

	<p>black cotton soil should be designed taking infiltrative rate of 10 l/m²/d.</p> <p>A vertical fill (envelope) of 300 mm in width with sand, gravel or ballast of small sizes should be provided all round the pit outside the pit lining in rocky strata with fissures and in black cotton soil.</p>
In water-logged areas	The pit top should be raised by 300 mm above the likely level of water above ground level at the time of water logging. Earth should then be filled well compacted all-round the pits up to 1.0 m distance from the pit and up to its top. The raising of the pit will necessitate the raising of latrine floor also. A typical pour flush latrine in water-logged areas is shown in Figure 3 .
In high subsoil water level	Where the subsoil water level rises to less than 300 mm below ground level, the top of the pits should be raised by 300 mm above the likely subsoil water level and earth should be filled all round the pits and latrine floor raised as stated above. A typical pour flush latrine with leach pits in high subsoil water level is shown in Figure 4.
Where space is a constraint	Where circular pits of standard sizes cannot be constructed due to space constraints, deeper pit with small diameter (not less than 750 mm), or combined oval, square or rectangular pits divided into two equal compartments by a partition wall may be provided. In case of combined pits and the partition wall should not have holes. The partition wall should go 225 mm deeper than the pit lining and plastered on both sides with cement mortar. A typical pour flush latrine with combined pits is shown in Figure 5.

II. Septic Tank

Description	A septic tank is a buried chamber that collects, stores and treats the wastewater under anaerobic conditions. Effluent from septic tanks should be discharged into a soak pit. A well-managed septic tank will remove about 50 to 60 % of the biological load in the wastewater
Mode of operation	Solids settle in the tank and digest anaerobically. This reduces sludge volume and enables wastewater to infiltrate into the ground without clogging the leaching system. Sludge settles in the tank and digests anaerobically over time, releasing methane and other gases.
O&M Requirements	Septage must be removed from septic tanks at least once every 2 or 3 years and transported off-site for treatment prior to disposal. Municipal utility or private contractors are required for desludging of septic tanks and to ensure safe disposal of septage at a treatment plant. However the responsibility for O&M of the septic tank itself lies with the owner of the property
Limitations	<ul style="list-style-type: none"> • Cost and space requirements for the soak pit. • Though septic tanks are designed for receiving black water, they often receive both black and grey water. As a result, the retention time in the septic tank is insufficient and the soak pit becomes hydraulically overloaded. This means that the septic tanks need to be de-sludged regularly
Specifications	<p>(a) Size options for toilet / super structure as shown in Fig. 1</p> <ul style="list-style-type: none"> • 750 mm x 900 mm x 1900mm or • 800 mm x 1000 mm x 1900 mm <p>(b) Material – Brick work (as per Fig. 1) / FRP / Pre-cast Cylindrical Unit</p> <p>(c) Minimum Land requirement - 40 Sq. ft. to 50 Sq. ft. (depending upon the location of superstructure)</p> <p>(d) Soak-pit size - The seepage pit may be of any suitable shape with the least cross-sectional dimension of 0.90 m and not less than 1 m in depth below the invert level of the inlet pipe. The construction shall be of perforated brickwork</p>

(e) **Recommended sizes of septic tanks** for households (up to 20 users – group / shared toilets) is given in Table 2 below:

No. of users	Length (m)	Breadth (m)	Liquid depth (m) (Cleaning interval of)	
			2 years	3 years
5*	1.5	0.75	1.0	1.05
10**	2.0	0.90	1.0	1.4
15**	2.0	0.90	1.3	2.00
20**	2.3	1.10	1.3	1.80

*- only for IHL

**- Group household toilets

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 assumption on peak discharges, as estimated in IS: 2470 (part 1) and while choosing the size of septic tank exact calculations shall be made.

Cost (for 5 users)

- Tentative cost varies from Rs. 25,000/- to Rs. 30,000/- depending upon the construction material (toilet and septic tank).
- Pre fabricated septic tanks are available at lower cost in the market, which also may be explored to speed up the implementation.

III. Biodigester Toilet (Developed by DRDO)

<p>Description</p>	<p>A bio-digester toilet is an anaerobic multi-compartment tank with inoculum (anaerobic bacteria) which digests organic material biologically. The details of bio-digester toilets are shown in Figure 7. This system converts faecal waste into usable water and gases in an eco-friendly manner.</p> <p>It can be connected to the toilet or a series of toilets. The toilet can be a superstructure fixed on the bio-digester or a separate unit. Bio-digester has an inlet, an outlet and a gas pipe.</p> <p>The tank has two components, namely, anaerobic microbial inoculum (seed bacteria) and specially designed fermentation tank. The tank can be made out of Stainless steel, Mild steel, FRP or concrete. Semi-treated water from bio-digester tank is needed to be further disposed into a soak pit or a reed bed arrangement for its treatment to acceptable levels of discharge.</p>
<p>Advantages</p>	<ul style="list-style-type: none"> • As there is no sludge formation, there is no need for de-sludging and treatment. It is therefore more economical in the long-term as it conserves water and has minimum O&M • Night soil degradation, occurs through microbial reaction which converts it into bio gas and odorless water. • Technology is environmental friendly, maintenance free and efficient without depending on conventional energy sources. • Permits use of toilet cleansing agents. • Suitable for mobile and stationary platforms. • Lifelong usage bio-digester tank does not need recharging, re-shifting or maintenance. • Costs lesser than the conventional toilets. • Easy to transport and install.

	<ul style="list-style-type: none"> • One-third to one-fourth capacity of septic tank • Space requirement is less. 																			
Limitations	<ul style="list-style-type: none"> • 																			
Specifications	<p>Toilet Superstructure</p> <p>(a) Size of Toilet / super structure – as shown in Fig. 1</p> <ul style="list-style-type: none"> • 750 mm x 900 mm x 1900mm or • 800 mm x 1000 mm x 1900 mm <p>(b) Material – Brick work (as per Fig. 1) / FRP/ Pre cast Cylindrical Unit</p> <p>Bio tank</p> <p>(a) Land requirement – 25 sq. ft.</p> <p>(b) Tank internal dimensions – 1336 mm x1036 mm x 900 mm</p> <p>(c) Diagonal partition wall of 8mm thickness (adequately stiffened by ribs)</p> <p>(d) Tank is buried 600mm deep and anchored by 300mm long stainless steel (SS316) anchor bolts at corners</p> <p>(e) FRP tanks of 8mm thickness</p> <p>(f) Provision of water sealed outlet from the tank</p> <p>(g) For 5-6 users:</p> <ol style="list-style-type: none"> Total capacity: 700 litres (1000 mmX700 mm and 1000 mm depth). Where space is a constraint the depth of the tank can be increased to 1.5 m Volume of anaerobic Compartment (30% of total capacity): 210 litres Tank may be constructed with masonry also. <p>Table 3 - Volume of bio-digester tank for various user groups:</p> <table border="1"> <thead> <tr> <th>No. of users</th> <th>Size of bio-digester / bio-toilet</th> <th>Remarks</th> </tr> </thead> <tbody> <tr> <td>4-8 (Single family)</td> <td>0.7m³ (FRP / RCC material)</td> <td>Individual</td> </tr> <tr> <td>8-15 (two families)</td> <td>1.2 m³ (FRP / RCC material)</td> <td>Group / shared</td> </tr> <tr> <td>30-50</td> <td>3.2 m³ (FRP / RCC material)</td> <td rowspan="4">Community</td> </tr> <tr> <td>100-120</td> <td>6.0 m³ (FRP / RCC material)</td> </tr> <tr> <td>200-220</td> <td>12.0 m³ (FRP / RCC material)</td> </tr> <tr> <td>500-600</td> <td>30.0 m³ (FRP / RCC material)</td> </tr> </tbody> </table>	No. of users	Size of bio-digester / bio-toilet	Remarks	4-8 (Single family)	0.7m ³ (FRP / RCC material)	Individual	8-15 (two families)	1.2 m ³ (FRP / RCC material)	Group / shared	30-50	3.2 m ³ (FRP / RCC material)	Community	100-120	6.0 m ³ (FRP / RCC material)	200-220	12.0 m ³ (FRP / RCC material)	500-600	30.0 m ³ (FRP / RCC material)	
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Cost Estimates	<ul style="list-style-type: none"> • Toilet cost between Rs. 12,000 and Rs. 15,000 depending on material of construction; • Bio-digester tank as per Table 4 below: <table border="1"> <thead> <tr> <th rowspan="2">Bio-digester tank -></th> <th colspan="3">Material of construction</th> </tr> <tr> <th>Masonry</th> <th>Precast Cylindrical Unit</th> <th>Fiber reinforced plastic</th> </tr> </thead> <tbody> <tr> <td>No. of users / Capacity</td> <td></td> <td></td> <td></td> </tr> <tr> <td>5 to 7 users (700 Litre)</td> <td>17,100</td> <td>11,600</td> <td>22,000</td> </tr> <tr> <td>10 to 12 users (1000 Litre)*</td> <td>19,000</td> <td>13,600</td> <td>24,000</td> </tr> </tbody> </table> <p>*Group / Shared toilets</p>	Bio-digester tank ->	Material of construction			Masonry	Precast Cylindrical Unit	Fiber reinforced plastic	No. of users / Capacity				5 to 7 users (700 Litre)	17,100	11,600	22,000	10 to 12 users (1000 Litre)*	19,000	13,600	24,000
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IV. Bio Tank / Bio Toilets (Patented by private operators and approved by the Department of Science and Technology)

Description	This technology differs from that of the bio-digester toilets developed by DRDO since the process adopted is aerobic - which involves a different multi-strain of bacteria which breaks down the waste matter through oxidization. Bio-toilets consist of a purpose built multi-
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	<p>chambered bio-tank in which the waste is stored as shown in Figure 8. The movement of the waste is slowed down as the waste flows from one chamber to another by a special process in the Bio-tank such that the multi-strain bio-media present in the tank can digest the waste and convert it fully into non-toxic neutral water. This water then passes through the last chamber for disinfection. Here water is treated with Chlorine where the majority of the germs are killed. The resultant water is free from all sorts of E-coli and fecal coliforms.</p> <p>The bricks and mortar Bio-tank is described in the last diagramme of Figure 8. The superstructure is made of bricks and mortar. These are available in both flush and non-flush models.</p>
<p>Advantages</p>	<ul style="list-style-type: none"> • Aerobic bacteria are very efficient in breaking down organic waste and the waste is decomposed into water by the bacteria within 24 hours. The end products of aerobic degradation are carbon dioxide (CO₂) and water (H₂O). • The aerobic pathway also releases a substantial amount of energy. • The Bio-toilet is available in both, portable as well as fixed models. The advantage of the portable model is that it can be shifted from one location to another as and when required, and the module can be assembled and disassembled easily. • The Bio-toilet eliminates the need for any periodic sludge removal.
<p>Limitations</p>	<ul style="list-style-type: none"> • The bacteria functions best in temperatures between 4 and 55 degrees centigrade • Bio-toilets need proper bacteria inoculation periodically depending on the usage at particular sites. An in-depth understanding of the operation and use of toilets in a given area must be undertaken BEFORE choosing bio-toilets as a solution. Attention must be given to O&M, especially in dense urban settlements where chances of blockage of bio-toilets increase, making it dysfunctional over a period of time if the inoculation is not done in time. • Phenyl/ Harpic or any strong detergent/acid and bleaching powder should not be used to clean the pan. Only herbal / ayurvedic cleaning agents should be used. • Chlorine dose is necessary for disinfection.
<p>O&M</p>	<p>Responsibility of cleaning the toilet / superstructure is with the owner of the household in the case of IHLs / shared latrines and with the ULB in the case of community / public toilets.</p>
<p>Specifications</p>	<p>(a) Size of Toilet/ Super Structure as shown in Fig. 1 –</p> <ul style="list-style-type: none"> • 750 mm x 900 mm x 1900mm or • 800 mm x 1000 mm x 1900 mm

	<p>(b) Material – Bricks and Mortar walls of Bio Digester tank and Superstructure, PCC tank floor, RCC toilet floor, PVC Door and Frame, RCC/PVC/GI sheet Toilet Roof.</p> <p>(c) The Bio-toilet system consists of:</p> <ul style="list-style-type: none"> • Bio digester Tank(Bricks & Mortar/FRP/Steel), • Superstructure(Bricks & Mortar/FRP) • Indian Pan/WC • Size: 4 feet x 4 feet tank base, 4 feet tank height, 6 feet superstructure height. • Maximum usage recommended: 30 defecations/ day/ bio-toilet (no limit on urination) <p>(d) Land requirement - 16 Sq. ft.</p>
Cost Estimates	<p>The tentative cost of bio-toilet including super structure is approximately Rs.20,000/- depending upon material of construction. The bio-toilets should be supplied by the manufacturers, and the O&M for at least 5 years (including the feeding of inoculum in the periodicity needed) along with IEC (to train users for O&M) by the manufacturer / supplier also should be built into the undertaking.</p>

Norms & Specifications for Community and Public Toilets

Description	<p>A community toilet block is a shared facility provided for a group of residents or an entire settlement. Community toilet blocks are used primarily in low-income informal settlements where space and/or land are constraints. Pour flush option is generally used in this kind of OSS systems. It is also advisable to provide facilities like washing, bathing, and a small incinerator in this block for the use of the community</p> <p>Public toilets are provided for the floating population / general public in places such as markets, train stations or other public areas, where there is a considerable number of people passing by.</p>				
Septic tanks for public / community toilets	Recommended sizes of septic tanks for community/ public toilets (up to 300 users) is given below in Table 5 .				
	No. of users	Length (m)	Breadth (m)	Liquid depth (cleaning interval of)	
				2 years	3 years
	50	5.0	2.00	1.0	1.24
	100	7.5	2.65	1.0	1.24
	150	10.0	3.00	1.0	1.24
	200	12.0	3.30	1.0	1.24
300	15.0	4.00	1.0	1.24	

	<p>Source: <i>Manual on Sewerage and Sewage Treatment Systems, 2013 Part A Engineering</i></p> <p>Note 1: A provision of 300 mm should be made for free board.</p> <p>Note 2: The sizes of septic tanks are based on certain assumptions on peak discharges, as estimated in IS: 2470 (Part 1) and while choosing the size of septic tank exact calculations shall be made.</p> <p>Note 3: For population over 100, the tank may be divided into independent parallel chambers of maintenance and cleaning</p>			
Community Toilet - Norms for toilet seats	<ul style="list-style-type: none"> • One seat for 35 men; • One seat for 25 women • Adequate bathing facilities 			
Public Toilets - Norms for toilet seats	Norms for toilet sets for public toilets are given in Table 6 below:			
	S. No.	Sanitary Unit	For Male	For Female (A)
	i.	Water Closet	One per 100 persons up to 400 persons; For over 400 persons, add at the rate of one per 250 persons or part thereof	Two for 100 persons up to 200 persons; over 200 persons, add at the rate of one per 100 persons or part thereof
	ii.	Ablution Taps	One in each W.C.	One in each W. C.
	iii.	Urinals	One for 50 persons or part thereof	Nil
iv.	Wash basins	One per W. C. and urinal provided	One per W. C. provided	
	<p>Source: <i>Manual on Sewerage and Sewage Treatment Systems, 2013 Part A Engineering</i></p> <p>Note:</p> <p>i) It may be assumed that two-thirds of the number are males and one-third females</p> <p>ii) One water tap with drainage arrangements shall be provided for every 50 persons or part thereof in the vicinity of water closet and urinals.</p> <p>* At least 50% of female WCs may be Indian pan and 50% EWC</p> <p>iii) Separate seat may also be provided for trans-genders</p> <p>iv) <i>Special arrangements may be made for physically challenged.</i></p>			
Treatment units	<ol style="list-style-type: none"> 1. Bio Digester with reed bed systems/ soak pits 2. Bio Tank 3. Septic Tank with Soak Pits 			
Cost	Tentative basic cost for community toilets is Rs. 65,000/- per seat and public toilets is Rs. 75,000/- per seat. However, the cost per seat would vary depending upon the construction material, quality of construction, type of treatment technology adopted and O&M for specified period etc. However the cost of toilet in bio-digester given by NBCC are as under.			

	Superstructure 5 Cubicle for 200 users		
	Pre Painted galvanized Sheets	Masonry	Cement Board
	Rs. 1,63,000.00/-	Rs.95,000.00/-	Rs. 80,000.00/-
	Superstructure 10 Cubicle for 400 users		
	Pre Painted galvanized Sheets	Masonry	Cement Board
	Rs.3,26,000.00/-	Rs. 1,80,000.00/-	Rs. 1,60,000.00/-
	Bio Digester Tank 10 KLD for every 200 users		
	Masonry		
	Rs. 1,74,000.00/- per 200 user		
Additional Infrastructure	It must be ensured that adequate water supply arrangement shall be made for proper functioning and upkeep of toilets. Wherever possible, ULBs should ensure that public and community toilets are outfitted with solar panels for the generation of electricity to ensure uninterrupted power supply and bring down O&M costs.		
Implementation Mode	All toilets shall be constructed through PPP mode with inbuilt provision of O&M for at least a period of 5 years.		

For additional details the guidelines developed by NBCC can be downloaded. (www.nbccindia.gov.in)

Figure 2: Pour-flush latrine with circular pits

(Source: Manual on Sewerage and Sewage Treatment Systems, 2013, Part A: Engineering)

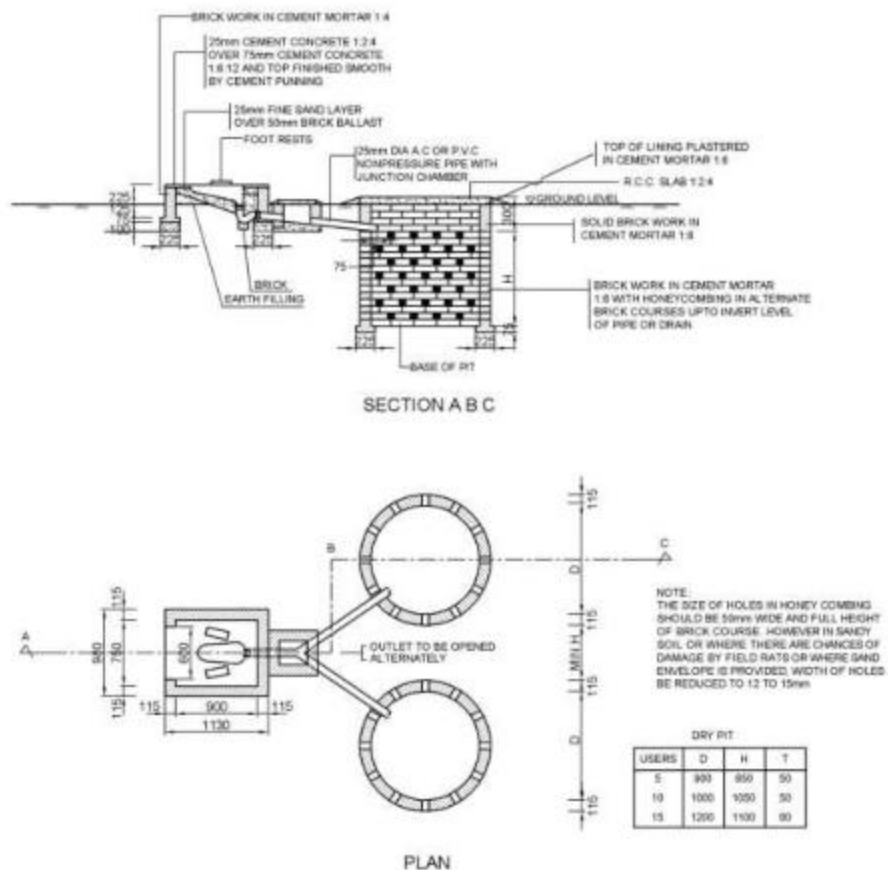


Figure 4: Leach pits in high subsoil water level

(Source: Manual on Sewerage and Sewage Treatment Systems, 2013, Part A: Engineering)

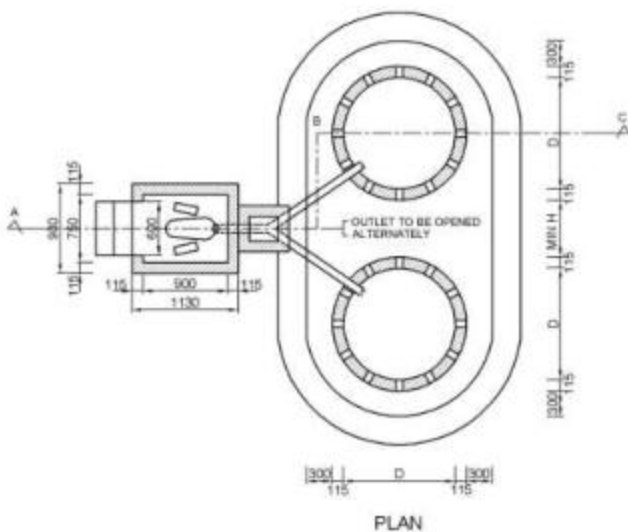
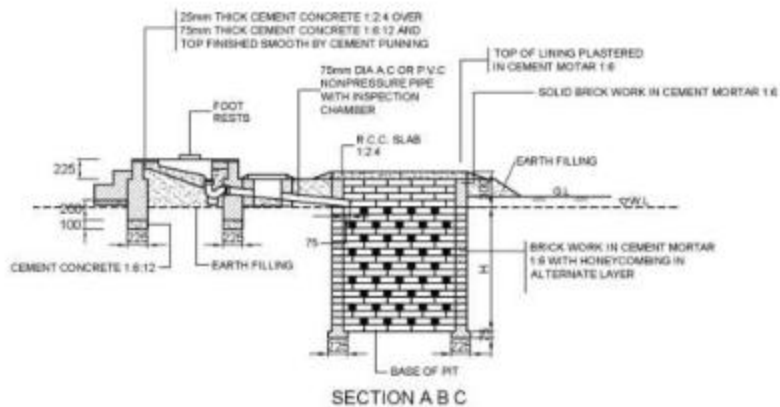


Figure 6: Typical sketch of two-compartment septic tank for 5 users
 (Source: Manual on Sewerage and Sewage Treatment Systems, 2013, Part A: Engineering)

(Dimensions in mm)

