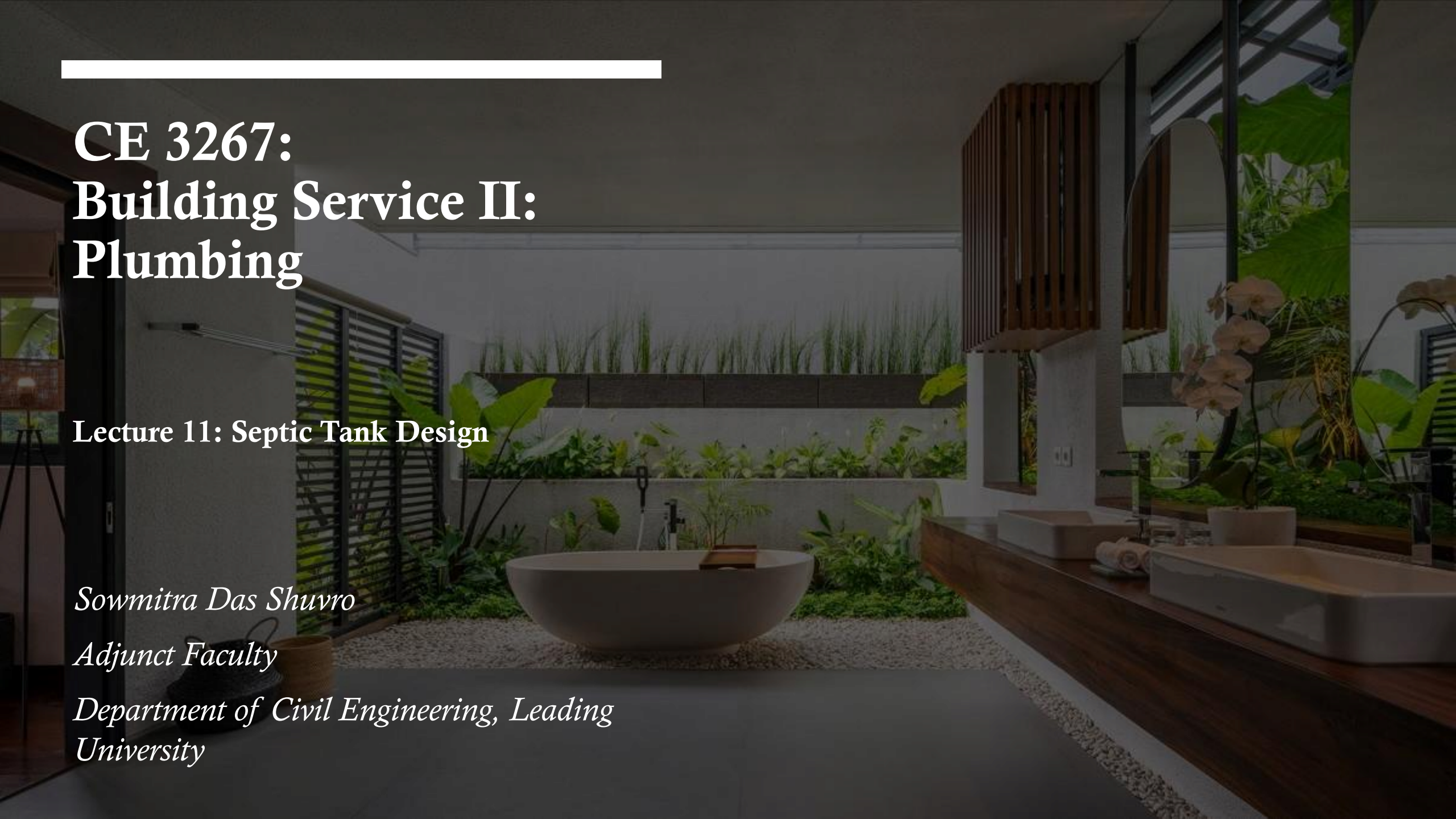


CE 3267: Building Service II: Plumbing

Lecture 11: Septic Tank Design

Sowmitra Das Shuvro

Adjunct Faculty

Department of Civil Engineering, Leading University

Type of Wastewater

Black Water

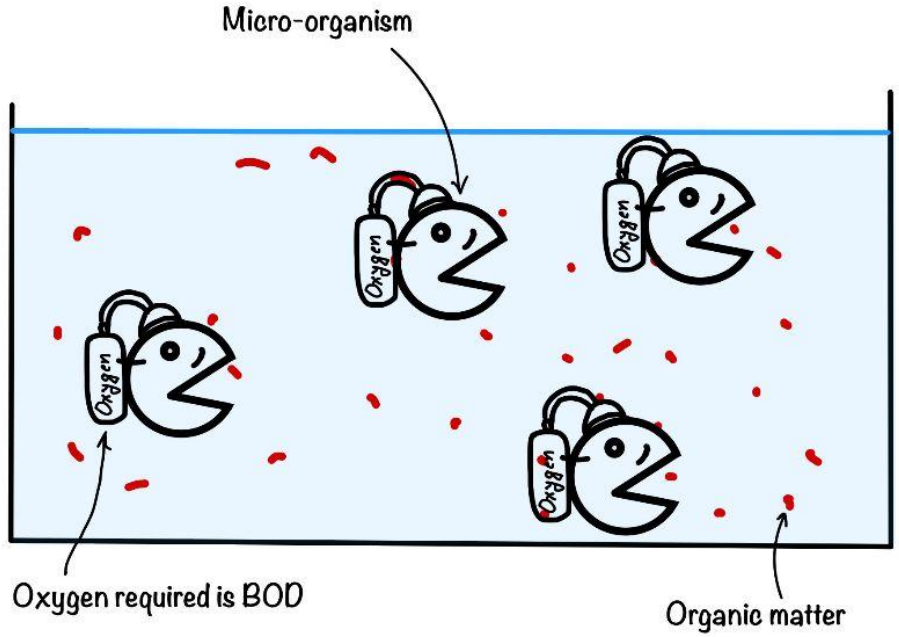
Domestic wastewater generated from toilet is termed as black water. It contains high volume of biological contamination. It may be combined with grey water as well.

Grey Water

Domestic wastewater generated from other than toilet is called grey water. It must not contain black water. However, it may contain solid waste. The biological contamination of grey water is far lesser contaminated in comparison to black water.

BOD

Biochamical Oxygen Demand, is a key water quality parameter that measures the amount of dissolved oxygen consumed by microorganisms to decompose organic matter in a water sample under aerobic conditions over a specific time. A higher BOD value indicates a greater amount of organic pollution, as more oxygen is required to break down the waste, thus lower oxygen level in water.



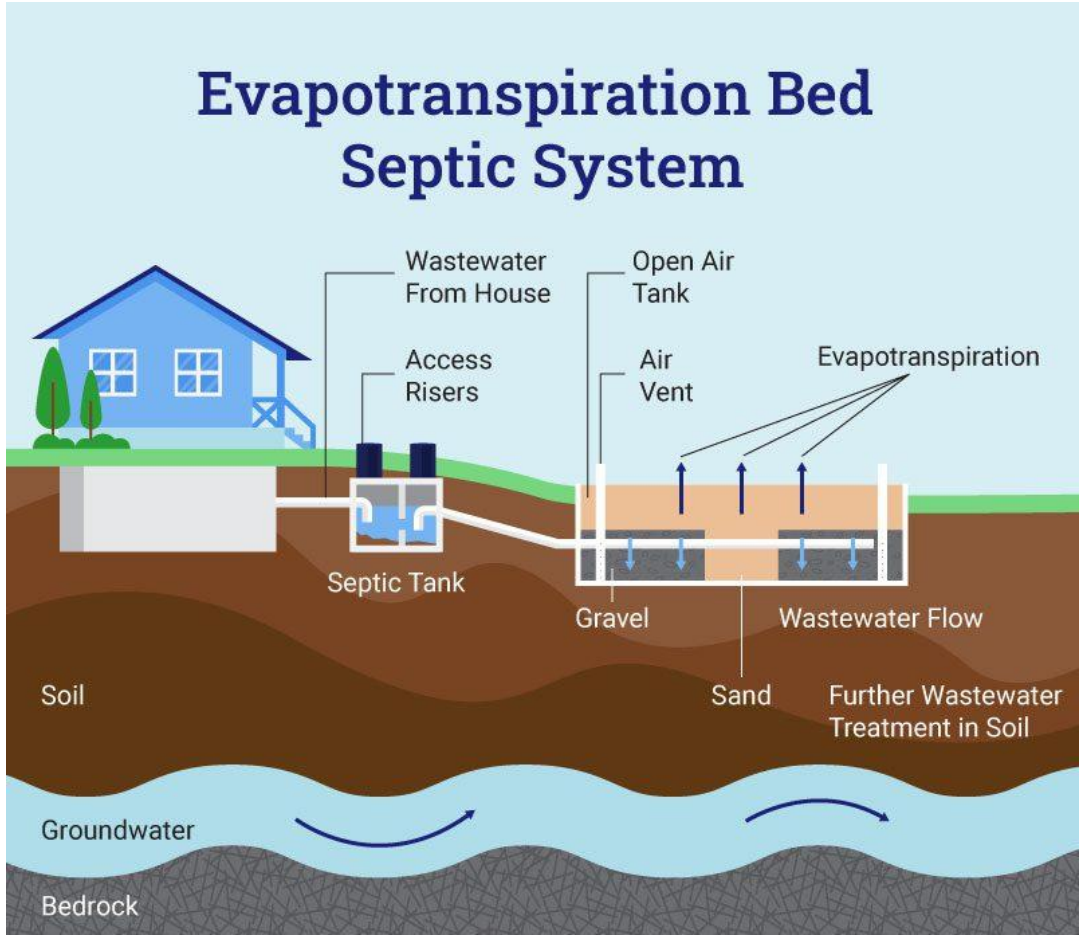
BOD5

BOD5, or Five-Day Biochemical Oxygen Demand, is a standard test used to measure the amount of oxygen consumed by microorganisms to break down organic matter in a water sample over a five-day period at 20°C

Category	Type	Typical BOD_5 Range (mg/L)	Description & Benchmark Purpose
Pure Water	**Drinking Water**	< 1 - 2	Very low organic content, highly treated and safe for consumption.
Environmental	**River Water (Fisheries)**	< 3 - 5	Supports healthy aquatic life; high oxygen levels are critical.
Environmental	**River Water (Agriculture)**	< 10 - 20	Suitable for irrigation; higher BOD may be tolerated but can indicate pollution.
Domestic	**Graywater**	100 - 300	From showers, sinks, laundry (no toilets).
Domestic	**Blackwater**	400 - 700	From toilets (urine, feces, toilet paper).
Domestic	**Septage**	1,500 - 5,000	Concentrated raw waste from septic tanks.
Industrial	**Mixed**	500 - 10,000+	Highly variable (e.g., food processing, chemical manufacturing).

Septic Tank

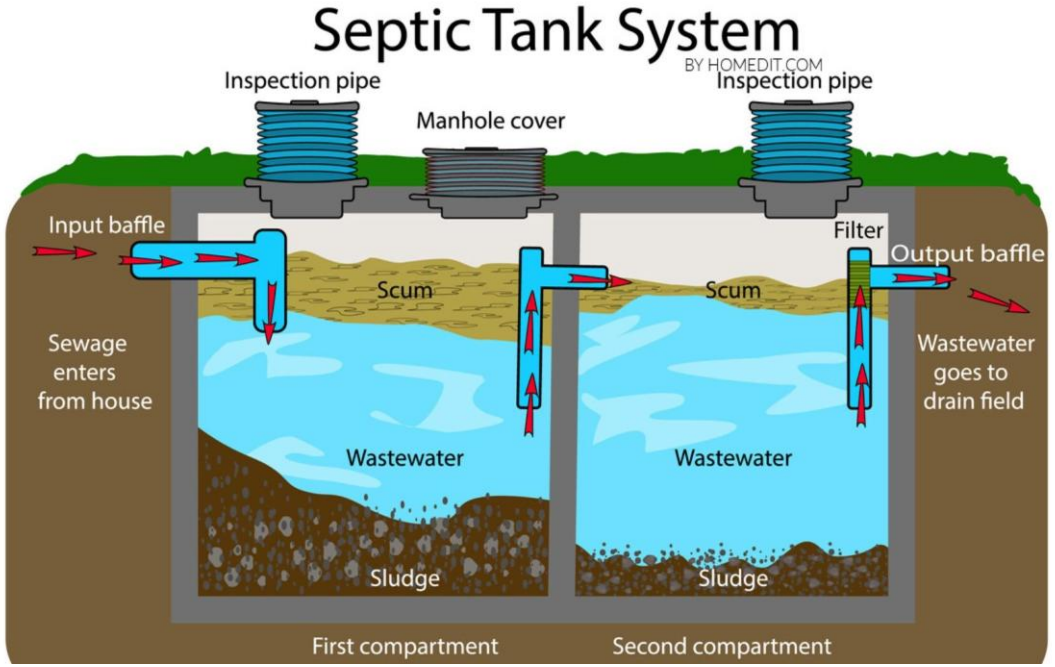
It is one of the simplest form of on-site treatment technologies, which allows to undergo anaerobic digestion of organic materials of wastewater coming into the system. Effluent from septic tank is infiltrated into ground using soak pit/leach field or is sent to sewer line for further treatment.



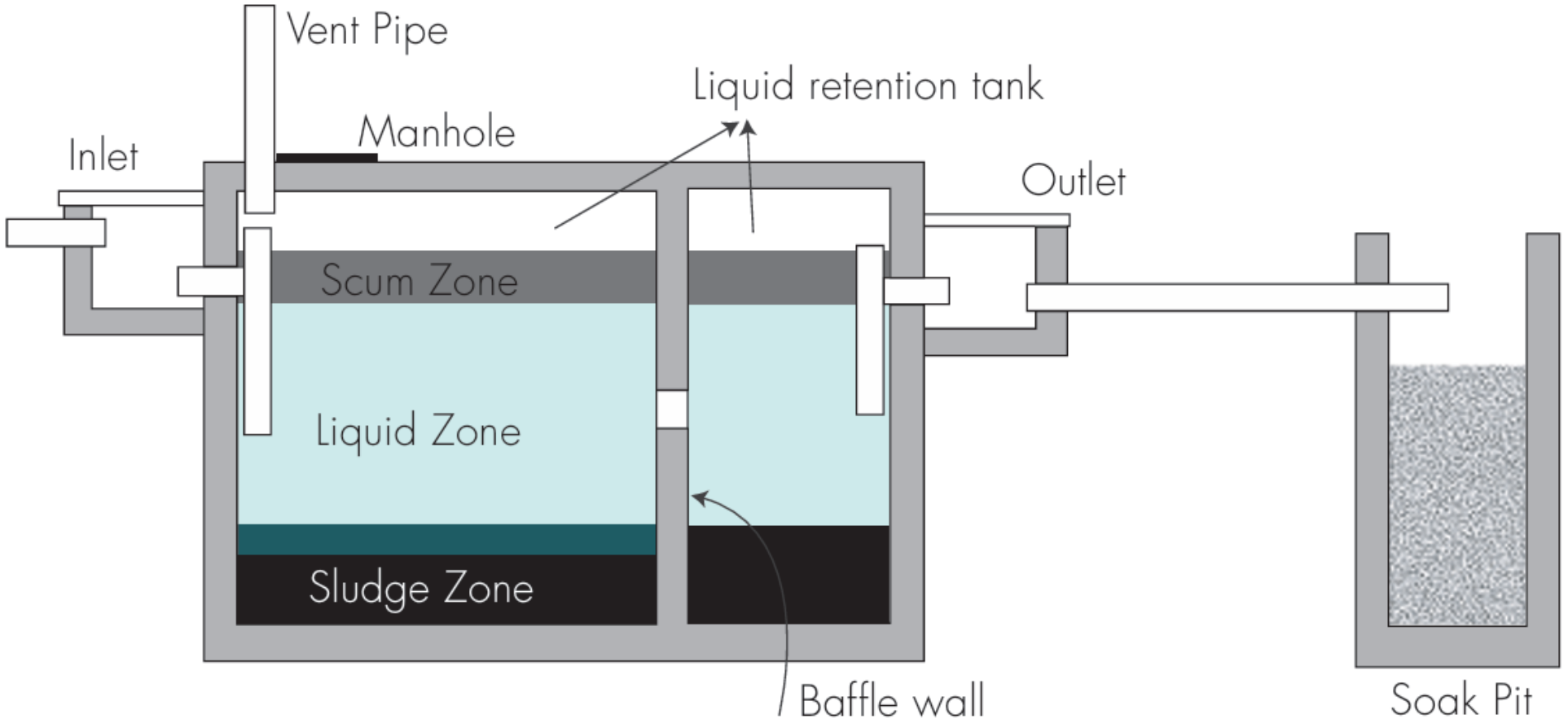
Septic Tank

A septic tank should have following three key characteristics-

- It should be watertight
- It should consist of at least two chambers separated by a baffle wall
- It should be assembled with soak pit or provided with outlet



Components of Septic Tank

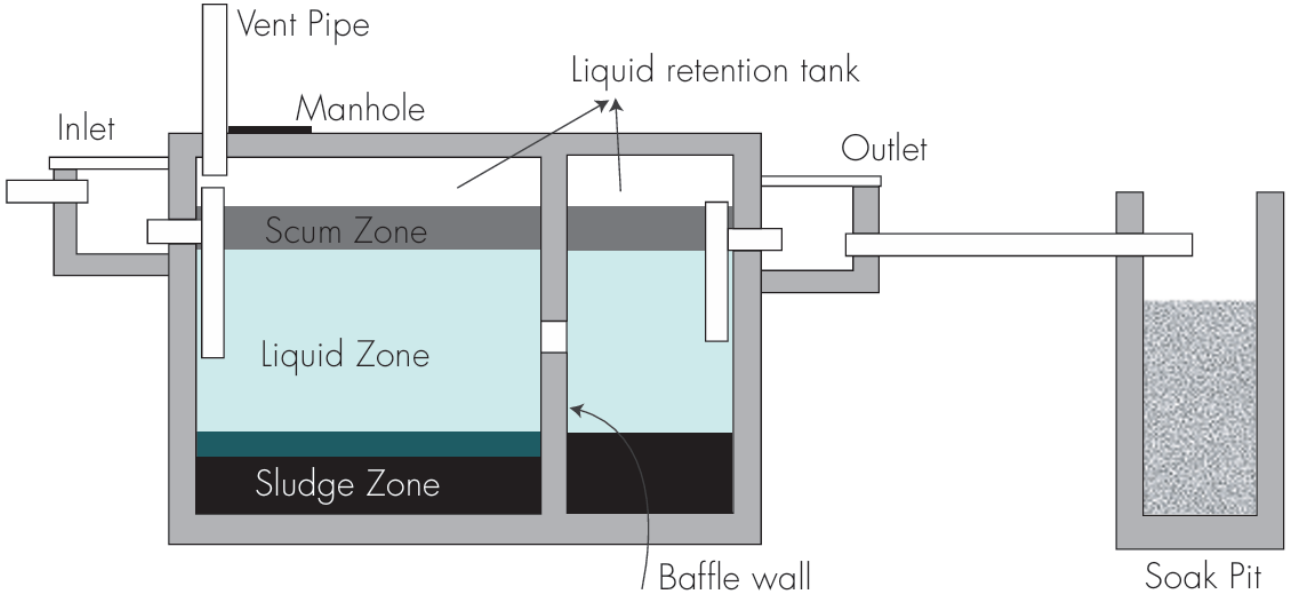


Components of Septic Tank

Inlet Chamber

Inlet is simply a chamber with cover, which allows wastewater in.

Generally, it is located at center along the breadth of septic tank and it should be at the level of 100 -150 mm above the outlet level to avoid clogging. The diameter of the Inlet should not be less than 100 mm. It consists of down pipe inside the septic tank.



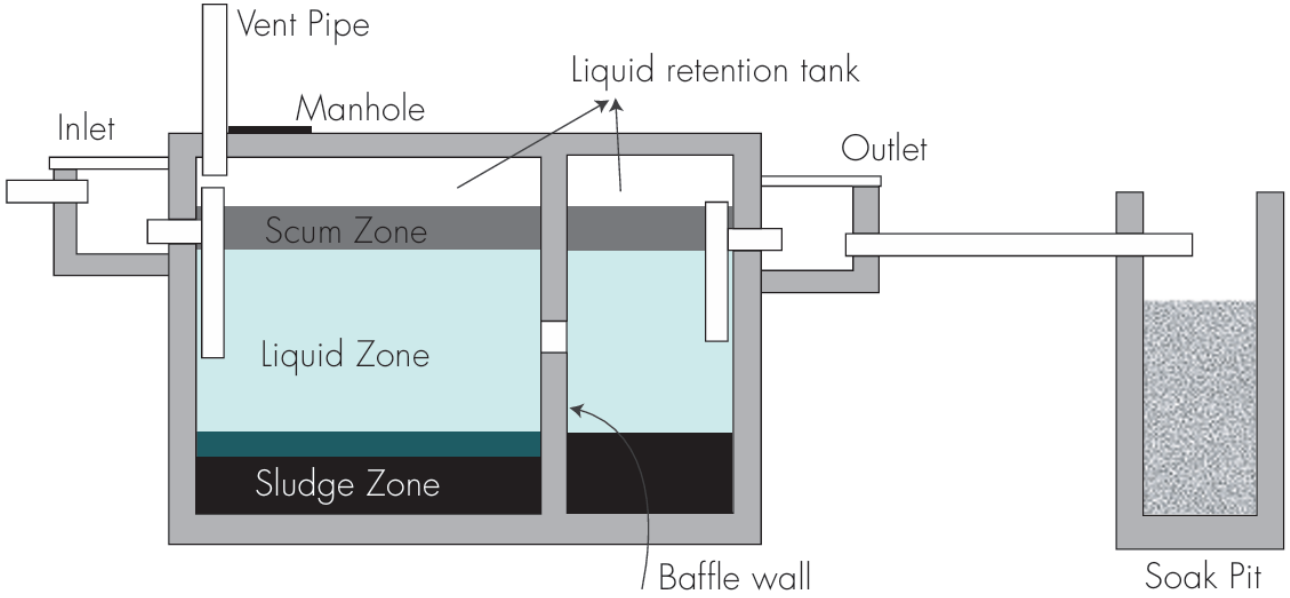
Components of Septic Tank

Outlet Chamber

Outlet is like inlet chamber, which is provided at the end of the septic tank.

It also is located at center along the breadth of septic tank. The level of outlet chamber should be minimum 1.2 m from bottom of septic tank.

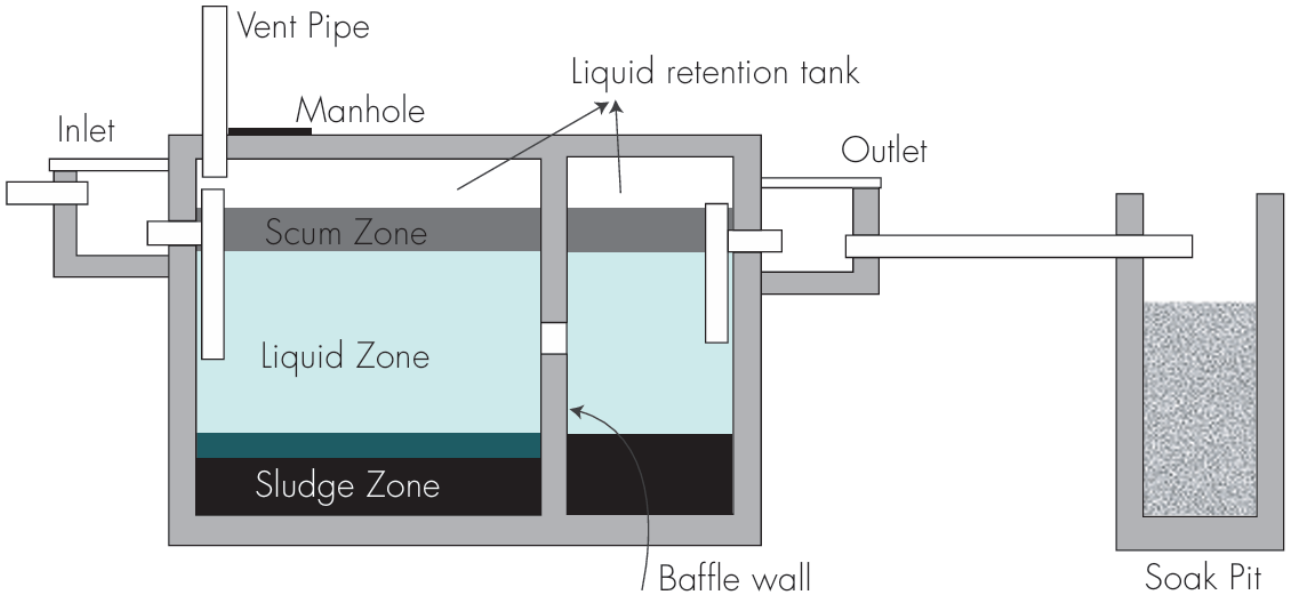
Normally the diameter of the Inlet should not be less than the inlet pipe. A down pipe is also provided at starting point of outlet inside the septic tank.



Components of Septic Tank

Manhole

- Provides safe and easy access for inspecting and desludging the septic tank.
- Requires a cover that is both lightweight for easy opening and strong enough to support an adult's weight.

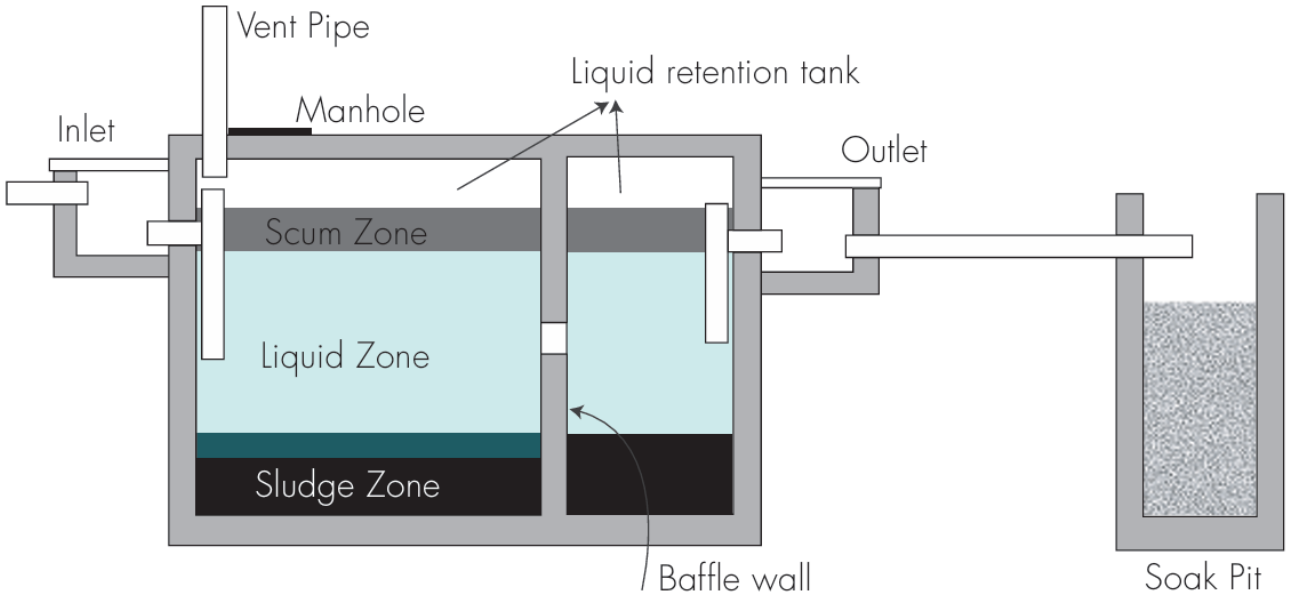


Components of Septic Tank

Hydraulic Retention Tank

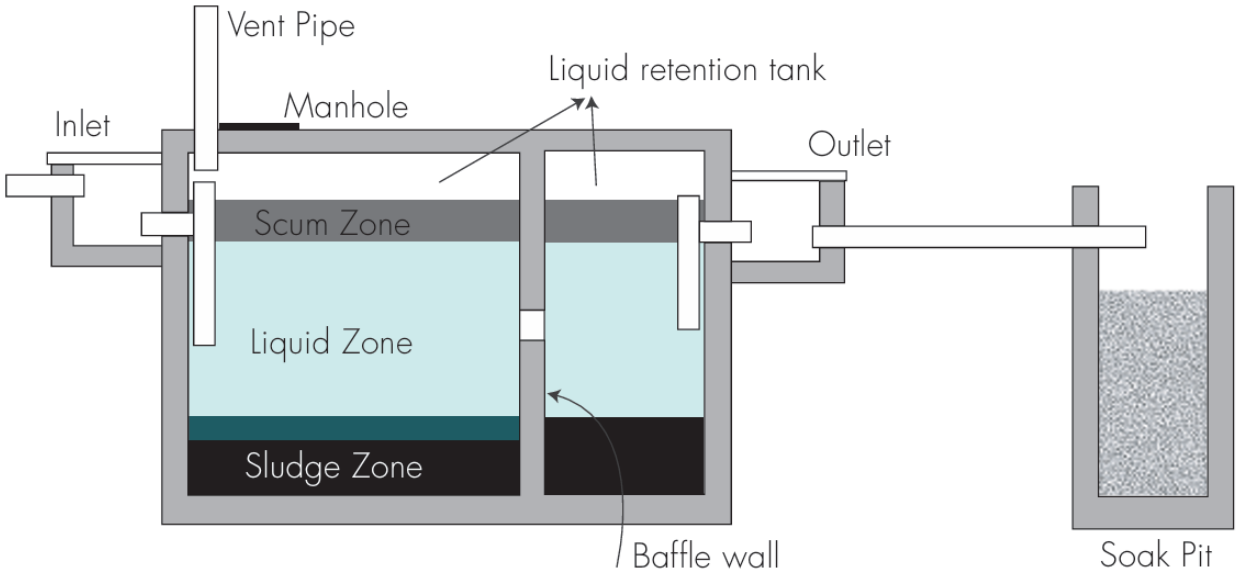
Multiple retention compartments is needed as it –

- Improved Solids Separation
- Enhanced Treatment Efficiency
- Prevents Clogging and System Failure



Components of Septic Tank

- **Baffle Wall:** Divides the tank, improving treatment by controlling the flow of wastewater between compartments.
- **Vent Pipe:** Safely releases poisonous and foul gases produced during anaerobic digestion out of the tank system.



Designing Septic Tank

Step 1: Calculation of Sewage Volume

Sewage Inflow per day = Total Population * per capita Sewage Production per day

Effective Sewage Volume = Sewage Inflow per day * (Detention period/24)

Step 2: Calculation of Sludge Volume

Sludge Inflow per day = Total Population * per capita Sludge Production per day

Effective Sludge Volume = Sludge Inflow per day * 365 * Desludging period

Step 3: Calculation of Septic Tank Volume

Total Volume = Effective Sewage Vol. + Effective Sludge Vol.

Designing Septic Tank

Step 4: Assume Depth (D)

Liquid Depth should be between 1.2 - 2.2 m.

Step 5: Select Width to Length Ratio (W : L)

Typical width to length ratio is between 1 : 2~4

Step 6: Calculate W and L

Total Volume = D*W*L

Step 7: Spacing of Baffle Wall

Length of 1st Compartment = 2 * Length of 2nd Compartment

Problem: Determine the dimensions of a Septic Tank. Given that, the total population is 15, per capita sewage production is 90 liter/day, detention period is 48 hours, and per capita sludge production is 3 liter/day. Assume the desludging period is 10 years.