Making cities ODF++

Manual for Operation and Maintenance of Faecal Sludge Treatment Plants

CWAS CENTER FOR WATER AND SANITATION
CRDF CEPT RESEARCH AND DEVELOPMENT FOUNDATION
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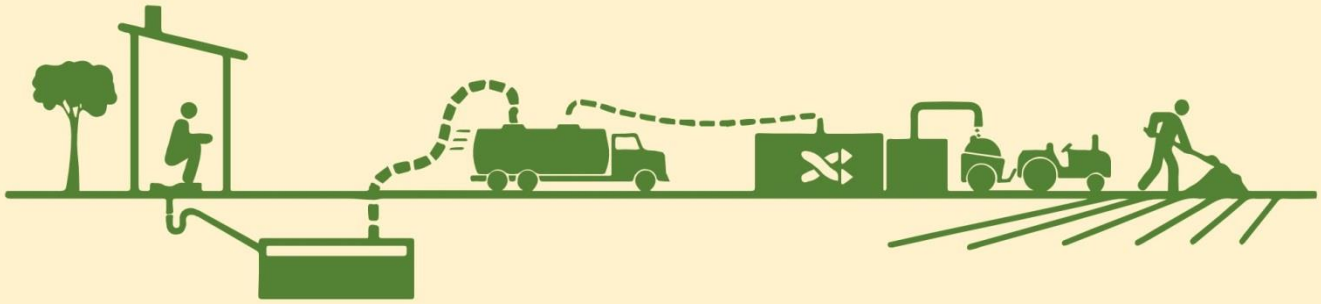


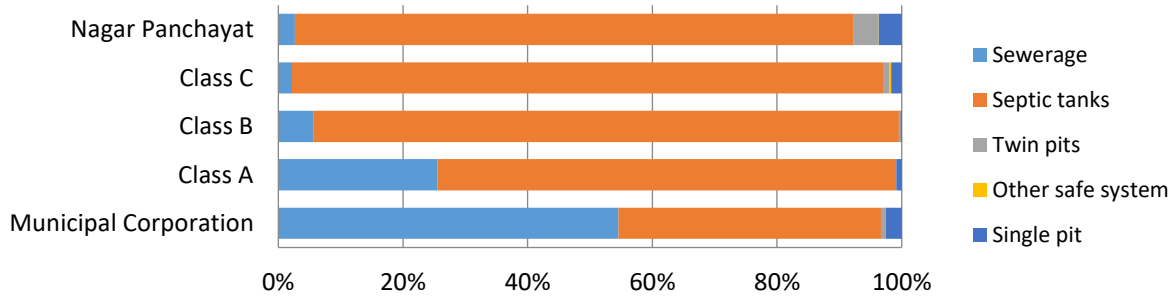
1 Faecal Sludge Treatment Plants across Urban Maharashtra

Maharashtra is the second-most populous state in India with its residents accounting for nearly 10% of India's population. The state is also highly urbanised state with 393 Urban Local Bodies (ULB) and 60 million urban residents, the highest number of urban residents in any Indian state.

The Swachh Maharashtra Mission for Urban Areas (SMMUA) has already achieved its goal of making all its cities Open Defecation Free on October 1st 2017. It has now resolved to sustain this ODF status and also address the sanitation service chain "beyond toilets" by ensuring that faecal waste is properly collected, conveyed, treated and reused. These principles are well articulated in Government of India (GoI) and Government of Maharashtra's (GoM) framework for ODF+/++.

The state government has made efforts to ensure underground sewerage and sewage treatment plants (STPs) in all large ULBs. However, majority of small and medium size cities in Maharashtra are fully dependent on onsite sanitation systems. Thus, GoM has placed special focus on Faecal Sludge and Septage Management as articulated in its resolution and ODF sustainability charter.

Wastewater disposal in urban Maharashtra



FSSM is gaining acknowledgement nationally, and across the world, for providing economical and sustainable solutions for accessible and safe sanitation and the state has also rolled out various guidelines for septage management in Maharashtra and guidebook for ULBs to implement septage management in their cities. A resolution was also issued asking cities to use ODF incentive fund and 14th FC funds for moving towards ODF+/++.

Establishing treatment plants and ensuring safe disposal of faecal waste is a key component to becoming ODF++ and in order to achieve state-wide coverage, all ULBs were classified into 3 categories –

- **Category A - ULBs with functional or proposed STPs** but are partially dependent on onsite systems. These cities can co-treat their collected septage at own STPs. ULBs in this category that do not have full coverage of sewerage system will treat ULBs septage collected from onsite systems in their own STPs. Government of Maharashtra has issued a GR: SMU-2018 /Cr No. 351/UD-34 on 15th December, 2018 which lists ULBs with STPs to treat their septage at own STP.

- **Category B – (Co-treatment at Nearby STPs):** The ULBs which are located within 20 Km of Category A ULBs will need to co-treat their septage at a nearby ULB's STP. Government of Maharashtra's GR: SMU-2018 /Cr No. 351/UD- already list potential ULBs that can take up co-tretment at nearby ULB's STP.

- **Category C – (ULBs with independent FSTPs):** These ULBs are entirely dependent on onsite sanitations systems and where no plan for sewerage projects. These ULBs need to have an independent Faecal Sludge Treatment Plant (FSTPs).

The Government of Maharashtra, in its Resolution (SMMUA – 2019 / Circular No. 124 / UD - 34, Dated 8th Nov, 2019) for making the State ODF++, had planned for construction of FSTP's across 311 cities. These identified ULBs were directed to float a short tender notice. Technical approval of "Type DPRs" of these FSTPs is given by MJP (Maharashtra Jeevan Pradhikaran) and the sizes of FSTPs are decided based on population.

Figure 1: Faecal Sludge Treatment Plant **Source: Indapur FSTP**

These FSTPs are easy to construct and less cost intensive compared to conventional Sewage treatment plants (STPs) in most cases. Though, it is necessary to perform appropriate operations and maintenance activities in order to ensure the treatment plant's durability and productivity. Operations generally comprises of the activities that are carried out to run the treatment facilities and to ensure

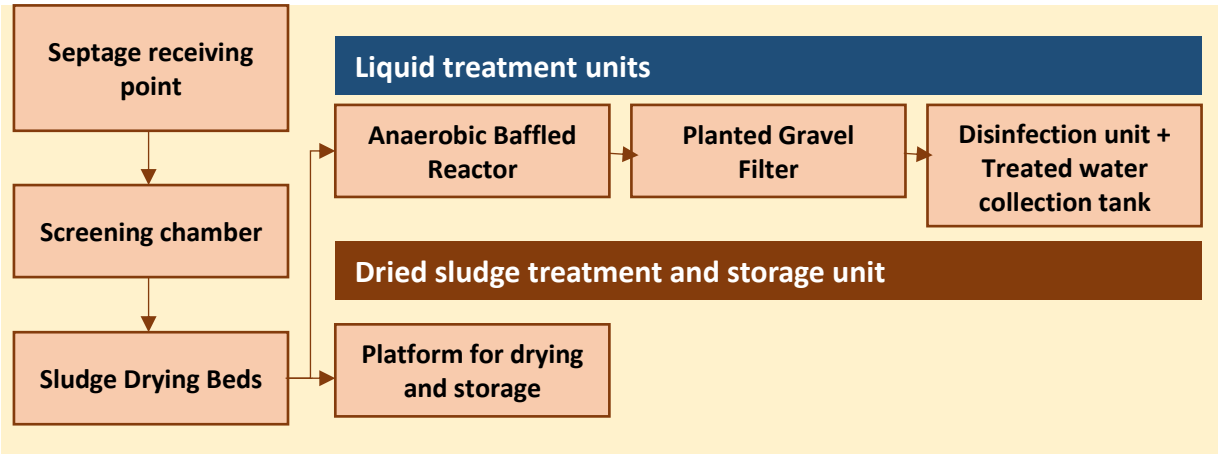
that FSTP delivers designed output, whereas the maintenance comprises of planned or reactive activities to ensure long terms operation of FSTP.There are a number of tasks, required to be performed regardless of the treatment plant's size or technological complexity. Having these tasks performed by skilled operators/workers in a timely manner and in accordance with best practices will make the FSTP most efficient and ensure its long-term sustainability.

This manual is intended to guide the operators/caretakers/ULB Engineers and maintenance staff of FSTP in carrying out the routine and periodical O&M activities which are specific to each components of the FSTP. The manual focusses on the operation and maintenance related tasks that are necessary in order to ensure efficient and effective performance of the FSTP facilities set up in ULBs of Maharashtra.

2 Introduction to FSTP modules and process description

The technology selected for state-wide construction of FSTPs involves five major treatment modules namely 1) Screening, 2) Sludge Drying Beds (SDB), 3) Anaerobic Baffled Reactor (ABR) 4), Planted Gravel Filter (PGF), 5) Disinfection unit. The following diagram given represents the process flow:-

Figure 2: Schematic representation of Faecal Sludge Treatment Plant's process



Screening Chamber

The desludging truck carrying septage will be directed to a receiving point inside the treatment facility. The septage received at the treatment facility will first pass through the screening chamber that will help in avoiding entry of unwanted solid waste into the subsequent treatment modules like plastic bottles, waste fabric, plastic wrappers etc.

Solid treatment

Sludge Drying Beds:

The septage from the screening chamber is further conveyed to the Sludge Drying Beds which acts as a dewatering and drying unit. It is a simple, permeable bed with sloped base at the bottom holding graded filter media like sand and gravel. When loaded with sludge, the percolate liquid (filtrate) gets out from the bottom of bed through the drainand sludge on the top surface dries by evaporation. This process ideally takes 8-12 days after applying each load during which the beds are used in rotation. Once the moisture content in the sludge reduces to around 30 to 40% , it can be removed and stored on a drying platform for further treatment and safe disposal or reuse.

Sludge percolate/liquid treatment

Liquid treatment

Anaerobic Baffled Reactor (ABR) with filters

The collected filtrate from the sludge drying beds is treated in liquid treatment units. In the first stage, the liquid passes through an Anaerobic Baffled Reactor (ABR) for reducing its pollutant levels. An ABR is a fixed-bed biological reactor with one or more filtration four chambers in series. As wastewater flows through the filter media, particles are trapped and organic matter is degraded by the active biomass that is attached to the surface of the filter material.

Planted gravel filter (PGF)

Liquid from the ABR is subjected to further treatment in the horizontal planted gravel filter, which is large gravel and sand-filled basin that is planted with wetland vegetation like *Canas indica, Phragmites* etc. As wastewater flows through the basin, the filter material filters out particles and microorganisms degrade the organics. The filter media acts as a filter for removing solids, provides a fixed surface upon which bacteria can attach, and also acts as a base for the vegetation. Although facultative and anaerobic bacteria degrade most organics, the vegetation transfers a small amount of oxygen to the root zone so that aerobic bacteria can colonize the area and degrade organics as well. The plant roots play an important role in maintaining the permeability of the filter media.

Disinfection unit + treated water collection tank

The final part of the treatment process includes disinfection unit in the form of an Electro Chlorinator or a Chlorine dosing unit. The treated wastewater from the horizontal planted gravel filter will be further collected in 3000 litres capacity of treated water tank. Chlorination of water is carried out in this unit for disinfection. A pump shall be installed at the collection tank for disposal or reuse of treated wastewater. Treated wastewater can be reused for landscaping/ tree plantation and vermi-composting plant within the treatment plant premises as per Maharashtra Pollution Control Board (MPCB) regulations or can be disposed safely into the nearby drain.

The following chapters describe the procedures and protocols for day to day operations of these treatment modules.

3 Protocol to be followed at the entry of desludging vehicle at FSTP

There are a few activities to be performed before feeding the FSTP with the emptied septage. These include basic data recording tasks. For each of these a register should be maintained: -

1. Name of the desludging vehicle operator
2. Location of the septage collected (i.e. HH/CT/PT)
3. Volume of septage to be received at the FSTP
4. Collection of sample from the tanker (Once a week for testing)
5. Testing of sludge samples for pH, TSS, BOD & COD at regular interval
6. Maintain logbook for daily collection of septage, vehicle details, quality test results, output of treated sludge and treated water volume, reuse practices and list of visitors

4 Sludge Drying Beds

Sludge drying beds are one of the simplest and oldest techniques for sludge dewatering. A Sludge Drying Bed (SDB) is a simple, permeable bed that, when loaded with sludge, collects percolated leachate and allows the sludge to dry by evaporation. In SDB liquid gets filtered out from the bottom of bed and sludge is further dried on the top surface. The dried sludge can subsequently be removed for disposal or further treatment and reuse. The collected filtrate has to be further treated for its safe disposal or reuse.

Figure 3: Levelled sand surface of SDB
Source: Ner, Amravati FSTP

Figure 4 Splash pad to avoid disturbance of filter media
Source: FSTPs of Maharashtra

1. Initial inspection before loading the beds

1. The sand surface should be levelled
2. Clear all debris/ waste/ unwanted materials from the surface of bed
3. Make sure a splash pad/plate is in place where the sludge enters the bed

Figure 5: Facilitating flow of sludge on to splash pad
Source: C-WAS

Figure 6 Sludge to be filled up till red marking
Source: C-WAS

2. Operations

1. Start flow of liquid sludge into respective/allocated bed. A strainer should be used at the outlet point of the pipe while emptying the liquid sludge from the truck on to the splash pad of the SDB to prevent the entry of solid waste on the drying beds.
2. Stop flow when the liquid is approximately 40 cm deep throughout the bed that is denoted by a red line marking.
3. Remove dried sludge from the bed when it is visibly dry (moisture content less than 50%), sand layer is visible through cracks and can be easily handled. When sludge is dry (normally 8-12 days or more depending upon weather conditions and depth of sludge load applied) remove the sludge using shovel or shovel and plastic/ metal bowls. The dried sludge should be transferred in to the wheelbarrows. Post this, dried sludge shall be stored or staked in an allocated/dedicated storage area for further treatment at least for sixty days before further use or disposal.
4. After the sludge is removed, inspect the bed, rake the surface of the sand to level it and remove any solid waste/ unwanted materials and add makeup sand to the required depth if necessary.
5. The bed is ready for the next application of sludge.

Figure 7: Removing dried sludge using shovel
Source: Khopoli FSTP (C-WAS)

Figure 8 Maintaining effluent collection chambers
Source: Risod FSTP (C-WAS)

3. Maintenance

1. Inspect the beds every few days noting any bad odors or inspect problems if any. In case of odor, apply lime powder (500 grams per KL of faecal sludge applied on the bed) to overcome the issue.
2. Remove any weed growth or unwanted plants on regular basis
3. Some sand is removed during each sludge removal cycle. The amount depends on the method of removing the dried sludge. The sand bed thickness should be checked periodically from the established reference point such as the top of the bed wall or the optimum sludge marking line (red line). Accordingly, the replenishment and leveling of sand in the sludge drying beds is to be done. Adequate volume with required specification of sand should be available at site at any given point of time.
4. The drainage system should be inspected and maintained so that free drainage takes place from the drying beds. It can be inspected for proper operation shortly after new sludge is placed in a bed. The operator shall have to check the flow in the drain through effluent inspection chamber at the outlet side of SDB regularly.
5. The Engineer in charge for the FSTP should inspect the filtration process of each Sludge Drying Bed and take a decision of replacing the entire filter media if required. Generally, the filter media is required to be replenished at an interval of 12-18 months depending upon the sludge loading rate.
6. Solid waste entrapped in the strainer, should be collected using a rake and transferred into a plastic/metal tray or bowl and further dried by keeping the plastic/metal tray in sunlight till they dry sufficiently. The dried waste to be disposed at the nearby solid waste management facility.
7. Effluent collection chambers to be regularly inspected to ensure that there is no leakage.
8. Structural repairs/painting is to be done on requirement basis.

4. Precautions to be taken

1. Sludge can be removed by shovel when the liquid sludge forms a cake with certain moisture content (at least less than 50%). If the sludge gets too dry (10% moisture content) it will be dusty and will be difficult to remove because it will crumble as it is removed. This will result into clogging the drainage system.
2. The method of removal of dried sludge should not disturb the filter media of bed, because this restricts drainage on subsequent sludge loading applications. During the removal, be careful of not removing the sand along with the dried sludge.
3. Heavy equipment should not be used on the surface of the bed, which may disturb the filter media or compact the sand surface. Planks or rake should be used instead.
4. Dried sludge should not be removed by bare hands. Operator must use PPE.
5. Operator must ensure that the site should not become a breeding place for flies and mosquitos and should be controlled by taking appropriate measures like spraying insect repellants.
6. Sludge drying beds should be covered with a water proof material like tarpaulin during a case of heavy rains.

Figure 9: Range of Personal protective equipment (PPE)
Source: KAM Foundation, Pune

Figure 10 Mandatory usage of PPE while operating FSTP
Source: Wai FSTP (C-WAS)

5. Equipment /PPE required

Strainer, Shovel, Scrapper, plastic/metal bowls, Wheelbarrows, Plank, Splash pad, Gum boots, Gloves, Apron, Mask, Plastic cover sheets/tarpaulin.

5 Anaerobic Baffled reactors (ABR) with filters

The leachate or liquid collected from the sludge drying beds shall be further treated in Anaerobic Baffled Reactor with filters. An ABR is a biological reactor with one or more filtration chambers in series. As wastewater flows through the filter, particles are trapped and organic matter is degraded by the active biomass that is attached to the surface of the filter material.

1. Operations

1. The flow from the SDB into the ABR is by gravity (preferably). If not by gravity, the pump discharge should match the design discharge to avoid sludge washout.
2. An ABR requires a start-up period of several months (generally 3 to 6 months) to reach full treatment capacity since the slow growing anaerobic biomass first needs to be established in the reactor.
3. Scum and sludge levels need to be monitored with appropriate measuring device to ensure timely descumming and desludging of excess sludge.

2. Maintenance

1. Process operation in general is not required, and maintenance is limited to the removal of accumulated sludge and scum at regular interval. It is recommended to remove scum from the first chamber at least once in 6 months. It is to be removed normally with L-shovel or sieves. It is recommended to remove sludge once in 1-3 years. This is to be done using either through motorized vacuum emptying truck or sludge pump. Remove the excess sludge using the sludge pump or a motorized vacuum emptying truck but leave 10 cm of sludge to ensure continuous treatment of wastewater.
2. ABR tanks should be checked from time to time to ensure that they are watertight.
3. Inspection to be done once in a week to check the color of inlet/ outlet of ABR. If the efficiency deteriorated, the filter must be cleaned.
4. Inspection to be done once in a week to check the piping arrangement from ABR to PGF. It is to ensure that there are no leakages from the piping arrangement.
5. The top slab of ABR should be checked from time to time to ensure that there are no cracks developed.
6. Cleaning of internal pipes with required tools (brush with long handle) to ensure free flow of liquid from chamber to chamber once in 6 months.
7. The inspection hole (maintenance hole) covers to be painted with anticorrosive paints or replaced from time to time.

8. The annual painting work must be carried out with weather coat for outer portion.
9. Structural repairs to be carried out on requirement basis.

Figure 11: Checking sludge levels
Source: Angul FSTP O&M manual (CDD society)

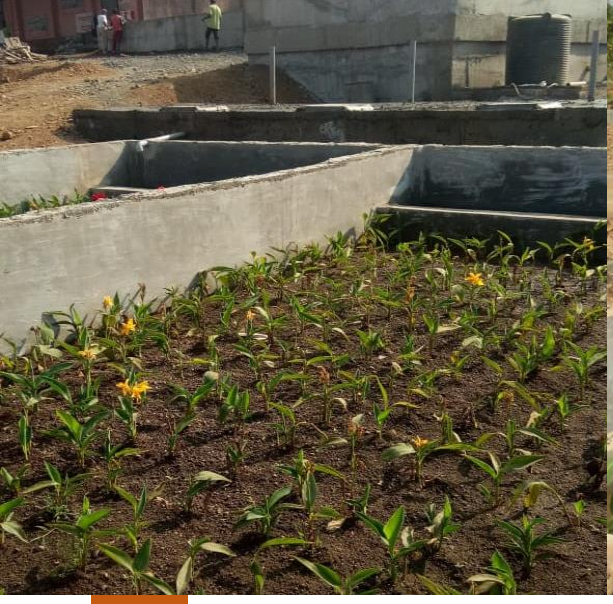
Figure 12 Desludging first chamber of ABR unit
Source: C-WAS

3. Precautions to be taken

1. Operators should never come in contact with the influent or effluent.
2. Care should be taken not to discharge harsh chemicals into the ABR
3. Scum and sludge must be handled with care as they contain high levels of pathogenic organisms
4. Inspection covers (manhole) should be closed immediately after inspection or maintenance

4. Equipment / PPE required

Motorized vacuum emptier truck or sludge pump, Iron bar, brush, sludge depth measurement device, L-showel, sieves, gloves and mask



6 Planted Gravel Filter

A planted gravel filter with horizontal subsurface flow is a large gravel and sand-filled basin that is planted with wetland vegetation. As wastewater flows through the basin, the filter material filters out particles and microorganisms degrade the organics. The filter media acts as a filter for removing solids, a fixed surface upon which bacteria can attach, and a base for the vegetation. Although facultative and anaerobic bacteria degrade most organics, the vegetation transfers a small amount of oxygen to the root zone so that aerobic bacteria can colonize the area and degrade organics as well. The plant roots play an important role in maintaining the permeability of the filter.

Figure 13: Pruning plants and removing dead leaf litter
Source: Angul FSTP O&M manual (CDD society)

Figure 14 Carrying out annual painting works
Source: Khopoli FSTP, (C-WAS)

1. Operations

1. Flow of water from the ABR unit should be distributed equally in each PGF bed
2. Flow from the PGF is to be monitored to keep the water in the PGF beds at an optimum level.
3. Inspection to be done on a weekly basis to check the color of water at the inlet and outlet of PGF.
4. Inspection to be done on a weekly basis to check that there are no leakages from the piping arrangements or the PGF bed

2. Maintenance

1. Pruning plants once in 15-30 days or as per growth. Weeding out unwanted plants is to be carried out on regular basis
2. Cleaning filter media (graded gravels) once in 3 years

3. Cleaning and levelling of the filter media (sand and gravel)
4. Watering the plants in case of adequate load is not received by FSTP
5. Regular replantation to be done as per requirement
6. The drainage system (the perforated pipe at the base) should be inspected once in 6 months and cleaned so that free drainage takes place from the PGF
7. The annual painting work must be carried out with weather coat for outer portion.
8. Structural repairs to be carried out on requirement basis

3. Equipment / PPE required

Gardening scissors or Pruning shears, Mask, Gloves, Protection glasses, Gum boots, shovel

7 General Safety requirements and Emergency Response Procedures

1. General Safety Measures

Following general safety measures shall always be followed at the FSTP: -

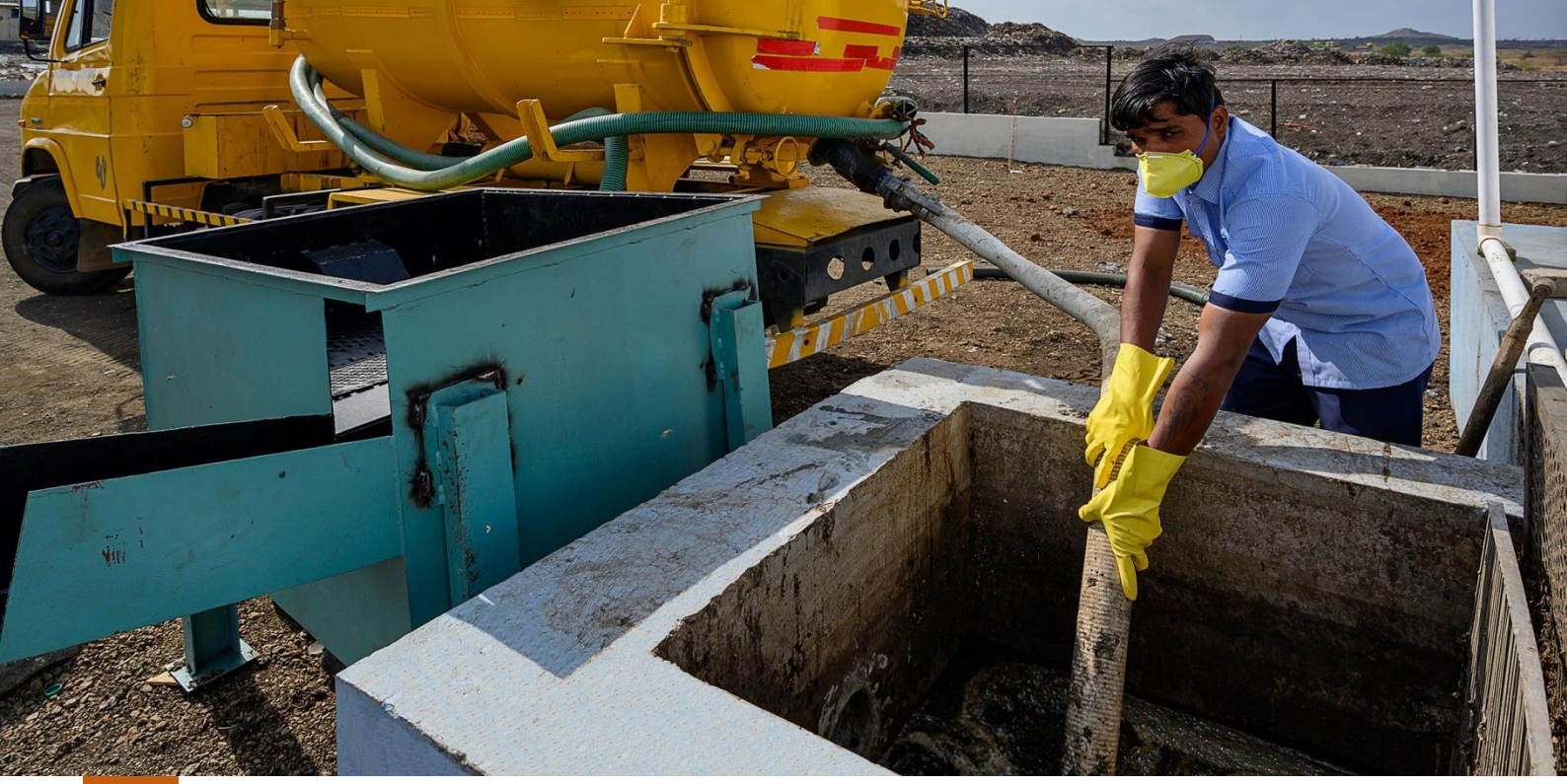
1. No person shall make any direct skin contact with the Faecal sludge. In case of direct contact immediately wash the portion with soap, dry with clean cloth.
2. The entire staff that is involved in emptying the tanker or emptying the dried sludge from the SDB shall wear rubber hand gloves up to elbow, gum boots and cover their face with a mask and safety glasses.
3. The premises shall have mandatory signs indicating “No Smoking” and “No Alcohol” area.
4. Staff can have their food within the premises, however before taking the meal they are required to clean their hands and face with soap.
5. As there is no hazardous waste coming to the premises safety equipment other than Gloves, gum boot, mask and safety glasses will not be required.
6. A first aid kit shall be kept available for the emergency situations.

2. Emergency Response Procedure

In case of emergency situation due to the mishandling of the septage, following care shall be taken: -

1. If a spillage is observed, check for the connections of the pipe from the vehicle transferring septage. Close the valve and re-connect the pipe to avoid further spillage. Any material spilled out to the surface shall be required to be put back in the SDB by using spade.
2. SDBs are to be filled till the red marking only, in case of choking the filtrate won’t pass through the SDB and that may cause the SDB to overflow. In such a scenario remove the first two layers of SDB i.e. sand and gravel, dry them for a day and replenish them in to the SDB.

3. In case of higher water levels in PGF, turn on the pump and remove the treated water from the outlet chamber to the storage tank or to the gardening area.
4. In case sludge is found in PGF, immediately stop feeding of septage and remove the sludge from the ABR by using the suction cum jetting machinery and feed it to the SDB for the further process.



8 Activities and checklists

This chapter shows the activity and time checklists of activities that need to be carried out for proper O&M of FSTP.

1. Daily O&M checklist for treatment modules

Date: **Name of operator/s:**				
Description of activity	**Time**	**Done/Not done**	**Remarks**	**Sign**
Apply sludge from vacuum emptying truck to the screening chamber				
Cleaning of the screens for free flow of septage				
Drying collected solids from screening chamber				
Disposing dried waste at nearby Solid waste Management facility				
Filling SDB with septage by directing the flow on to splash pad				
Removing dried sludge from SDB/s				
Levelling the filter media after removal of dried sludge from SDB/s				
Pumping treated wastewater from PGF to storage tank				
Disinfection using Chlorine dosing unit				

2. Periodic O&M checklist for treatment modules

Date: Name of operator/s:					
Weekly activities					
Description of activity	**Date of performing the activity**				**Sign**
Remove any weed growth or unwanted plants on regular basis from SDB					
Monitoring and maintaining the drainage system and inspection chambers for SDB					
Monitoring scum and sludge levels of ABR unit					
Pruning plants from PGF					
Weeding out unwanted weeds and removing dried leaves from PGF					
Collecting samples from each module for quality testing					
Yearly and need based activities					
Description of activity	**Date of performing the activity**				**Sign**
Replenishing filter media from SDB					
Removing excess scum and sludge from ABR and emptying it on the SDBs					
Replenishing filter media from PGF					
Replacing plants that have died in the PGF unit					
Annual painting works for weather proofing					
Structural repairs					
Maintenance of plumbing systems					

3. Attendance Register for FSTP employees

Name							
Designation							
Year							
Month		**January**	**February**	**March**	**April**	**May**	**....**
Date	**1**						
	2						
	3						

4. Septage load Database sheet

Sr. No.	Date	Origin of septage load	Desludger	Vehicle no.	Driver's name	Vehicle's arrival time	Volume of load in litres	Driver's Signature
1	1/2/20	Household from Saheed Nagar (Prop no ABC011234)	XYZ desludgers (private)				2,000	
2	2/2/20	Hotel from Vani Vihar (Prop no ABC025678) - trip 1	XYZ desludgers (private)				5,000	
3	2/2/20	Hotel from Vani Vihar (Prop no ABC025678) - trip 2	XYZ desludgers (private)				3,000	
4	3/2/20	Government institution	Municipality				3,500	
5	3/2/20	Community toilet	Municipality				5,000	

EXAMP

5. Lab-testing results

Date	Time	Sampling location	Temp°C	pH	BOD (mg/L)	COD (mg/L)	TSS (mg/L)	Total phosphate (mg/L)	TKN (mg/L)	Total coliform (MPN/100m	Faecal coliform
		Effluent standard for FSTP (CPCB)									
		Influent of SDB									
		Effluent of SDB									
		Effluent of ABR									
		Effluent of PGF									

6. Logbook for visitors

Sl. No.	Name	Designation	Organization	Date of Visit	Email address	Phone No.
1						
2						
3						
…						

9 Checklist: Operation and maintenance

1. General FSTP Operations:
   - ☑ **Desludger and FSTP operator** should be wearing Hand Gloves, Face Mask and Gum Boots during operations.


2. Screening
   - ☑ **Daily cleaning** of screens using broom and water- Cleaning of solids and deposited sludge

3. Sludge Drying Bed
   - ☒ Do not put another load on the same SDB chamber until the previous load (Sludge layer of 40 cm) of dries up.

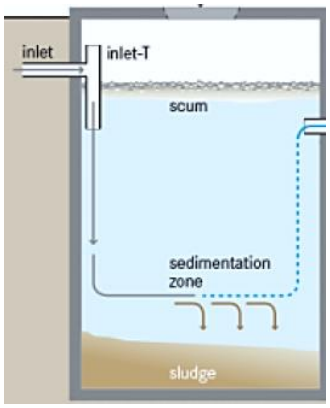
- ☑ Flow of sludge from the screen chamber outlet should be directed on the splash pad.

- ☑ After every new sludge load, the drainage system should be inspected and maintained so that free drainage takes place from the drying beds. The operator should check the flow in the effluent chamber regularly.
- ☑ The Engineer in charge for the FSTP should inspect the filtration process of each Sludge Drying Bed and take a decision of replacing the entire filter media if required. Generally, the filter media is required to be replenished at an interval of 12-18 months depending upon the sludge loading rate.
- ☑ Sludge can be removed by shovel or forks when the sludge into cake formation. If the sludge gets too dry (10% of moisture content) it will be dusty and will be difficult to remove because it will crumble as it is removed. This will result into clogging the drainage system.

- ☑ Post this, dried sludge shall be stored or staked at least **for two months** before further use.

4. Anaerobic Baffled reactors (ABR)

- ☑ Scum and sludge levels need to be monitored and handled with care to ensure that the reactor is functioning well. Remove the excess sludge from the chambers at every 1 to 3 years using the sludge pump or a motorized vacuum emptying truck.
- ☑ Leave 10 cm of sludge in every chamber to ensure continuous treatment of wastewater.



- ☑ **Every year** wash the filter media present in the middle chambers.

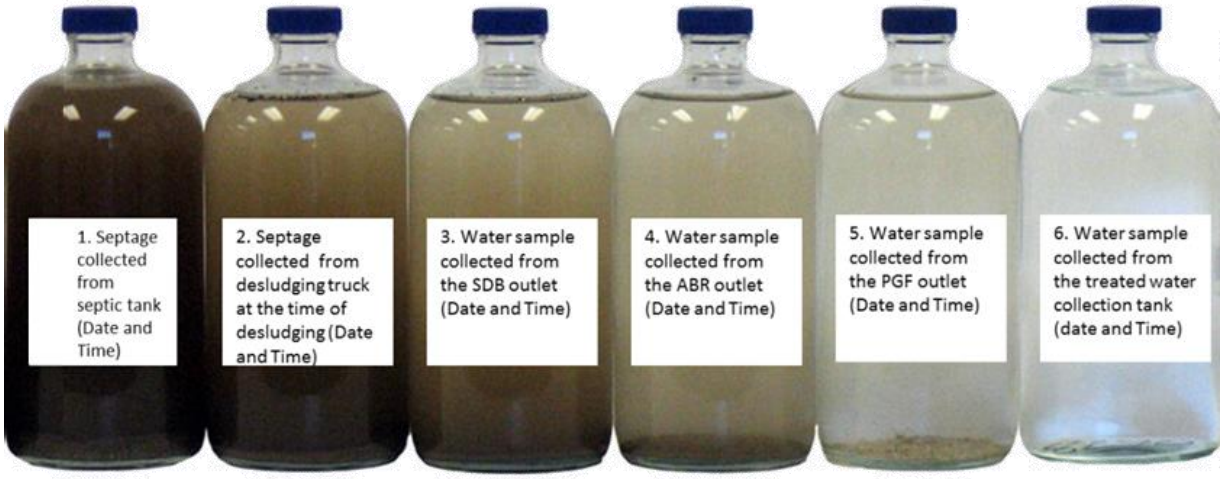
5. Planted Gravel Filter(PGF)

- ☑ Distribute the equal water flow to the PGF beds.
- ☑ Flow from the PGF is to be monitored to keep the water level in PGF at an optimum.
- ☑ Pruning plants once in 15-30 days as per growth
- ☑ Cleaning filter media (graded gravels) once in 3 years
- ☑ Cleaning and levelling of the filter media (sand and gravel), weeding out unwanted plants is done on regular basis
- ☑ Watering the plants in case there is no adequate load received by FSTP
- ☑ Regular replantation to be done as per requirement

6. Water Quality sampling

Sludge/ Water / Treated wastewater samples should be collected at the following stages in the transparent water bottle once in a week. The name of the stage where water is being collected with the date and time should be labelled on the transparent water bottle:

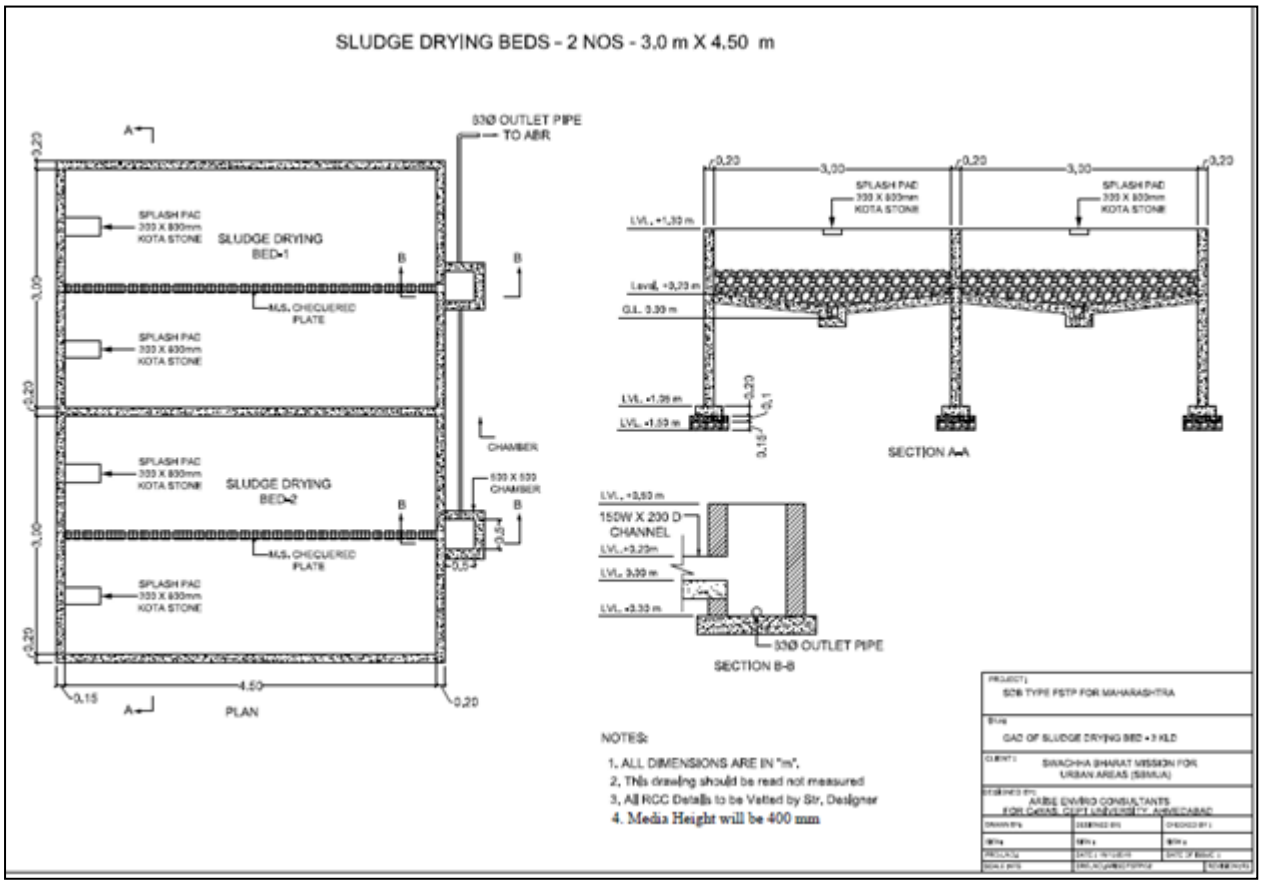
1. Sludge sample from the desludging vehicle at the time of desludging sludge on the screen
2. Sludge sample at the inlet and outlet of the SDB
3. Sludge sample at the outlet of ABR
4. Sludge of the sample at the PGF Outlet
5. Treated water sample.


1. Septage collected from septic tank (Date and Time)
2. Septage collected from desludging truck at the time of desludging (Date and Time)
3. Water sample collected from the SDB outlet (Date and Time)
4. Water sample collected from the ABR outlet (Date and Time)
5. Water sample collected from the PGF outlet (Date and Time)
6. Water sample collected from the treated water collection tank (date and Time)

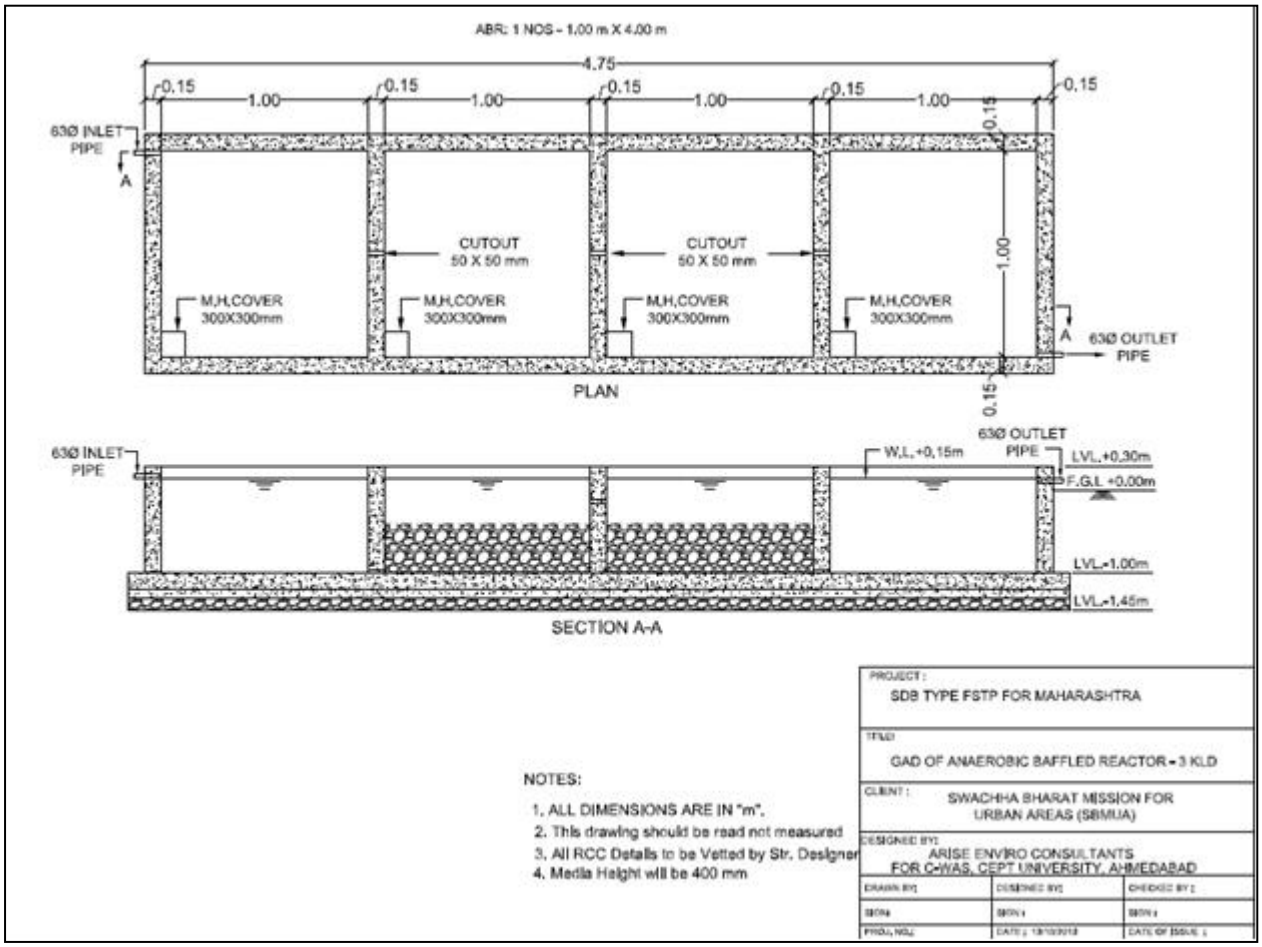
10 Annexure

1. General Arrangement drawings for a 3 KLD FSTP

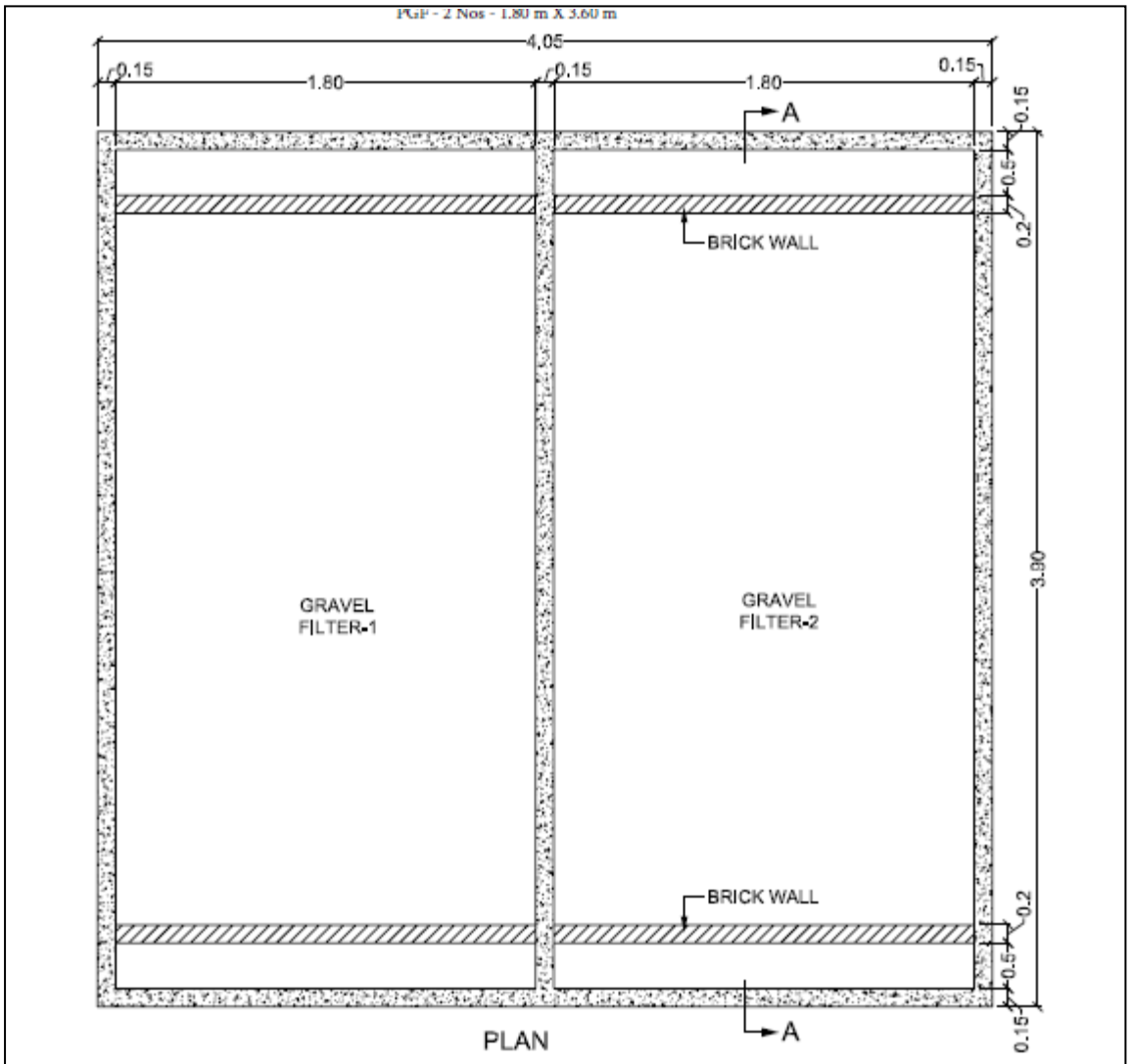
1. G.A.D. for Sludge Drying Beds

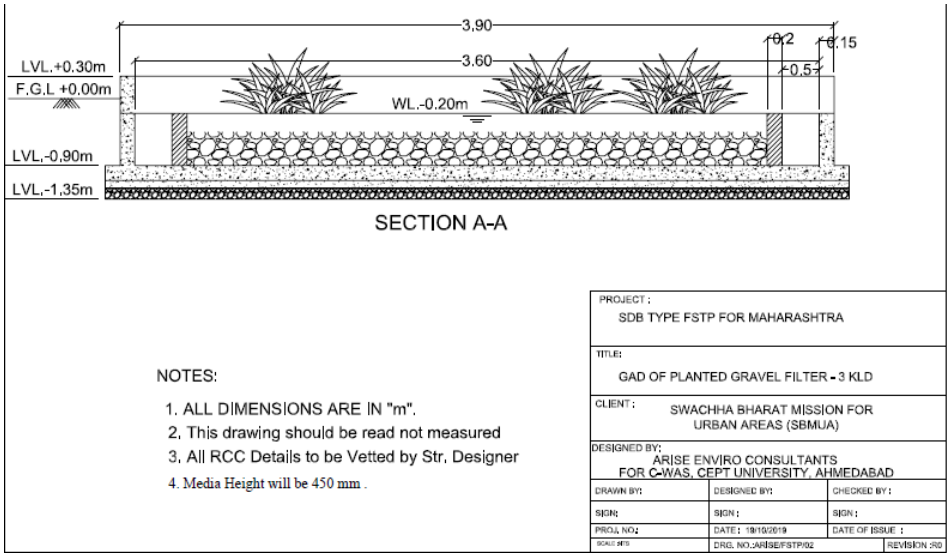


2. G.A.D. for Anaerobic Baffled Reactor



3. G.A.D. for Planted Gravel Filter





2. Filter media specifications and layer thickness in each unit

Description as per MJP DSR	Thickness of layer in different units		
Providing, lowering, laying and placing in position, shrouding material for porous pipe gallery / slotted pipe gallery/ trench gallery with all leads and lifts involved including transportation of materials to site of works, screening and washing of materials and placing in position with given section, etc. complete as directed by Engineer-incharge.	**Sludge Drying Beds**	**Anaerobic Baffled Reactor**	**Planted Gravel Filter**
40 mm Pebbles	**0.20 m**	**0.15 m**	**0.15 m**
12 to 20 mm Pebbles	**0.10 m**	**0.15 m**	**0.15 m**
Fine Sand	**0.10 m**	**0.10 m**	**0.15 m**

3. Parameters for treated dried sludge

1. Parameters for dewatered septage/sludge use as fertilizer in agriculture application: -

Sr. no.	Description of parameter	Qualifying criteria	Source
1	Fecal coliform density	< 1000 MPN/g total dry solids	Advisory on onsite and offsite sewage management practices, 2020
2	Salmonella sp. density	3 MPN per 4 g of total dry solids.	
3	Helminth egg concentration	< 1/g total solids	Septage management in India advisory (2013)
4	E coli	<1000/g total solids	

2. Parameters for dewatered septage/sludge for co-composting: -

According to the advisory by MoHUA on onsite/offsite sewage management practices, 2020, the co-compost must adhere to the Fertilizer control order from Ministry of Agriculture. The table given below shows the list of parameters that need to be tested for co-compost: -

Table 3.7: Compost Quality Standards as per Solid Waste Management Rules, 2016; Fertiliser Control Order, 2009; and Fertiliser Control Order, 2013

PARAMETERS	ORGANIC COMPOST	PHOSPHATE RICH ORGANIC MANURE (PROM)
	FCO 2009	FCO (PROM) 2013
Arsenic (mg/kg)	10.00	10.00
Cadmium (mg/kg)	5.00	5.00
Chromium (mg/kg)	50.00	50.00
Copper (mg/kg)	300.00	300.00
Lead (mg/kg)	100.00	100.00
Mercury (mg/kg)	0.15	0.15
Nickel (mg/kg)	50.00	50.00
Zinc (mg/kg)	1000.00	1000.00
C/N ratio	<20	less than 20:1
pH	6.5 - 7.5	(1:5 solution) maximum 6.7
Moisture, % by weight, maximum	15.0-25.0	25.0
Bulk density (g/cm^3)	<1.0	Less than 1.6
Total organic carbon, % by weight, minimum	12.0	7.9
Total nitrogen (N), % by weight, minimum	0.8	0.4
Total phosphate (P_2O_5), % by weight, minimum	0.4	10.4
Total potassium (K_2O), % by weight, minimum	0.4	–
Colour	Dark brown to black	–
Odour	Absence of foul odour	–
Particle size	Minimum 90% material should pass through 4.0 mm IS sieve	Minimum 90% material should pass through 4.0 mm IS sieve
Conductivity (as dsm^{-1}), not more than	4.0	8.2

Note:

- Tolerance limits as per FCO:
  i. For compost- A sum total of nitrogen, phosphorus and potassium nutrients shall not be less than 1.5% in compost
  ii. For PROM- No such directive
- "–" Not applicable