

Indian Standard

CODE OF PRACTICE FOR
INSTALLATION OF SEPTIC TANKS

PART I DESIGN CRITERIA AND CONSTRUCTION

(Second Revision)

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BUREAU OF INDIAN STANDARDS
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Indian Standard

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PART I DESIGN CRITERIA AND CONSTRUCTION

(Second Revision)

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IS : 2470 (Part 1) - 1985

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Indian Standard

CODE OF PRACTICE FOR INSTALLATION OF SEPTIC TANKS

PART I DESIGN CRITERIA AND CONSTRUCTION

(Second Revision)

0. FOREWORD

0.1 This Indian Standard (Part 1) (Second Revision) was adopted by the Indian Standards Institution on 28 February 1985, after the draft finalized by the Water Supply and Sanitation Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 This standard was first printed in 1963 and subsequently revised in 1968 which covered small installation. Large installation septic tanks were given in IS : 2470 (Part 2) which was first printed in 1964 and subsequently revised in 1971. This revision incorporates the following major changes.

0.2.1 Design criteria of septic tank, based on certain assumptions, has been given in detail.

0.2.2 Design of inlets and outlets have been modified for the smooth working of the tanks.

0.2.3 Arrangements for installing tanks in parallel for the treatment of sewage for population of more than 300 persons have been included.

0.2.4 The procedure for the removal of the sludge has been elaborated.

0.2.5 This standard covers the design and construction of septic tank for small installations (up to 20 persons) as well as large installations.

0.2.6 The requirements for secondary treatment and disposal of septic tank effluent have been covered in Part 2 of this Code.

0.2.7 The title of the code which was originally 'Code of practice for design and construction of septic tank : Part I Small installations and Part II Large installations', has also been amended to read 'Code of practice for installation of septic tanks : Part I Design criteria and construction'.

0.3 In unsewered areas, if adequate water supply is available for flushing, treatment of the liquid waste in septic tanks is recommended.

0.4 This code of practice represents a standard of good practice and therefore takes the form of recommendation.

0.5 Septic tank offers a preliminary treatment of sewage prior to final disposal. Sewage is held in these tanks for some prescribed period during which time the suspended solids present in the storage settle down. The settled sludge and the supernatant liquor undergoes anaerobic digestion. The digestion results in appreciable reduction in the volume of sludge and reduction in organic matter in the liquid.

0.6 Unsatisfactory design, construction and maintenance of septic tanks constitute a health hazard. It is, therefore, considered essential to lay down minimum standards for guidance of concerned authorities. It is hoped that this code which has been prepared with a view to giving guidance on proper design, construction and maintenance of septic tanks, will be found useful by local bodies, public works departments and others engaged in this field.

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

1. SCOPE

1.1 This code (Part 1) lays down recommendations for the design, layout, construction and maintenance of septic tanks. It is applicable to houses, flats, residential housing colonies, hostels and boarding schools where the number of users does not exceed 300 persons.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Effluent — The supernatant liquid discharge from a septic tank.

2.2 Invert — The lowest point of the interior of a sewer or drain at any cross-section.

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

2.4 Septic Tank — A water-tight single storeyed tank in which sewage is retained sufficiently long to permit sedimentation.

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

2.5 Sewage — The liquid waste of a household or community including human excreta.

2.6 Sludge — Sludge is the settled solid matter in semi-solid condition.

2.7 Surface Water — The run-off from precipitation and other water that flows over surface of the ground.

2.8 Supernatant Liquor — The layer of liquid overlying the settled solids which have separated from it.

2.9 Suspended Solids — The solids which are suspended in a sewage or effluent.

2.10 T. W. L. — The top water level in a tank.

2.11 Waste Water (Sullage) — The discharge from wash basins, sinks and similar appliances, which does not contain human excreta.

3. DESIGN CONSIDERATIONS

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

3.1.1 Surface and subsoil water should not find way into the septic tank.

3.1.2 Normally, the septic tanks are designed for foul sewage (faecal matter and urine). Sullage wastes may be distributed crudely by throwing on the gardens or grassed areas and so dispersed and absorbed, or may be drained to a seepage pit or dispersion trench from which it overflows into or is absorbed by the surrounding soil.

NOTE — Pits and trenches for the disposal of sullage shall be so located as to avoid contamination of watercourses or underground water supplies.

3.1.3 Under no circumstances should effluent from a septic tank be allowed into an open channel drain or body of water without adequate treatment.

3.1.4 Wastes containing excessive detergents, grease and disinfectants should not be treated in septic tank as they adversely affect the anaerobic decomposition.

3.1.5 Where the incoming drain is steep due to site conditions, the last section of the drain, at least 12 m in length should not be laid at a gradient not steeper than 1 : 50 in order to minimize turbulence in the tank.

3.1.6 When the pumping arrangement is provided before the septic tanks the sewage from the pump should not be discharged directly into the

septic tank. Normally, the discharge from the pump is first lead into a tank and then the sewage is allowed to flow into the septic tank gravitationally and the provisions of 3.1.5 shall also be observed.

3.1.6.1 The rate of pumping of sewage shall not exceed three times D.W.F.

3.1.7 Pipe Diameter — For practical considerations, a minimum nominal diameter of 100 mm is recommended.

3.2 Layout

3.2.1 The layout should be as simple and direct as practicable.

3.2.2 The pipes should be laid, as far as possible, in straight lines in both vertical and horizontal planes; however, where bends are unavoidable, they should be long radius bend with cleaning eyes. Anything that is likely to cause irregularity of flow should be avoided.

3.2.3 At junctions of pipes in manholes, direction of flow from a branch connection should not make an angle exceeding 45° with the direction of flow in the main pipe.

3.2.4 A typical arrangement of the layout of septic tank sewerage system is illustrated in Fig. 1.

3.3 Location of Septic Tank

3.3.1 Septic tank should be located at a place open to sky, as far away as possible from the exterior of the wall of building and should not be located in swampy areas or areas prone to flooding. It should also be accessible for cleaning.

3.4 Septic Tank Design

3.4.1 Sewage flow

3.4.1.1 The maximum flow to the tank is based on the number of plumbing fixtures discharging simultaneously. For this purpose various sanitation facilities are equated in terms of fixtures units. Fixture equivalents are given in Table 1.

NOTE — Fixture unit is a quantity in terms of which the load producing effect of different plumbing fixtures on the plumbing system are expressed on some arbitrarily chosen scale. In the design of septic tank, it is taken as 9 litres per minute.

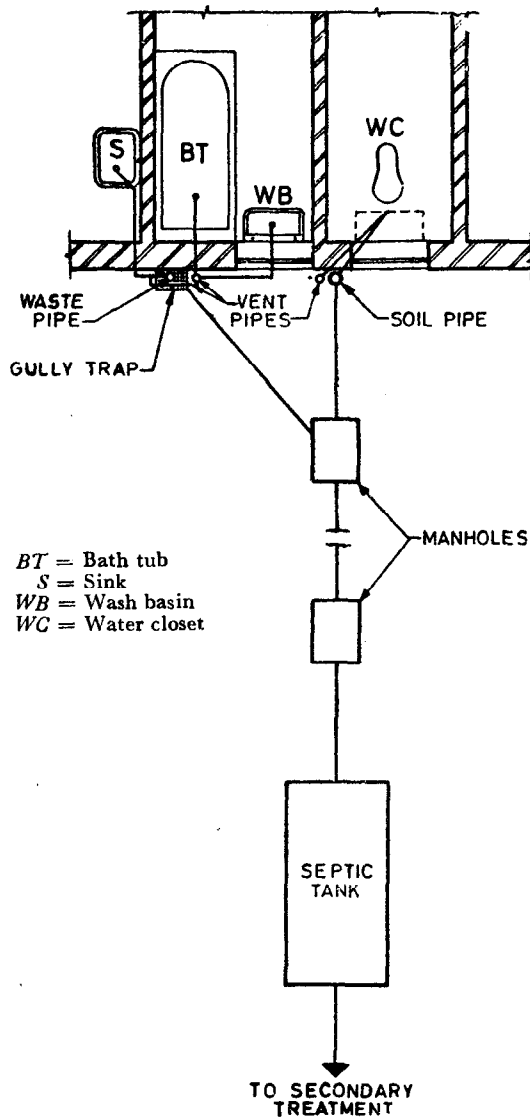


FIG. 1 TYPICAL LAYOUT OF A SEPTIC TANK SEWERAGE SYSTEM

TABLE 1 FIXTURE EQUIVALENT

(Clause 3.4.1.1)

FACILITY	EQUIVALENT FIXTURE UNIT
Water closet	1
Bath	1/2
Wash basin/kitchen sink	1/2
Urinal (with autoflush)	1
Urinal (without autoflush)	1/2
Slop sink	1
Laboratory sink	2
Combination fixture	1
Shower bath	1
Bath tub	2
Drinking fountain	1/2
Ablution tap	1/2
Dish water	1/2

3.4.1.2 The estimated number of fixture units and the number of fixture units that contribute to the peak discharge in small installations serving up to 20 persons, for residential housing colonies up to 300 persons and for hostels and boarding schools are given in Tables 2 to 4.

TABLE 2 ESTIMATED PEAK DISCHARGE FOR SMALL TANKS UP TO 20 USERS

NUMBER OF USERS	NUMBER OF FIXTURE UNITS	PROBABLE NUMBER OF FIXTURE UNITS DISCHARG- ING SIMULTANEOUSLY	PROBABLE PEAK DISCH- ARGE lpm
(1)	(2)	(3)	(4)
5	1	1	9
10	2	2	18
15	3	2	18
20	4	3	27

NOTE 1 — Number of fixture units is based on the assumption that each house consisting of 5 persons may have one WC which will discharge into septic tank.

NOTE 2 — Probable number of fixture units are based on 70 percent fixture units discharging simultaneously.

TABLE 3 ESTIMATED PEAK DISCHARGE FOR RESIDENTIAL COLONIES
(Clause 3.4.1.2)

No. OF USERS	No. OF HOUSEHOLDS	No. OF FIXTURE UNITS	PROBABLE PEAK DISCHARGE lpm
(1)	(2)	(3)	(4)
50	10	20	108
100	20	40	216
150	30	60	324
200	40	80	432
300	60	120	648

NOTE 1 — Probable peak discharge is based on 60 percent fixtures units discharging simultaneously

NOTE 2 — Each household consisting of 5 persons may have 1 WC, 1 bath and 1 wash basin/kitchen sink.

TABLE 4 ESTIMATED PEAK DISCHARGE FOR HOSTELS AND BOARDING SCHOOL

(Clause 3.4.1.2)					
No. OF USERS	W. C.	BATH	WASH BASIN/ KITCHEN SINK	No. OF FIX- TURE UNITS	PROBABLE PEAK DISCHARGE lpm
(1)	(2)	(3)	(4)	(5)	(6)
50	6	6	6	12	76
100	12	12	12	24	130
150	19	19	19	38	205
200	25	25	25	50	270
300	37	37	37	74	400

NOTE — Probable peak discharge is based on 70 percent of fixture units discharging simultaneously.

3.4.2 Sedimentation

3.4.2.1 The surface area of the tank required will be 0.92 m^2 for every 10 litres per minute of peak flow rate at a temperature of 25°C .

3.4.2.2 A minimum depth of sedimentation shall be 250 to 300 mm.

3.4.3 Sludge Digestion

3.4.3.1 Per capita suspended solids entering the tank may be taken as 70 g/day.

3.4.3.2 The capacity required for sludge digestion is 0.033 m^3 per capita at 25°C .

3.4.3.3 Volume of digested sludge is normally 0.00021 m^3 per capita per day.

3.4.4 Detention Time

3.4.4.1 A septic tank designed on the basis of 3.4.1, 3.4.2 and 3.4.3 provides a detention period of 24 to 48 hours based on an average daily flow of sewage.

3.4.5 Dimensions of Septic Tank

3.4.5.1 Septic tank shall have minimum width of 750 mm, minimum depth of one metre below water level and a minimum liquid capacity of 1 000 litres.

3.4.5.2 For rectangular septic tanks, the length of the tank shall be 2 to 4 times the width. Suitable sizes of septic tanks are given in Appendix A.

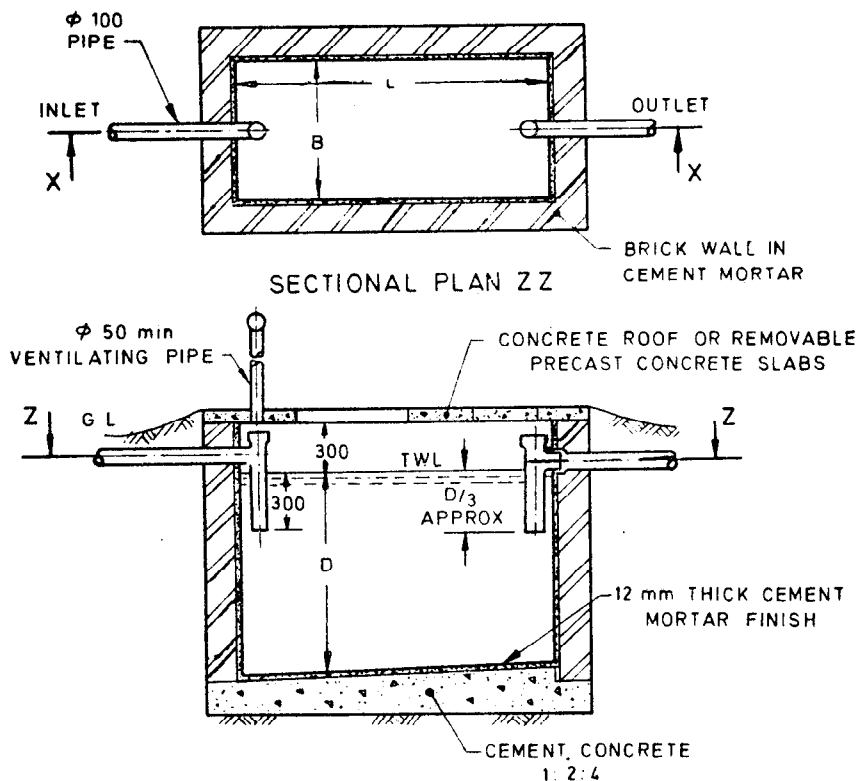
3.4.5.3 For circular tanks the minimum diameter shall not be less than 1.35 m and operating depth shall not be less than 1.0 m.

3.4.5.4 Inlet — The design of septic tank inlets shall be such as to introduce the crude sewage with the least possible disturbance of the settled sludge or the surface scum. For tanks not more than 1 200 mm wide, T-shaped dip-pipe not less than the nominal bore of incoming drain may be provided. The pipe shall be fixed inside the tank, with top limb rising above scum level and the bottom limb extending about 300 mm below the top water level. Typical sketch of the septic tank is given in Fig. 2 and 3.

For tanks in excess of 1200 mm in width, two or more submerged inlets are preferable. Typical sketch of the septic tank is shown in Fig. 4. One method of providing such inlets is by the use of submerged bends of the same nominal bore (not less than 100 mm) set as closely together as practical in a shallow sump formed within a small benched chamber (see Fig. 5). It is important that the invert of the benched channel be 58 mm above the top water level and the inlet ends of the submerged bends should be set flush with the floor of the sump which should be not less than 75 mm below top water level. The sump may be the full width of the chamber, but should not exceed 1.5 times the nominal bore of the inlet bends in other direction. The inverts of the outlet ends of these bends should be between 300 and 525 mm below top water level in the tank. A baffle should be provided 150 mm from the inlet end of the tank, extending 150 mm below the invert of the inlet pipes and 150 mm above the top water level.

3.4.5.5 Outlet — The final outlet for tanks which are less than 1 200 mm wide should be by 100 mm nominal bore dip-pipe fixed inside the tank with a top limb rising above scum level and the bottom limb extending to about 1/3 of the liquid depth below top water level. The invert of the outlet pipe shall be 50 mm below the invert of the inlet pipe.

For wider tanks, it is necessary to use a weir outlet extending the full width of the tank and protected by a scumboard fixed 150 mm from the weir and extending 150 mm above and 1/3 of liquid depth below the top water level. A deflector should be formed either in the structure of the end (outlet) wall or by a purpose-made deflector to prevent rising particles from reaching the outlet weir. This deflector should be located 150 mm below the base of the scum board and protrude 150 mm into the tank (see Fig. 4).



All dimensions in millimetres.

FIG. 2 TYPICAL SKETCH OF SINGLE COMPARTMENT SEPTIC TANK UP TO 20 USERS

3.4.6 Partitions — Where the capacity of a septic tank exceeds 2 000 litres, the tank may be divided into two chambers by means of a fixed durable partition. The partition shall be located so that the capacity of the first chamber is twice that of the second chamber. Suitable openings rectangular or circular with minimum dia 100 mm and maximum 150 mm shall be provided in the partition at approximately 300 mm below TWL.

3.4.7 For population of over 100, duplicating tanks, each providing half the total calculated capacity required, should be installed and operated in parallel. This arrangement permits all the flow to be passed through one unit while the other is being desludged. To enable the top water to be decanted when desludging, a decanting valve should be provided in the wall dividing the two tanks; the invert of this valve should be 625 mm below TWL.

3.4.8 Free-Board — A minimum free board of 300 mm should be provided.

3.4.9 Access Openings and Cover — Each compartment of a septic tank shall be provided with a rectangular access opening measuring not less 455 × 610 mm or a circular opening 500 mm diameter. The cover to access openings shall be of reinforced concrete or of cast iron. A cover shall incorporate a suitable lifting device and when in place after installation of the septic tank shall fit neatly and be sealed to prevent the ingress of water.

3.4.10 Ventilating Pipe — Every septic tank shall be provided with ventilating pipe of at least 50 mm diameter. The top of the pipe shall be provided with a suitable cage of mosquito proof mesh.

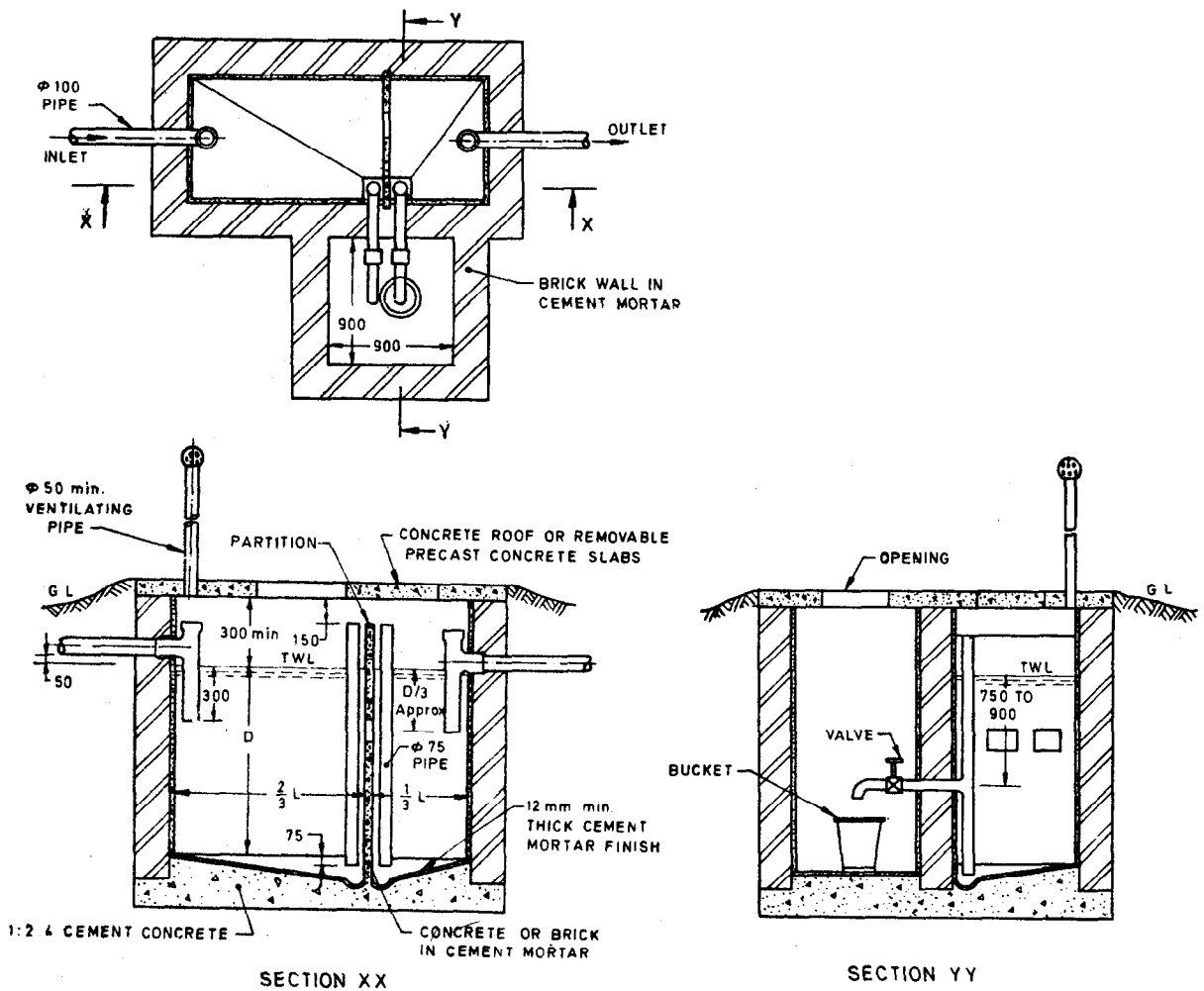
The ventilating pipe shall extend to a height which would cause no smell nuisance to any building in the area. Generally the ventilating pipe may extend to a height of about 2 m when the septic tank is at least 20 m away from the nearest building and to a height of 2 m above the top of the building when it is located closer than 20 metres. The ventilating pipe may also be connected to the normal soil ventilating system of the building where so desired.

4. SEPTIC TANK CONSTRUCTION

4.1 Floor — It is essential that the floor of the tank be water tight and of adequate strength to resist earth movement and to support the weight of the tank walls and contents.

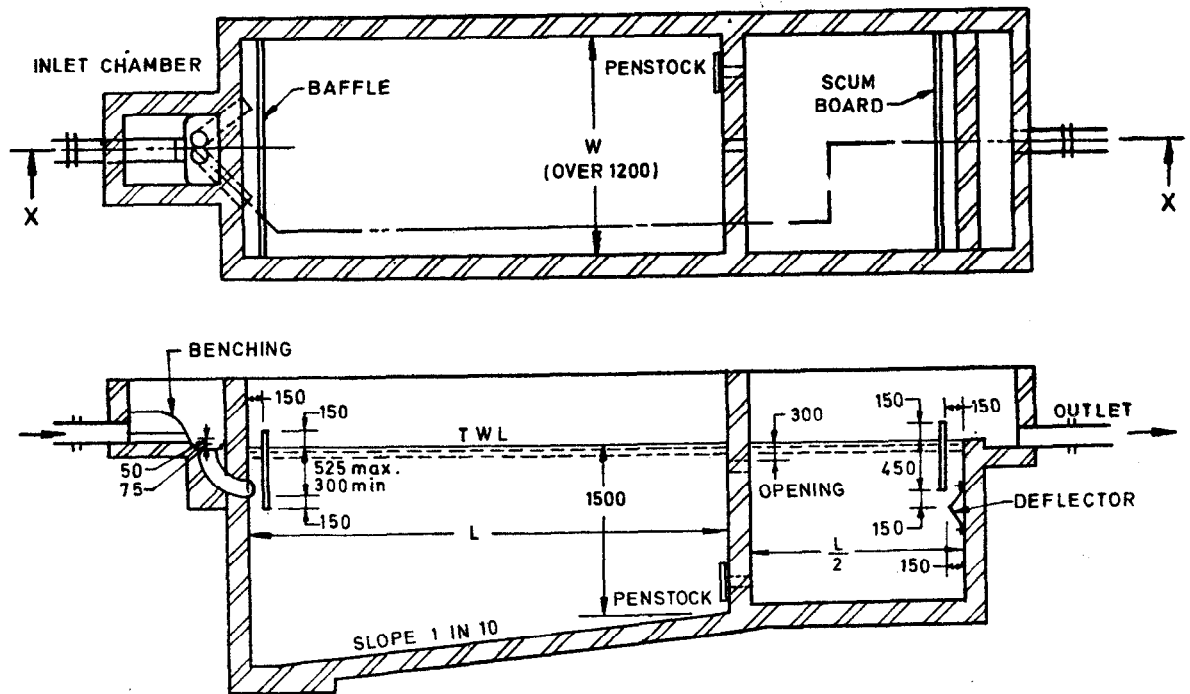
4.1.1 The floor may be of cement concrete of minimum M 15 grade (see IS : 456-1978*) and a minimum slope of 1 : 10 may be provided towards the sludge outlet to facilitate desludging.

*Code of practice for plain and reinforced concrete (third revision).



All dimensions in millimetres.

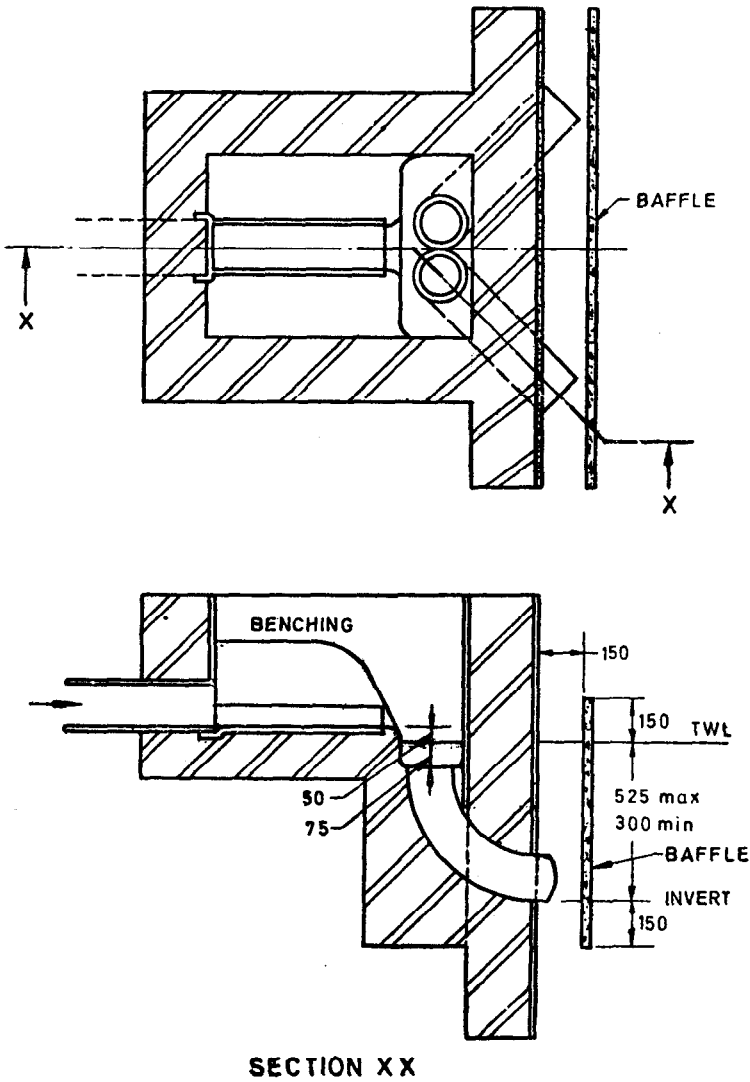
FIG. 3 TYPICAL SKETCH OF TWO COMPARTMENT SEPTIC TANK FOR POPULATION UP TO 50



SECTION XX

All dimensions in millimetres.

FIG. 4 TYPICAL SKETCH OF TWO COMPARTMENT SEPTIC TANK FOR POPULATIONS OVER 50



All dimensions in millimetres.

FIG. 5 TWIN INLET FOR TANKS IN EXCESS OF 1 200 mm WIDE

4.2 Walls — The walls should be of such thickness as to provide adequate strength and watertightness.

4.2.2 Walls built out of brick should not be less than 200 mm thick and should be plastered to a minimum thickness of 12 mm inside and outside with cement mortar not weaker than 1 : 3; where they are built out of the stone masonry. They should have a minimum thickness of 370 mm.

5. SLUDGE WITHDRAWAL

5.1 Half yearly or yearly desludging of septic tank is desirable. Small domestic tanks, for economic reasons, may be cleaned at least once in 2 years provided the tank is not overloaded due to use by more than the number for which it is designed.

NOTE — Frequent desludging inhibits the anaerobic action in the tank. Normally, the tanks are cleaned when the sum of the depth of the scum and the sludge is observed to exceed half the depth of the tank.

5.2 A portion of sludge not less than 25 mm in depth should be left behind in the tank bottom which acts as the seeding material for the fresh deposits.

5.3 The digested sludge should be withdrawn through a dip pipe of not less than 150 mm dia under a hydrostatic pressure of at least 450 mm. The sludge pipe shall deliver the sludge to the sump and be provided with a delivery valve to draw the sludge as required. Portable pumps may also be used for desludging in which case there will be no need for sludge pipe or sludge pump. Manual handling of sludge should be avoided.

5.3.1 When removal of the sludge is carried out the scum in the first tank should not be disturbed more than necessary, this scum is needed to ensure efficient operation.

5.4 Sludge from septic tanks may be delivered into covered pits or into a suitable vehicle for removal from the site. Spreading of sludge on the ground in the vicinity should not be allowed.

6. COMMISSIONING OF SEPTIC TANK

6.1 The sewerage system should be complete and ready for operation before connection is made to the building.

6.2 The tank should be filled with water to its outlet level before the sewerage is let into the tank. It should, preferably, be seeded with small quantities of well digested sludge obtained from septic tanks or sludge

digestion tanks. In absence of digested sludge a small quantity of decaying organic matter, such as digested cow dung may be introduced.

7. DISPOSAL OF SEPTIC TANK EFFLUENT

7.1 Effluent from the septic tank shall be disposed of by one of the methods given in IS : 2470 (Part 2)-1985*.

APPENDIX A

(Clause 3.4.5.2)

SIZES OF SEPTIC TANK

A-1. Recommended sizes of septic tanks for 20 users are given in Table 5.

TABLE 5 RECOMMENDED SIZES OF SEPTIC TANK FOR 20 USERS

No. of Users	LENGTH	BREADTH	LIQUID DEPTH (CLEANING INTERVAL OF)	
			1 Year	2 Year
(1)	(2)	(3)	(4)	(5)
	m	m	m	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.

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

NOTE 3 — The sizes of septic tank are based on certain assumptions (see 3.4), while choosing the size of septic tank exact calculations shall be made.

*Code of practice for installation of septic tank : Part 2 Secondary treatment and disposal of septic tank effluent (second revision).

A-2. Recommended sizes of septic tank for housing colonies (up to 300 persons) and for hostels and boarding schools are given in Table 6 and 7 respectively.

TABLE 6 RECOMMENDED SIZES OF SEPTIC TANKS FOR RESIDENTIAL COLONIES

No. of Users	Length	Breadth	Liquid Depth (Cleaning Interval of)	
			1 Year	2 Year
(1)	(2)	(3)	(4)	(5)
	m	m	m	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

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

NOTE 2 — The sizes of the septic tank are based on certain assumptions (see 3.4) while choosing the size of septic tank, exact calculation shall be made.

NOTE 3 — For population over 100, the tank may be divided into independent parallel chambers for ease of maintenance and cleaning.

TABLE 7 RECOMMENDED SIZES OF SEPTIC TANKS FOR HOSTELS AND BOARDING SCHOOLS

No. of Users	Length <i>L</i>	Width <i>B</i>	Liquid Depth (<i>D</i>) for Stated Intervals of Sludge Withdrawal	
			Once in a Year	Once in 2 Years
(1)	(2)	(3)	(4)	(5)
	m	m	m	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

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

NOTE 2 — The sizes of the septic tank are based on certain assumptions (see 3.4), while choosing the size of septic tank exact calculation shall be made.

NOTE 3 — For population over 100, the tank may be divided into independent parallel chamber for ease of maintenance and cleaning.

(Continued from page 2)

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