

# **SEPTIC TANK**

**CONCEPTS AND DESIGN**

# WATER REQUIREMENTS

WATER REQUIREMENTS FOR DOMESTIC PURPOSES

<i>S.No.</i>	<i>Description</i>	<i>Amount of water in litres per head per day</i>
1	Bathing	55
2	Washing of clothes	20
3	Flushing of W.C.	30
4	Washing the house	10
5	Washing of utensils	10
6	Cooking	5
7	Drinking	5
<b>Total</b>		<b>135 litres</b>



# DOMESTIC AND NON DOMESTIC NEEDS

**WATER FOR DOMESTIC AND NON-DOMESTIC NEEDS**

<i>Description</i>	<i>Amount of water (lcpd)</i>
1. For communities with population upto 20,000	40 (min.)
(a) Water supply through stand post	
(b) Water supply through house service connection	70 to 100
2. For communities with population 20,000 to 100,000	100 to 150
3. For communities with population above 100,000	150 to 200



IS : 2470 (PART 1) - 1985

CODE OF PRACTICE FOR INSTALLATION OF SEPTIC TANKS  
PART 1 DESIGN CRITERIA AND CONSTRUCTION

- Arrangements for installing tanks in parallel for the treatment of sewage for population of more than 300 persons have been included.
- The procedure for the removal of the sludge has been elaborated.
- This standard covers the design and construction of septic tank for small installations (up to 20 persons) as well as large installations.
- In unsewered areas, if adequate water supply is available for flushing, treatment of the liquid waste in septic tanks is recommended.



# SEPTIC TANK ?

- 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.
- 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.



## WHERE USED?

- 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.
- In un-sewered 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, up-flow anaerobic filter, on the land or in a sub-surface disposal system.



## DESIGNED FOR ?

- 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.
- Under no circumstances should effluent from a septic tank be allowed into an open channel drain, or body of water without adequate treatment
- Wastes containing excessive detergents, grease and disinfectants should not be treated in septic tank as they adversely affect the anaerobic decomposition.



# BASICS

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





# WATER FIXTURES

- The maximum flow to the tank is based on the number of plumbing fixtures discharging simultaneously

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

# ESTIMATED PEAK DISCHARGE FOR SMALL TANKS UP TO 20 USERS

No. of Estt. Users	No. of fixture units	Probable No. of fixture discharging simultaneously	Probable peak discharge in LPM
5	1	1	9
10	2	2	18
15	3	2	18
20	4	3	27



# ESTIMATED PEAK DISCHARGE FOR RESIDENTIAL COLONIES

No. of Estt. Users	No. of fixture units	Probable No. of fixture discharging simultaneously	Probable peak discharge in LPM
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



## WHERE CONSTRUCTED?

- 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.
- At junctions of pipes in manholes, direction of flow from a branch connection should not make an angle exceeding  $45^\circ$  with the direction of flow in the main pipe.
- 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.



# *SEDIMENTATION AND SLUDGE DIGESTION*

- The surface area of the tank required will be 0.92 m<sup>2</sup> for every 10 litres per minute of peak flow rate at a temperature of 25°C.
- A minimum depth of sedimentation shall be 250 to 300 mm.
- Per capita suspended solids entering the tank may be taken as 70 g/day.
- The capacity required for sludge digestion is 0.033 m<sup>3</sup> per capita at 25°C.
- Volume of digested sludge is normally 0.000 21 m<sup>3</sup> per capita per day.



# *DETENTION TIME AND DIMENSIONS OF SEPTIC TANK*

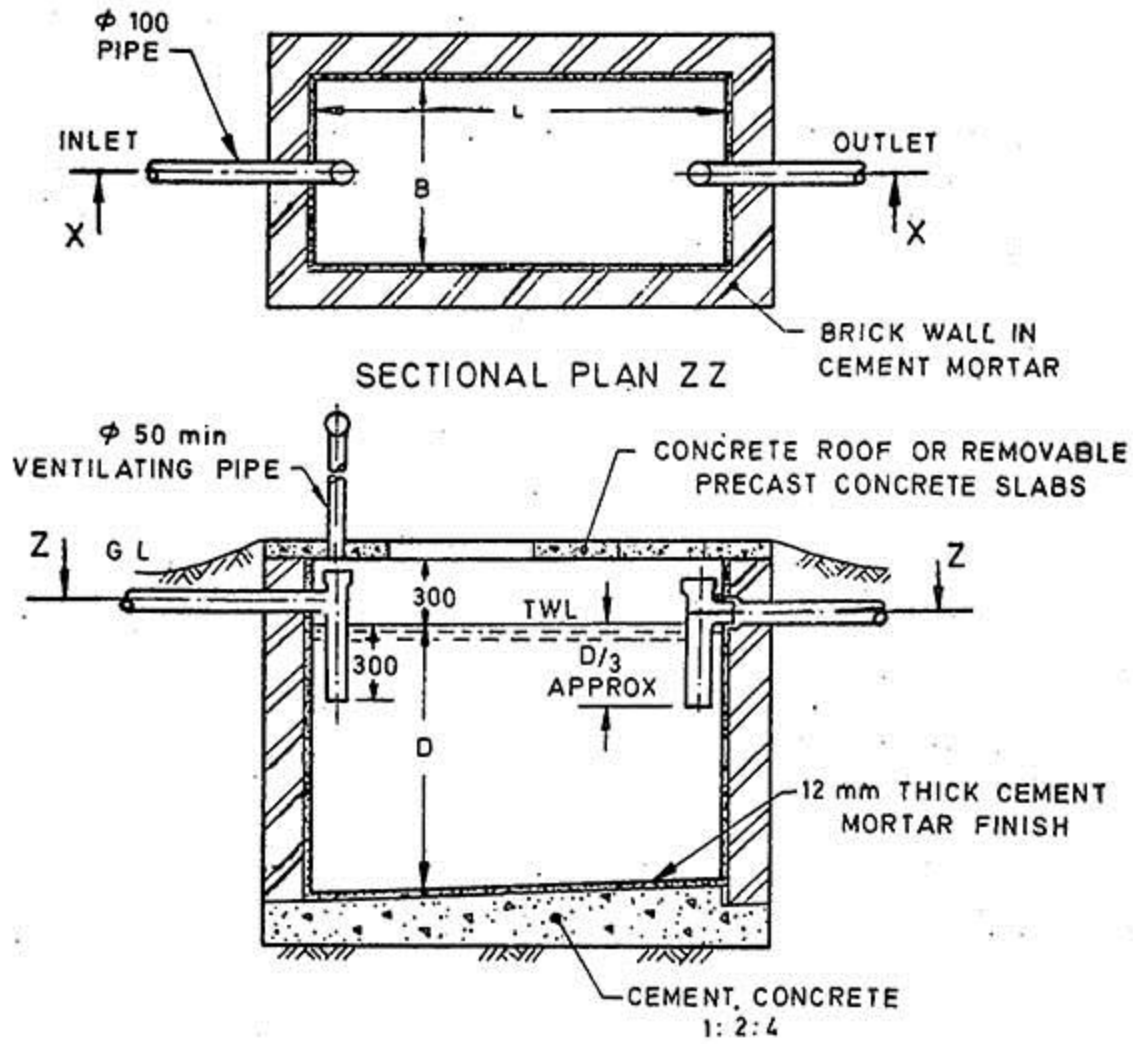
- A septic tank designed on the basis of above provides a detention period of 24 to 48 hours based on an average daily flow of sewage.
- Septic tank shall have minimum width of 750 mm, minimum depth of one metre below water level and a minimum liquid capacity of 1000 litres.
- For rectangular septic tanks, the length of the tank shall be 2 to 4 times the width.
- 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.



# INLET AND OUTLET

- *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. 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.
- For tanks in excess of 1200 mm in width, two or more submerged inlets are preferable.
- *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.





SECTION XX  
All dimensions in millimetres.





# *PARTITIONS*

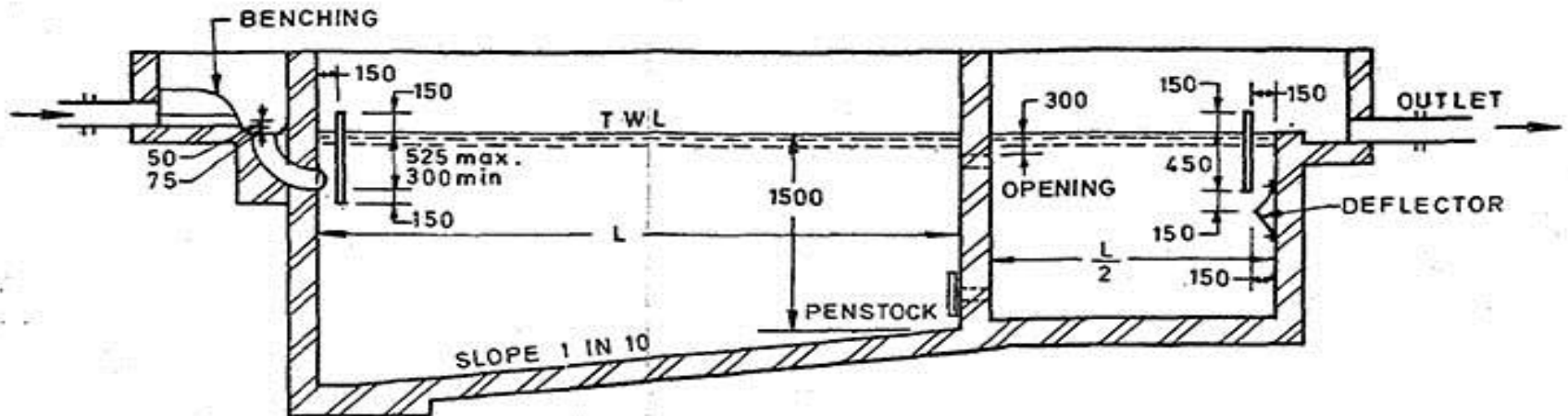
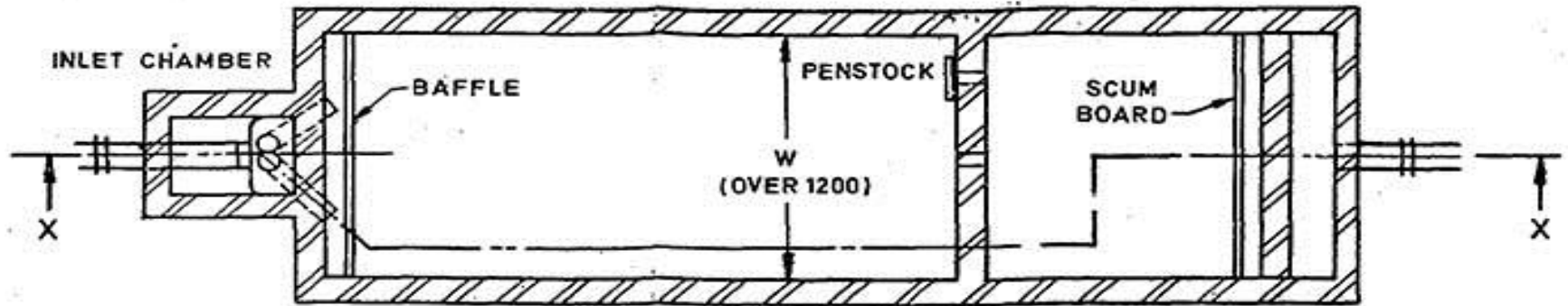
- Where the capacity of a septic tank exceeds 2 000 litres, the tank may be divided into two chambers by means of a fixed durable partition. The partition shall be located so that the capacity of the first chamber is twice that of the second chamber. Suitable openings rectangular or circular with minimum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

# SEPTIC TANK CONSTRUCTION

- **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.
- The floor may be of cement concrete of minimum M 15 grade and a minimum slope of 1 : 10 may be provided towards the sludge outlet to facilitate desludging.
- **Walls**—The walls should be of such thickness as to provide adequate strength and watertightness
- 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



# TWO COMPARTMENT SEPTIC TANK



SECTION XX

All dimensions in millimetres.

# SLUDGE WITHDRAWAL

- 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.
- 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
- 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.
- 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.



# RECOMMENDED SIZES (IN M )OF SEPTIC TANK FOR 20 USERS

No. of Users	Length	Breadth	Liquid Depth (Cleaning Interval of)	
			1 Year	2 Year
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

**TABLE 6 RECOMMENDED SIZES OF SEPTIC TANKS FOR RESIDENTIAL COLONIES**

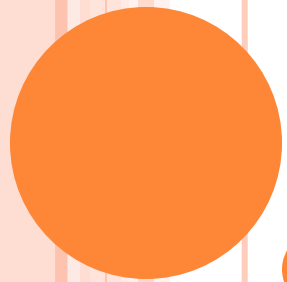
No. of Users	Length	Breadth	Liquid Depth (Cleaning Interval of)	
			1 Year	2 Year
(1)	(2)	(3)	(4)	(5)
	m	m	m	m
50	5.0	2.0	1.0	1.24
100	7.5	2.65	1.0	1.24
150	10.0	3.0	1.0	1.24
200	12.0	3.3	1.0	1.24
300	15.0	4.0	1.0	1.24

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 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.





# SEPTIC TANK

Towards advancement

# EFFICIENCY

- The septic tank reduces BOD up to 50%, so if underground penetration is impossible due to high groundwater levels, rocky strata, non-availability of land for soak-pit, another method must be employed.
- When this system is applied to an urban area with high population density, care must be taken not to have a negative effect on the surrounding environment.





# ADVANCED TREATMENT SYSTEM

- Conventional septic tanks system, if properly designed and with proper septage removal frequency can effectively remove about 40-50% BOD and 50-70% TSS.
- Unavailability of space for soak pits and under rocky strata,
- Effluent is commonly discharged to open storm water drains
- Unsightly conditions, eutrophication, odour, vector and water related diseases.



# ADVANCED TREATMENT SYSTEMS...

## CONTD...

- Anaerobic baffled reactor or the post treatment of septic tank effluents by anaerobic filters.
- Capital cost of these systems may not be more than 20-30%, but cannot bring down the BOD and TSS levels up to the national effluent discharge standards.
- Aerobic type post treatment such as contact aeration, but expensive.



## CONVENTIONAL SEPTIC TANK

- Experience has shown that in order to provide sufficiently quiescent conditions for effective sedimentation of the suspended solids, the minimum liquid retention time should be 24 hours. Therefore, considering the volume required for sludge and scum accumulation, the septic tank may be designed for 1 to 2 days of sewage retention.
- The septic tank to be an efficient suspended solids remover, it should be of sufficient capacity with proper inlet and outlet arrangements.
- Accumulated sludge and scum occupy only half or maximum two-thirds the tank capacity, at the end of the design storage period.
- The liquid depth is 1-2 m and the length to breadth ratio is 2-3 to 1.

# DISPERSION SYSTEM

- The subsoil dispersion system shall be at least 20 m away from any source of drinking water. It should also be as far as possible from the nearest dwellings, but not closer than 7 m to avoid any corrosive effect due to tank gases vented into atmosphere. Subsoil dispersion system is not recommended in limestone or crevice rock formations, where there may be solution cavities that may convey the pollution to long distances and pollute water resources. In impervious soils such as dense clays and rocks, where percolation rate exceeds 25 minutes/cm, adoption of up flow or reverse filters, trickling filters, subsurface sand filters or open sand filters followed by chlorination should be considered, particularly for larger installations.

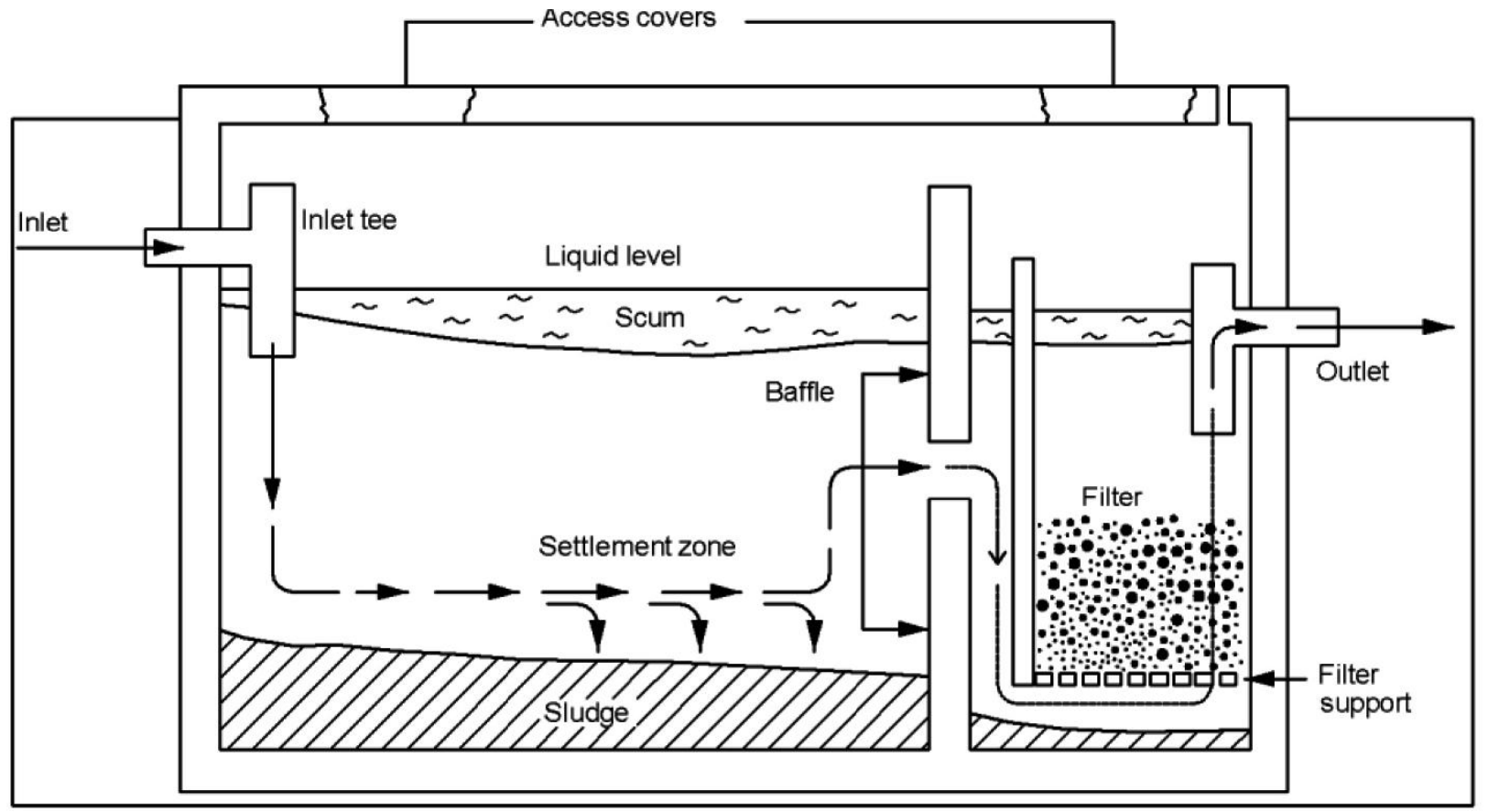


# ANAEROBIC FILTERS

- The up-flow filter can be successfully used for secondary treatment of septic tank effluent in areas where dense soil conditions, high water table and limited availability of land preclude soil absorption or the leaching system for effluent disposal. It is a submerged filter with stone media or half broken chamber well burnt bricks by hand and the septic tank effluent is introduced from the bottom.
- The microbial growth is retained on the stone media, making possible higher loading rates and efficient digestion. The capacity of the unit is 0.04 to 0.05 m<sup>3</sup> per capita or 1/3 to 1/2 the liquid capacity of the septic tank it serves. BOD removals of 70% can be expected. The effluent is clear and free from odour. This unit has several advantages viz, (a) high degree of stabilization; (b) little sludge production; (c) low capital and operating cost; and (d) low loss of head in the filter (10 to 15 cm) in normal operation.

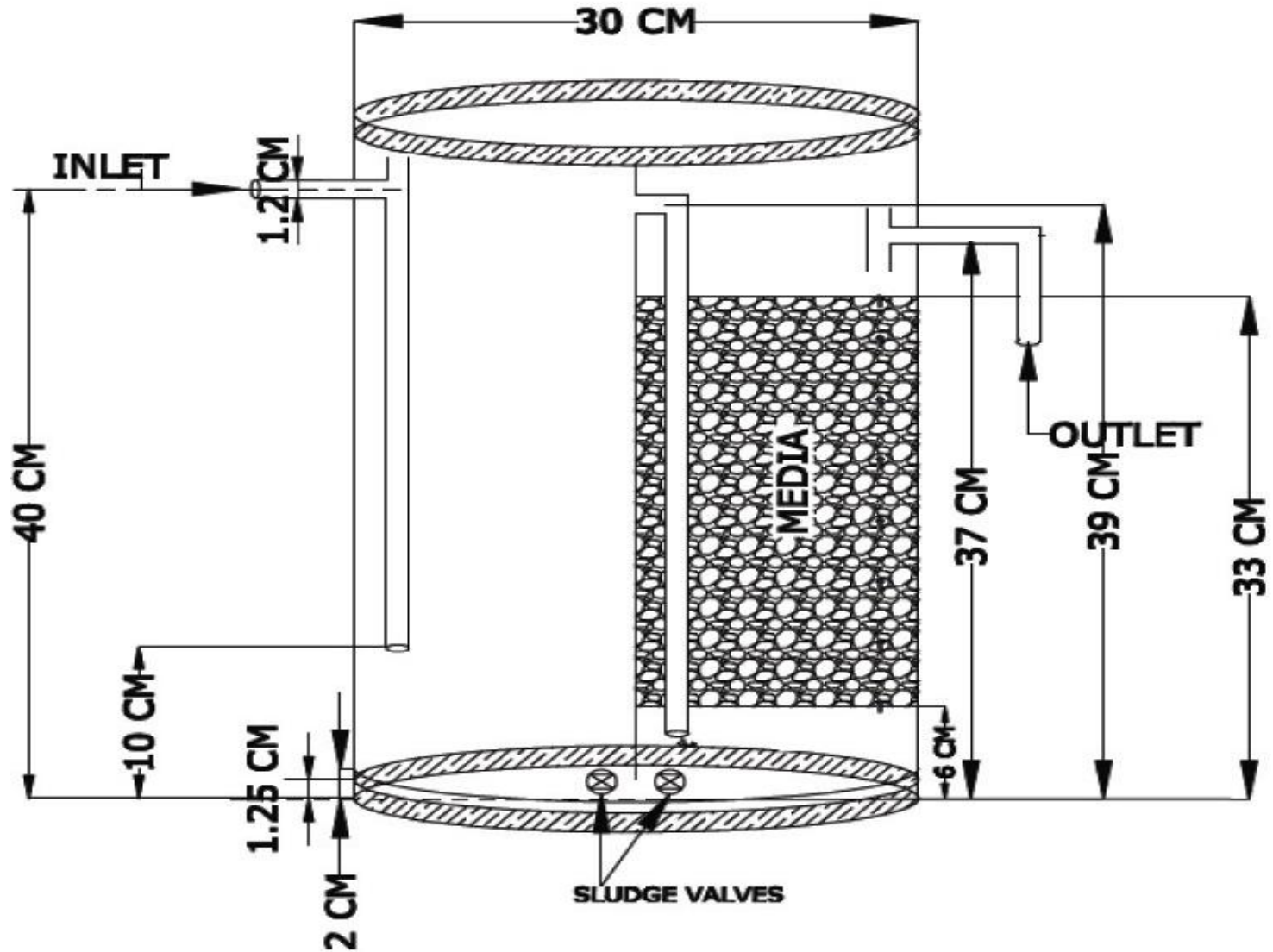


# WITH UP-FLOW ANAEROBIC FILTER



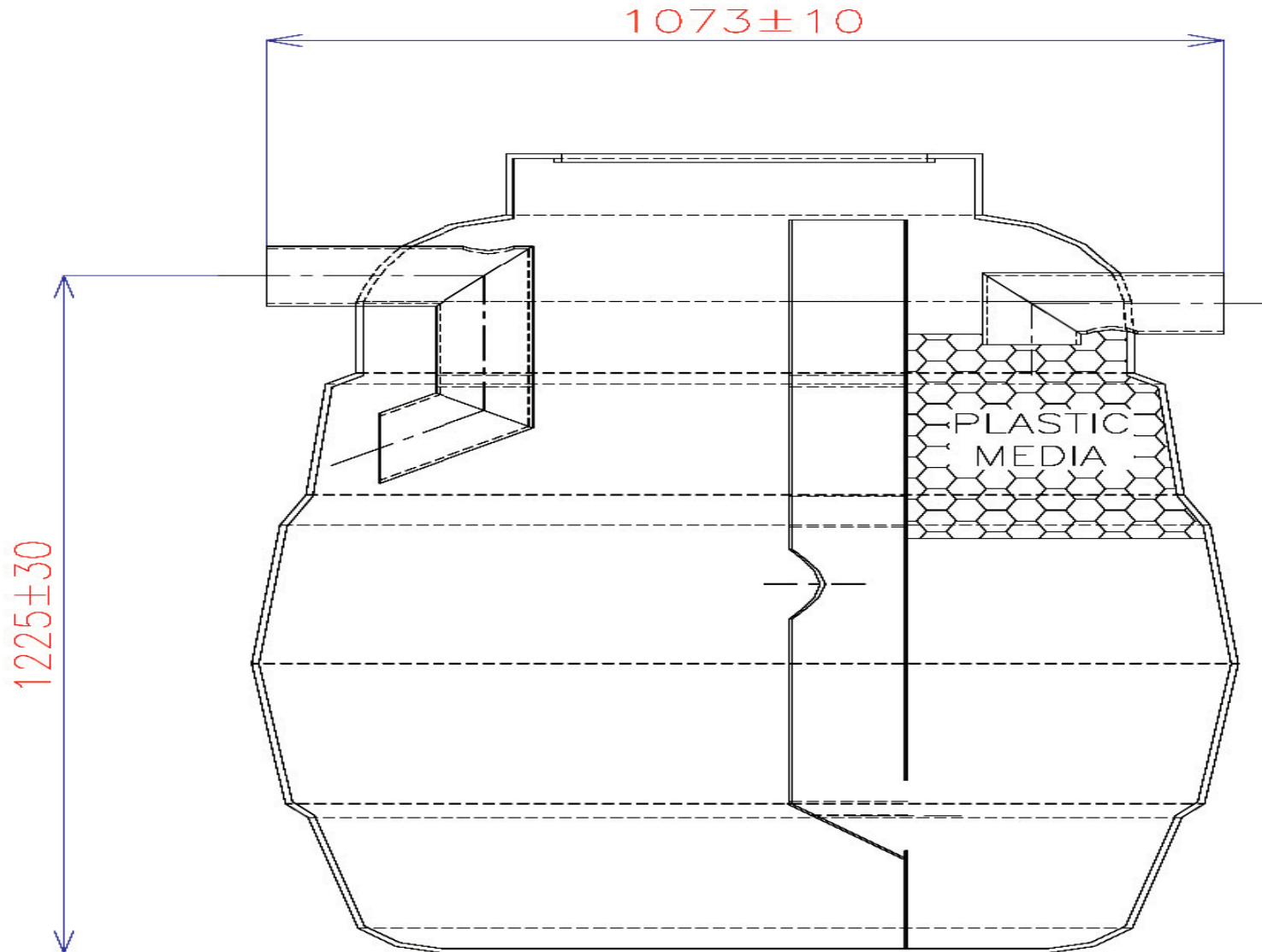


# Package septic tanks Lab scale


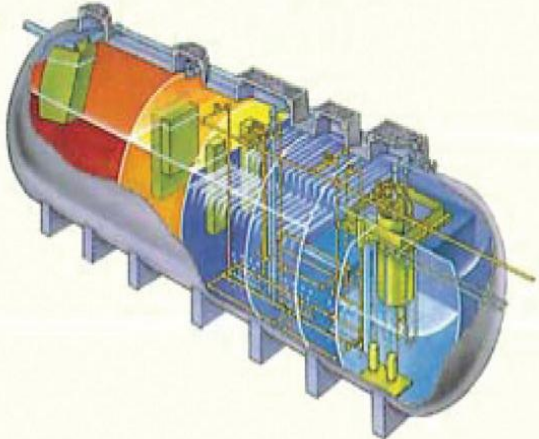
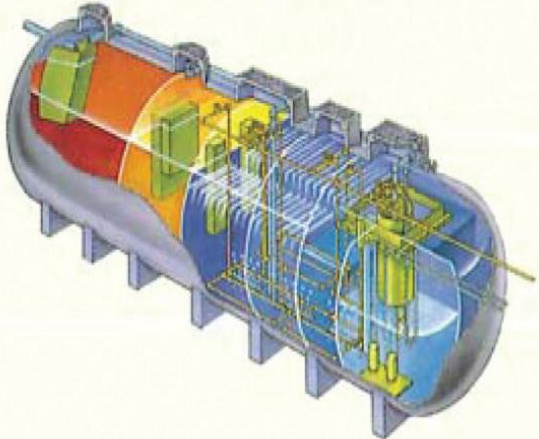





# Contact aeration system for 80% removal of BOD



# New Models brought in by JAPAN -with anaerobic filters -BOD removal 90%

Package-type			On-site construction-type
Small-scale	Medium-scale	Large-scale	Medium/Large-scale
(About 5 to 50 people)	(About 51 to 500 people)	(Approx. 500 to 5,000 people)	(More than 500 people)
			

**THANKS**

