOMMENDED SIZES OF SEPTIC TANKS FOR RESIDENTIAL COLONIES

No. of users	Length m	Breadth m	Liquid depth (cleaning interval of	
			1 year m	2 year m
50	5.0	2.0	1.0	1.24
100	7.5	2.65	1.0	1.24
150	10.0	3.0	1.0	1.24
200	12.0	3.3	1.0	1.24
300	15.0	4.0	1.0	1.24

1. A provision of 300mm should be made for free board

- The sizes of septic tanks are based on certain assumptions, while choosing the size of septic tank exact calculation shall be made
- For population over 100, the tank may be divided into independent parallel chambers for ease of maintenance and cleaning.

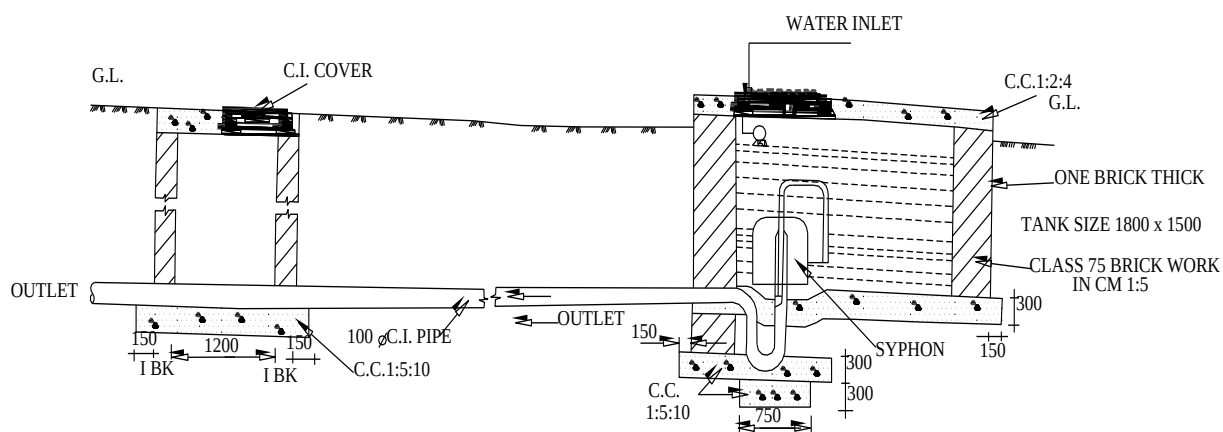
RECOMMENDED SIZES OF SEPTIC TANKS FOR HOSTEL AND BOARDING SCHOOLS

No. of users	Length m	Breadth m	Liquid depth (cleaning interval of	
			1 year m	2 year m
50	5.0	1.6	1.3	1.4
100	5.7	2.1	1.4	1.7
150	7.7	2.4	1.4	1.7
200	8.9	2.7	1.4	1.7
300	10.7	3.3	1.4	1.7

- A provision of 300mm should be made for free board
- The sizes of septic tanks are based on certain assumptions, while choosing the size of septic tank exact calculation shall be made
- For population over 100, the tank may be divided into independent parallel chambers for ease of maintenance and cleaning.

AUTOMATIC FLUSHING TANK

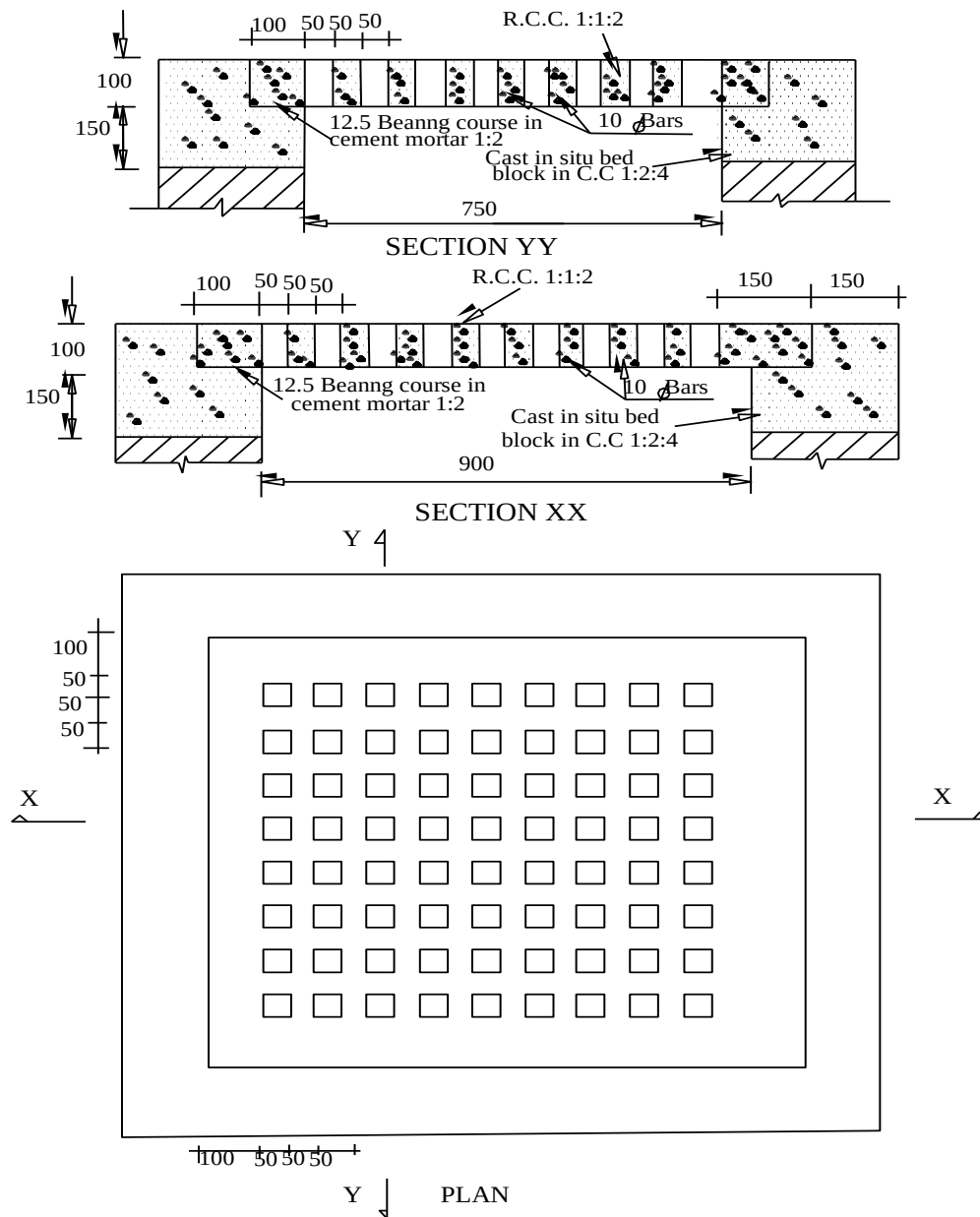
FIGURE 14.1



All dimensions are in mm
Drawings not to Scale

R.C.C. ROAD GRATING

FIGURE 14.2



CLEAR COVER OVER REINFORCEMENT SHALL BE 20 MM

THE SLAB COVERS SHALL CAST IN R.C.C.. 1:1:2

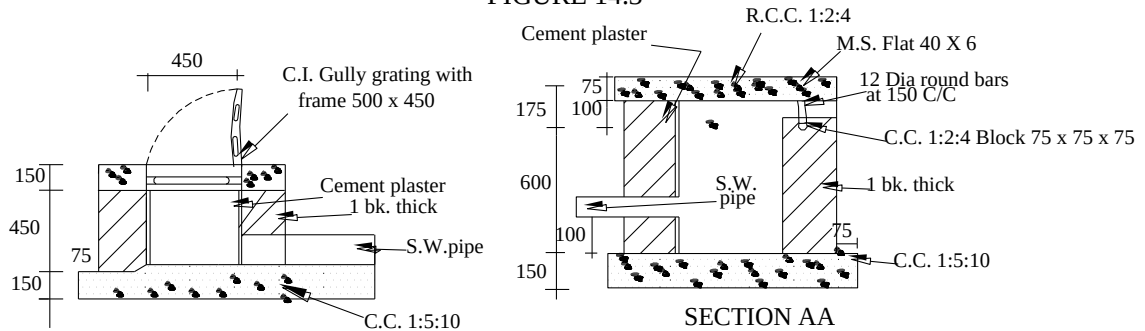
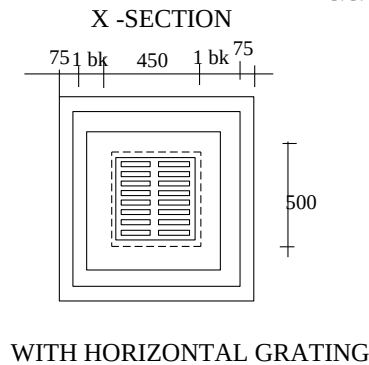
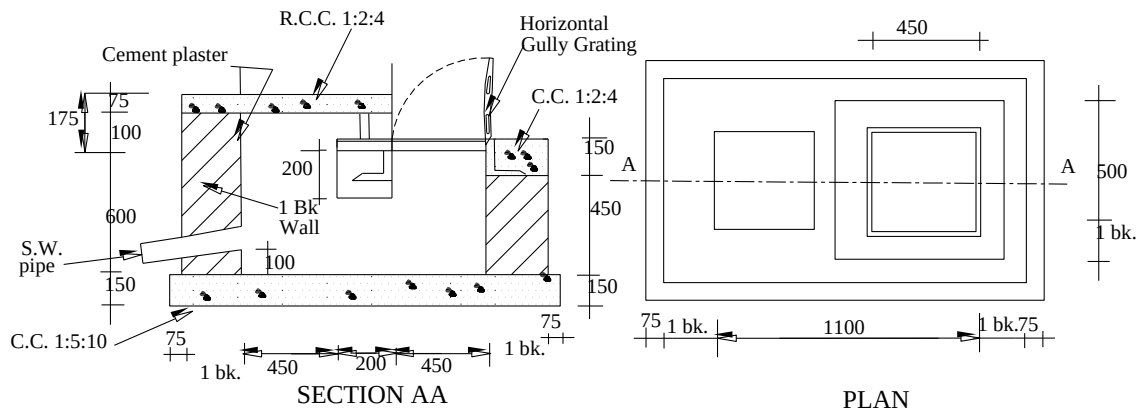
THE R.C.C. COVER SHALL BE PROPERLY CURED

All dimensions are in mm

Drawings not to Scale

ROAD GULLY CHAMBER WITH HORIZONTAL GRATING

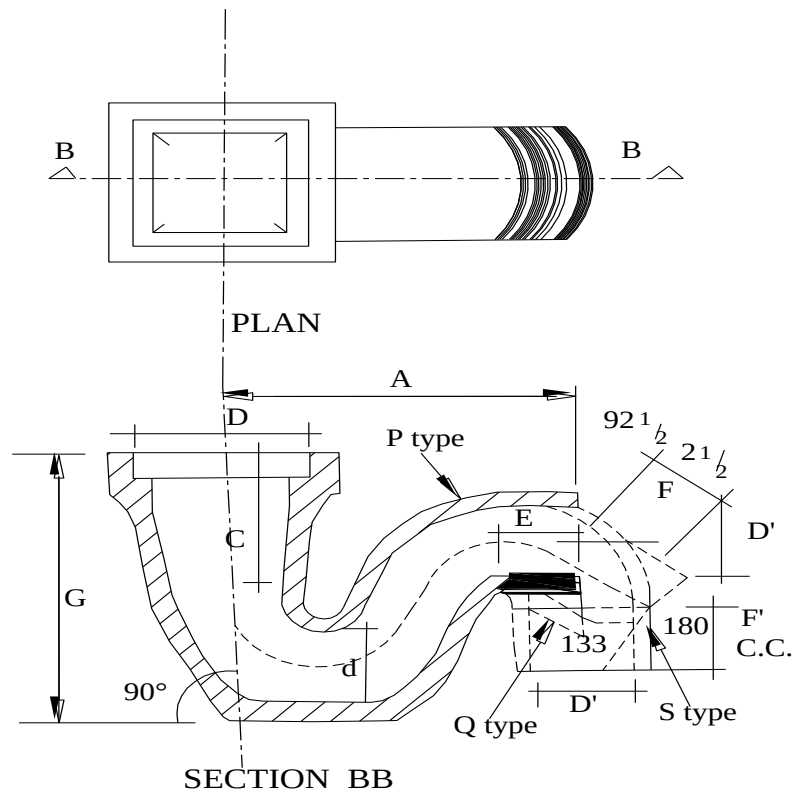
FIGURE 14.3



All dimensions are in mm
Drawings not to Scale

STONE WARE GULLY TRAP

FIGURE 14.4



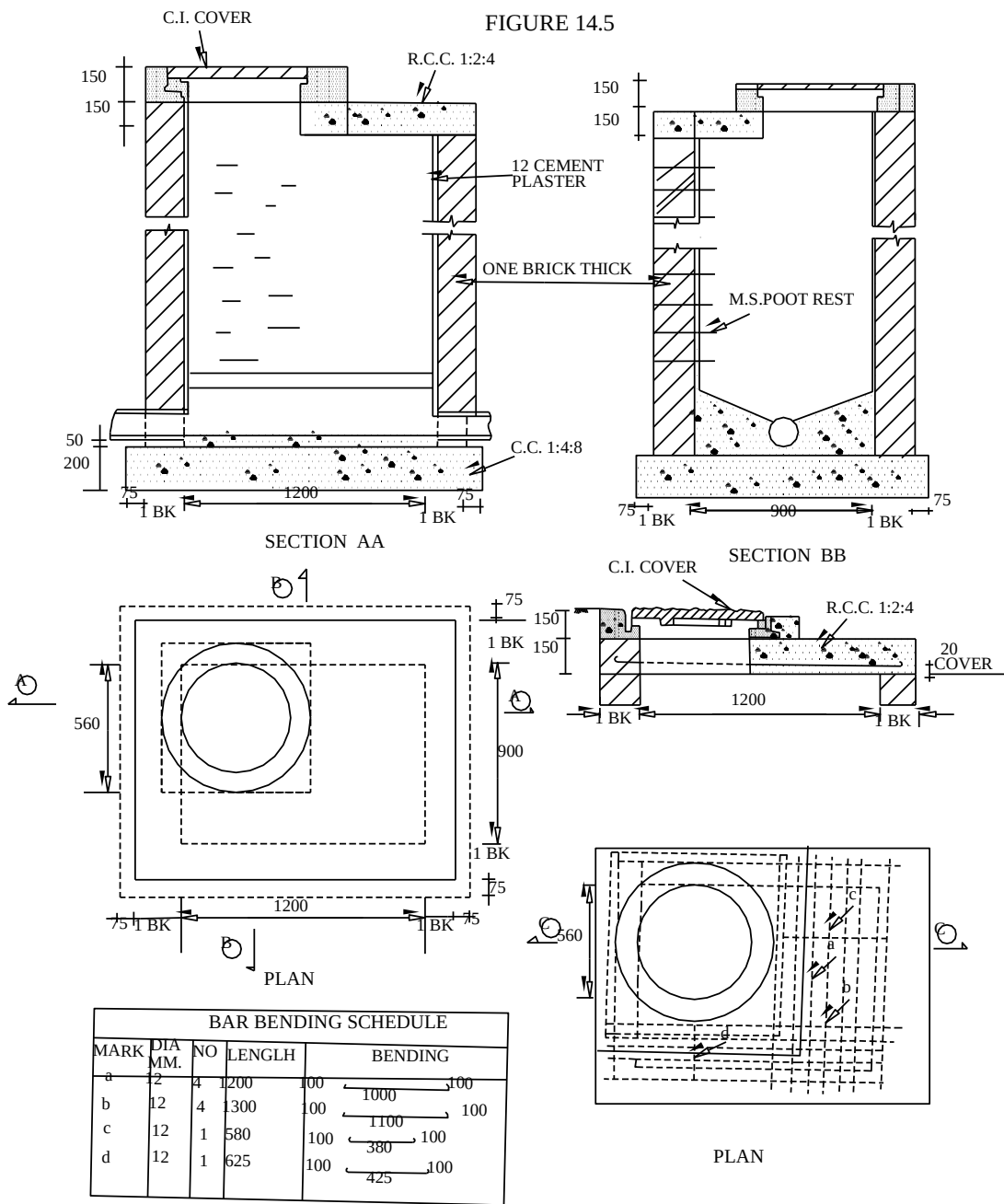
STONEWARE GULLY TRAP

Type	Size	A	C	d	D	D	E	F	F	G
P	100x100	305	175	100	100	100	65	-	-	330
P	125x100	265	165	75	125	100	60	-	-	345
P	150x100	330	165	100	150	100	75	-	-	346
P	180x100	320	200	75	180	100	65	-	-	380
P	180x150	405	270	140	180	150	75	-	-	520
Q	125x100	330	165	75	125	100	-	80	-	345
S	125x100	290	165	90	125	100	-	-	100	345
S	150x100	330	165	100	150	100	-	-	115	346
S	180x150	445	275	125	180	150	-	-	125	520

All dimensions are in mm
Drawings not to Scale

MANHOLE
SIZE 1200 x 900 HEAVY DUTY COVER

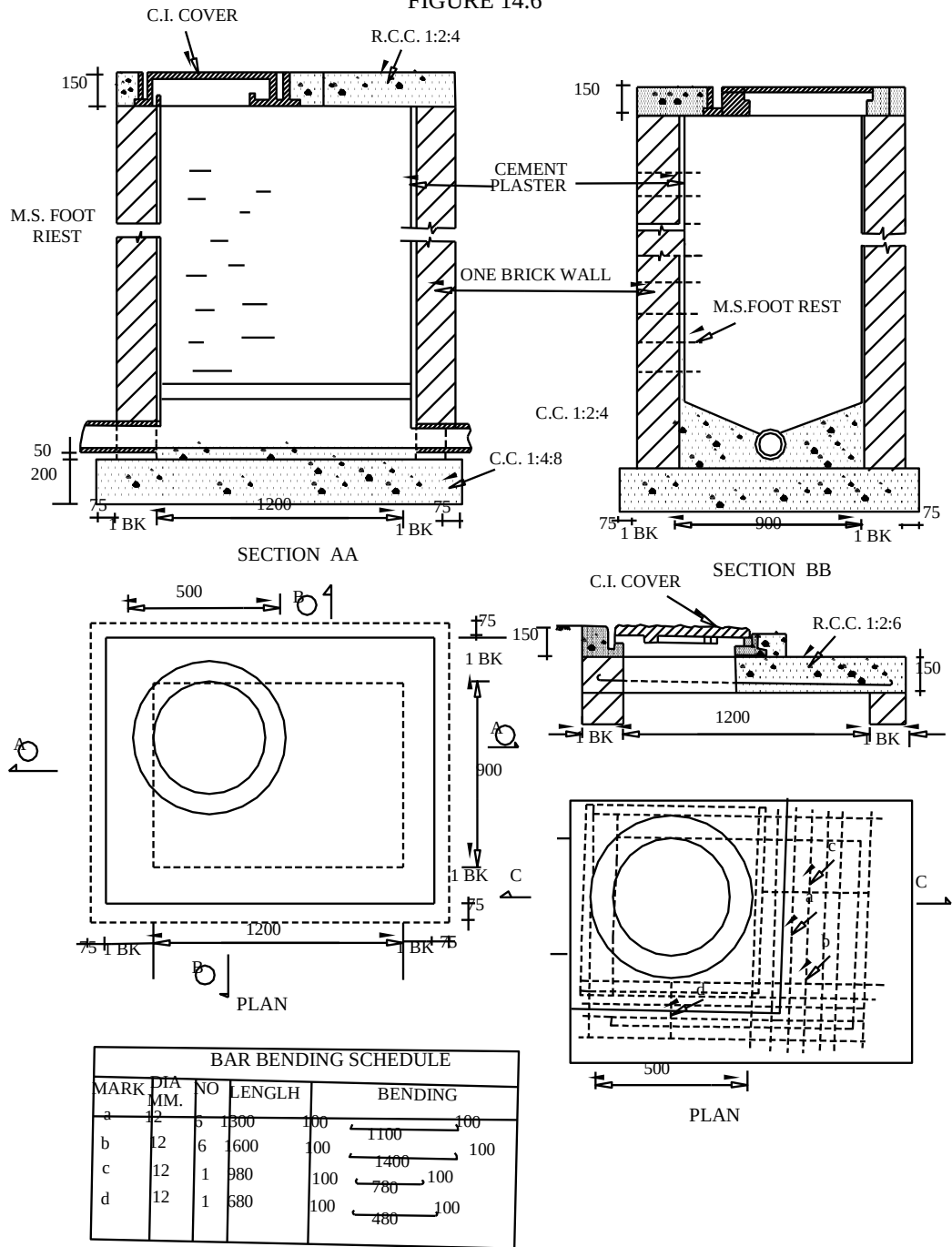
FIGURE 14.5



All dimensions are in mm
Drawings not to Scale

MANHOLE (CONTD.)
SIZE 1200 x 900 WITH MEDIUM DUTY COVER

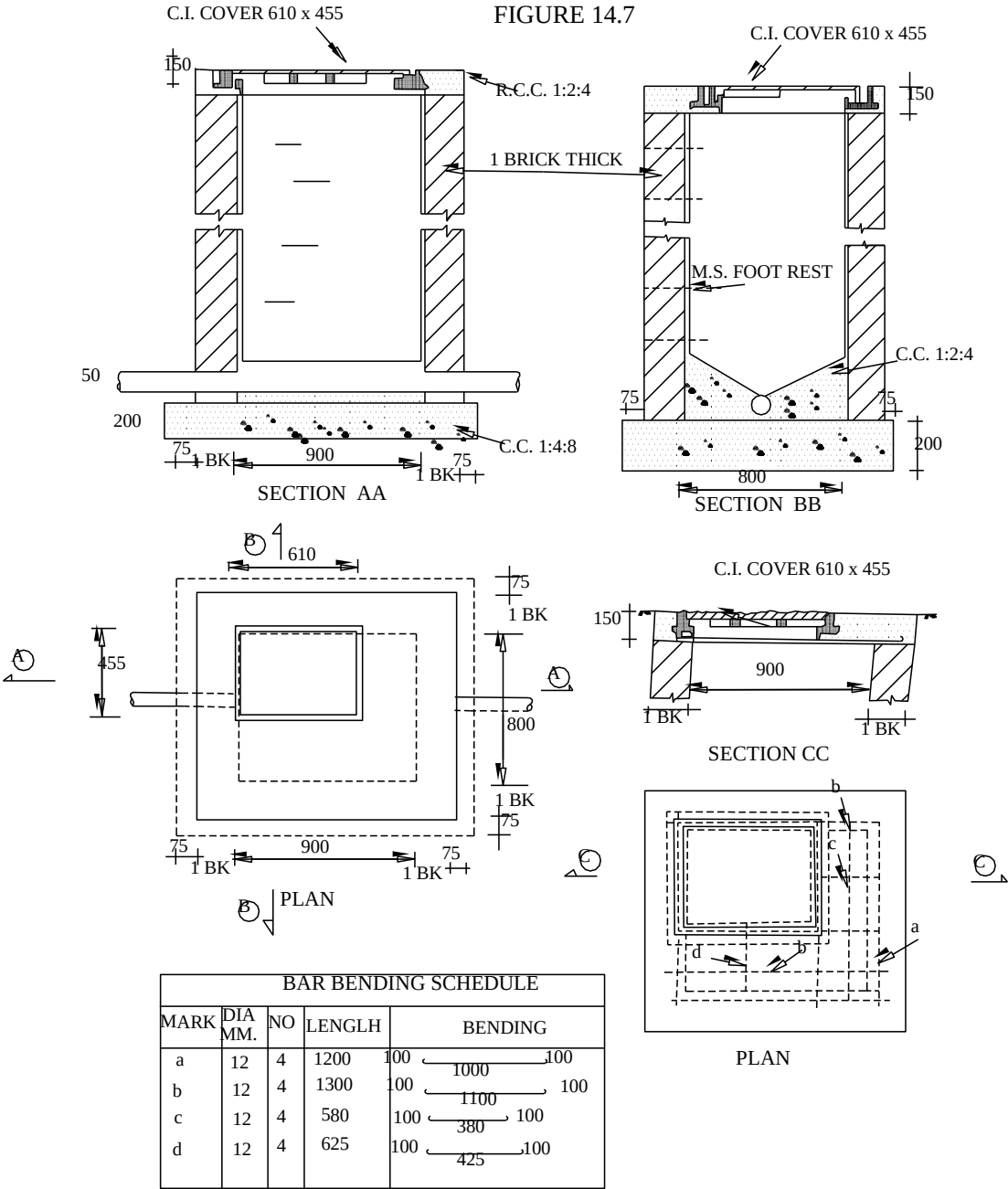
FIGURE 14.6



All dimensions are in mm
Drawings not to Scale

MANHOLE (CONTD)
SIZE 900 x 800 WITH LIGHT DUTY COVER

FIGURE 14.7

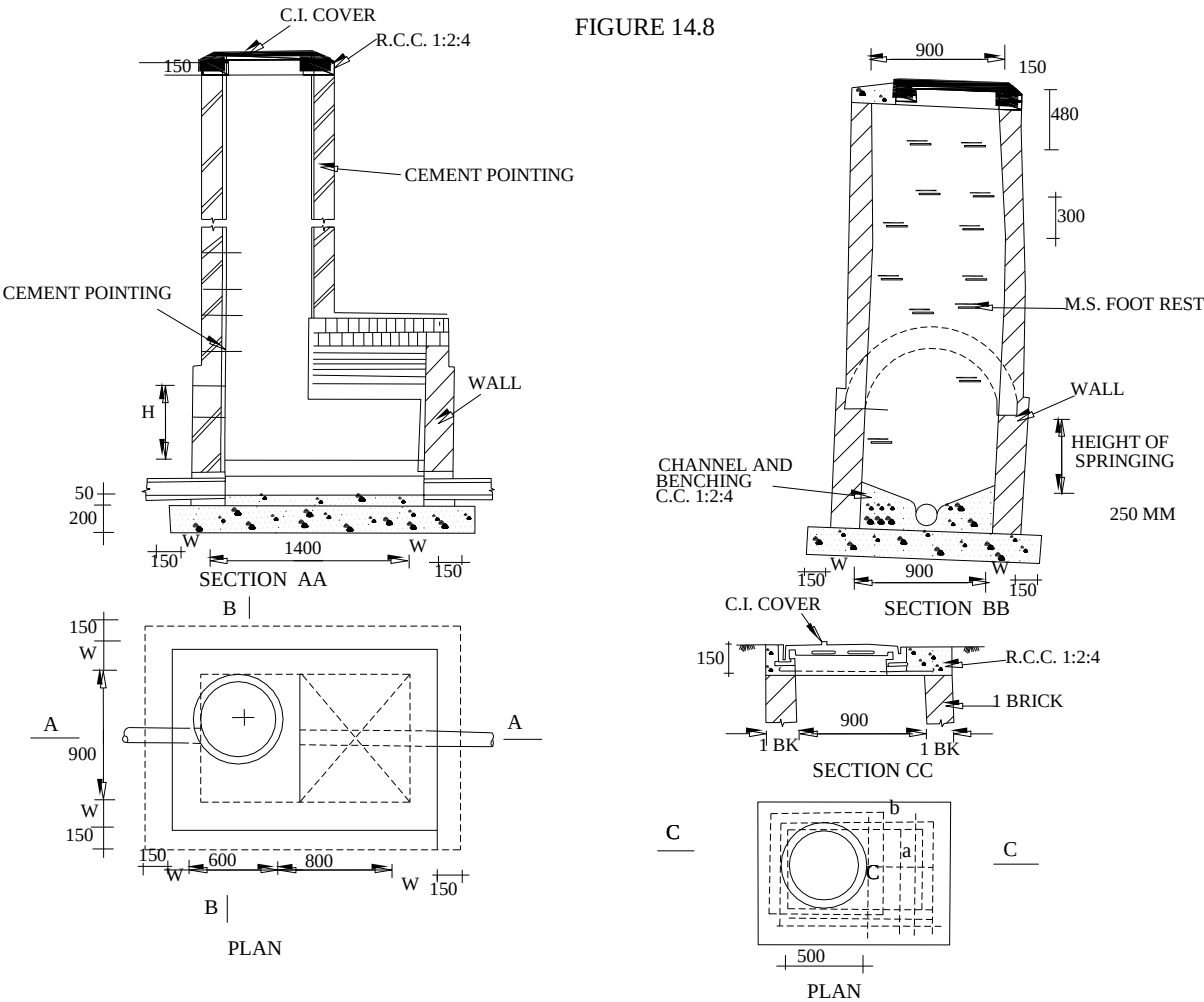


All dimmensions are in mm
Drawings not to Scale

MANHOLE (CONTD)

ARCHED TYPE 1400 x 900

FIGURE 14.8



DEPTH OF MANHOLE FROM TOP OF C.I. COVER	FROM TOP 4250 (W)	FROM 4250 TO 9750 FR- OM TOP (W)	BEYOND 9750 FROM TOP (W)	H	T
2450 to 4250	1 BK.	-	-	900	200
MORE THAN 4250 UP TO 9750	1 BK.	1 1/2 BK.	-	1800	300
MORE THAN 9750	1 BK.	1 1/2 BK.	2 BK.	1800	300

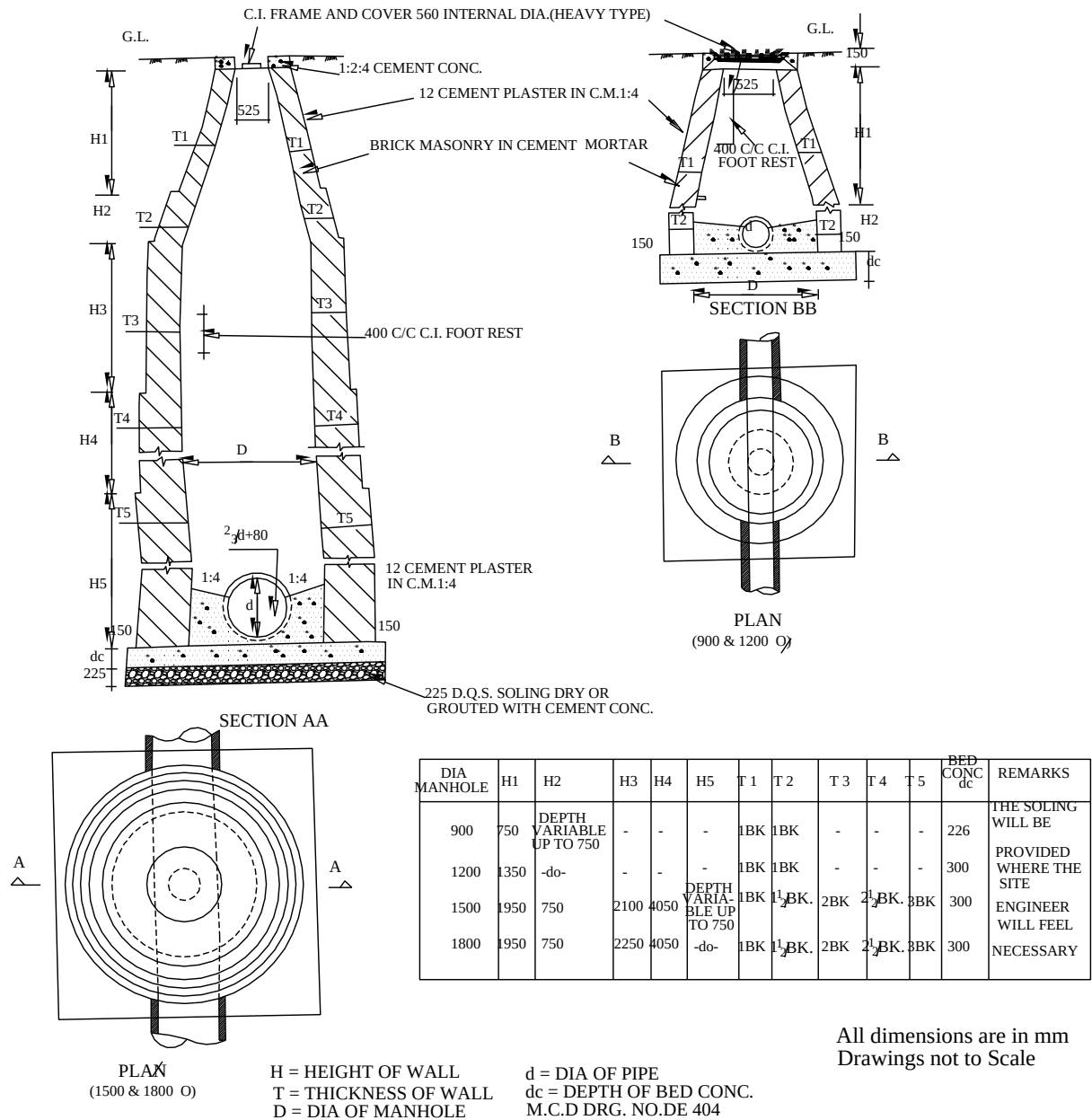
W = WIDTH OF WALL.
H = HEIGHT OF SPRING OF ARCH ABOVE THE BENCHING LEVEL.
T = THICKNESS OF FOUNDATION CONCRETE

BAR BENDING SCHEDULE					
FOR MED- IUM DUTY	MARK	DIA	NO	LENGH	BENDING
	a	12	5	1000	100 800 100
	b	12	3	1300	100 1100 100
	c	12	1	880	100 480 100
FOR HEAVY DUTY	a	12	5	1000	100 800 100
	b	12	2	1300	100 1100 100
	c	12	1	620	100 420 100

All dimensions are in mm
Drawings not to Scale

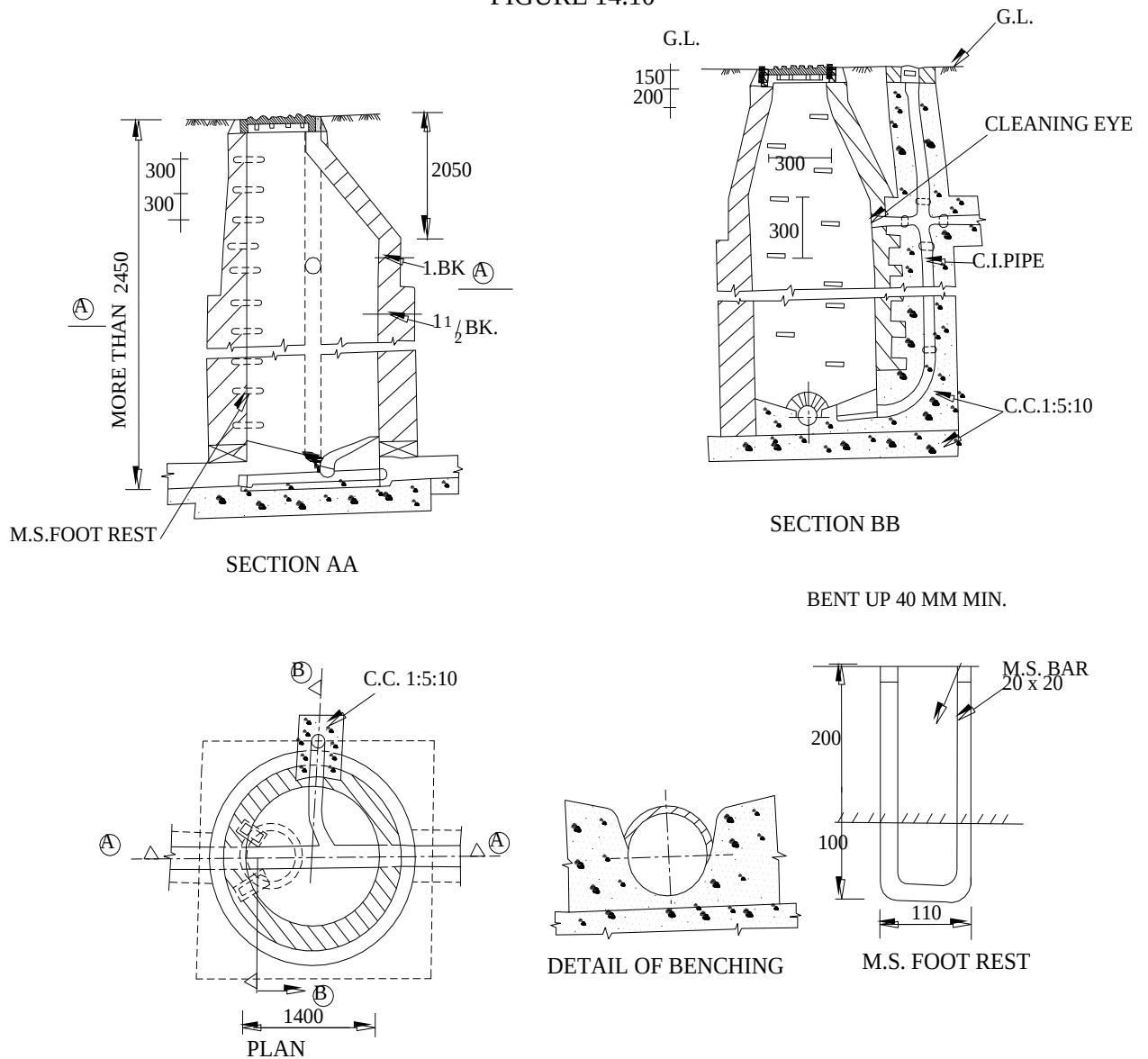
MANHOLE
(CIRCULAR TYPE 900x1800 MM DIA)

FIGURE 14.9



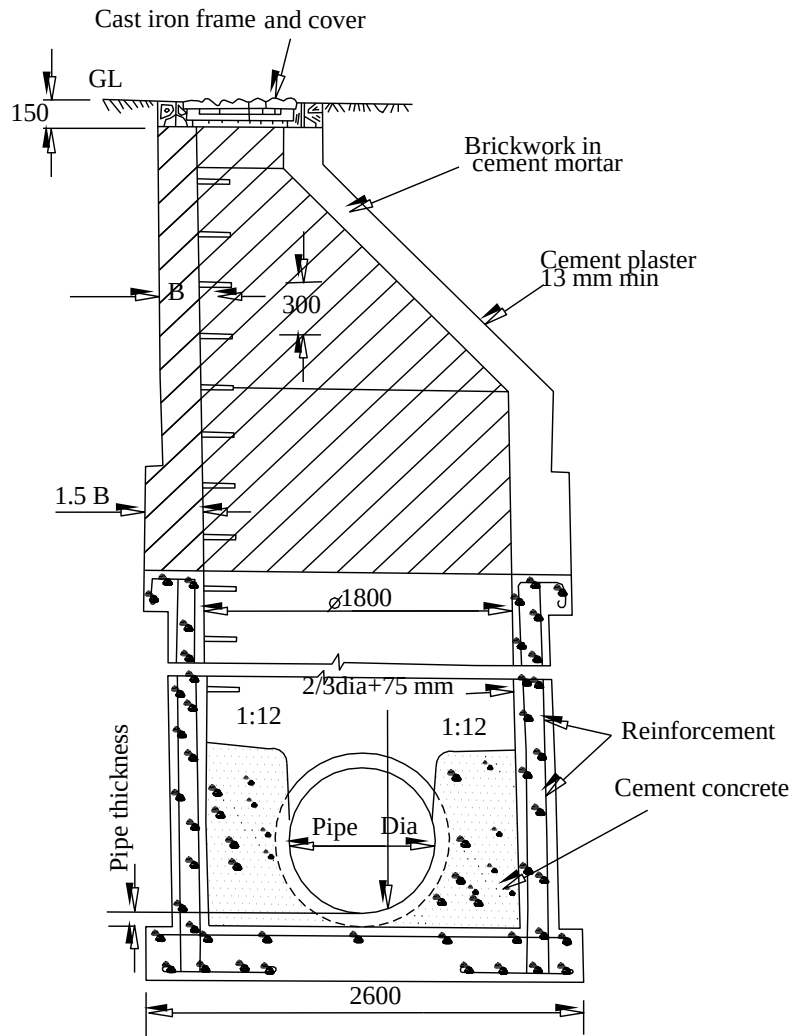
MANHOLE (WITH DROP CONNECTIONS)

FIGURE 14.10



All dimensions are in mm
Drawings not to Scale

FIGURE 14.11
IS 4111-1986 Part 1

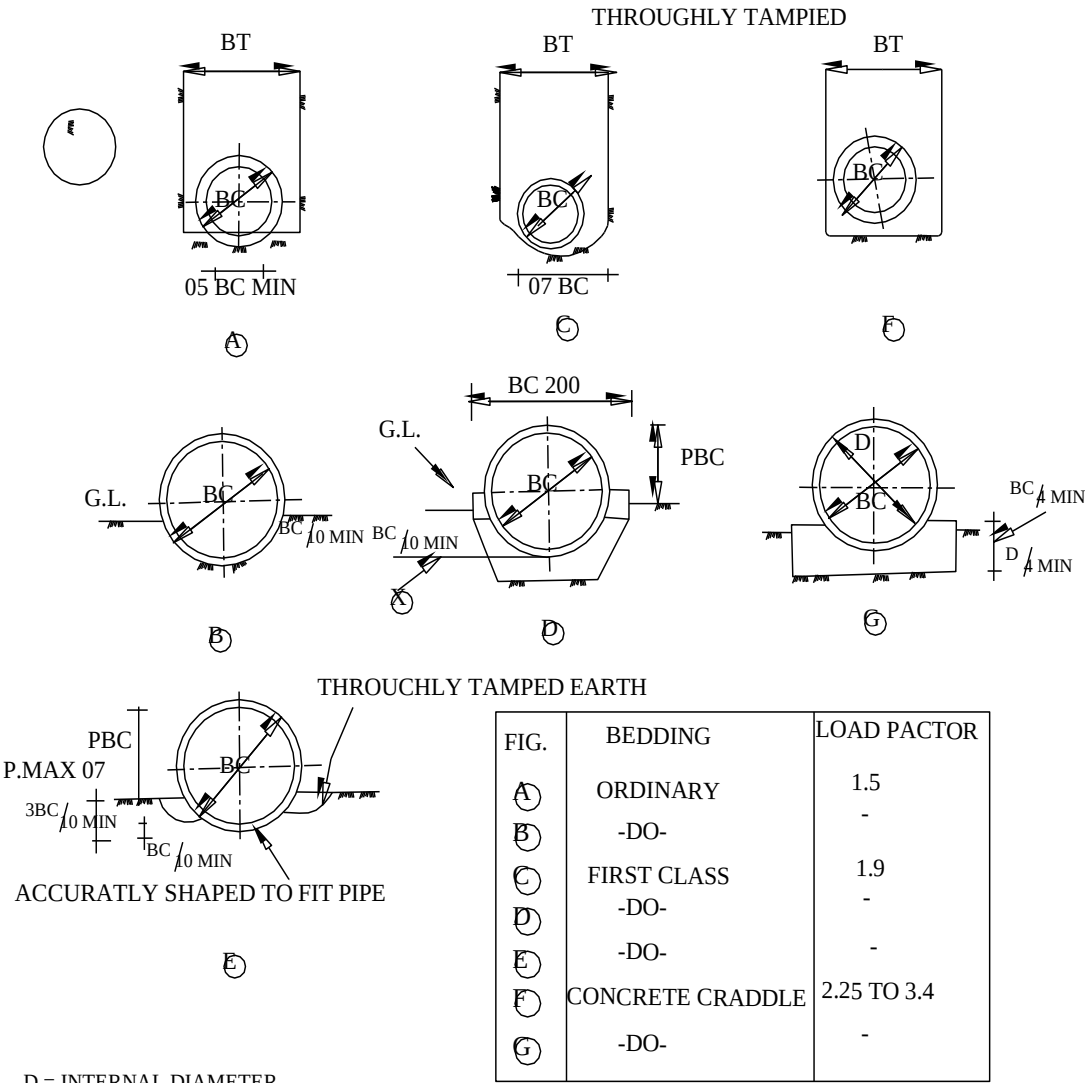


B - Thickness of Wall

All dimensions are in mm

BEDDING OF PIPES

FIGURE 14.12

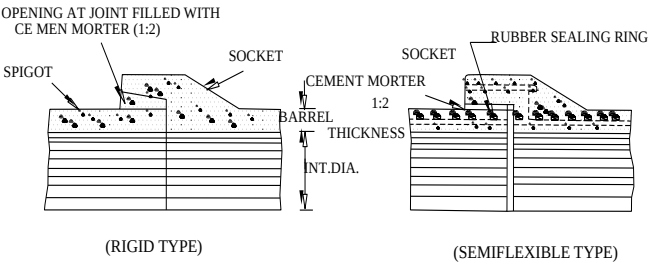


D = INTERNAL DIAMETER
BC = HORIZONTAL BREADTH OUTSIDE OF THE PIPES IN METRES
BE= HORIZONTAL WIDTH OF TRENCH IMMCIATELY BELOW THE
TOP OF THE PIPE IN METRES.
H = HEIGHT OF FILL ABOVE TOP OF PIPE IN METRES
⊗ = MIN 200 FOR 'H' < 5000 WHEN 'H' > 5000 10 FOR EVERY 250 OF 'H'

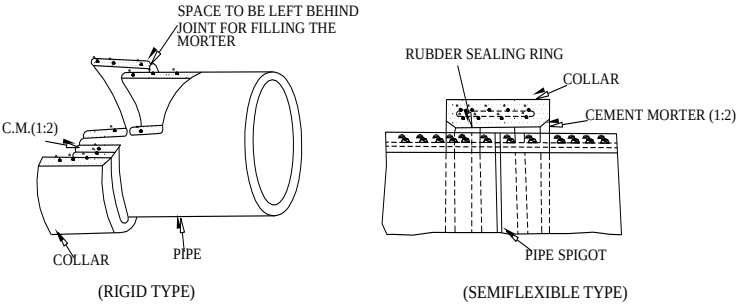
All dimensions are in mm
Drawings not to Scale

JOINTS OF CONCRETE PIPES

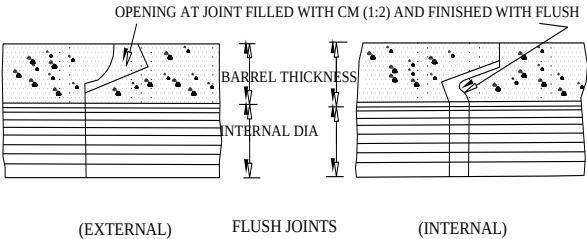
FIGURE 14.13



SPIGOT & SOCKET JOINTS



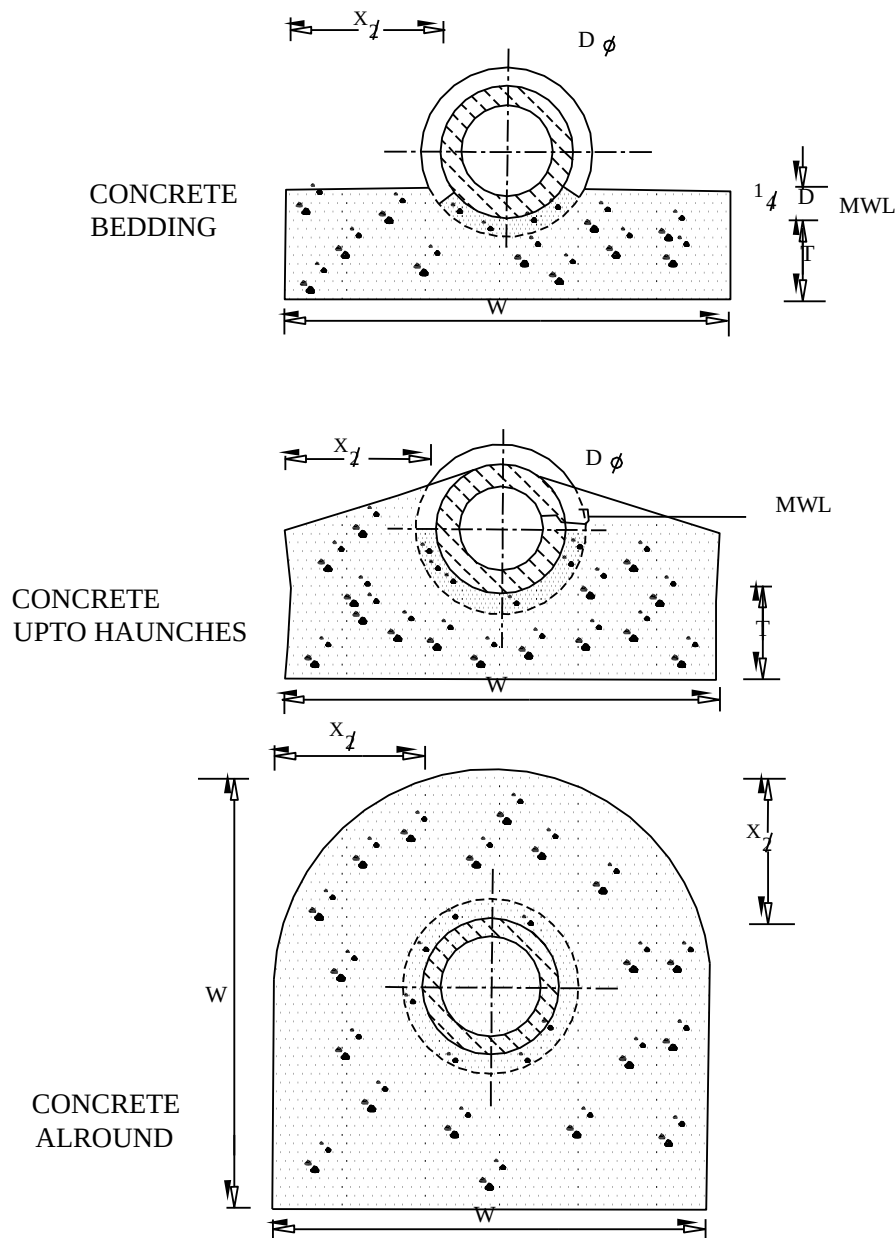
COLLAR JOINTS



Drawings not to Scale

BEDDING/ENCASING STONE WARE PIPES

FIGURE 14.14



$W = D + X$, WHERE D IS THE EXTERNAL DIAMETER OF THE PIPE

$X = \{300 \text{ UPTO TRENCH DEPTH OF } 1200$

$\{400 \text{ TRENCH DEPTH MORE THAN } 1200$

$T = 100 \text{ FOR PIPES UNDER } 150, \frac{1}{4} \text{TH INTERNAL}$

$\text{DIA. SUBJECT TO A MIN. OF } 1500 \text{ AND MAX. } 300$

$\text{FOR PIPES MORE THAN } 1500 \text{ DIA.}$

MWL = MAXIMUM WATER LEVEL.

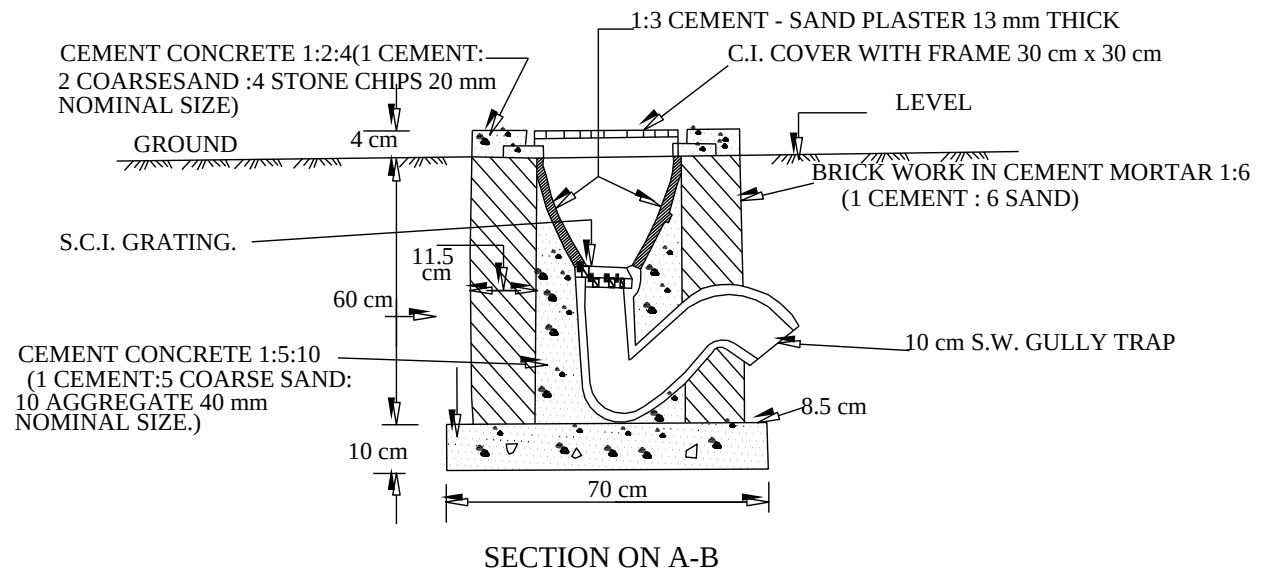
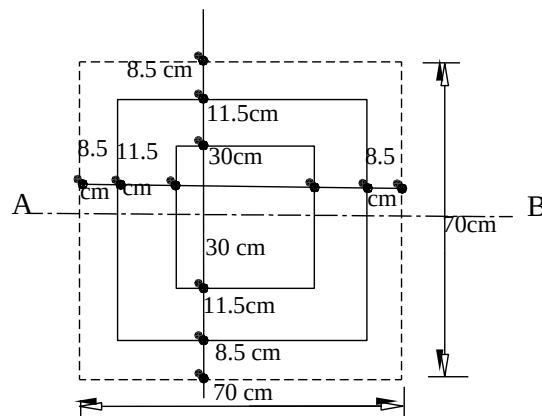
All dimensions are in mm
Drawings not to Scale

FIXING SW GULLY TRAP

10 cm S.W. GULLY TRAP WITH BRICK MASONRY CHAMBER

FIGURE 14.15A

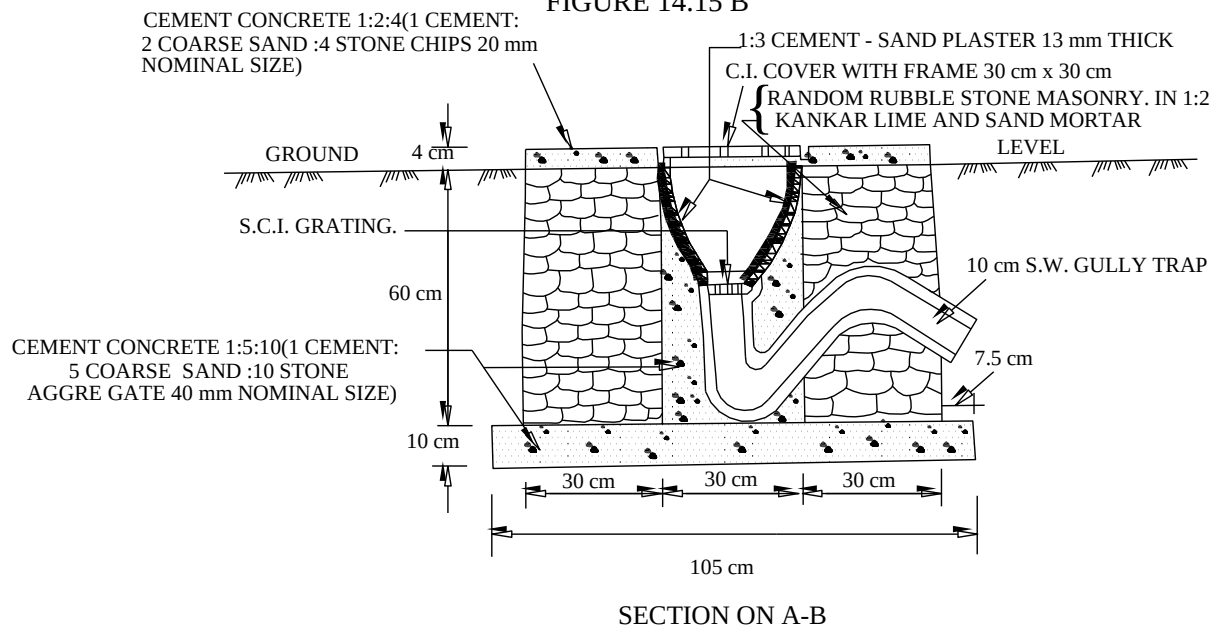
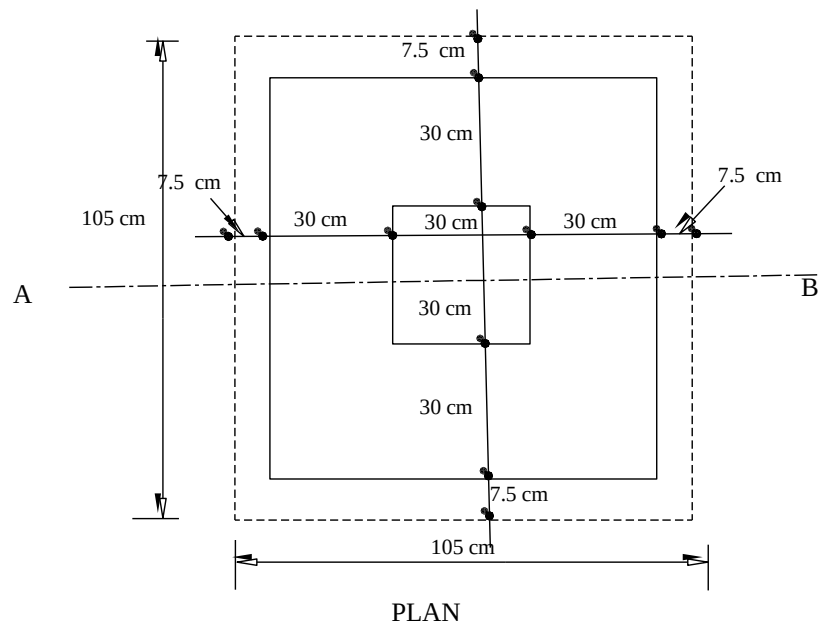
NOT TO SCALE



PLAN

10 cm S.W. GULLY TRAP WITH RANDOM RUBBLE STONE MASONRY CHAMBER

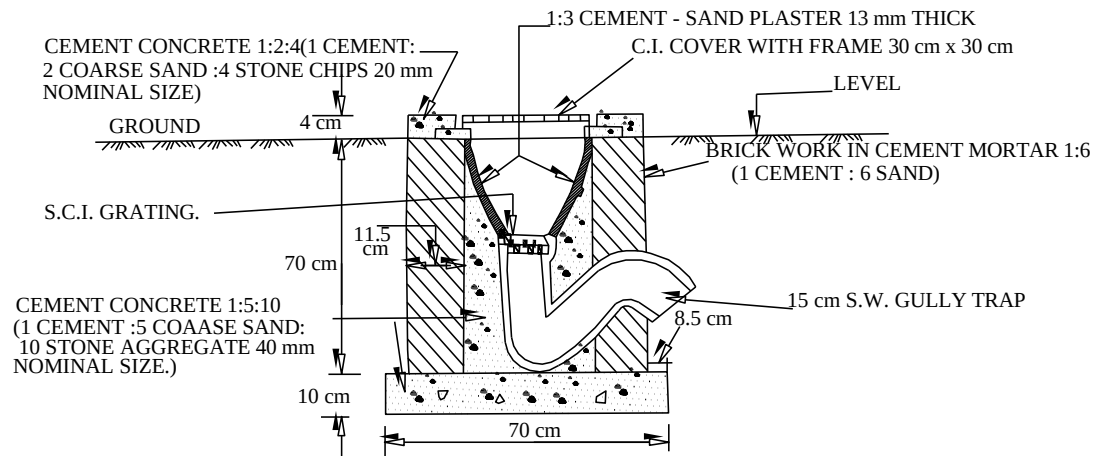
FIGURE 14.15 B



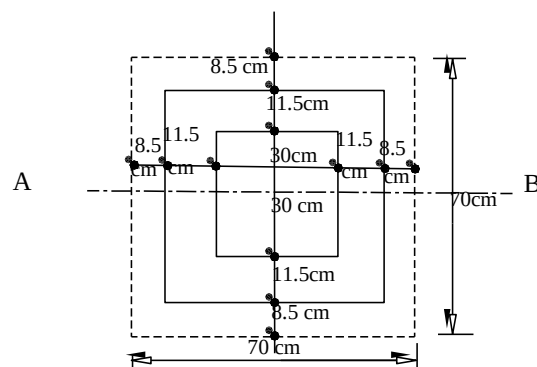
15 cm S.W. GULLY TRAP WITH BRICK MASONRY CHAMBER

FIGURE 14.15 C

NOT TO SCALE



SECTION ON A-B

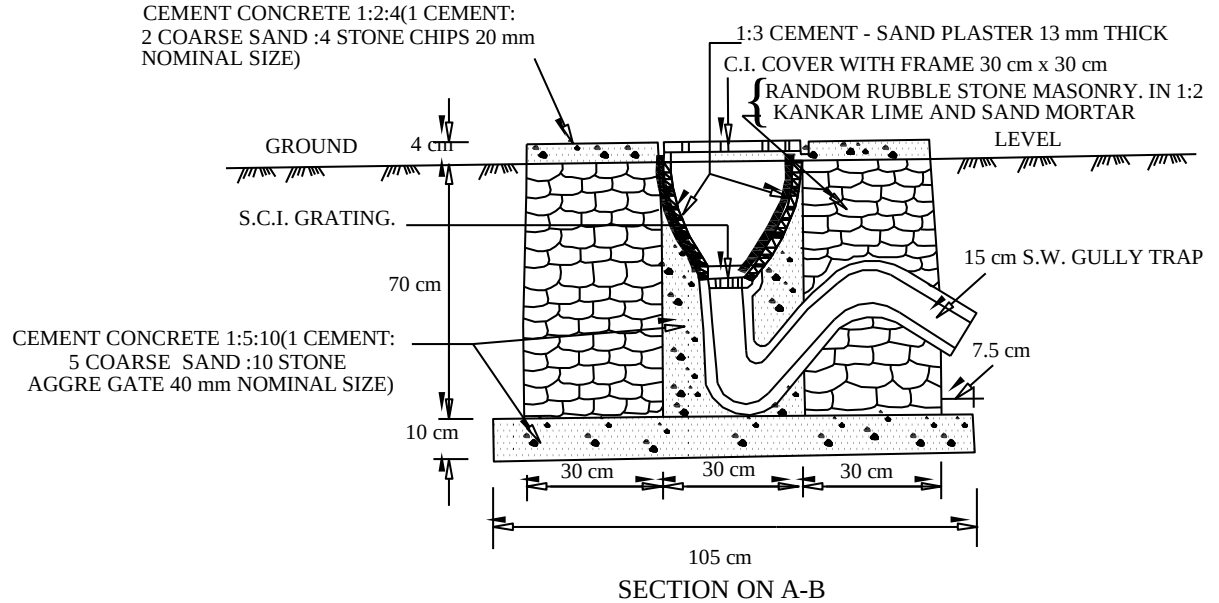
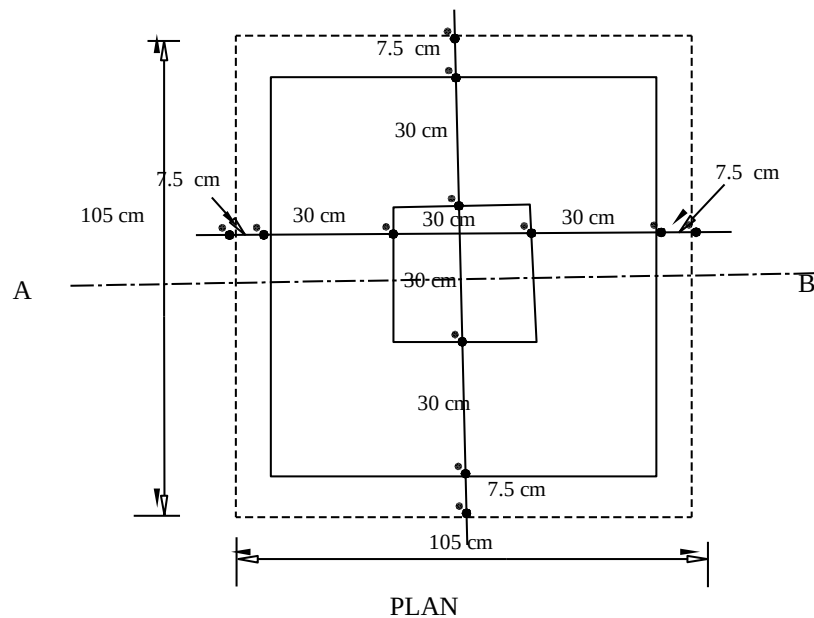


PLAN

15 cm S.W. GULLY TRAP WITH RANDOM RUBBLE STONE MASONRY CHAMBER

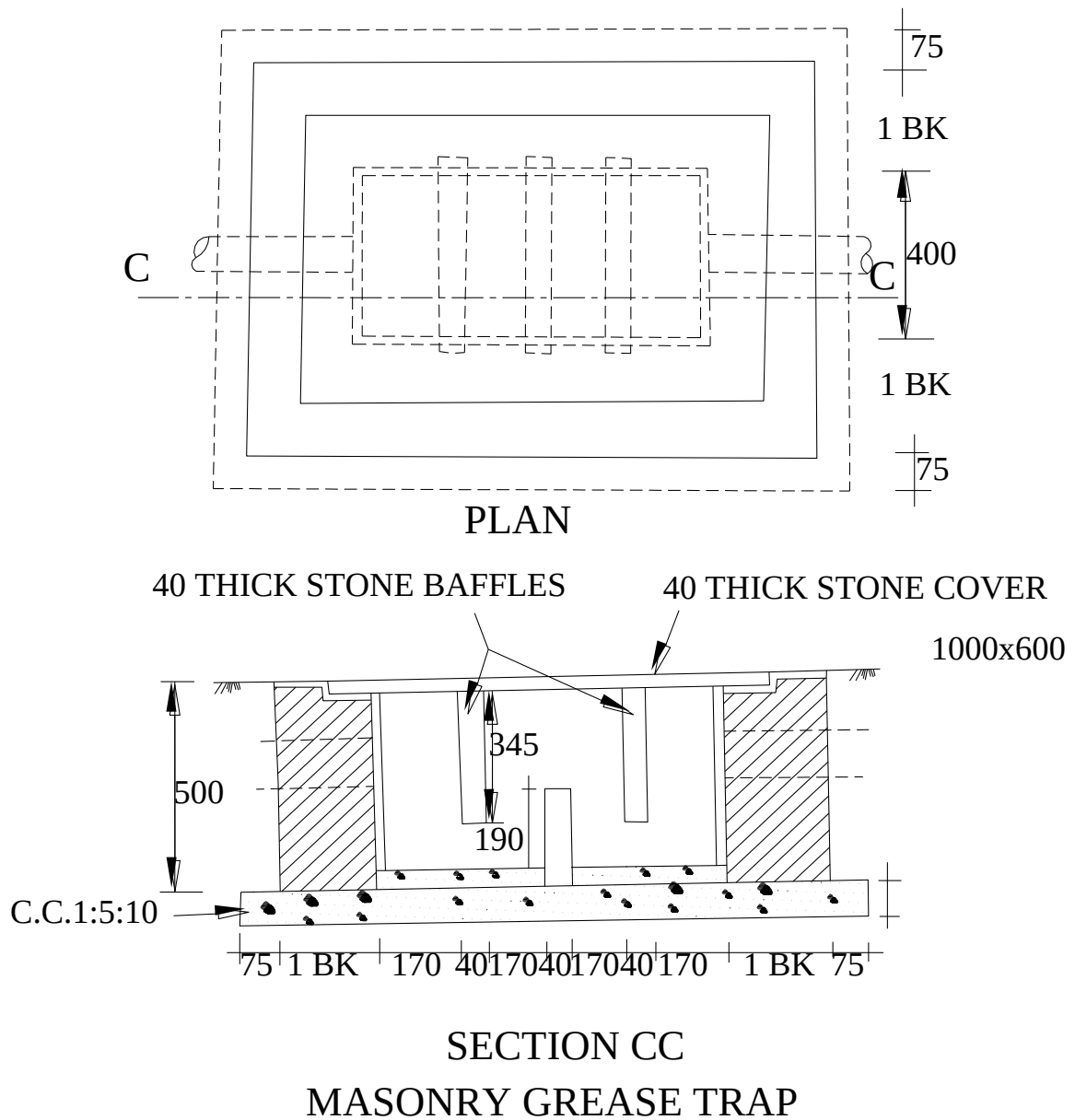
FIGURE 14.15 D

NOT TO SCALE



GULLY GREASE TRAP

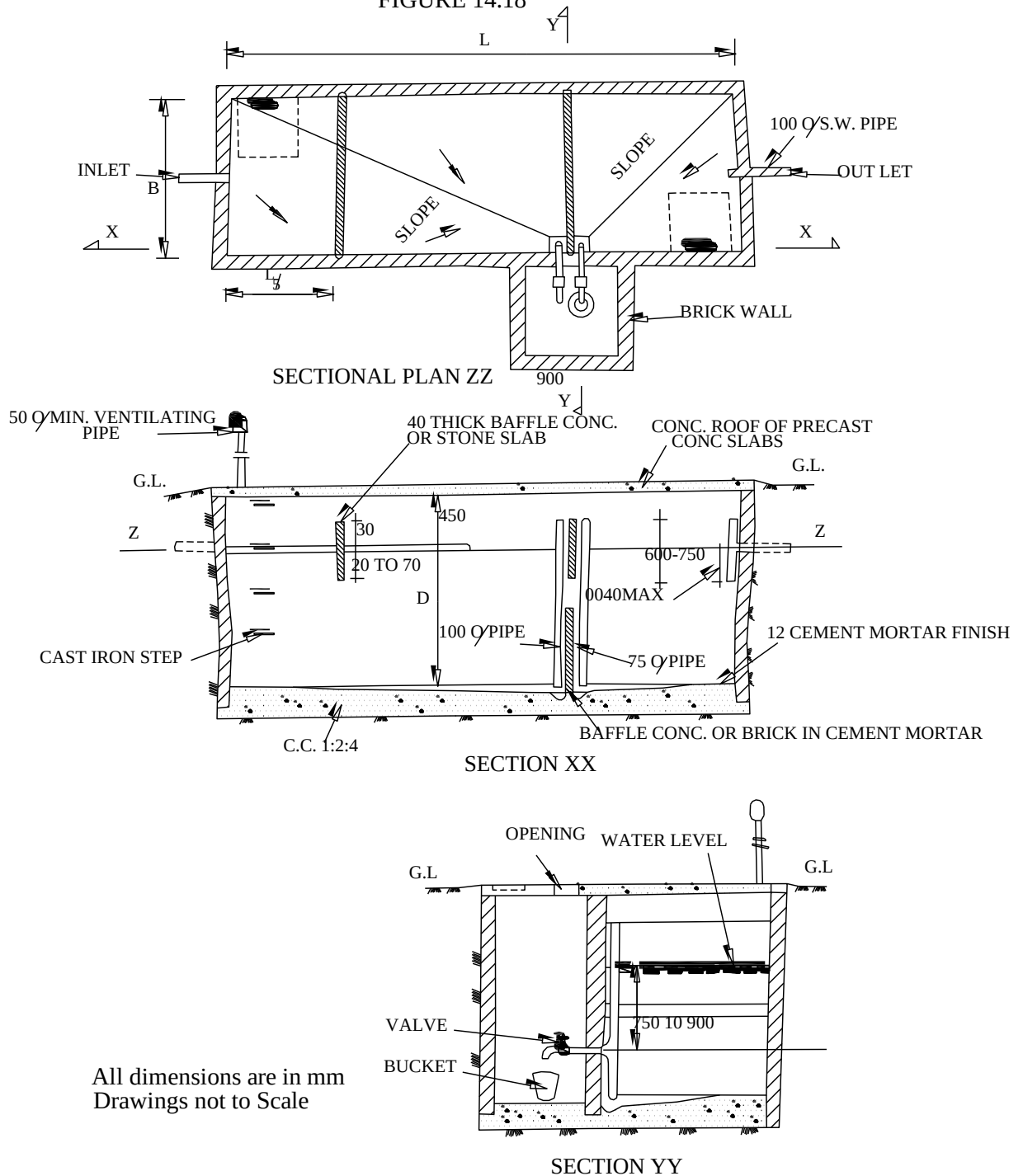
FIGURE 14.17



All dimensions are in mm
 Drawings not to Scale

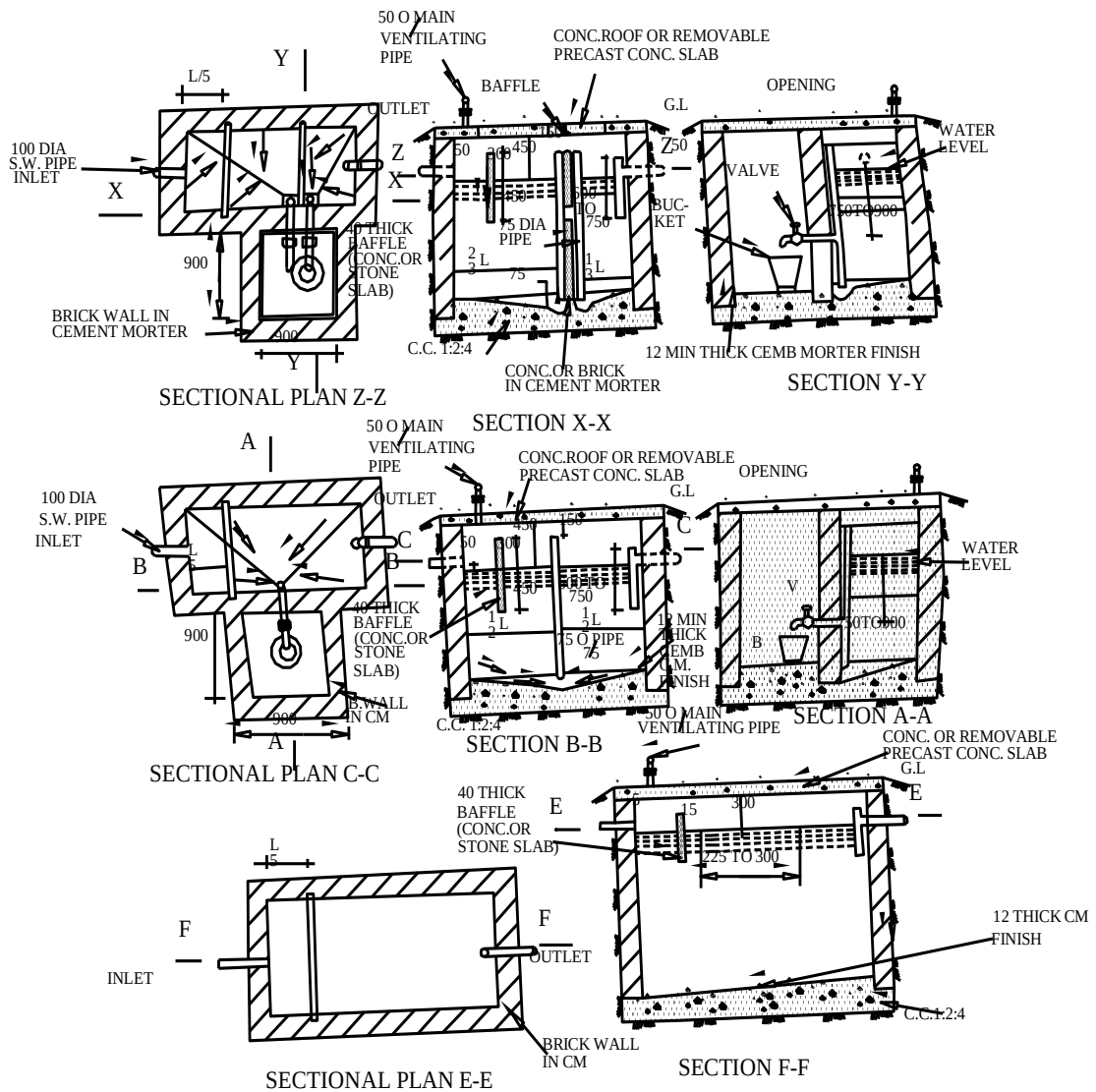
SEPTIC TANK

FIGURE 14.18



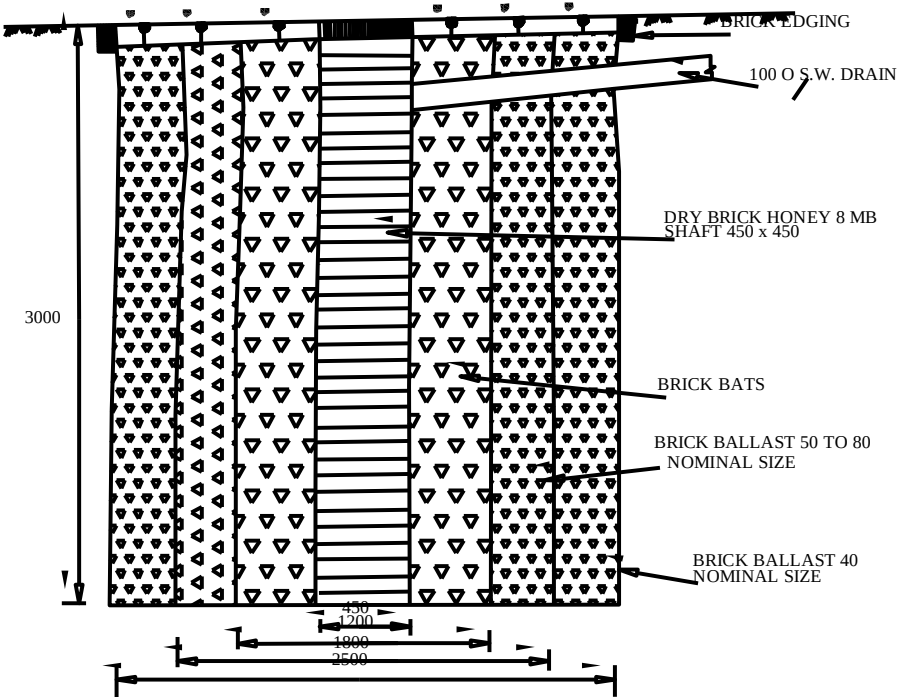
SEPTIC TANK (CONTD.)

FIGURE 14.18

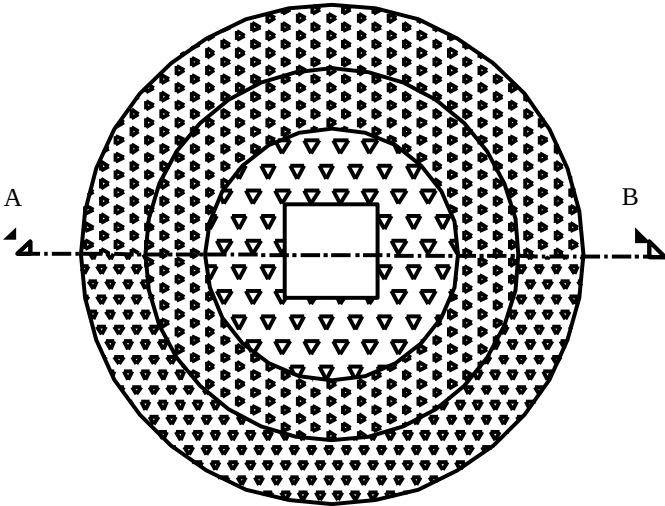


All dimensions are in mm
Drawings not to Scale

SOAK PIT
(2.5M DIA x 3.0 M DEEP)
FIGURE 14.19



SECTION A B



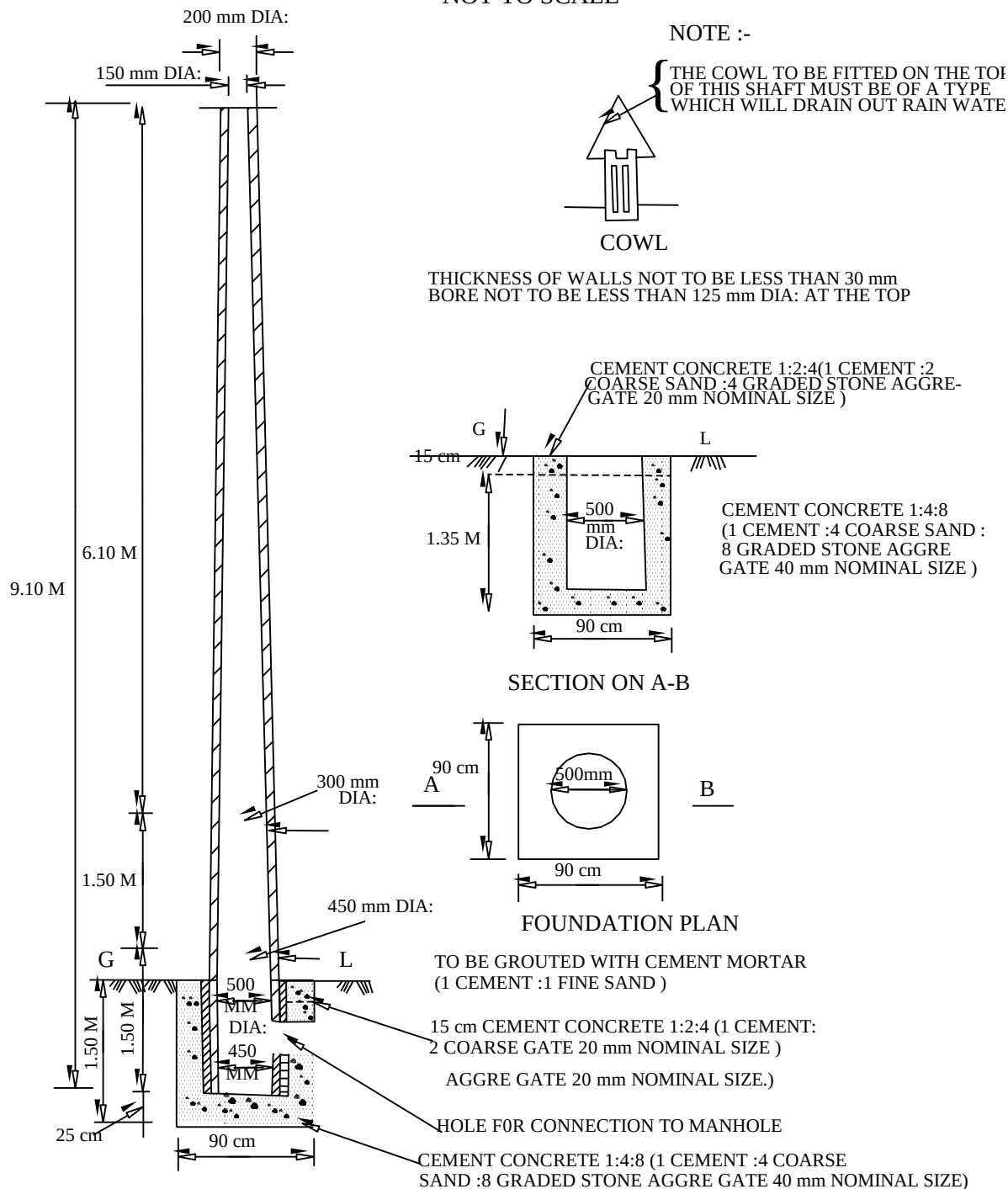
PLAN

All dimensions are in mm
Drawings not to Scale

RCC VENT SHAFT

FIGURE 14.21

NOT TO SCALE



Chapter 15

Sanitary Installations

15. Terminology :

Antisiphon Pipe (Fig.15.1): A ventilating pipe connected to or close to the outlet side of a trap seal.

Automatic Flushing Cistern (Fig.15.3): A flushing cistern arranged to discharge its content by siphonage at regular intervals, determined by the rate at which water is fed into the cistern.

Ball Cock (Fig.15.3): A faucet opened or closed by the fall or rise of a ball floating in the surface of water.

Ball Valve (Fig.15.3): A simple non return valve consisting of a ball resting on a cylindrical seat within a fluid passageway.

Bell mouth (Fig.15.3): An expanded rounded entrance to a pipe or orifice.

Bend :Length of pipe bent or cast into an angle shape.

Bib Tap :A tap with a horizontal inlet and nozzle bent to discharge in a downward direction.

Blister :A raised portion of the surface protruding not more than one millimetre above the surface and not greater than 3 mm in its greatest dimension.

Box Union: A device for joining two threaded pipes.

Branch (Fig. 15.1):

(a) A special form of vitrified sewer and cast iron pipe used for making connections to a sewer or water main. The various types are called T, Y, T-Y, double Y, and V branches, according to their respective shapes.

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

Caulking:

(a) The process of driving, pouring or forcing lead, oakum, plastic or other material into a joint to make it leakproof.

(b) The material used in the caulking process.

Caulked Joint: A spigot and socket joint in which the jointing material is compacted by means of caulking tool and hammer.

Chase: A continuous recess in wall, floor or ceiling for the purpose of holding pipes and conduits.

Cistern (Fig.15.3): A fixed container for water in which the water is at atmospheric

pressure. The water is usually supplied through a ball valve.

Collar :A pipe fitting in the form of sleeve for jointing the spigot ends of two pipes in the same alignment.

Cowl (Fig.15.1): A hood on the top of a vent pipe or soil stack.

Craze or Crazing :Fine cracks in the glaze

Cross: A pipe fitting used for connecting four pipes at right angles.

Fittings: Coupling, flange, branch, bend, tee, elbow, union, waste with plug, P or S trap with vent, ferrule, stop tap, bib tap, pillar tap, , ball valve, cistern, storage tank, baths, water closets, boiler geyser, pumping set with motor and accessories, metre, hydrant valve and any other article used in connection with water supply, drainage and sanitation.

Float Valve (Fig 15.3): A valve in which the closure to an opening such as plug or gate, is actuated by a float to control the flow into a tank.

Flush Bend: A bend located at the bottom of low level flushing cistern for the purpose of flushing pedestal type water closet and similar fixture.

Flushing cistern (Fig.15.3): A cistern provided with a device for rapidly discharging the contained water and used in connection with a sanitary appliance for the purpose of cleaning the appliance and carrying away its contents into a drain.

Gasket :A piece of compressible material used to make a joint between two flat surfaces.

Oakum: Hemp or old hemp rope soaked in oil to make it water proof.

One Pipe System (Fig. 15.1): In this a single soil waste pipe conveys both soil and waste directly to the building drain.

Pinhole: A hole in the body, less than 1.5 mm, in its maximum dimension.

Reducer: A pipe fitting with inside threads larger at end than at the other. All such fittings having more than one size are reducers because of the custom of stating the larger size first.

Single stack system (Fig. 15.1): This is the name given to a simplified one pipe system wherein all ventilation pipes are omitted. The

stack itself is made to cater (or provide) for all the vent requirements by restricting the flow into the stack to certain predetermined limits.

Sink (Fig.15.7): A shallow fixture, ordinarily with a flat bottom, that is usually used in kitchen or in connection with the preparation of food, laboratory purposes and for certain industrial processes.

Socket: The female part of spigot. and socket joint.

Soil Pipe: A pipe which conveys to drain the discharge from a water closet or urinals. In 'One pipe' and 'single stack' system, the soil pipe also conveys to a drain the discharges from bath, wash basins, sinks, and similar appliances.

Speck: Area of the finished surface with contrasting colour less than one millimetre maximum dimension.

Spigot: The male part of a spigot and socket joint.

Spigot and Socket Joint: Joint in which the end of the one pipe enters the enlarged end of the next pipe.

Stack: A main vertical discharge or ventilating pipe.

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

Two pipe system (Fig. 15.1). In this, the soil pipe conveys discharges from water closets, urinals, and similar soil appliances directly to the drainage system and the waste pipe conveys waste from ablutionary and culinary appliances to the drainage system directly or through a trapped gully where desired.

Union: A pipe fitting used for joining the ends of two pipes neither of which can be turned.

Valve: A device used for controlling the flow of liquid in a line of pipe.

Ventilating pipe (Vent pipe) The pipe which provides a safe outlet into the atmosphere for the foul gases in the drain or sewer.

Warpage Distortion of original shape during manufacturing process.

Water Seal The depth of water which should be removed from a fully charged trap before air can pass through the trap.

Waste Pipe : A pipe used to convey liquid waste not containing human excreta.

Waste Stack: A vertical pipe used to convey

liquid waste not containing human excreta.

15.1 APPLIANCES AND FITTINGS:

15.1.0. General:

(a) **Materials:** All sanitary appliances and their components shall be durable, impervious corrosion resisting, and have a smooth surface which can be easily cleaned. All materials shall conform to the relevant Indian Standards where they exist; otherwise they shall be of the best quality and workmanship. All sanitary appliances and fittings shall be got approved from the Engineer before use.

(b) **Conformity with byelaws and rules:** All sanitary installations shall comply with the bye-laws and rules regulations laid down by the Local Bodies or State Government from time to time. All sanitary installation work shall be carried out by experienced and licensed plumbers.

(c) **Fixing :** All appliances and sanitary accommodation shall be arranged to facilitate access for cleaning and repairing.

Soil, waste and ventilating branch connections with supporting brackets, shall be fitted before the erection of appliances is begun.

Care should be taken at all times, particularly after fixing, to protect appliances from damage. All orifices shall be temporarily plugged during the progress of work to prevent obstruction.

All damage done to floors, walls etc. during the course of sanitary installation work shall be restored to its original condition free of cost. Appliances shall be finally cleaned of all marks of cement, lime, oil, paint, etc. for which nothing extra shall be paid.

(d) **Traps :** Traps for sanitary fittings shall be of an approved type, made of H.C.I., stoneware or brass or of the same material as the appliance itself. Traps to soil fittings shall have a minimum water seal of 5 cm and traps to waste fittings (other than those leading into soil pipes) shall have a minimum water seal of 4 cm.

(e) **Joints :** (i) Between stoneware traps of sanitary fittings and cast iron soil pipes, jointing may be done as for stoneware pipes provided special C.I. sockets or brass thimbles are used to suit the girth of the trap outlet.

ii) Unless otherwise specified, the methods summarized below shall be followed for jointing of pipes of different materials, used in sanitary installations –

Materials of pipes	Method of jointing
Lead to Lead	Wiped solder joint
Iron to iron	Two rings of hemp yarn, caulked with cement mortar
Lead to Stoneware	Thimble or socket of brass with wiped solder joint to lead pipe and caulked cement mortar joint to stoneware pipe
Lead to cast iron	Brass thimble or socket as above, but final joint in socket of iron pipe with yarn and molten lead, properly caulked
Iron to stoneware	Hemp yarn and caulked cement mortar
Stoneware to iron	As described in sub-para (i) above
Lead to galvanized iron	Brass plumber's union, with wiped solder joint on lead pipe and connected to a nipple on the iron pipe, secured to the latter by a nut and lock nut

iii) Each connection between a G.I. water pipe and a sanitary fitting shall generally be with a lead pipe, properly jointed with plumber's brass unions to the fitting and to the G.I. Pipe. Where specially permitted, the connection may be given directly with the use of suitable GI pipes and specials, fitted up accurately. Alternately the connection may be made with the help of polyethylene pipe of suitable length fitted with coupling nuts at both ends. The coupling nuts are to be screwed to the metal fittings of the sanitary fittings and the GI pipes at the other end. Care shall be taken to see that there is no twisting of the polyethylene pipe which may block the flow of water.

(f) **Pipes:** Galvanized or black M.S. pipes shall not be used for soil, waste, vent or antisiphonage pipes. Stoneware pipes for soil and waste shall be used only below ground. A.C. building pipes for soil, waste, vent or antisiphonage shall not be laid below ground level.

(i)(g) General reference

(ii)(i) For pipe system and parts refer **Figure 15.1**.

(iii)(ii) For details IS:5329-1943 (Code of Practice for Sanitary Pipe work above ground for buildings) may be referred to.

(iii) For guidance in Design IS:1172-1993 (Code of Basic requirement for water supply, drainage and sanitation) may be referred to.

(iv)(iv) For guidance on selection, installation and manufacture of sanitary appliances Code of Practice IS:2064-1993 may be referred to.

(v)(v) Brief details of items covered by IS:5329-1983, IS:1172-1993 and IS:2064-1993 have been given in **Annexure 15.1**.

15.1.1 Isolation: In all sanitary installation works, unless otherwise ordered, one screw-down gun metal isolation stop cock shall be fitted on each water supply pipe leading to a

sanitary fitting, in addition to any tap forming part of the fitting, to enable the water supply being cut off when the fitting is to be repaired.

15.1.2 Vitreous sanitary appliances : All vitreous sanitary appliances (Vitreous China) shall conform to IS : 2556 (Part-I) general requirements.

The chromium plating shall conform to IS : 4827 and shall be of grade 2 (thickness 10 micron). The chromium plating shall never be deposited on brass unless a heavy coating of nickle is interposed. In case these are required to be nickle plated, the plating shall be of first quality with a good thick deposit of silvery whiteness capable of taking high polish which will not easily tarnish or scale. In finish and appearance the plated articles when inspected shall be free from plating defects such as blisters, pits, roughness and unplated areas and shall not be stained or discoloured. Before fitting is plated the washer plate shall be removed from the fitting. The gland packing shall be protected from the plating solution.

15.1.3. Flushing cisterns (Fig.15.3)

The flushing cisterns shall be automatic or manually operated, high level or low level as specified, for water closets and urinals. A high level cistern is intended to operate with minimum height of 125 cm and a low level cistern with a maximum height of 30 cm between the top of the pan and the under side of the cistern.

Cisterns shall be of cast iron, Vitreous China, (IS : 774 for Flushing type and IS : 2326 for Automatic Flushing Cistern) and Plastic (IS:7231).

The thickness of the body including cover shall be not less than 5 mm & 6 mm for cast iron and vitreous China cisterns respectively. The body of the pressed steel cistern shall be of seamless or welded construction. The

outlet of each syphon or stand pipe shall be securely connected to the cistern by means of lock nut. The cistern shall be free from manufacturing faults and other defects affecting their utility. All working parts shall be designed to operate smoothly and efficiently. Cistern shall be mosquito proof. A cistern shall be considered mosquito proof only if there is no clearance anywhere which would permit a 1.6 mm wire to pass through in the permanent position of the cistern i.e. in the flushing position or filling position.

The breadth of a low level cistern, from front to back shall be such that the cover or seat, or both, of water closet pan shall come to rest in a stable position when raised.

The cistern shall be supported on two cast iron brackets of size as approved by the Engineer and embedded in cement concrete 1:2:4 block 100x75x150 mm. The cast iron brackets shall conform to IS : 775. These shall be properly protected by suitable impervious paint. Alternatively the cisterns shall have two holes in the back side above the overflow level for screwing into the wall, supplemented by two cast iron wall supports. A 5 litres cistern, however, may be supported by larger brackets cast on the body of the cistern.

The cistern shall have a removable cover which shall fit closely on it and be secured against displacement. In designs where the operating mechanism is attached to the cover this may be made in two sections, but the section supporting the mechanism shall be securely bolted or screwed to the body. The outlet fitting of each cistern shall be securely connected to the cistern. The nominal internal diameter of cistern outlet shall be not less than 32 mm and 38 mm for high level and low level cisterns respectively. The length of the outlet of the cistern shall be 37 ± 2 mm.

Ball valve shall be of screwed type 15 mm in diameter and shall conform to IS 1703. The float shall be made of polyethylene as specified in IS 9762. (The design shall permit the cistern to fill in rapidly and close effectively when the level of water reaches the working water level.)

In the case of high level manually operated cistern, the level arm of the cistern shall have a suitable hole near the end through which a split ring or a (S) hook shall pass. A chain

shall be attached to the ring or the hook. The chain shall be of G.I. and strong enough to sustain a suddenly applied pull of 10 Kg or a dead load of 50 Kg without any apparent or permanent deformation of the shape of the ring. The chain shall terminate in suitable handle or 'Pull' which shall be of pottery, galvanised iron, non ferrous metal or a moulding in any heat resisting and non absorbent plastic. The finish shall be smooth and free from burrs. In case of low level flushing cisterns, the handle shall be of a chromium plated brass. The cast iron cisterns shall be painted with two coats of black bitumastic paint on the inside and two or more coats of paint of approved quality and shade on the outside.

In the case of manually operated cisterns the siphonic action of the flushing cistern shall be capable of being rapidly brought into action by the operating lever, but shall not self siphon or leak. When tested according to IS 774 the discharge rate shall be 10 ± 0.5 litre in 6 seconds and 5 ± 0.5 litre in 3 seconds for cisterns of capacities 10 litre and 5 litre respectively. The cisterns shall be so designed that there is not appreciable variation in the force of flush during the discharge of the required quantity of water. The cistern shall have a discharge capacity of 5 & 10 litres as specified. When required to give a full flush, they shall respectively discharge 5 litres and 10 litres with variation of ± 0.5 litres.

The flush pipe shall be of (a) medium quality galvanised iron having internal diameter of 32 ± 1 mm for high level cistern and 38 ± 1 mm for low level cistern. The flush pipe shall be of suitable length with bends etc. as required for fixing it with front or back inlet W.C. Pan. (b) Polyethylene pipes low density conforming to IS:3076 or high density conforming to IS:4984 (c) Unplasticized PVC pipes conforming to IS:4985. For high density polyethylene and unplasticized PVC pipes, the outside diameter of the pipes shall be 40 mm. When PVC plumbing pipes are used the outside diameter of the pipe shall be 40 mm for high level cisterns and 50 mm for low level cisterns.

In case of high level cistern the flush pipe shall be a vertical pipe 125 cm long and having a nominal internal dia 32 ± 1 mm (except plastic flush pipes) and in case of low level cistern 30 cm long and 38 ± 1 mm diameter (except plastic flush pipes).

Over flow pipe

(i) GI overflow pipe shall be of not less than 20 mm nominal bore and shall incorporate a non corrodible mosquito proof brass cover having 1.25 mm dia perforation, screwed in a manner which will permit it to be readily Cleaned or renewed when necessary. No provision shall be made whereby the overflow from the cistern shall discharge directly into the water closet or soil pipe without being detected.

(ii) The invert of the overflow pipe in the case of high level and low level cisterns shall be 19 mm minimum above the working water level. In case of overflow due to any reason water should drain out through the over flow pipe and not through the syphon pipe.

(iii) The plastic overflow pipes shall be manufactured from high density polyethylene conforming to IS : 4984 or unplasticized P.V.C. conforming to IS:4985.

Inlet and overflow holes The cistern shall be provided with inlet and overflow holes, situated one at each end which shall be capable of accommodating an overflow pipe of not less than 20 mm nominal bore and a 15 mm size ball valve. The holes shall be cleanly cast or drilled and the adjacent surfaces shall be smooth.

15.1.4. Draining board :

Draining board manufactured from stainless steel conforming to IS:13983 shall be provided.

Alternately Draining board made of Kota or similar Stone or Marble / granite Stone conforming to Specifications and as per directions of The Engineer, duly rubbed and polished without groove shall be provided. The draining board shall be provided with 15 mm thick back and side skirting. The size of the board measured from outside of skirting shall be 75x45x2.5 cm, 60x45x2.5 cm or as specified. The skirting measured from inside shall be 65 mm to 75 mm high with edges rounded off. The entire surface including bottom of the-board shall be finished smooth.

15.1.5. Foot rests (Fig. 15.4) :

Foot rests shall be of Vitreous China conforming to IS:2556 (Part-X). Foot rests which are rectangular shall meet the minimum requirements and dimensions shown in **Fig. 15.4** and may be of different designs where so specified. Foot rests of different shapes and sizes shall also be allowed subject to approval of the Engineer.

15.1.6. Glass Shelf :

Glass shelf shall consist of an assembly of glass shelf, with anodised aluminium angle frame to support the glass shelf. The shelf shall be of glass of best quality with edges rounded off, and shall be free from flaws specks or bubbles. The size of the shelf shall be 60x12 cm unless otherwise specified and thickness not less than 5.5 mm. The shelf shall have C.P. brass brackets which shall be fixed with C.P. brass screws to rawl plugs firmly embedded in the walls.

PVC shelf as per manufacturer's specifications and size as specified shall be provided.

15.1.7. Mirror :

The mirror shall be of superior sheet glass with edges rounded off or bevelled, as specified. It shall be free from flaws, specks or bubbles. The size of the mirror shall be 60x45 cm unless specified otherwise and its thickness shall not be less than 5.5 mm. It shall be uniformly silver plated at the back and shall be free from silvering defects. Silvering shall have a protective uniform covering of red lead paint. Where bevelled edge mirrors of 5;5mm thickness are not available, fancy looking mirrors with PVC beading/border or aluminium beading or stainless steel beading/ border based on manufacture's specifications be provided nothing extra shall be paid on this account. Backing of mirrors, shall be provided with environmentally friendly material other than asbestos cement sheet.

15.1.8. M.S. Stays and Clamps (Fig. 15.5) :

The clamps shall be made from 1.5 mm thick M.S. flat of 32 mm width, bent to the required shape and size to fit tightly on the socket, when tightened with nuts & bolts. It shall be formed of two semicircular pieces with flanged ends on both sides with holes to fit in the screws, bolts and; nuts 40 mm long. The stay shall be minimum one metre long of 10 mm dia M.S. bar. One end of the stay shall be bent for embedding in the wall in cement concrete block of size 20x10x10 cm in 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size). The concrete shall be finished to match with the surrounding surface.

15.1.9. Pillar Taps :

Pillar taps shall be chromium plated brass and shall conform to IS:1795. The nominal

sizes of the pillar tap shall be 15 mm or 20 mm as specified. The nominal size shall be designated by the nominal bore of the pipe

outlet to which the tap is to be fitted. Finished weights of 15 mm and 20 mm pillar taps shall be as prescribed in **TABLE 15.1**.

TABLE 15.1 - MINIMUM FINISHED WEIGHTS OF PILLAR TAPS

Particulars	Weights for	
	15 mm size gm	20 mm size gm
Body	255	505
Washer plate loose valve	15	28
Back nut	40	50
Tap	650	1175

Casting shall be sound and free from laps, blow hole and pitting. External and internal surfaces shall be clean, smooth and free from sand and be neatly dressed. The body, bonnet and other parts shall be machined true so that when assembled, the parts shall be axial, parallel and cylindrical with surfaces smoothly finished.

The area of waterway through the body shall not be less than the area of the circle of diameter equal to the bore of the seating of the tap. The seating of pillar tap shall be integral with the body and edges rounded to avoid cutting of washer. Pillar taps shall be nickle chromium plated and thickness of coating shall not be less than service grade No. 2 of IS:4827 and plating shall be capable of taking high polish which shall not easily tarnish or scale.

Every pillar tap, complete with its component parts shall withstand an internally applied hydraulic pressure of 20 Kg/sq. cm maintained for a period of 2 minutes during which period it shall neither leak nor sweat.

15.1.10. Sand Cast Iron or Centrifugally Cast (Spun) Iron Pipes and Fittings :

Sand cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories shall conform to IS: 1729. Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories shall conform to IS:3989.

The fittings shall conform to the same I.S. specifications to which the pipe itself conforms in which they are connected.

The pipes shall have spigot and socket ends, with head on spigot end in case of sand cast iron pipes and without head on spigot end in case of cast iron (Spun) pipes. The pipes and fittings shall be true to shape, smooth and cylindrical, their inner and outer surface being as nearly as practicable concentric.

They shall be sound and shall be free from cracks, taps, pinholes and other imperfections and shall be neatly dressed and carefully fettled. All pipes and fittings shall ring clearly when struck with a light hand hammer.

The ends of pipes and fittings shall be reasonably square to their axis. The sand cast iron pipes shall be 1.5/1.8/2.0 metre in length including socket ends, cast iron (Spun) pipes shall be 1.5/1.75/2.0/2.5/3.0 metre in length excluding socket ends, unless shorter lengths are either specified or required at junctions etc. The pipe and fittings shall be supplied without ears, unless specified or directed otherwise.

All pipes and fittings shall be coated internally and externally with the same material at the factory, the fitting being preheated prior to total immersion in a bath containing a uniformly heated composition having a tar or other suitable base. The coating material shall have good adherence and shall not scale off. In all instances where the coating material has tar or similar base it shall be smooth and tenacious and hard enough not to flow when exposed to a temperature of 77 degree centigrade but not so brittle at a temperature of 0 degree centigrade as to chip off when scribed lightly with a pen knife.

The standard weights and thicknesses of pipes and their tolerances shall be as prescribed in ANNEXURE 15.3.

The thickness of fittings and their socket and spigot dimensions shall conform to the thickness and dimensions specified for the corresponding sizes of straight pipes. The tolerance in weights & thicknesses shall be the same as for straight pipes.

The access door fittings shall be designed so as to avoid dead spaces in which filth may accumulate. Doors shall be provided with 3

mm rubber insertion packing and when closed and bolted, these shall be water tight.

Sand Cast Iron Floor Trap or Nahani Trap

: Sand cast Iron Floor trap or Nahani trap shall be 'P' or 'S' type with minimum 50 mm seal. However, if the plumbing is in two pipe system and with a gully trap at the ground level the minimum water seal shall be 35 mm. The traps shall be of self cleansing design and shall have exit of same size as that of waste pipe-These shall conform to IS : 1729.

15.1.11. Plastic seat and covers for water closet (Fig. 15.6) :

The seat and cover shall be of thermosetting or thermoplastic conforming to IS:2548 Part I and 2 respectively or as specified. Unless and otherwise specified these shall be of closed pattern.

15.1.11.1. Thermosetting plastic used shall conform to grade 2 or 3 of IS : 1300 when it is phenolic or IS: 3389 when of urea formaldehyde.

Thermo plastic materials used may be of Polystyrene conforming to type 2 or 3 of IS : 2267 or of polypropylene, Appendix A of IS:2548. In public buildings where rough and heavy use of seats and covers are common, plastic seats shall be moulded out of thermosetting materials, phenolic or urea formaldehyde only and the under side of the seat shall be flat with solid moulding.

15.1.11.2. The hinging device shall be bronze or brass with nickel chromium plating conforming to IS : 2548 and the seat shall have not less than three rubber or plastic buffers unless otherwise specified. The cover shall be fitted with the same number of buffers as provided for the seat.

15.1.11.3. Seats shall have a smooth finish and shall be non absorptive and free from cracks and crevices. They shall be capable of being easily cleaned and shall not be adversely affected by common solvents or household cleanser.

15.1.11.4. Strength : The seats shall withstand without permanent distortions of the seat or hinge fittings and damage to any finish when a load of 1150 N for 30 minutes is applied in the manner prescribed in IS 2548.

15.1.12. Sinks (Fig. 15.7) :

15.1.12.0. Laboratory sinks shall be of White vitreous china with dimensions as specified conforming to IS : 2556 (Pt. V). Kitchen sinks shall be of white glazed fire clay conforming to IS : 771 (part-II) . The kitchen sink shall be of one piece construction with or without rim,

with or without overflow.

15.1.12.1. Wherever specified stainless steel kitchen sink of size as specified conforming to IS:13983 shall be provided.

15.1.12.2. Brackets for sinks shall be as shown in **Figure 15.8.**

15.1.13. Towel rails - The towel rail shall be of :

a) CP Brass with two CP brass brackets coated with nickel chromium plating of thickness not less than grade no.2 of IS : 4827.

b) Anodised aluminium fluted surface with two anodised aluminium brackets. The size of the rail shall be 75 cm x 20 mm dia or 60 cm x 20 mm dia, 1.25 mm thick as specified. The fixing screw shall be of C. P. brass.

15.1.14. Toilet paper holder : The toilet paper holder shall be of CP brass or vitreous china as specified and of size and design as approved by the Engineer. It shall be fixed in position by means of C.P. brass screws and rawl plugs embedded in the wall.

15.1.15. Urinals

15.1.15.1. Bowl type urinals (Fig. 15.9) : Urinal basins shall be of flat back or corner wall type lipped in front. These shall be of white vitreous china conforming to IS : 2556- (Part VI) Sec.I. The urinals shall of one piece construction. Each urinal shall be provided with not less than two fixing holes of minimum dia 6.5 mm on each side. Each urinal shall have an integral; flushing rim of suitable type and inlet or supply horn for connecting the flush pipe. The flushing rim and inlet shall be of the self draining type. It shall have a weephole at the flushing inlet of the urinals.

At the bottom of the urinal an outlet horn for connecting to an outlet pipe shall be provided. The exterior of the outlet horn shall not be glazed and the surface shall be provided with grooves at right angles to the axis of the outlet to facilitate fixing to the outlet pipe. The inside surface of the urinal shall be uniform and smooth throughout to ensure efficient flushing. The bottom of pan shall have sufficient slope from the front towards the outlet such that there is efficient draining.

The following tolerances may be allowed on the dimensions :

- a) On dimension 50 mm and over ± 4 percent
- b) On dimensions less than 50 mm ± 2 mm
- c) On all angles ± 3 degree

15.1.15.2. Stall Urinals (Fig. 15.10) : The

stall urinal and its screens shall be of white glazed fire clay conforming to IS : 771 (Pt.3-Sec.2). The stall shall be 1140 mm high and 460 mm wide with 400 mm overall depth at the base. Where specified, screens which shall be 1200 mm high and 15 cm wide (overall) and projecting 50 cm after suitable embedment in the wall shall be provided as directed by the Engineer. In case of a range of two or more urinals, there shall be further division screens as shown in Fig. 15.10. The end screen shall also be suitably fixed as directed by the Engineer. The range shall have 15 cm deep standard pattern tread plates of fire clay or black granite as specified or otherwise directed by the Engineer. The inside surface of the stall and its screens shall be regular and smooth throughout to ensure efficient

15.1.15.3. Half stall urinals (Fig. 15.11) : They shall be of white vitreous China conforming to IS : 2556 (Part VI-Sec.2). They shall be of one piece construction with or without an integral flushing box rim and provided with slots or alternative fixing arrangement at the flat back end. They shall be provided with ridges where integral flushing rim is not provided in the sides of the interior of the bowl, to divert the water towards the front line of the urinal where integral flushing box rim is specified, water spreaders provided shall conform to IS : 2556 Part-VI Sec.6 (**Fig.15.12**). These shall be vitreous China of one piece construction with integral flush inlet.

The tolerance of ± 4 percent may be allowed on the dimensions specified.

15.1.15.4. Urinal Partition Slabs: Urinal Partition slabs shall be provided, as specified. IS:771 Part 3 Section 1 gives the specifications for glazed fire clay sanitary applications on slab urinals.

15.1.15.5. Squatting Plate Urinal (Fig. 15.13) : The plates shall be of white vitreous china conforming to IS : 2556 (Part-I) and IS : 2556 (Part-VI)/Section 3) with internal flushing rim with front or side inlet. Squatting Plate shall be of one piece construction. Each urinal shall have integral longitudinal flushing pipe of suitable type which may be connected to flush pipe. Following tolerances maybe allowed on the dimensions :

- a) On dimension 50 mm and over ± 4 percent
 - b) On dimensions less than 50 mm ± 2 mm
- These shall be 100 mm dia white glazed vitreous

15.1.16. Wash Basins (Fig. 15.14, 15.15,

15.16, 15.17 & 15.18) :

Wash basins shall be of white vitreous china conforming to IS: 2556 (Part-I) and IS: 2556 (Part I). Wash basins either of flat back or angle back as specified shall be of one piece construction, including a combined overflow. All internal angles shall be designed so as to facilitate cleaning. Each basin shall have a rim on all sides, except sides in contact with the walls and shall have a skirting at the back. Basins shall be provided with single or double tap holes as specified. The tap holes shall be 28- mm square or 30 mm round or 25 mm round for pop up hole. A suitable tap hole button shall be supplied if one tap hole is not required in installation. Each basin shall have circular waste hole to which the interior of basin shall drain. The waste hole shall be either rebated or bevelled internally with dia meter of 65 mm at top. Each, basin shall be provided with a nonferrous 32 mm waste fitting. Stud slots to receive the brackets on the underside of the wash basin shall be suitable for a bracket with stud not exceeding 13 mm diameter, 5 mm high and 305 mm from the back of basin to the centre of the stud. The stud slots shall be of depth sufficient to take 5 mm stud. Every basin shall have an integral soap holder recess or recesses, which shall fully drain into the bowl. A slot type of overflow having an area of not less than 5 sq. cm shall be provided and shall be so designed as to facilitate cleaning of the overflow.

Where oval shape or round shape wash basins are required to be fixed these shall be fixed preferably in RCC platform with available stone topping either fully sunk in stone top or top flush with the stone topping as directed by the Engineer.

The wash basins shall be one of the following patterns and sizes as specified (**Fig. 15.14**).

a) Flat back : 630 x 450 mm 550 x 400 mm 450 x 300 mm

b) Angle back : 600 x 400 mm 400 x 400 mm

White glazed pedestals for wash basins, where specified shall be provided. The quality of the glazing of the pedestal shall be exactly the same as that of the basin along with which it is to be installed. It shall be completely recessed at the back to accommodate supply and waste pipes and fittings. It shall be capable of supporting the basin rigidly and adequately and shall be so designed as to make the height from the floor to top of the rim of basin 75 to 80 cm as shown in Fig. 15.14,15.15,15.16,15.17 & 15.18. All the waste fittings shall be brass

chromium plated, or as specified. The following tolerances may be allowed on dimensions specified :

- a) On dimension 75 mm and over ± 4 percent
- b) On dimensions less than 75 mm ± 2 mm
- c) Diameter of the waste hole $+ 3$ mm

15.1.17. Waste fittings and CI Brackets for wash basins and sinks (Fig. 15.8):

The waste fittings shall be of nickel chromium plated brass, with thickness of plating not less than service grade 2 of IS : 4827 which is capable of receiving polish and will not easily scale off. The fitting of copper alloy shall conform in all respect to IS : 2963 and shall be sound, free from laps, blow holes and pittings and other manufacturing defects. External and internal surfaces shall be clean and smooth. They shall be neatly dressed and be truly machined so that the nut smoothly moves on the body.

Waste fitting for wash basins shall be of nominal size of 32 mm. Waste fittings for sinks shall be of nominal size 50 mm. C.I. Brackets also shown in figure 15.8 shall be to IS specification IS 775-1970.

15.1.18. Water closets (Fig. 15.19, 15.20 & 15.21)

15.1.18.1. Squatting pans (Fig. 15.19 & 15.20) : IS:11246-1992 deals with the specification for Glass Fibre Reinforced Polyester resin (GRP) squatting Pans. Squatting pans shall be of white vitreous china conforming to IS : 2556 Part-I for General Requirements and relevant I.S. codes for each pattern as described below :

- i) Long pattern-conforming to IS :2556 (Part-III).
- ii) Orissa pattern-conforming to IS :2556 (Part-III).
- iii) Integrated type conforming to IS :2556 (Part.. XIV).

Preferably Orissa type pan should be used.

Each pan shall have an integral flushing rim of suitable type. It shall also have an inlet or supply horn for connecting the flush pipes, as shown in **Fig. 15.19, 15.20 & 15.21.**

The flushing rim and inlet shall be of the self draining type. It shall have weep hole at the flushing inlet to the pan. The flushing inlet shall be in the front, unless otherwise specified or ordered by the Engineer. The inside of the bottom of the pan shall have sufficient slope from the front towards the outlet and the surface shall be uniform and smooth to enable easy and quick disposal

while flushing. The exterior surface of the outlet below the flange shall be an unglazed surface which shall have grooves at right angles to the axis of the outlet. In all cases a pan shall be provided with a (100 mm) S.C.I. trap 'P' or 'S' type with approximately 50 mm water seal and 50 mm dia vent horn, where required by the Engineer.

The following tolerances may be allowed on the dimensions specified :

- i) Long pattern and Orissa pattern
 - a) On dimension 50 mm and over ± 4 percent
 - b) On dimensions less 50 mm than ± 2 mm
 - c) On all angles ± 3 deg.
- d) The top surface of long pattern pan shall not at any point vary from its designed plane or contour by more than 6 mm for size 580 mm and by more than 10 mm for sizes 630 mm and measured vertically. This value shall not exceed 10 mm in case of Orissa pattern pans.
- ii) Integrated squatting pan:
 - a) On dimension 50 mm and over ± 4 percent
 - b) On dimensions less than 50 mm ± 2 mm
 - c) On all angles. ± 3 deg.

15.1.18.2. Water closet (Wash Down Type) (Fig. 15.20 & 15.21) :

Water closets shall be of white vitreous china conforming to IS : 2556 (Part-I) and 2556 (Part-II), as specified and shall be of "Wash down type". The closets shall be either of the two patterns (Pattern I & Pattern II) and sizes as shown in **Fig. 15.20 & 15.21** as specified. The closets shall be of one piece construction. Each water closet shall have not less than two holes having a minimum diameter of 6.5 mm for fixing to floor and shall have an integral flushing rim of suitable type. It shall also have an inlet or supply horn for connecting the flushing pipe of dimensions confirming to 'E' in table in **Fig. 15.20 & 15.21** the flushing rim may be boxed or open type. In the case of box rims adequate number of holes, on each side together with a slot opposite the inlet shall be provided. The flushing rim and inlet shall be of the self draining type. The water closet shall have a weep hole at the flushing inlet. Each water closet shall have an integral trap with either 'S' or 'P' outlet with at least 50 mm water seal. For P trap, the slope of the outlet shall be 14 deg. below the horizontal. Where required the water closet shall have an

antisiphonage 50 mm dia vent horn on the outlet side of the trap with dimension conforming to those given in **Fig. 15.21** and on either right or left hand or centre as specified set at an angle of 45 deg. and invert of vent hole not below the central line of the outlet. The inside surface of water closets and traps shall be uniform and smooth in order to enable an efficient flush. The serrated part of the outlet shall not be glazed externally. The water closet when sealed at the bottom of the trap in line with the back plate, shall be capable of holding not less than 15 litres of water between the normal water level and the highest possible water level of the water closet as installed.

15.1.18.3. Dimensions and Tolerances : The dimensions of pattern I and II shall confirm to those given in table in **Fig. 15.20 and 15.21** respectively. Where tolerances are not given for a specific dimension, the following shall be permissible.

- a) On dimension 75 mm and over ± 4 percent
- b) On dimensions less than 75 mm ± 2 mm
- c) On all angles ± 3 deg.

15.2. GENERAL REQUIREMENTS FOR INSTALLATION OF WC PAN

15.2.1. General: The work shall be carried out, complying in all respects with the requirements of relevant byelaws of the local body in whose jurisdiction the work is situated.

15.2.2. Care in installation: Any damage caused to the building, or to electric, sanitary, water supply or other, installations etc. therein, either due to negligence on the part of the contractor, or due to actual requirements of the work, shall be made good and the building or the installation shall be restored to its original condition by the contractor. Nothing extra shall be paid for such restoration works except where otherwise specified.

15.2.3 Specifications for associated works: For making good the damage to the undermentioned items of work, the specifications as given in the following paras shall apply, unless directed otherwise.

a) Masonry Work : The masonry work shall be made good by using the same class of bricks, tiles or stones as was damaged during the execution of the work. The mortar used shall be cement mortar 1:5 (1 cement : 5 fine sand) or as directed by the The Engineer.

b) Plain Concrete Works : Concrete work for sub-grade of the flooring, foundations and other plain concrete works shall be cement concrete 1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregate 40 mm nominal size). A coat of neat cement slurry shall be applied at the junction with old work, before laying fresh concrete.

c) Cement Concrete Flooring and R.C.C. Works : Cement concrete 1: 2: 4 (1 Cement: 2 Coarse sand : 4 graded stone aggregate 20 mm nominal size) shall be used after applying a coat of neat cement slurry at the junction with old work, and the surface finished to match with the surrounding surface.

d) Plastering : Cement plaster 1:4 (1 cement :4 sand) shall be used. The sand shall be fine or coarse, as used in the original work. The surface shall be finished with two or more coats of white wash, colour wash, distemper or painting as required, but where the surface is not to be white washed, colour washed, distempered or painted, it shall be finished as required to match with the surrounding surface.

e) Other Items : Damage to any other item shall be made good as directed by the Engineer.

Note : In all the above operations the damaged portion shall be cut in regular geometric shape and cleaned before making good the same.

15.2.4 Painting. All exposed G.I., C.I. or lead pipes and fittings shall be painted with approved quality of paint and shade as specified. The painting work shall conform to specification described under sub head Painting.

15.2.5. Workmanship: All sanitary and plumbing work shall be carried out through licensed plumbers.

15.2.6 Cleaning of site: On completion of the work the site shall be cleaned and all rubbish disposed off as directed by the the Engineer .

15.2.7 Payment for items:- Various sanitary fittings described under 15.1 including fixing shall be enumerated individually or in combination under relevant items of works as described below. When used. in combination, specifications as described under relevant paras shall apply but nothing extra shall be paid for making connections required for successful functioning of the combination.

15.3. INSTALLATION OF DRAINING

BOARD:

15.3.1. Fixing : One end of the board shall rest on sink and the other end shall be supported on C.I. bracket embedded in cement concrete (1:2:4) block 100x75x150 mm. The brackets used shall be of cantilever type or wall fixed type as for the sink.

15.3.2. Painting : The brackets shall be painted with two or more coats of approved paint.

15.3.3. Measurements : Draining board shall be enumerated in case payable separately.

15.3.4. Rate : The rate shall include the cost of all materials and labour involved in all operations.

15.4. INSTALLATION OF FLUSHING CISTERN:**15.4.1. Fixing:**

15.4.1.1. High Level Cistern: The cistern shall be fixed on C.I. cantilever brackets which shall be firmly embedded in the wall in cement concrete (1:2:4) block 100x75x150 mm. The cistern shall be provided with 20 mm nominal bore G.I. overflow pipe 185 cm long with fittings. The outlet or flush pipe from the cistern shall be connected to the pan by means of cement or putty joint. The flush pipe shall be fixed to wall by using holder bat clamps of required shape and size so as to fit tightly on the pipes when tightened with screwed bolts. The clamps shall be embedded in brick work in cement mortar 1:3 (1 cement : 3 coarse sand). If connection between cistern and pan is made with G.I. pipe the bends and offsets shall be made cold.

15.4.1.2. Low Level Cistern: Para 15.4.1.1 shall apply except that connection between cistern and closet shall be made by means of 40 mm dia flush bend with rubber or G.I. inlet connection as specified.

15.4.1.3. Automatic Cistern: Para 15.4.1.1 shall apply except that CP Brass stop cock shall be provided for cistern having a capacity of more than 5 liter. The main & distribution flush pipe shall be fixed to the wall by means of standard pattern holder bat clamp shown in **Fig. 15.10**.

15.4.2. Painting: The cistern, brackets, overflow and flush pipe etc. shall be painted, if specified, with two or more coats of paint of approved shade and quality.

15.4.3. Measurements: Cistern, including all fittings, shall be enumerated.

15.4.4. Rate: The rate shall include the cost

of all materials and labour involved in all the operations described above.

15.5. INSTALLATION OF MIRROR:

15.5.1. Fixing: The mirror shall be mounted on backing with environmentally friendly material other than asbestos cement sheet and shall be fixed in position by means of 4 C.P. brass 'screws and C.P. brass washers, over rubber washers and wooden plugs firmly embedded in walls. C.P. brass clamps with C.P. brass screws may be an alternative method of fixing, where so directed. Unless specified otherwise the longer side shall be fixed horizontally.

15.5.2. Measurements: Mirror shall be enumerated.

15.5.3. Rate: Rate shall include the cost of all the materials and labour involved in all the operations described above.

15.6. FIXING AND JOINTING OF PIPES AND FITTINGS ,

15.6.0 General: The specifications described in para 10.26.3 shall apply, as far as applicable, except that the joint shall be lead caulked. All soil pipes shall be carried up above the roof and shall have sand cast iron / wire cowls / A.C terminal guard.

15.6.1. Height of Ventilating Pipes : The ventilating pipe or shaft shall be carried to a height of at least 60 cms above the outer covering of the roof of the building or in the case of a window in a gable wall or a dormer window it shall be carried upto the ridge of the roof or at least 2 metres above the top of the window. In the case of a flat roof to which access for use is provided it shall be carried upto a height of 2 metres above the roof and shall not terminate within 2 metres, measured vertically from the top of any window opening which may exist upto a horizontal distance of 3 meters from the vent pipe into such building and in no case shall be carried to a height less than 3 metres above plinth level. In case the adjoining building is taller, the ventilating pipe shall be carried higher than the roof of the adjoining building, wherever it is possible.

The pipes above the parapet shall be secured to the wall by means of M.S. stay and clamps as specified in para 15.1.8.

The connections between the main pipe and branch pipes shall be made by using branches and bends with access doors for, cleaning. The waste from lavatories, kitchen, basins, sinks, baths and other floor traps

shall be separately connected to respective waste stack of upper floors. The waste stack of lavatories shall be connected directly to manhole while the waste stack of others shall separately discharge over *gully* trap. Where single stack system is provided, the connection shall be made direct to the manhole.

15.6.2. Jointing: The interior of the socket and exterior of the spigots shall be thoroughly cleaned and dried. The spigot end shall be inserted into the socket right upto the back of the socket and carefully centered by two or three laps of treated spun yarn, twisted into ropes of uniform thickness, well caulked into the back of the socket. No piece of yarn shall be shorter than the circumference of the pipe. The jointed pipe line shall be at required levels and alignment.

The leading of pipes shall be made by means of ropes covered with clay or by using special leading rings. The lead shall be melted so as to be thoroughly fluid and each joint shall be filled in one pouring. caulking lead shall conform to IS:782-1978. Lead required per joint for 50 mm, 75 mm and 100 mm diameter pipes is 0.77 Kg, 0.88 Kg., and 0.98 Kg respectively.

The following precautions shall be taken for melting lead :

- a) The pot and the ladle in which lead shall be put shall be clean and dry.
- b) Sufficient quantity of lead shall be melted.
- c) Any scum or dross which may appear on the surface of the lead during melting shall be skimmed off.
- d) Lead shall not be overheated.

After the lead has been run into the joint the lead shall be thoroughly caulked. Caulking of joints shall be done after a convenient length of the pipes has been laid and leaded.

The leading ring shall first be removed and any lead outside the socket shall be removed with a flat chisel and then the joint caulked round three times with caulking tools of increasing thickness and hammer 2 to 3 kg weight. The joints shall not be covered till the pipe line has been tested under pressure.

Use of collars for jointing is not permitted in any concealed or embedded location. However, in exposed locations where full length pipes can not be fixed due to site constraints, collars (and not loose sockets) may be used subject to the following:

Note : The dimensions of loose sockets and collars for different sizes of pipes are given in **Figure 15.22.**

a) No two consecutive joint shall be with the use of collars.

b) The joint of collar with the cut/spigot end of the pipe shall be made on the ground in advance and tested against leakage before fixing.

c) Cut/spigot end of the pipes shall be inserted in the collars upto the projection inside the collar and jointing shall be done as in the case of socket and spigot joint. The jointed pipe line shall be at required level/slope and alignment.

Note : The dimensions of loose sockets and collars for different sizes of pipes are given in **Figure 15.22.**

15.6.3. Testing :

In order to ensure that adequate lead is poured properly into the joints and to control waste in use of lead, at the beginning of work three or four sample joints shall be made and the quantum of lead per joint approved by the Engineer. All sand cast iron/cast iron (Spun) pipes and fittings including joint shall be tested by smoke test to the satisfaction of the Engineer and left in working order after completion. The smoke test shall be carried out as under :-

Smoke shall be pumped into the pipes at the lowest end from a smoke machine which consists of a bellow and burner. The material usually burnt is greasy cotton waste which gives out a clear pungent smoke which is easily detectable by sight as well as by smell, if there is leak at any point of the drain.

15.6.4. Painting : All sand cast iron/cast iron (Spun) pipes and fittings shall be painted with shade to match the colour of the back ground as directed by the Engineer.

15.6.5. Measurements:

15.6.5.1. The pipes shall be measured net when fixed in position excluding all fittings along its length, correct to a cm.

15.6.5.2. When collars are used for jointing SCI pipes these shall be measured as fittings and shall be paid for separately.

15.6.5.3. No allowance shall be made for the portions of the pipe lengths entering the sockets of the adjacent pipes or fittings. The above shall apply to both cases i.e. whether

the pipes are fixed on wall face or embedded in masonry.

15.6.5.4. No deduction shall be made in the former case from the masonry measurement for the volume of concrete blocks embedded therein. Similarly no deduction shall be made for the volume occupied by the pipes from the masonry when the former are embedded in the later.

15.6.6. Rates : The rate shall include the cost- of all labour and materials involved in all the operations described above, excluding fittings, lead caulk jointing, the supply and fixing M.S. holder bat clamps and M.S. stays and clamps, floor trap and painting, which shall be paid for separately.

15.6.7 FIXING AND JOINTING OF LEAD PIPES:

15.6.7.1. General : Lead pipes shall be used only for short branch soil, waste or vent connections. The lead pipe shall conform to IS:404-1977. The minimum weight of lead pipes for use as soil, waste, or vent pipes shall be 3.28 kg per metre and 3.95 kg per metre for 32mm and 40mm nominal internal diameter respectively. When not supported

on bearers, all lead pipes shall be supported by strong lead tacks atleast 38mm wide soldered on to the pipes at suitable intervals. All joints of lead pipes shall be wiped solder joints.

15.6.7.2 Wiped solder joints: The pipe ends to be jointed shall be cleaned with wire brush and freed from oxide, if any. Chalk shall then be rubbed to kill the greasy nature of the lead. After this plumbers black shall be applied. The length of the joint as given below shall then be marked on the pipe. A fine shaving of lead shall be removed from this length with shave hook. Tallow shall then be smeared over the prepared surface. The molten solder, an alloy composed of 3 parts of tin and 7 parts of lead, shall be poured in a thin stream from a ladle moved in an elliptical direction over the joint position including a portion of the soil pipe at each end beyond the mark. When sufficient solder has been poured the joint shall be wiped with a pad of wiping cloth with long continuous movements in one direction only so as to leave a neatly formed elliptical shaped joint. Surplus solder remaining on the joint shall be removed with a tool called "draw off".

Length of the wiped solder joint shall be as follows :

Diameter of pipe	Length of wiped solder	
	Minimum	Maximum
15mm	60mm	70mm
20mm	65 mm	70 mm
25 mm	70 mm	75 mm
32 mm	70 mm	80 mm
40 mm	70 mm	80 mm
50 mm	75 mm	90 mm

The joints shall be watertight, airtight and shall be free from tears, burrs, strings ribands or droppings.

15.6.7.3 Lead pipe connections:

(a) For joints between lead pipe and C.I. or stoneware pipe, one end of the brass ferrule or thimble shall be slipped into or over the lead pipe and jointed to it by means of a wiped solder joint. The other end of the ferrule shall then be inserted into the socket of the cast iron or stoneware pipe. In the case of former, the joint shall be made with molten lead (lead caulked) and in case of the latter with cement mortar as in stoneware pipe drains.

(b) For joints between outgo of a W.C. pan and a lead pipe, the lead pipe shall be slipped into a brass socket and jointed to it

by wiped solder joint. The outgo of a W.C. pan shall then be inserted into the socket and jointed by using cement mortar as in stoneware pipe drains.

15.6.7.4 Painting: All exposed lead pipes shall be painted as in S.C.I. pipes and fittings.

15.7. INSTALLATION OF SEAT AND COVER TO WATER CLOSET:

15.7.1. Fixing: The seat shall be fixed to the pan by means of two corrosion resistant hinge bolts with a minimum length of shank of 65 mm and threaded to within 25 mm of the flange supplied by the manufacturer

along with the seat. Each bolt shall be provided with two suitably shaped washers of rubber or other similar materials for adjusting the level of the seat while fixing it to the pans. In addition, one non-ferrous or stainless steel washer shall be provided With each bolt. The maximum external diameter of the washer fixed on the underside of the pan shall not be greater than 25 mm. Alternative hinging devices as supplied by the manufacturer of the seat can also be used for fixing with the approval of the Engineer.

15.7.2. Measurements : Seat with cover shall be enumerated.

15.7.3. Rate: Rate shall include the cost of all the materials and labour involved in all the operations described above.

15.8. INSTALLATION OF SINK:

15.8.0. General: The installation shall consist of assembly of sink C.I. brackets, union and G.I. or P.V.C. waste pipe.

15.8.1. Fixing: The sink shall be supported on C.I. cantilever brackets, embedded in cement concrete (1:2:4) block of size 100x75x150 mm: Brackets shall be fixed in position before the dado work is done. The C.P. brass or P.V.C. union shall be connected to 40 mm nominal bore G.I. or PVC waste pipe which shall be suitably bent towards the wall and shall discharge into a floor trap. C.P. brass trap and union and waste shall be paid separately. The height of front edge of sink from the floor level shall be 80 cm.

15.8.2. Measurements : The sinks shall be enumerated.

15.8.3. Rate: Rate shall include the cost of all materials and labour involved in all the operations described above but shall not include the cost of waste fitting and brackets which shall be paid for separately.

15.9. INSTALLATION OF URINAL LIPPED, HALF STALL (SINGLE OR RANGE) (FIG.15.9 & 15.11)

15.9.0. General: Urinal installation shall consist of a lipped urinal (Single or range), an automatic flushing cistern, G.I. flush and waste pipe. The capacity of flushing cistern and relevant size of flush pipe for urinals in a range shall be as prescribed in **Table 15.2**.

Waste pipe shall be of 32 mm nominal bore G.I. pipe and shall be paid separately.

15.9.1. Fixing : Urinals shall be fixed in position by using wooden plugs and screws. It shall be at a height of 65 cm from the standing level to the top of the lip of the urinal, unless otherwise directed by the Engineer. The size of wooden plugs shall be 50 mm x 50 mm at base tapering to 38 *mm x38 mm at top and of length 5.0 cms. These shall be fixed in the wall in cement mortar 1:3 (1 cement : 3 fine sand). After the plug fixed in the wall, the mortar shall be cured till it is set.

Each urinal shall be connected to 32 mm dia waste pipe which shall discharge into the channel or a floor trap. The connection between the urinal and flush or waste pipe shall be made by means of putty or white lead mixed with chopped hemp.

TABLE 15.2

No. of in range Urinals	Capacity of Flushing Cistern	(Galvanised iron)	
		Main	Distribution
One	5 Litres	15 mm	15mm
Two	10 Litres	20 mm	15 mm
Three	10 Litres	25 mm	15 mm
Four	15 Litres	25 mm	15 mm

15.9.2. Measurements : Urinals shall be enumerated.

15.9.3. Rate : Rate shall include the cost of all the materials and labour involved in all the operations described above.

15.10. INSTALLATION OF STALL URINAL (SINGLE OR RANGE) (FIG. 15.10) :

15.10.0. General : The installation shall consist of stall urinal (single or range), automatic flushing cistern, C.P. brass standard flush pipes, C.P. brass spreader and C.I. trap with tail piece and outlet grating of C.P. brass. Capacity of flushing cistern and relevant size of flush pipe, C.I. trap shall be as prescribed in **Table 15.3**.

15.10.1. Fixing: The floor slab shall be suitably sunk to receive the stall urinal. Where the floor slab is not sunk, the stall urinal shall be provided over a platform. The lip of the stall urinal shall be flush with the finished floor level adjacent to it. The stall urinal shall be laid over a fine sand cushion of average 25 mm thickness. A space of not less than 3mm shall be provided around, in front, sides and filled with water proofing plastic compound. Care shall be taken that after the sub-grade for the floor is cast, one week should lapse before urinals are

installed. Generally fixing of the tread plate shall be as specified in 15.12.1. The trap and fittings shall be fixed as directed by the Engineer. Payment for the floor and its sub-grade shall be made separately.

15.10.2. Measurements : Stall urinals shall be enumerated.

15.10.3. Rate : The rate shall include the cost of all the materials and labour involved in all the operations described above.

TABLE 15.3

No. of Urinals in range	Capacity of Flushing cistern	Size of flush pipe(Chromium Plated)		Diameter of C.I. traps
		Main	Distribution	
One	5 Litres	15 mm	15 mm	50 mm
Two	10 Liters	20 mm	15 mm	50 mm
Three	15 Litres	25 mm	15 mm	80 mm
Four	15 Litres	25 mm	15 mm	80 mm

15.11. INSTALLATION OF WASH BASIN (FIG. 15.14, 15.15, 15.16, 15.17 & 15.18)

15.11.0. General. The installation shall consist of an assembly of wash basin, pillar taps, C.I. brackets, C.P. brass or P.V.C. union, as specified. The wash basin shall be provided with one or two 15 mm C.P. brass pillar taps, as specified. The height of top of the rim of wash basin from the floor level shall be within 750 mm to 800 mm.

15.11.1. Fixing : The basin shall be supported on a pair of C.I. cantilever brackets conforming to IS : 775 & be embedded in cement concrete (1:2:4) block 100x75x150 mm. Use of M.S. angle or Tee section as bracket is not permitted. Brackets shall be fixed in position before dado work is done. The brackets have been shown in **Fig. 15.15**. The wall plaster on the rear shall be cut to rest over the top edge of the basin so as not to leave any gap for water to seep through between wall plaster & skirting of basin. After fixing the basin, plaster shall be made good and surface finished to match with the existing one S.C.I. floor traps conforming to IS : 1729 having 50 mm water seal (minimum 35 mm in two pipe system with gully trap) should be used. Waste pipes laid horizontally should have gradient not flatter than 1 in 50 and not steeper than 1 in 10.

The waste water from wash basin shall be discharged directly to vitreous semi-circular open drain, discharging to a floor trap and finally to the vertical stack (**Fig-15.15**) on upper floors and in case of ground floor, the waste water shall be discharged either directly to the gully trap or through the floor trap (**Fig.15.16**). C.P. brass trap and union are not to be used in such situations.

If waste pipe is concealed or crosses the wall, waste water shall be discharged through non ferrous trap like PVC Engineering plastic or C.P. brass and union (**Fig.15.17**) to vertical stack. The C.P. brass trap and union shall be paid for separately.

Where so specified a 20 mm G.I. puff pipe terminating with a perforated brass cap screwed on it on the outside of the wall or connected to the antisiphon stack shall be provided.

15.11.2. Measurements : Wash basins shall be enumerated.

15.11.3. Rate : The rate shall include the cost of all the materials and labour involved in all the operations described above.

15.12. INSTALLATION OF SQUATTING PAN

15.12.0. General: The installation shall consist of squatting pan, flushing cistern,

flush pipe and a pair of foot rests.

15.12.1. Fixing : The pan shall be sunk into the floor and embedded in a cushion of average 15 cm thick cement concrete 1:5:10 (1 Cement : 5 fine sand : 10 graded brick ballast 40 mm nominal size). The concrete shall be left 115 mm below the top level of the pan so as to allow flooring and its bed concrete. The pan shall be provided with a 100 mm S.C.I., P or S type trap with an approximately 50 mm seal and 50 mm dia vent horn, where required by the Engineer. The joint between the pan and the trap shall be made leak proof with cement mortar 1:1 (1 cement : 1 fine sand).

15.12.0. General. The installation shall consist of squatting pan, flushing cistern, flush pipe and a pair of foot rests.

15.12.1. Fixing : The pan shall be sunk into the floor and embedded in a cushion of average 15 cm thick cement concrete 1:5:10 (1 Cement : 5 fine sand : 10 graded brick ballast 40 mm nominal size). The concrete shall be left 115 mm below the top level of the pan so as to allow flooring and its bed concrete. The pan shall be provided with a 100 mm S.C.I., P or S type trap with an approximately 50 mm seal and 50 mm dia vent horn, where required by the Engineer. The joint between the pan and the trap shall be made leak proof with cement mortar 1:1 (1 cement : 1 fine sand).

15.12.2. Measurements: The squatting pans shall be enumerated.

15.12.3. Rate : Rate shall include the cost of all the materials and labour involved in all the operations described above'. Cost of concrete shall be paid separately

15.13. INSTALLATION OF WATER CLOSET:

15.13.0. General: Installation shall consist of water closet with seat and cover, flushing cistern and flush bend.

15.13.1. Fixing : The closet shall be fixed to the floor by means of 75 mm long 6.5 mm diameter counter-sunk bolts and nuts embedded in floor concrete.

15.13.2. Measurements : Water closets shall be enumerated

15.13.3. Rate : Rate shall include the cost of all the materials and labour involved in all the operations described ,above

15.14. INSTALLATION OF FOOT RESTS :

15.14.1. General: After laying the floor around squatting pan as specified a pair of foot rests shall be fixed in cement mortar 1 : 3 (1 cement : 3 coarse sand). The position of foot rests with respect to pan shall be as per **Fig. 15.4.**

15.14.2. Measurements : Pair of foot rests shall be enumerated.

15.14.3. Rate : Rate shall include the cost of all the materials and labour involved in all the operations described above.

15.15. INSTALLATION OF SQUATTING PLATE (SINGLE OR RANGE) (FIG. 15.12):

15.15.0.General: The installation shall consist of an assembly of squatting plates (single or range), vitreous China channel, automatic flushing cistern, flush pipe with fittings spreader and C.I. trap. The capacity of flushing cistern and relevant size of flush pipes shall be as specified in **Table 15.4.**

15.15.1. Fixing : The floor slab shall be suitably sunk to receive the squatting plate. Where the floor slab is not sunk, the plates shall be provided over a platform. The top edge of, the squatting plate shall be flush with the finished floor level adjacent to it. It shall be embedded on a layer of 25 mm thick cement mortar 1:8 (1 cement : 8 fine sand) laid over a bed of 'cement concrete 1:5:10 (1 cement : 5 fine sand : 10 graded brick aggregate 20 mm nominal size).

There shall be 100 mm dia, white glazed vitreous China channels with stop and outlet pieces suitably fixed in the floor in° cement mortar 1:3 (1 cement :3 coarse sand) and joint finished with white cement. The squatting plate shall have 1200 high and half brick thick wall in front and on either side of the squatting plate. The brick work for the walls shall be paid separately. The exposed surface of walls shall be lined with white glazed tiles / wall tiles with proper corners and angles set in neat cement mortar, the face of the joints shall be gone over with whiting so as to match with the colour of the tiles. The tiles shall be 15 mm square or of appoved size. Space if any, left between the side walls and squatting plate shall be finished to match the colour of the squatting plate. The trap and fittings shall be fixed as directed by the Engineer. The vitreous China channel shall discharge into a 65 mm diameter standard urinals, C.I. trap with vent arm having 65 mm C.P. brass outlet grating.

15.15.2. Measurements : Squatting plates shall be enumerated.

15.15.3. Rate: The rate shall include the cost of all the materials and labour involved in all

the operations described above.

TABLE 15.4

No. of squat- ting plates in range	Capacity of flushing cistern	Size of flush pipe (<u>galvanised iron</u>)	
		Main	Distribution
One	5 liters	-	20 mm
Two	10 liters	25 mm	20 mm
Three	15 liters	32 mm	20 mm
Four	15 liters	32 mm	20 mm

15.16. INSTALLATION OF TOWEL RAIL

15.16.0 General: It shall be fixed in position by means of C.P. brass screws on wall surface by PVC fasteners, firmly embedded in wall.

15.16.1. Measurements: Tower rails shall be enumerated

15.16.2. Rate : Rate shall include the cost of all the materials and labour involved in all the operations described above.

ANNEXURE 15.1

EXTRACTS OF ITEMS COVERED IN IS:5329-1983, IS:1172-1993, IS:2064-1993

A) IS:5329-1983 CODE OF PRACTICE FOR SANITARY PIPE WORK ABOVE GROUND FOR BUILDINGS

- 1) Scope
- 2) Terminology (Definition of items)
- 5) Material (Choice of materials for pipes & fittings – Asbestos cement, cast iron, salt glazed stoneware pipe, Galvanised steel & wrought iron, any other materials approved by the Local authority)
- 3) Design consideration (Pipe systems – Two pipe system, one pipe system, single stack system; pipe capacities, layout of pipes; connection of fixtures; traps; soil pipes; waste pipe; ventilating pipe; design data for single stack plumbing).
- 4) Inspection and Testing (Inspection, Testing of system – Water test, air test, smoke test, hydraulic performance).

B) IS 1172-1993 CODE OF BASIC REQUIREMENTS FOR WATER SUPPLY, DRAINAGE AND SANITATION

- 1) Scope

- 2) References (IS codes that are necessary adjuncts)

- 3) General requirements

- 4) Water supply requirements (For Residences; For buildings other than residences; For different types such as Factories, Hospitals, Hostels, Hotels, Offices, Schools etc.)

- 5) Drainage and sanitation requirements (For residences; for other than residences; for different types such as office buildings, factories, hospitals, schools, educational institutions, Hostels etc.)

- 6) Water supply, drainage and sanitation requirements for Railway platforms, bus stations, bus terminals etc.).

C) IS 2064-1993 CODE OF PRACTICE ON "SELECTION INSTALLATION AND MAINTENANCE OF SANITARY INSTALLATIONS"

- 1) Definition of sanitary appliances
- 2) Collection of data for selection of appliances
- 3) Time schedules
- 4) Materials
- 5) Design consideration for kitchen, bath rooms, bidet, shower, toilet, water closet,

wash basins, urinals.

6) Work on site – Chases and ducts, siting of appliances, fixing of appliances,

priorities, inspection and testing, maintenance

ANNEXURE 15.2

METHOD OF INSPECTION FOR DEFECTS OF BATH TUBS

The surface of the bath tubs shall be visually inspected for blemishes from a distance of 600 mm after being inked. The light source shall be partially diffused daylight supplemented, if necessary, with diffused artificial light to provide illumination comparable to that usually available within short distance of the outside window facing north, but not in direct sunlight. The illumination shall have an intensity of 1,000 to 2,000 lux. Blemishes other than those given in **Table 2** shall not be allowable.

INK TEST : To do the visual examination of the surface of the bath tub, ink is applied to the area to be inspected as follows :

a) Wash the entire area to be inspected with a water soluble ink.

b) Rinse the surface with fresh water and dry. Ink will remain entrapped in cracks pits etc.

All references to visible defects shall refer to defects apparent to the eye upon close inspection, after the surface has been ink tested.

Defects whose Presence cannot be Permitted : The defects whose presence cannot be permitted are listed in **Table 1**.

TABLE 1 - DEFECTS WHICH CANNOT BE PERMITTED

Part	Non-Permissible Defects
Upper rim, inner wall, bottom, apron, readily other visible faces	Small pores, wrinkle, craze, bubbles, injuries, defective impregnation, superficial defects, , aggregate defects.
Obscure faces	Defective impregnation, Superficial defects.

The Permissible Range of Defects :

The permissible range of various defects are listed in **Table 2**.

TABLE 2 - PERMISSIBLE DEFECTS

Defects/Parts	Upper Rim	Inner Wall	Apron	Bottom	Visible Parts
Traces of mending	2	2	2	2	Not conspicuous
Impurities	2	3	2	3	-do-
Pinholes	2	3	2	3	-do-
Colour blot	Should not be conspicuous				
Unevenness	Should not be conspicuous				
Deformity	The horizontal section of the upper rim shall drain off water readily. The bend of the section in contact with wall shall be less than 5 mm. Deformities of the other sections of the bath tub shall not be conspicuous				

ANNEXURE 15.3**STANDARD WEIGHTS AND THICKNESS OF C.I. PIPES****FOR SAND CAST IRON PIPES IS : 1729**

Nominal dia of bore (mm)	Thickness (mm)	Over all weight of pipe excluding ears		
		1.5 m long (Kg)	1.80 m long (Kg)	2.0 m long (Kg)
50	5.0	9.56	11.41	12.65
75	5.0	13.83	16.52	18.37
100	5.0	18.14	21.67	24.15
150	5.0	26.70	31.92	35.66

For Cast Iron Spun Pipes IS: 3989

Nominal dia (mm)	Thickness (mm)	Overall weight in Kg. for an effective length in metres of				
		3.000	2.500	2.000	1.800	1.500
50	3.5	13.40	11.3	9.2	8.4	7.1
75	3.5	20.0	16.8	13.8	12.5	10.6
100	4.0	30.0	25.5	21.0	18.8	16.0
150	5.0	56.0	47.0	38.5	34.9	29.5

Tolerances

- a) Tolerances on the external diameter of the barrel, the internal diameter of the socket and the depth of socket shall be as follows

Dimensions (mm)	Nominal Diameter (mm)	Tolerance(mm)
External , diameter of barrel	50,75	± 3.0
	100	± 3.5
	150	± 4.0
Internal diameter of socket	All diameters	± 3.0
Depth of socket	All diameters	± 10.0

The maximum and minimum jointing space resulting from these tolerances shall be such that the jointing of the pipes and fittings is not adversely affected. The tolerance on

length of pipes shall be ± 20 mm.

- b) The tolerances on dimensions of fittings shall be as given below :

Type of Casting	Dimension	Tolerance mm	
Bend pipes	a	+25	-10
	b	+20	-10
Branches with equal branch pipes	a	+25	-10
	b	+25	-10
Branches with unequal branch pipes	L	+30	-20
S. Shape casting	L	+50	-10

Taper collars	L	+25	-10
Other	L	+20	-10

Note :

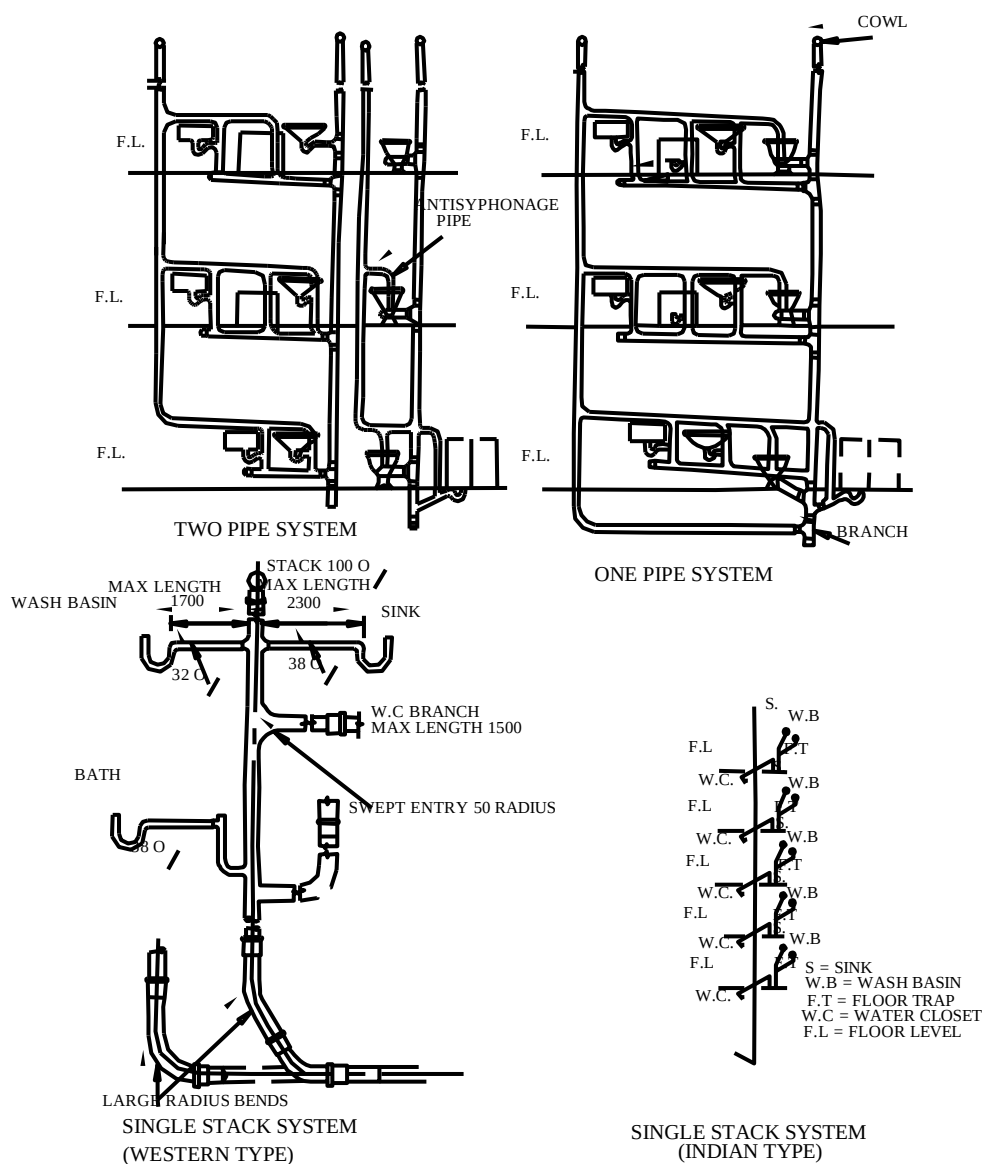
- 1) Tolerance on wall-thickness shall be limited to. -15 percent. No limits for plus tolerance is specified.
- 2) Tolerance for dimensions other-than those specified above shall be as specified in

IS : 5519.

- 3) Tolerance on mass shall be limited to -10 percent. No limit for plus tolerance is specified.

PIPE SYSTEMS AND PARTS

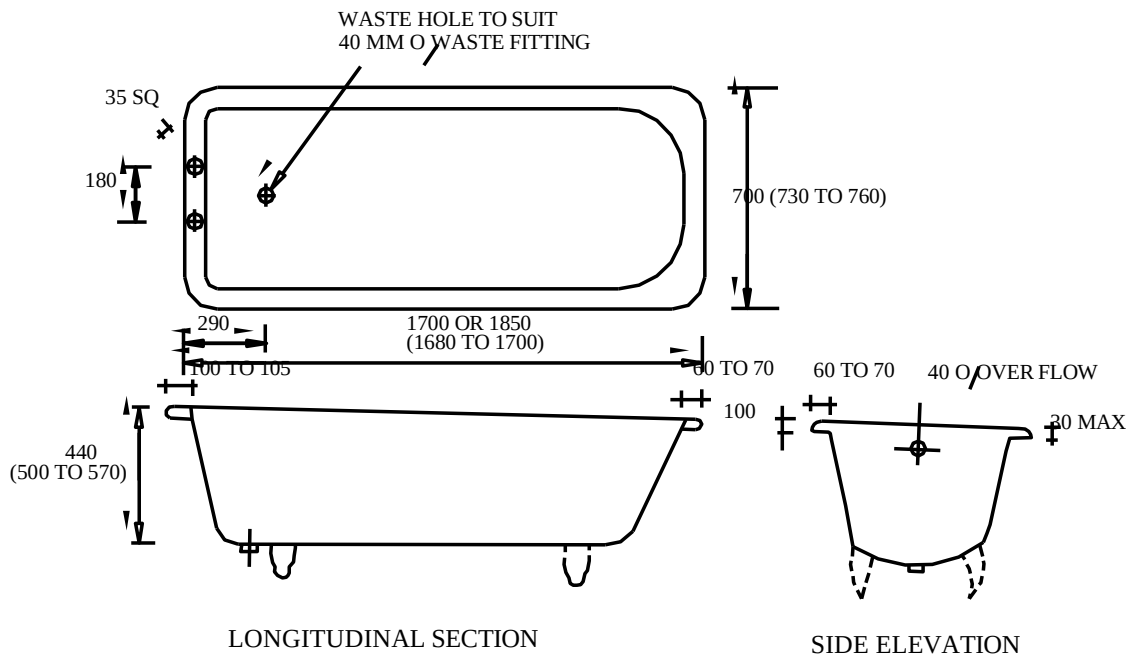
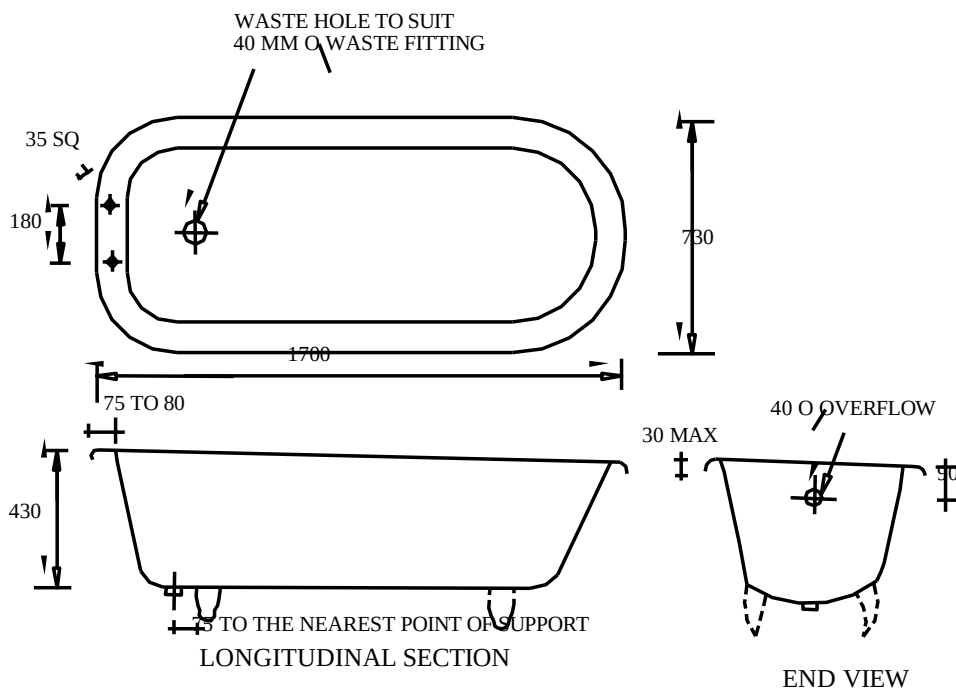
FIGURE 15.1



All dimensions are in mm
Drawings not to Scale

BATH TUB

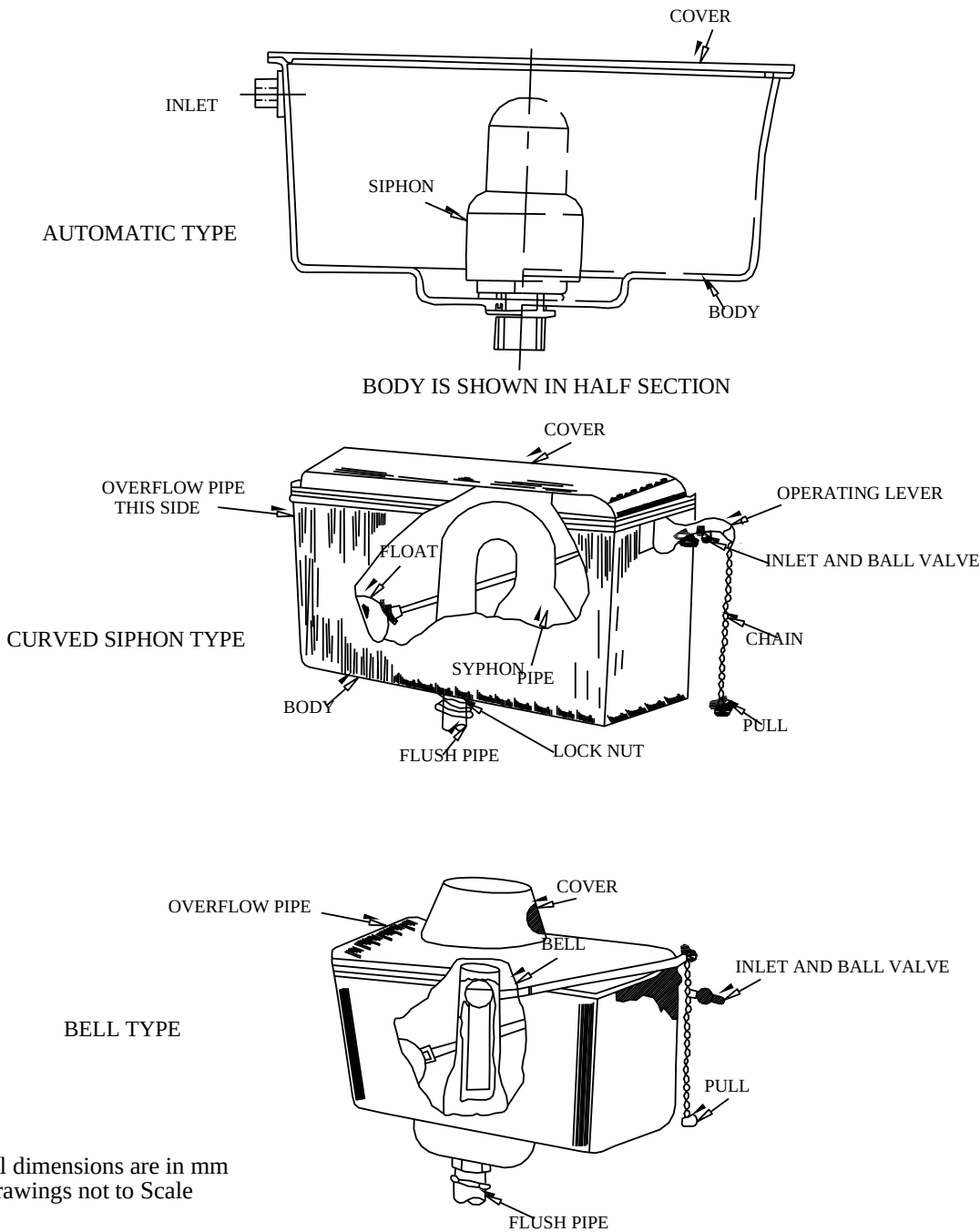
FIGURE 15.2



- 1 All dimensions are in mm
- 2 Drawings not to Scale
- A 3 ENAMELLED STEEL/GEL COATED
- 4 DIMS. WITHIN PARENTHESIS ARE FOR GELL COATED
- B 5 ENAMELLED STEEL ONLY.

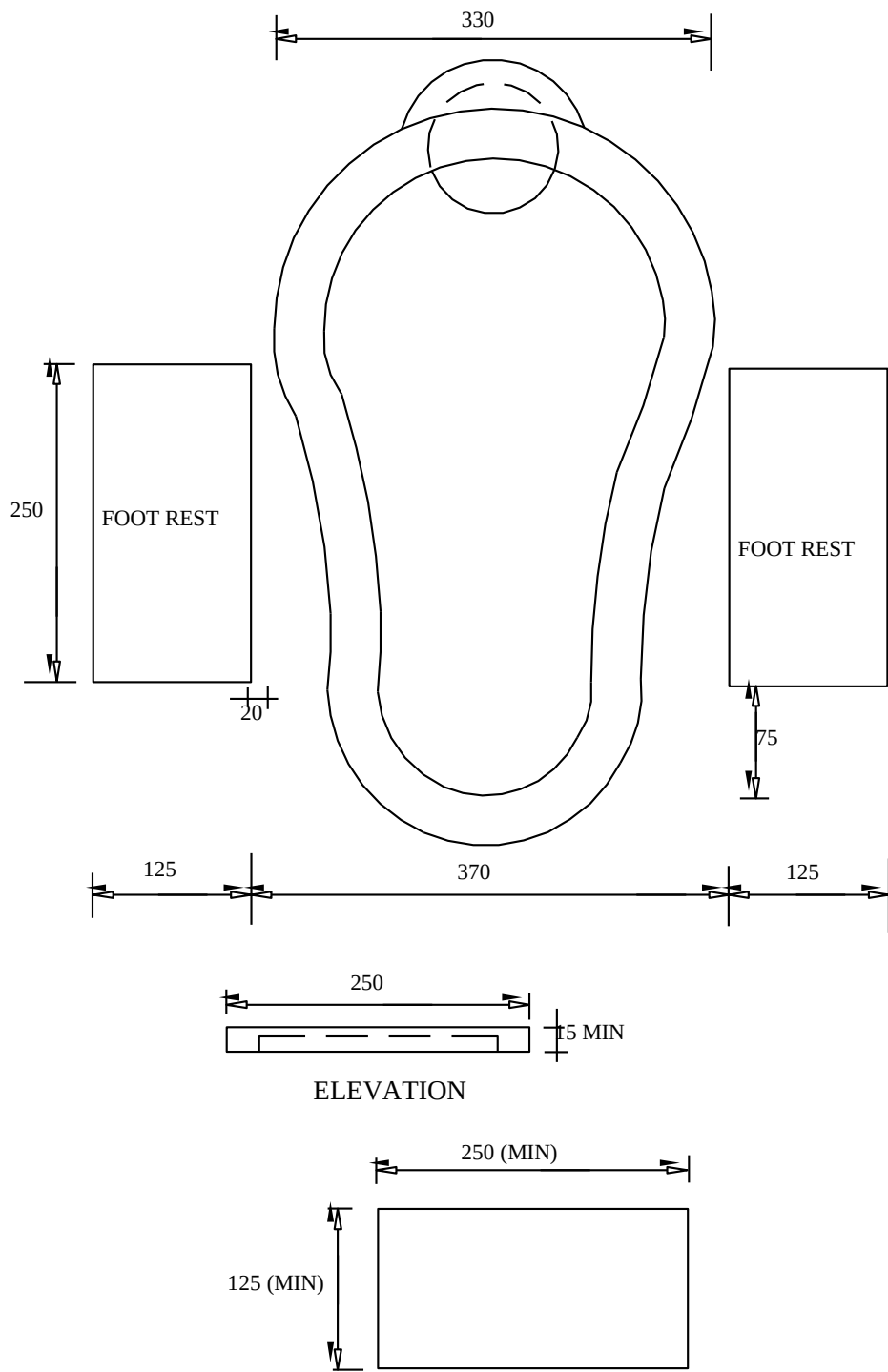
FLUSHING CISTERNS

FIGURE 15.3



FOOT REST

FIGURE 15.4

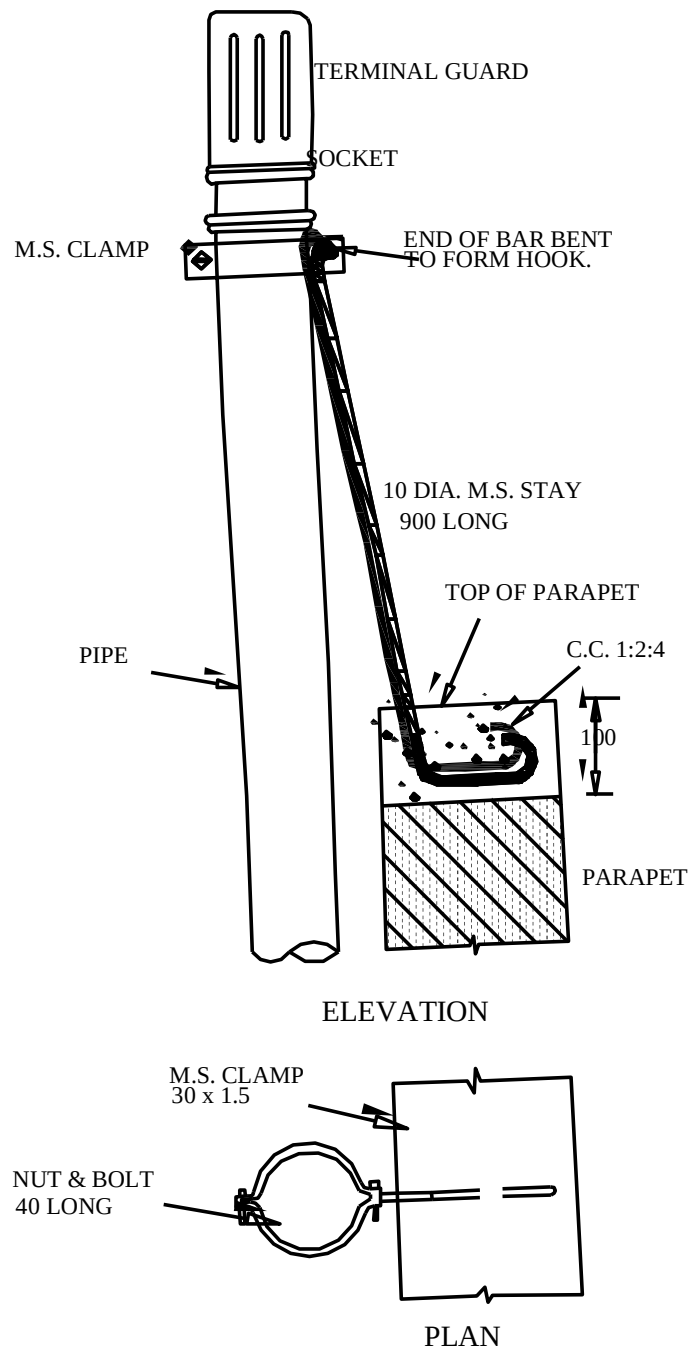


All dimensions are in mm
Drawings not to Scale

PLAN

M.S. STAYS AND CLAMP

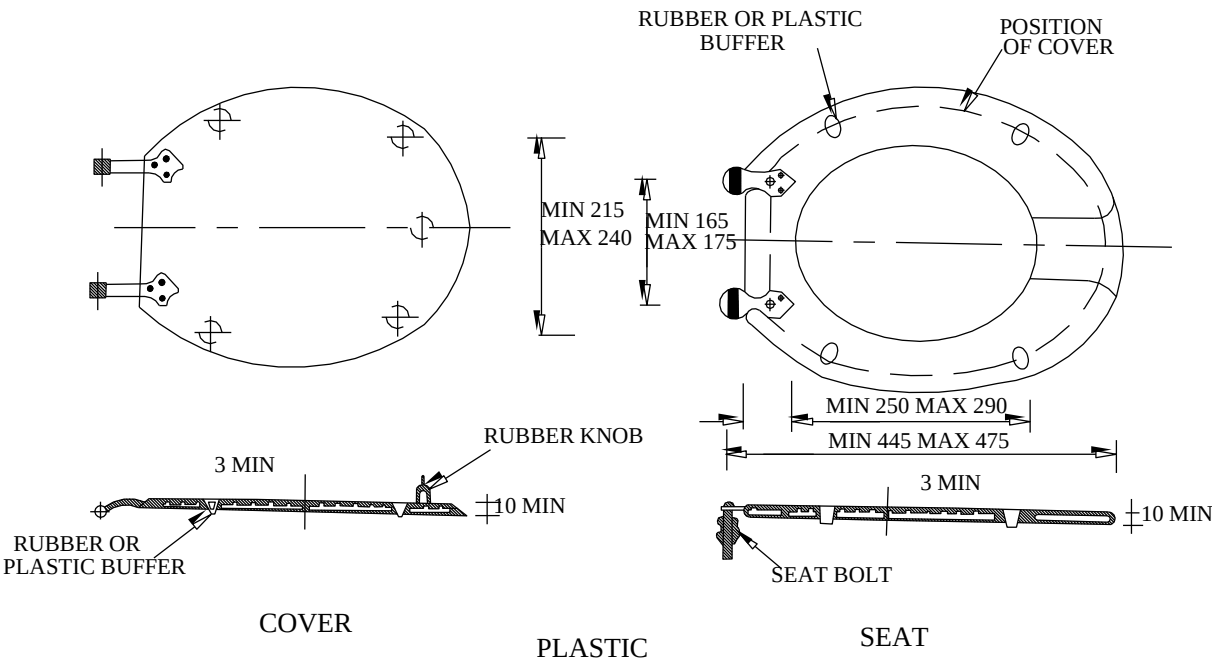
FIGURE 15.5



All dimensions are in mm
Drawings not to Scale

W.C. SEAT AND COVERS

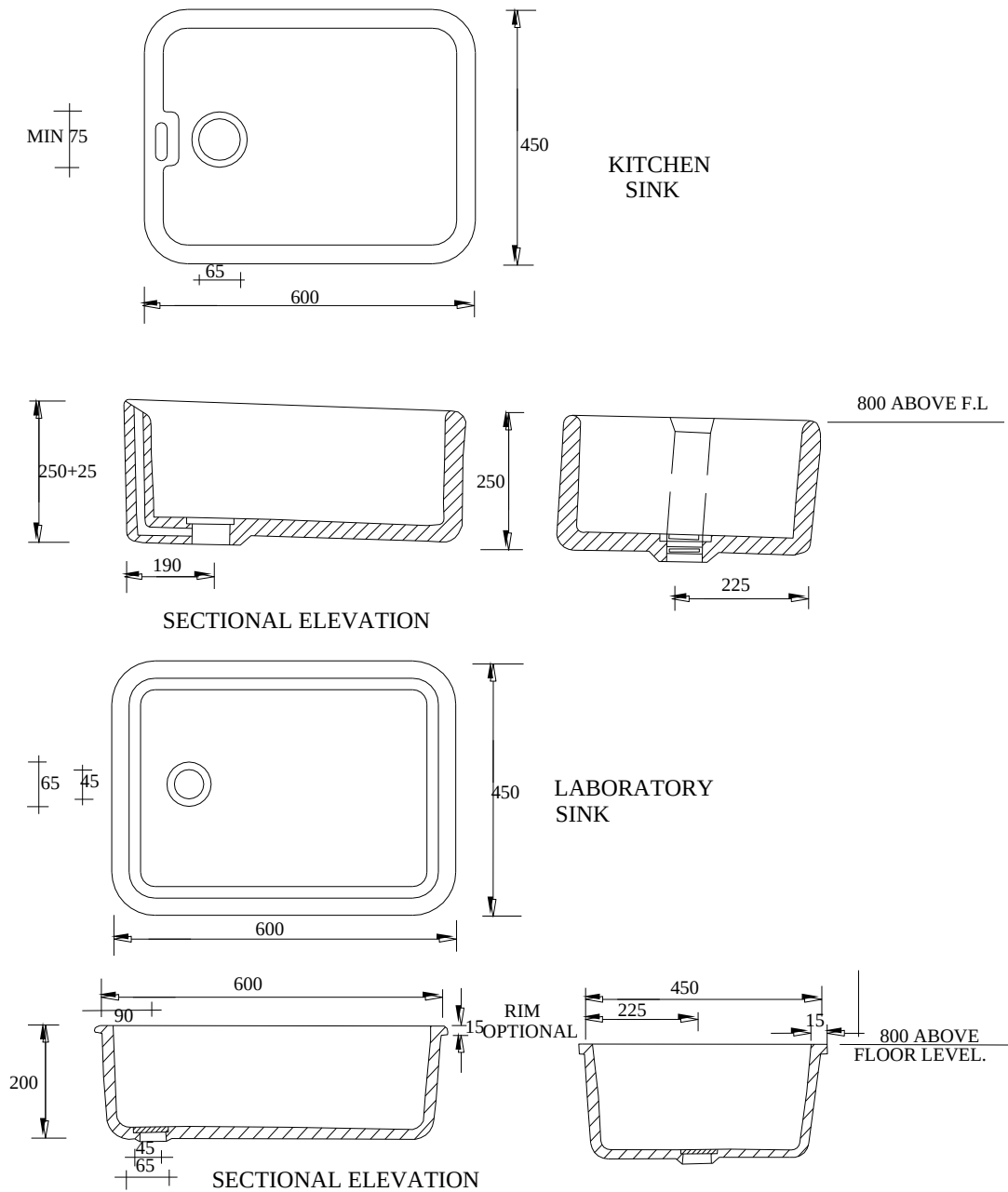
FIGURE 15.6



All dimensions are in mm
Drawings not to Scale

SINKS

FIGURE 15.7



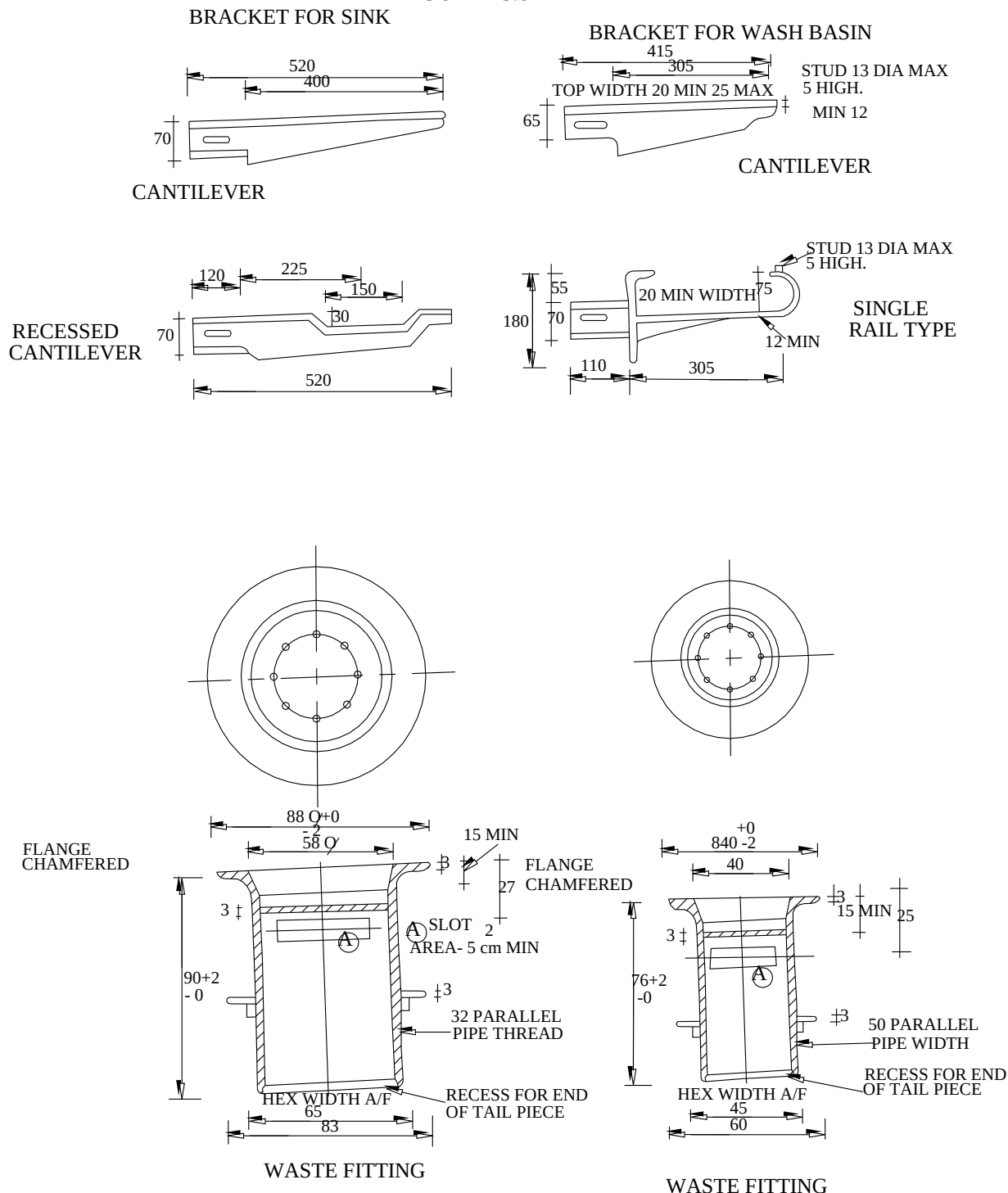
All dimensions are in mm

Drawings not to Scale

Hight of front edge of sink from floor level = 800

C.I. BRACKETS AND WASTE FITTINGS

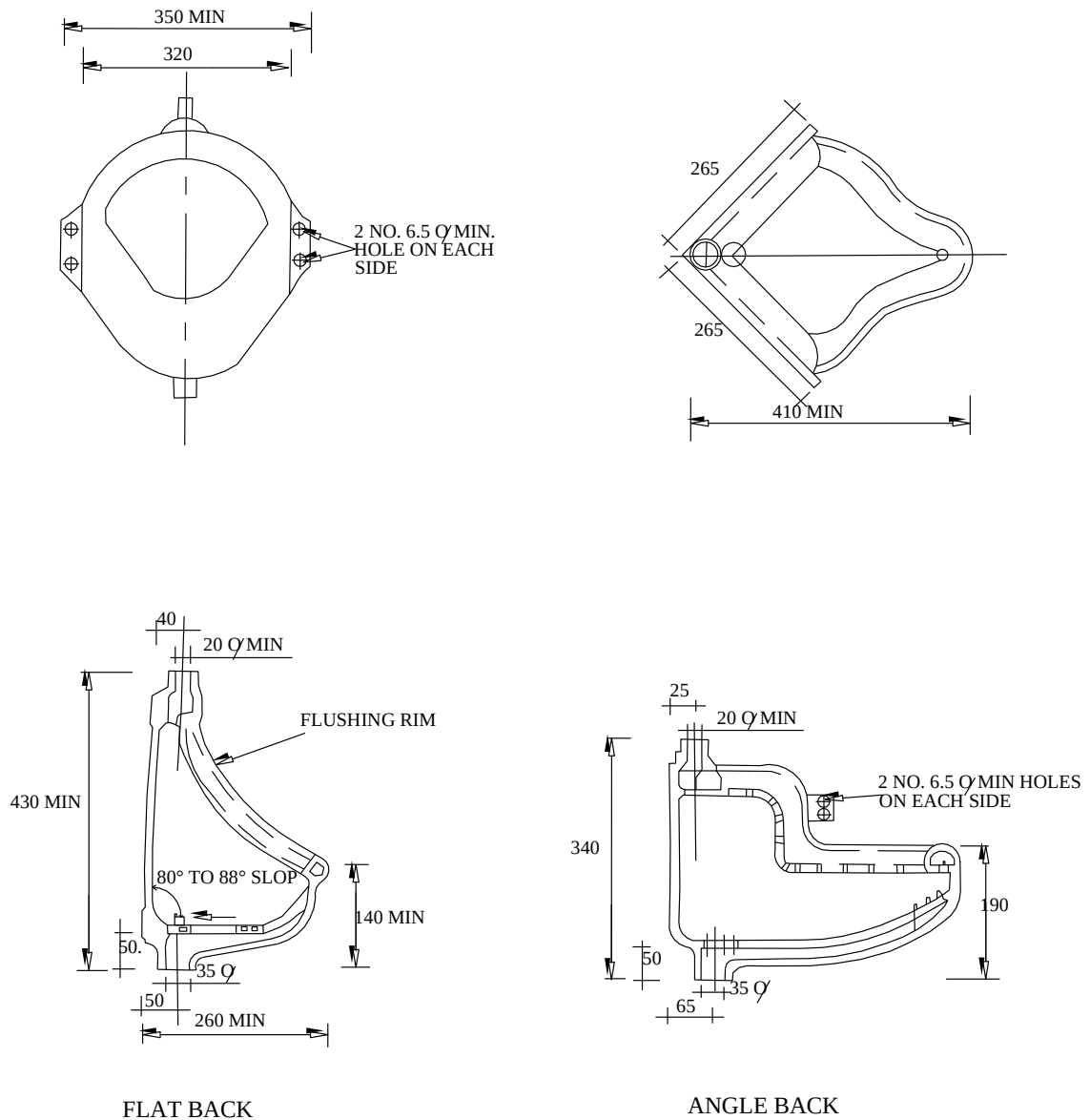
FIGURE 15.8



All dimensions are in mm
Drawings not to Scale
No and size of holes indicative.

URINAL BOWL TYPE

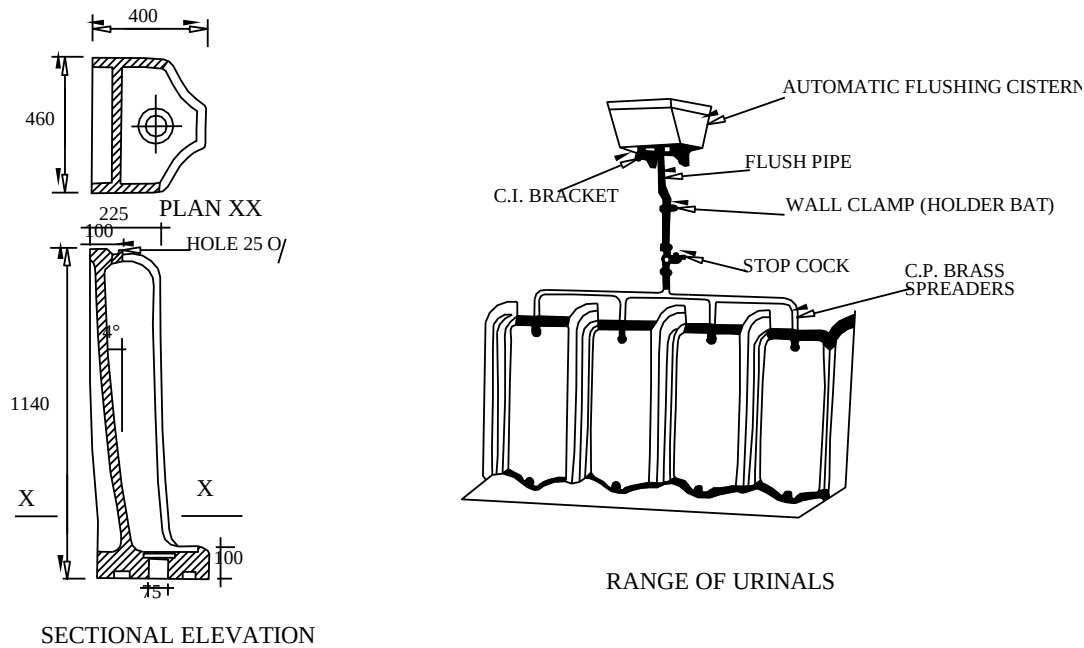
FIGURE 15.9



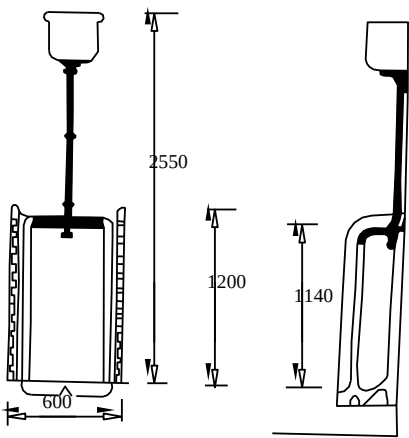
All dimensions are in mm
Drawings not to Scale

URINAL - STALL

FIGURE 15.10



ISOMETRIC

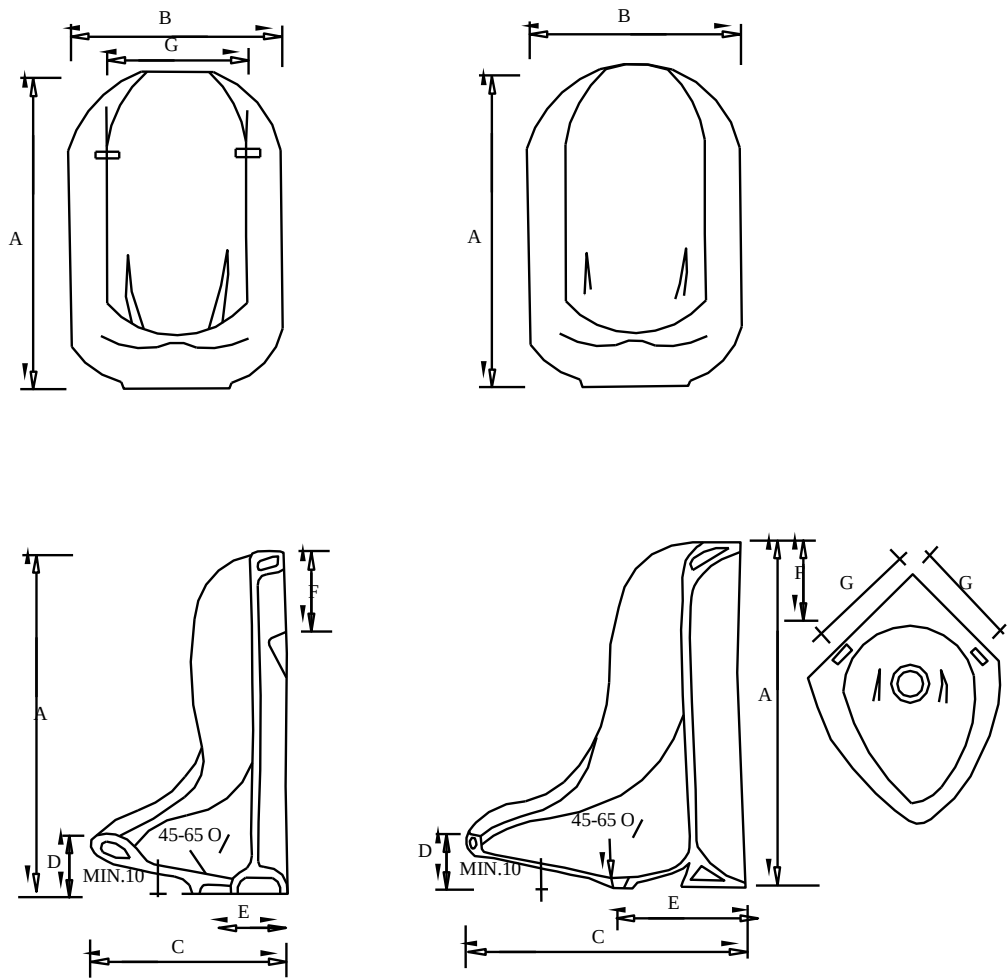


INSTALLATION OF URINAL

All dimensions are in mm
Drawings not to Scale

URINAL HALF STALL

FIGURE 15.11



FLAT BACK

ANGLE BACK

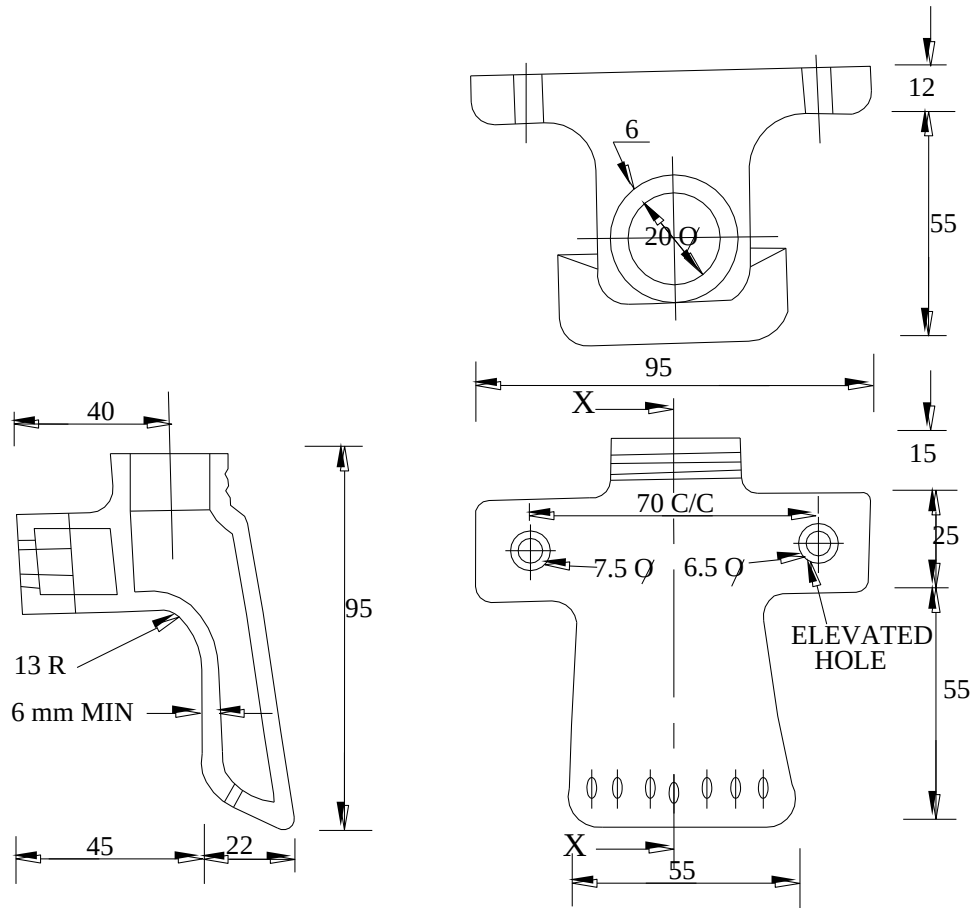
	A	B	C	D	E	F	G		A	B	C	D	E	F	G
	MIN.	MIN.	MIN.	MIN.	MIN.	MIN.	MIN.		MIN.	MIN.	MIN.	MIN.			
580 x 380 x 350 MIN.	580	380	350	100	100	150	250	450 x 375 x 350 MIN.	450	375	350	100	150	125	200
450 x 350 x 300 MIN.	450	350	300	100	100	125	200	580 x 400 x 500 MIN.	500	400	500	100	225	150	200

Height from standing level to the top of dip of urinal = 650

All dimensions are in mm
Drawings not to Scale

SPEADER FOR URINAL

FIGURE 15.12

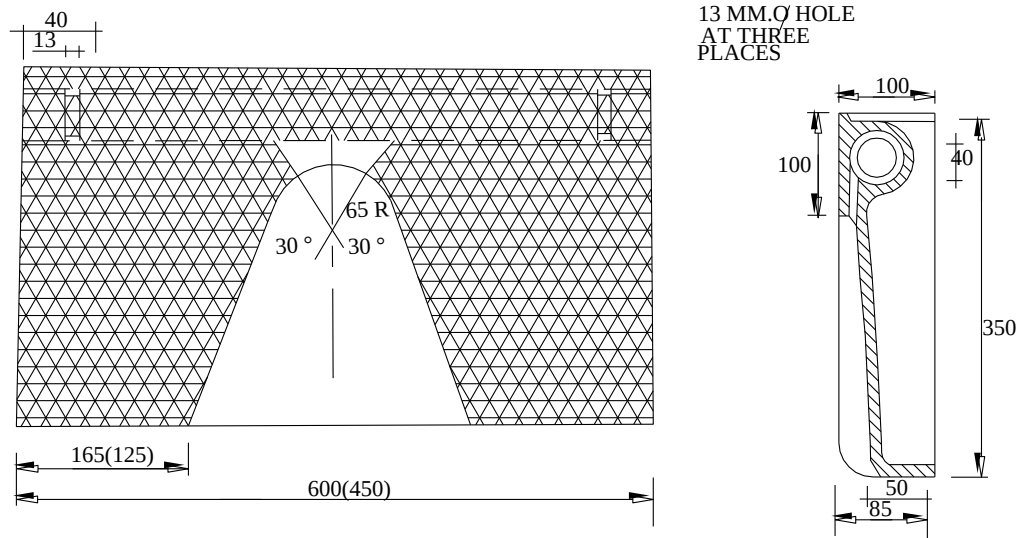
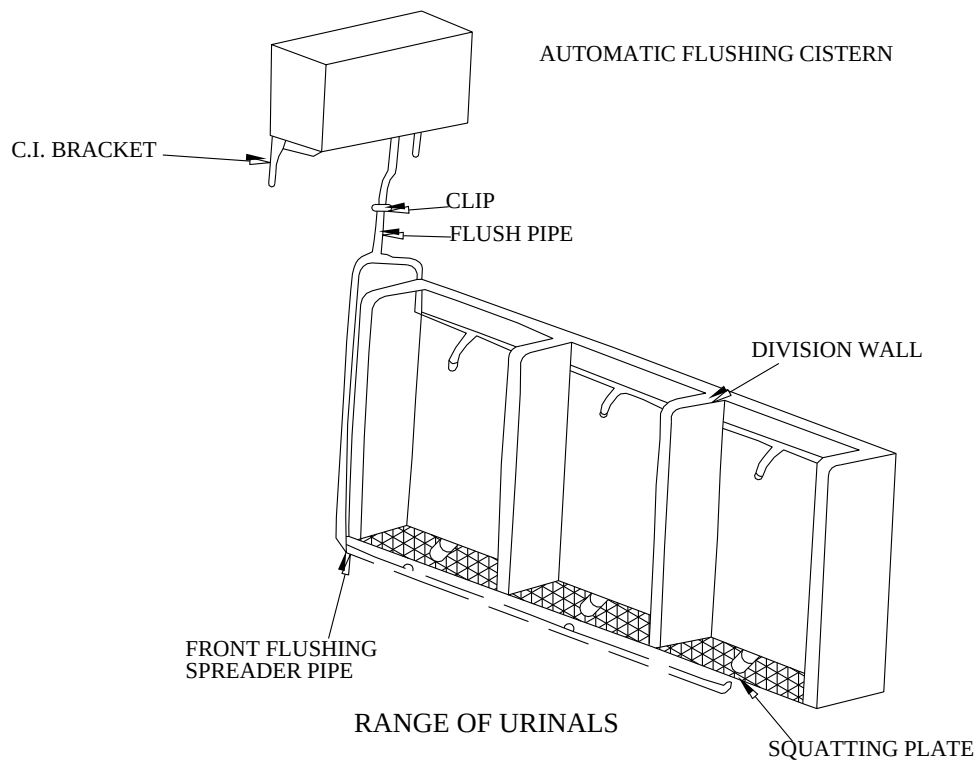


SECTION X-X

All dimensions are in mm
Drawings not to Scale

URINAL SQUATTING PLATE

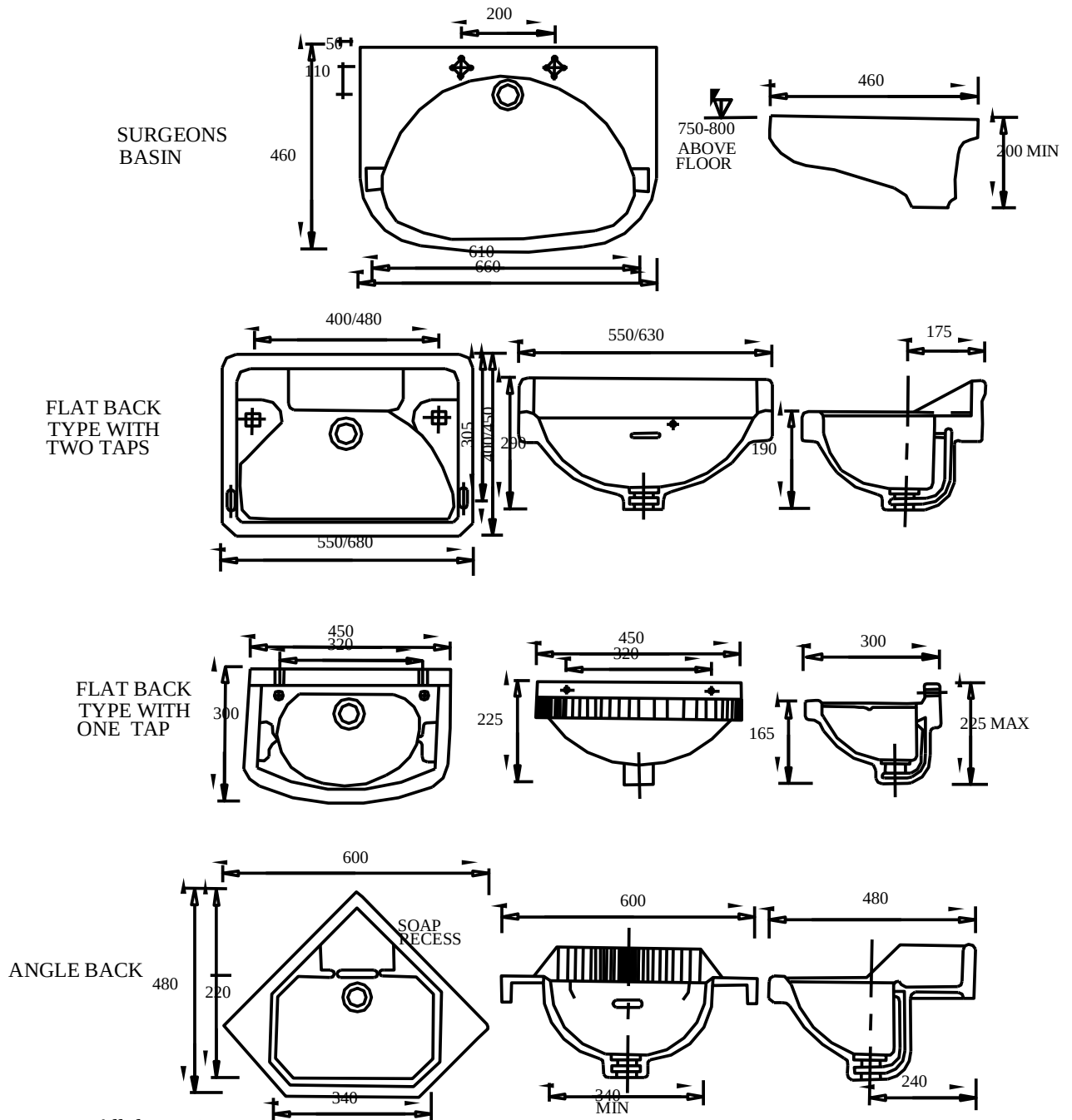
FIGURE 15.13



All dimensions are in mm
 Drawings not to Scale

WASH BASING

FIGURE 15.14

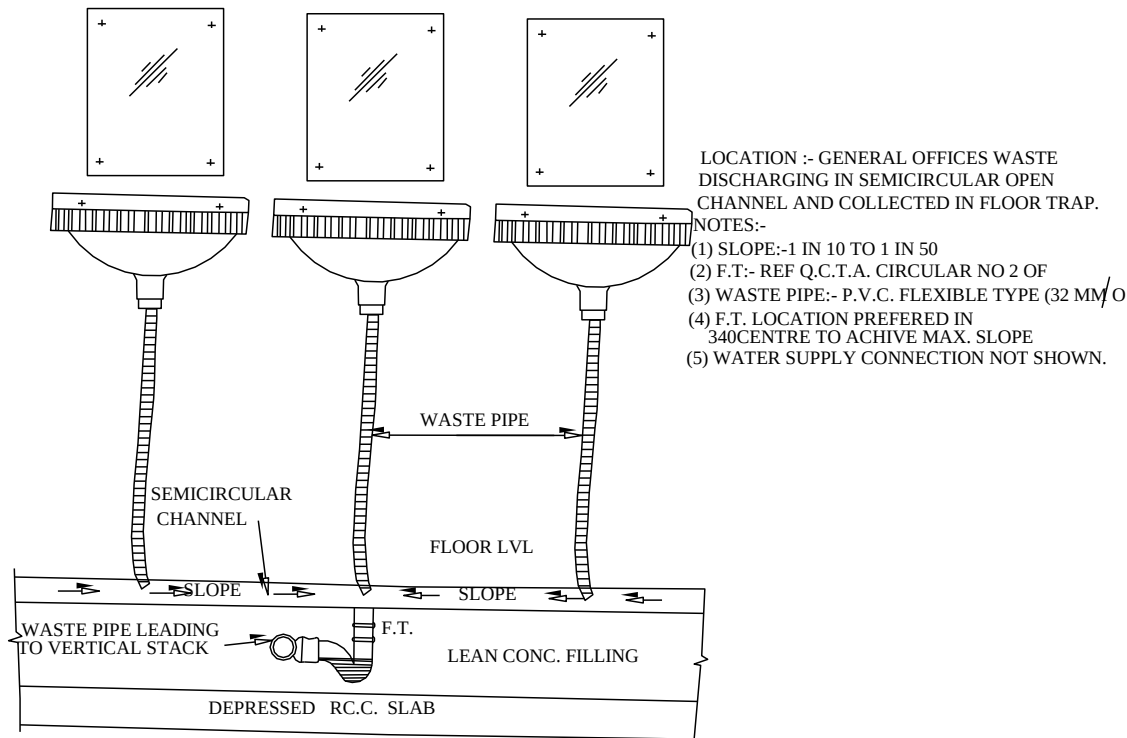


All dimensions are in mm
Drawings not to Scale

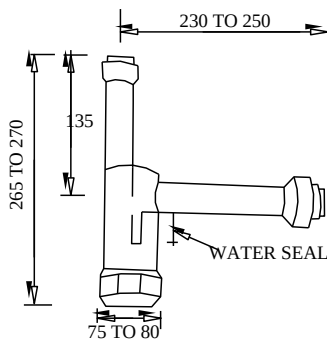
Height of rim of basin from floor = 750 to 800

FIXING ARRANGEMENT OF WASH BASIN
TYP. ELEVATION OF WASH BASIN

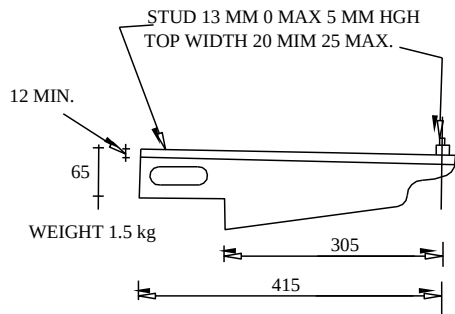
FIGURE 15.15



TYP. ELEVATION OF 3 WASH BASINS IN A ROW



TYP. DET. OF BOTTLE TRAP



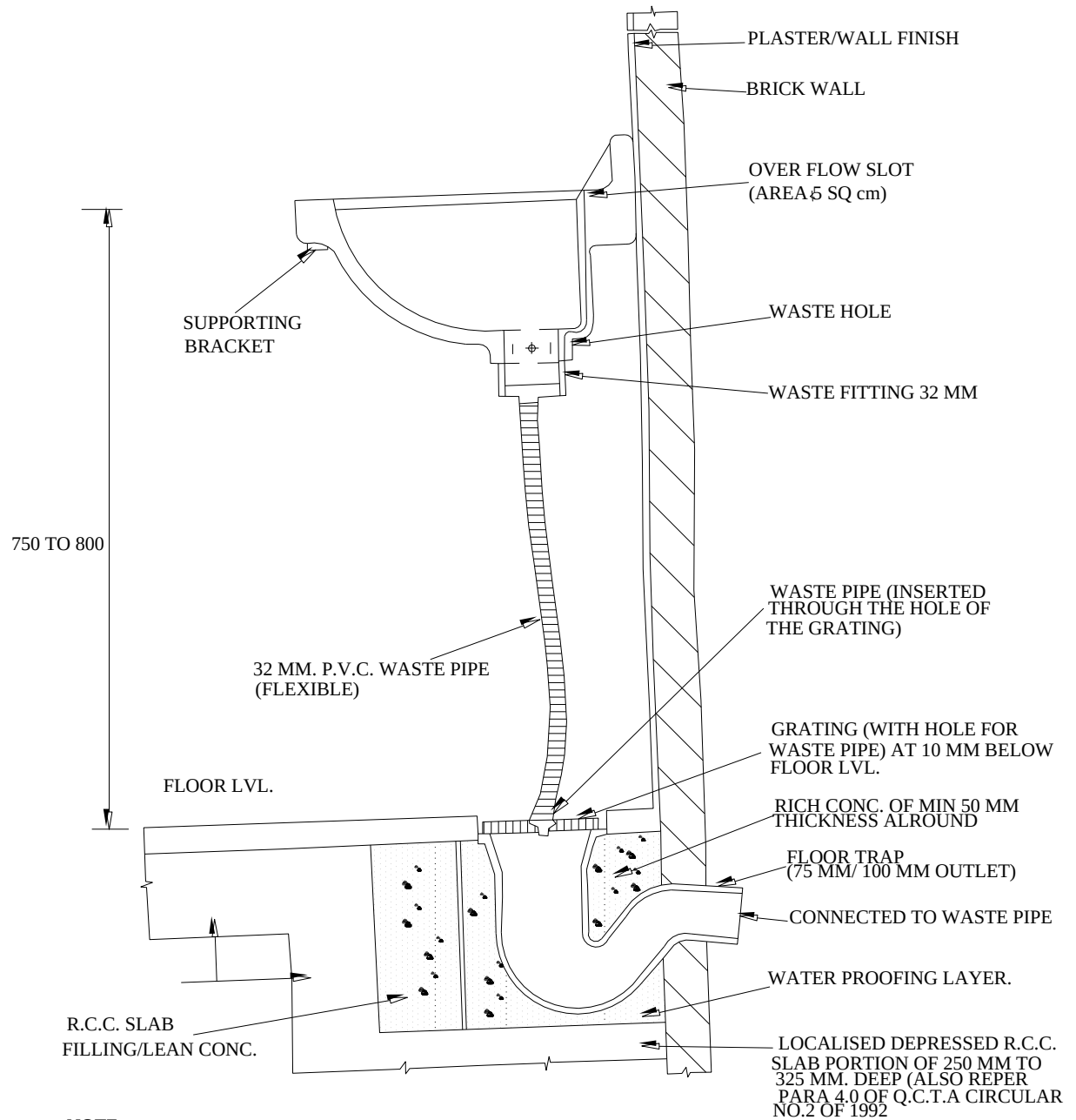
C.I. BRACKET (I.S. 775 1970)

NOTE:-
STUD SHALL BE PROVIDED FOR SUPPORTS
INTENDED FOR GLAZED EARTHENWARE,
VITREOWARE WASH BASINS ONLY

All dimensions are in mm
Drawings not to Scale

TYP. VERTICAL SECTION OF WASH BASIN (WASTE PIPE OPEN TO VIEW)

FIGURE 15.16

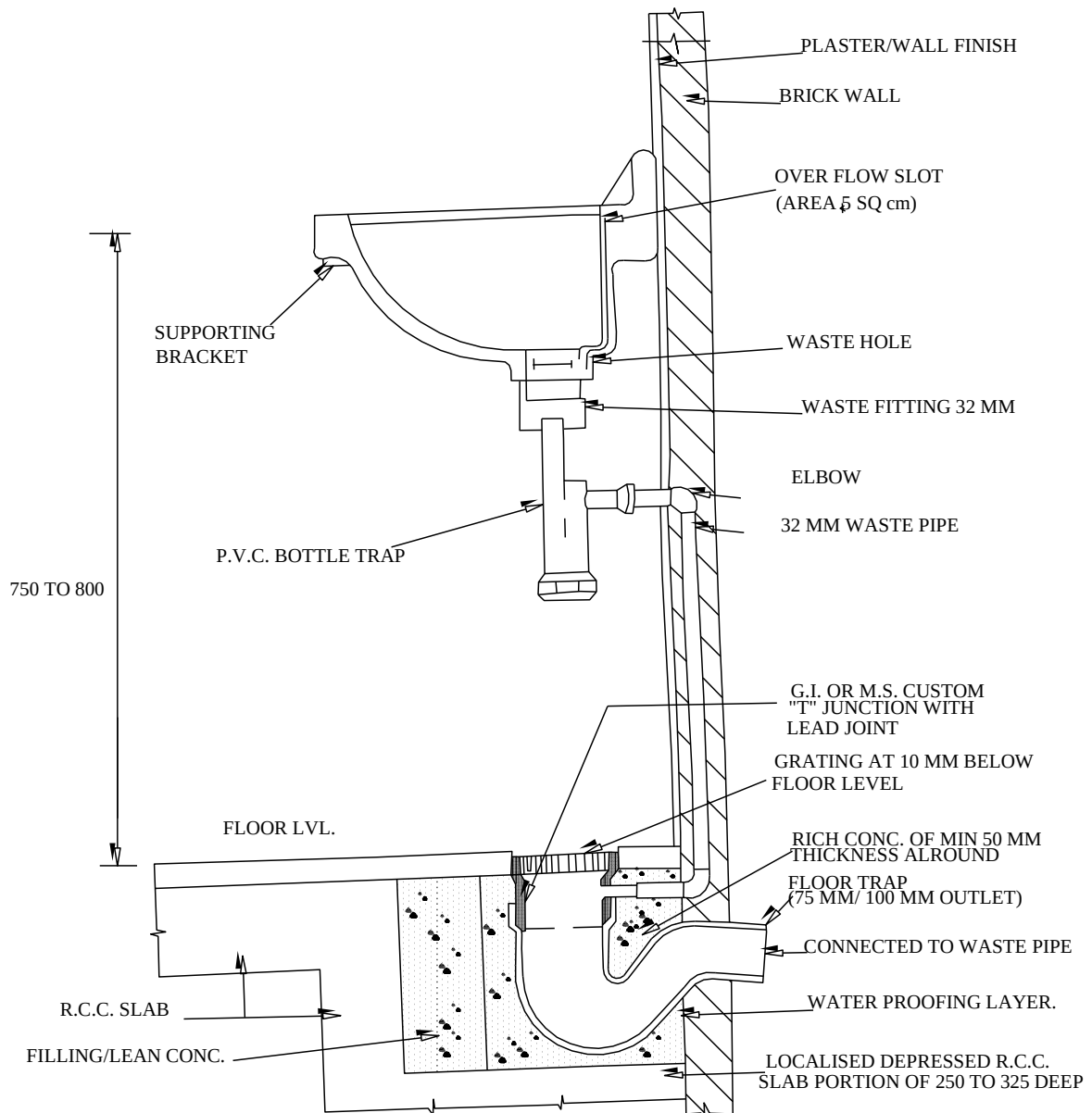


NOTE:-
Recommended for use up to type 3 quarters
& in general offices

All dimensions are in mm
Drawings not to Scale

TYP. VERTICAL SECTION OF WASH BASIN (WASTE PIPE CONCEALED FROM VIEW)

FIGURE 15.17

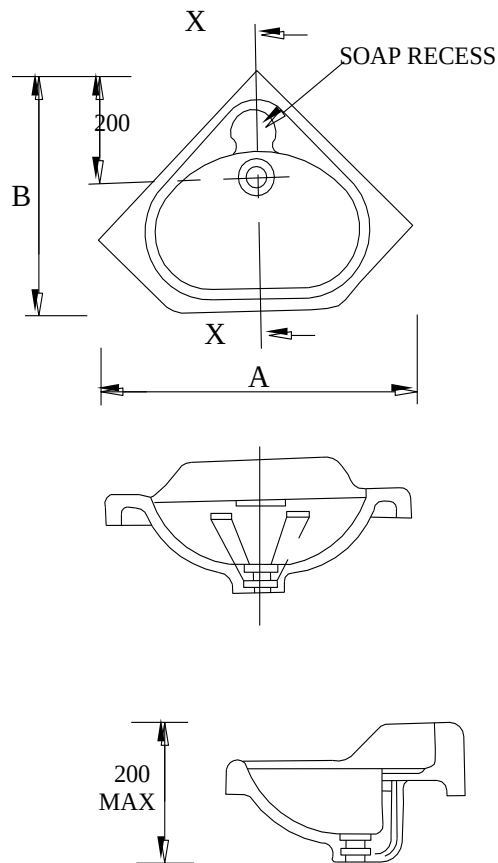


NOTE:-
Recommended for type 4 & above quarters
banglows V.I.P. locations five star hotels &
for personalised use

All dimensions are in mm
Drawings not to Scale

ANGLE BACK WASH BASIN (PATTERN-2)

FIGURE 15.18



SECTION -X-X

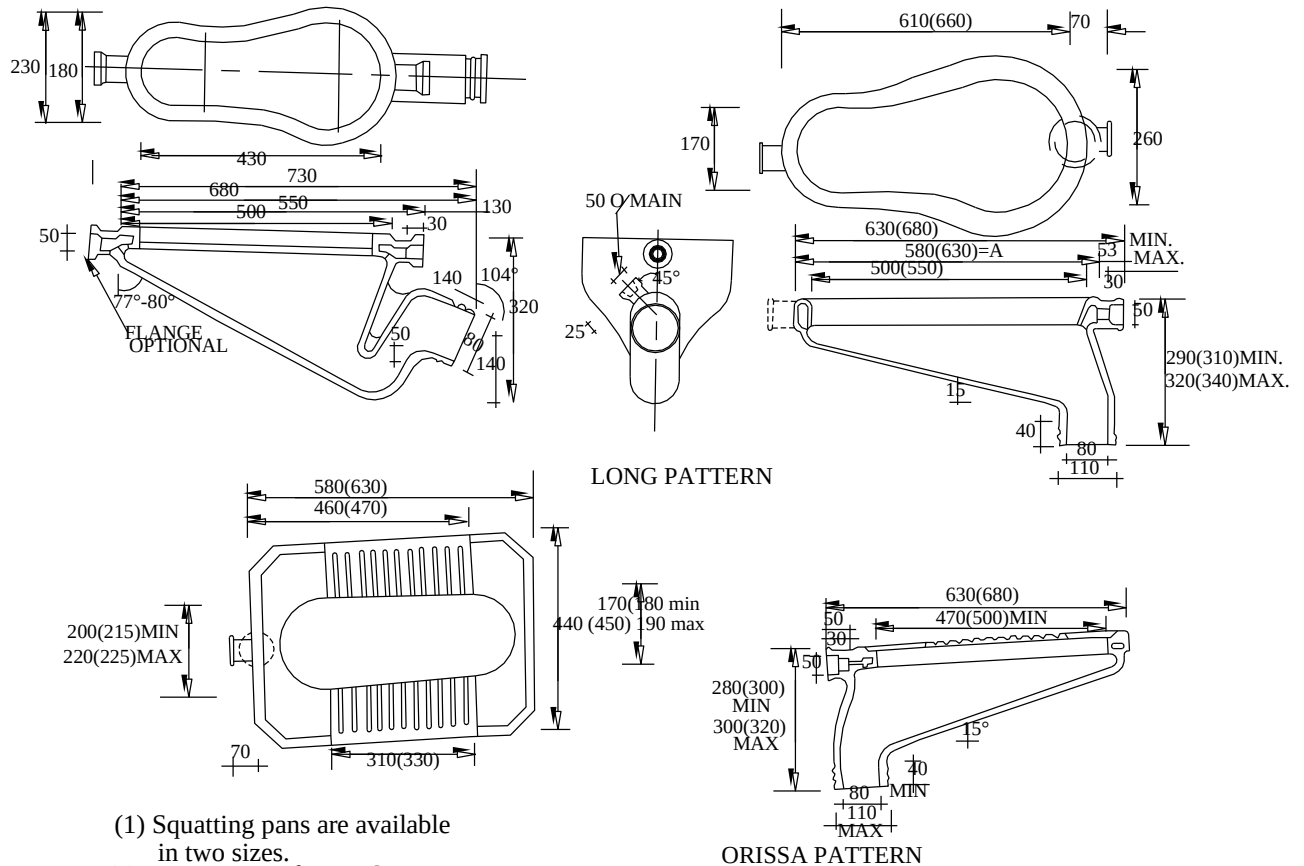
NOTES:-

- (1) Tap hole provisions are not shown, however provision shall be made for 1 or 2 tap holes in any suitable position.
- (2) Stud provisions are not shown but suitable provision shall be made for fixing purposes.
- (3) Provision of/soap recess need not be central in The case of single tap hole.

All dimensions are in mm Drawings not to Scale

SQUATTING PANS

FIGURE 15.19



- (1) Squatting pans are available in two sizes.
- (2) Dimensions of second size are shown within brackets.
- (3) A: size designating the pan

All dimensions are in mm
Drawings not to Scale

WATER CLOSET
(WASH DOWN EUROPEAN - PATTERN 1)

FIGURE 15.20

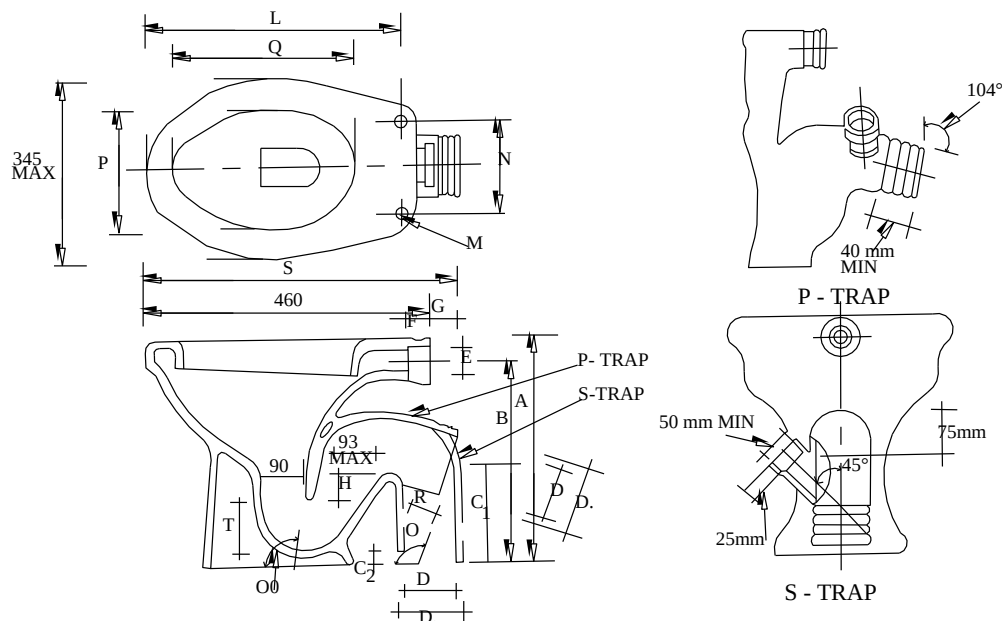


TABLE 1 DIMENSIONS AND PERMISSIBLE TOLERANCE OF
PATTERN 1 WATER CLOSETS
CLAUSE (2.3.1,2.4 AND FIG.1)
All dimensions are in mm

All dimensions are in mm					
S.NO.	DESCRIPTION	REF. IN FIG.2	PATTERN 1 S-TRAP P-TRAP		TOLERANCE
(1)	(2)	(3)	(4)	(5)	(6)
(1)	HEIGHT	A	390	390	±20
(2)	HEIGHT OF CENTRE LINE OF FLUSH INLET	B	350	350	±20
(3)	HEIGHT OF CENTRE LINE OF OUTLET FOR P-TRAP ONLY	C ₁	180		±10
(4)	DISTANCE FROM END OF TRAP TO FLOOR FOR S-TRAP ONLY	C ₂	20		±5
(5)	INTERNAL DIAMETER OF OUTLET, MIN. (SEE NOTE)	D	80	80	±1
(6)	EXTERNAL DIAMETER OF OUTLET, MAX. (SEE NOTE)	D	110	110	±1
(7)	INTERNAL DIAMETER OF FLUSH INLET SOCKET	E	50	50	±3
(8)	DEPTH OF FLUSH INLET SOCKET	F	30	30	±1
(9)	DISTANCE FROM END OF FLUSH INLET SOCKET TO OUTSIDE OF OUTLET, MIN.	G	45	45	±1
(10)	DEPTH OF WATER SEAL	H	NOT LESS THAN 50 mm WATER SURFACE		
(11)	LENGTH FROM SEAT BOLT HOLES TO FRONT RIM	L	430	430	±1
(12)	DIAMETER OF SEAT BOLT HOLES	M	13	13	±1
(13)	DISTANCE BETWEEN CENTRE OF SEAT BOLT HOLES	N	160 MAX.175	160 175	±1
(14)	WIDTH OF OPENING MIN.	P	240	240	±1
(15)	LENGTH OF OPENING MIN.	Q	290	290	±1
(16)	LENGTH OF SERRATED PART OF OUTLET, MIN.	R	40	40	±1
(17)	OVERALL LENGTH	S	500 TO 575	500 TO 575	±1
(18)	ANGLE OF BACK PLATE	90	TO 135	90 TO 135	±1
(19)	ANGLE OF OUTLET	90	TO 135	104	±1
(20)	TRAP INLET DEPTH, MIN.	T	75	75	±1

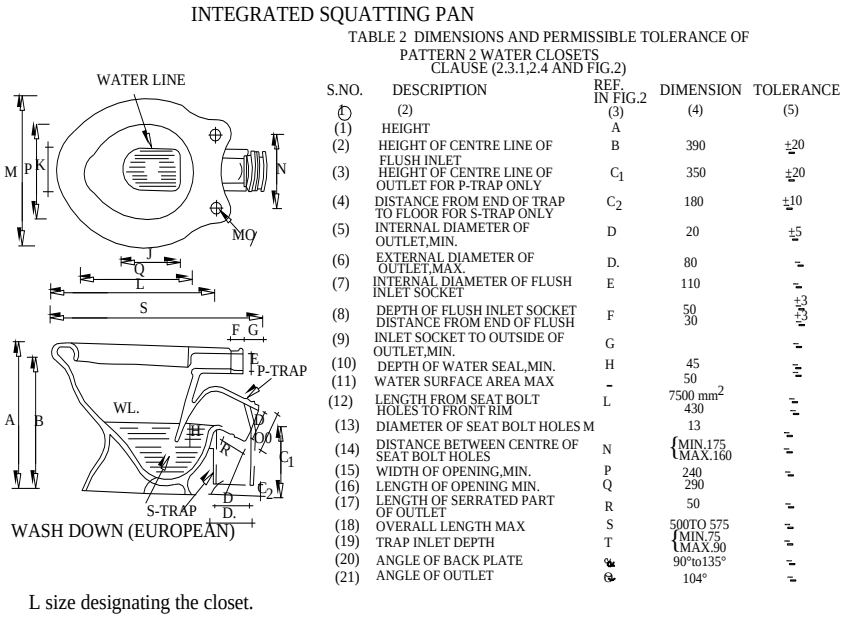
OVALITY PERMISSIBLE WITHIN THE DIMENSIONS FOR INLET AND OUTLET DIAMETERS.

THE DIMENSIONS FOR INTERNAL DIAMETER OF FLUSH INLET SOCKET

SPECIFIED IN THE 1973 VERSION OF THE STANDARD NAMELY, 55.5, SHALL CONTINUS TO BE PERMITTED UP TO 31 DECEMBER 1981 AS ALTERNATE DIMENSIONS AFTER WHICH DATE ONLY THE DIMENSIONS GIVEN IN THE ABOVE TABLE SHALL APPLY.

WATER CLOSET
(WASH DOWN EUROPEAN-PATTERN 2)

FIGURE 15.21



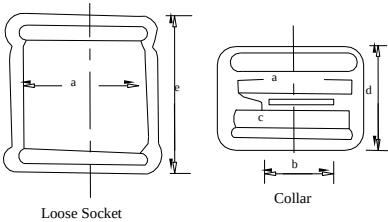
OVALITY PERMISSIBLE WITHIN THE DIMENSIONS FOR INLET AND OUTLET DIAMETERS.

THE DIMENSIONS FOR INTERNAL DIAMETER OF FLUSH INLET SOCKET SPECIFIED IN THE 1973 VERSION OF THE STANDARD NAMELY, 55+5, SHALL CONTINUE TO BE PERMITTED UP TO 31 DECEMBER 1981 AS ALTERNATE DIMENSIONS AFTER WHICH DATE ONLY THE DIMENSIONS GIVEN IN THE ABOVE TABLE SHALL APPLY.

All dimensions are in mm
Drawings not to Scale

LOOSE SOCKET & COLLARS FOR PIPES

FIGURE 15.22



As marked in Fig.	Pipe Dia (Size in mm)			
	50	75	100	150
(a)	76	101	129	131
(b)	50	75	100	150
(c)	10	10	10	10
(d)	79	89	95	108
(e)	89	101	114	140

Note : The dimensions of loose sockets shall correspond to those of appropriate nominal size of pipe.