Chapter 13

Rainwater Harvesting

Intoduction to RWH

- Definition of Rain water Harvesting
- Building code requirement – NBC 2016 Part-9 section -1
- Basic Hydrological Cycle
- Requirement of RWH
- Method of Rain water Harvesting
- Rain water harvesting illustration for a Residential project.
- Advantages & disadvantages of RWH
- Overview of RWH

In principle, rainwater harvesting consists of intercepting rainfall where it occurs, saving the water in various storage structures, which can be natural or manmade, percolating it in ground to raise water table level, prevention of losses through evaporation & and beneficially using stored water locally.

In the universe, life is known to exist nowhere except the Earth. Modern science unequivocally believes that life cannot exist without water.

Life has sustained on our Earth for 3.5 billion years because of some extraordinary attributes of the Earth.

One such attribute is the hydrological cycle, by which a small fraction of one per cent of all freshwater in the Earth is circulated over and over again

One part of rain falling on land flows in rivers and streams towards the ocean, and one part of it goes back to atmosphere as evaporation, and as transpiration by plants. The remaining part circulates underground as subsoil water and groundwater.

It is within this simple, and yet profound framework that rain harvest needs to be understood.

RWH is the need of time today for following reasons :

- Growing population
- Modernization / Industrialization & ill effect associated with it.
- Global warming, abnormal changes in hydrological cycle.
- Growing difference between availability & requirement of water globally
- Acute shortage of fresh potable water.
- To recharge the underground aquifer for sustainability of the water table at lower depths for its reuse to human needs

You will be surprised to know that the Cherapunji in Assam which receives highest rain fall in India to the tune of 11000 mm per year also suffer from acute shortage of drinking water not because rain water is not consumed but allowed to be drained away.
This has also resulted into over exploitation of surface sources like wells for drinking and industrial use, resulting to dropping of water levels and drying up of bore wells.

How can we harvest rain water broadly these are two ways harvesting

(1) Surface run-off harvesting.
(2) Root top rain water harvesting.

Any rainwater harvesting system will typically have following four elements

1) Catchments area

2) Conduits

3) First flush

4) Settlement Tank

5) Recharge facility or storage facility.

1) Catchment area :-

The catchment is the area or surface, which receives rainfall directly. It can be any surface such as paved area like a terrace or courtyard of building or an unpaved area, like Lawn or open ground.

Temporary structures like sloping sheds can also act as catchments.

Run-off factor determines the quantity of water which will be available from the catchment.

Run-off factors for wooded or grassy land is very less say 10% rest is absorbed by percolation, whereas run-off factor for paved or terraced area is 70 to 90% as most of the rainwater is available for recharge or storage except for water lost due to evaporation.

2) Conduits : -

Conduits or the pipes carry rainwater from the catchments or roof tops to harvesting/storage system. The conduits may be of any materials like PVC, HDPE , galvanized or locally available metal like earthen pipes, RCC pipes .

3) First flush :-

First flush is advice used to flush the water received in first shower. The first shower needs to be flushed off to avoid contamination at atmospheric and catchment roof. It will also help cleaning the silt and other materials deposited on the roof (like bird drops) during dry season.

4) Settlement Tank :-

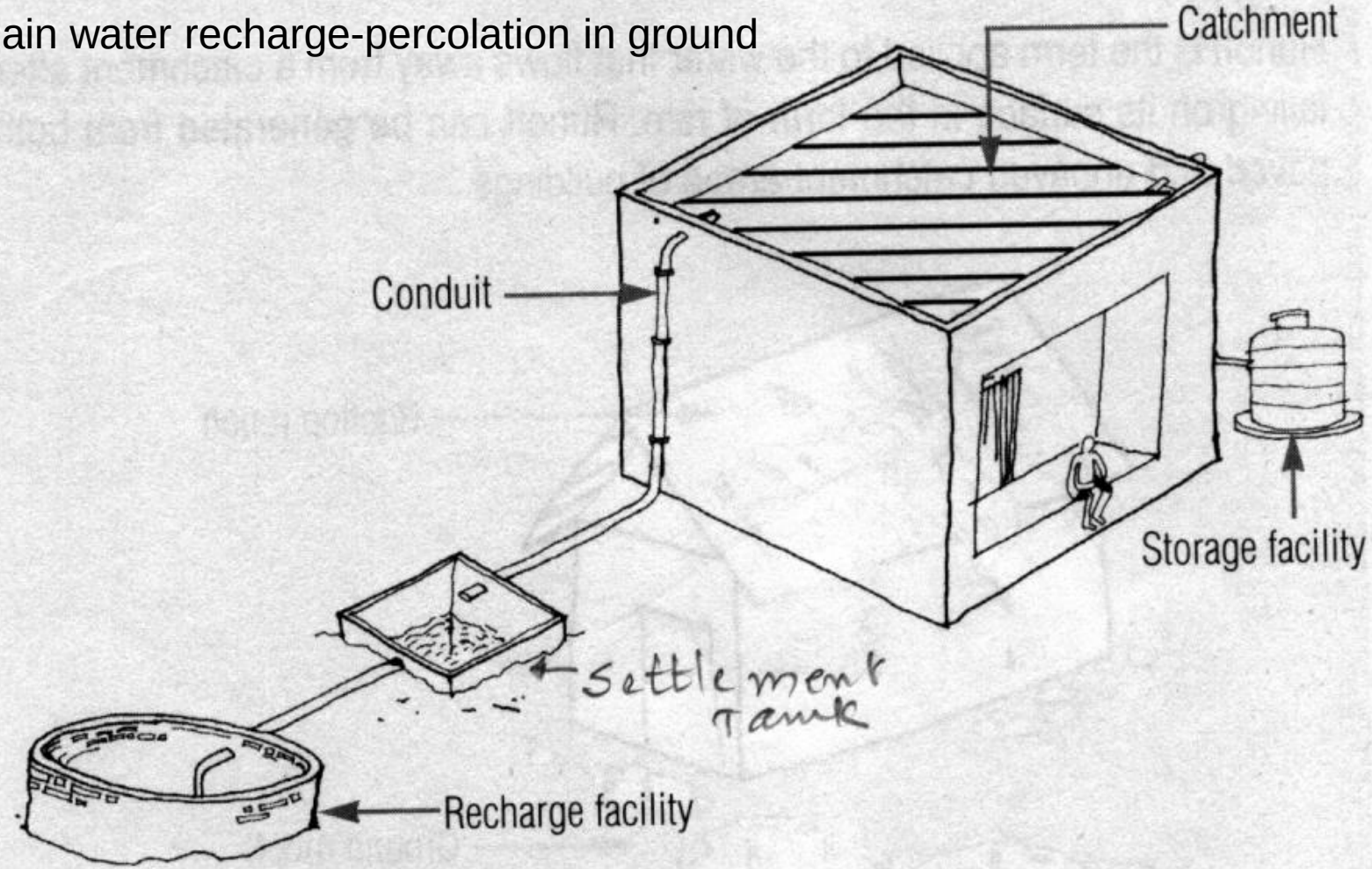
For rural areas , rain water carries lot of dust, mud, dirt along with it, all this matter is removed by introducing a settling tank with gravity filter to arrest the mud, silt .
Water settles there & overflow is connected to recharge facility.
These settling tanks are required to be cleaned from time to time.

Whenever we try to store the rain water from terrace directly, we provide grating at the inlet of down take pipes. Also we flush out the first rain to storm water drain & then clean water from further rains are collected in storage tanks.
As volume of water generated by RWH is very large it becomes uneconomical to store all the water in tanks, then we try to percolate this water in the nearby aquifer by connecting harvested water to dry bore, existing well, hand pump etc. A typical arrangement of recharge is shown in the sketch below.

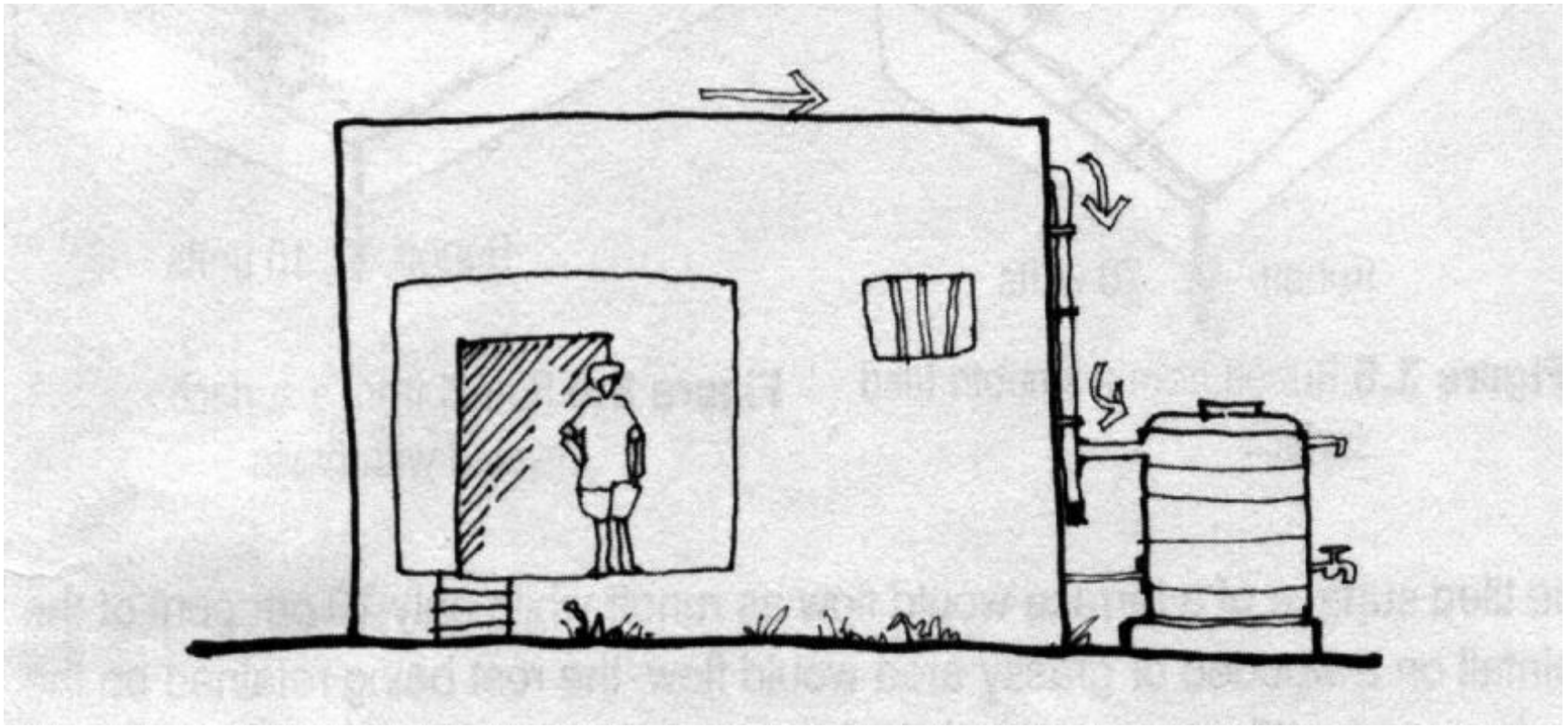
There is major difference between methods adopted for RWH in Urban area & rural area. In urban areas you have lot of hard terraced area, paved pathways & roads, so you get a good quantity & reasonably pure water from collection. But problem is limited & costly space for storage.

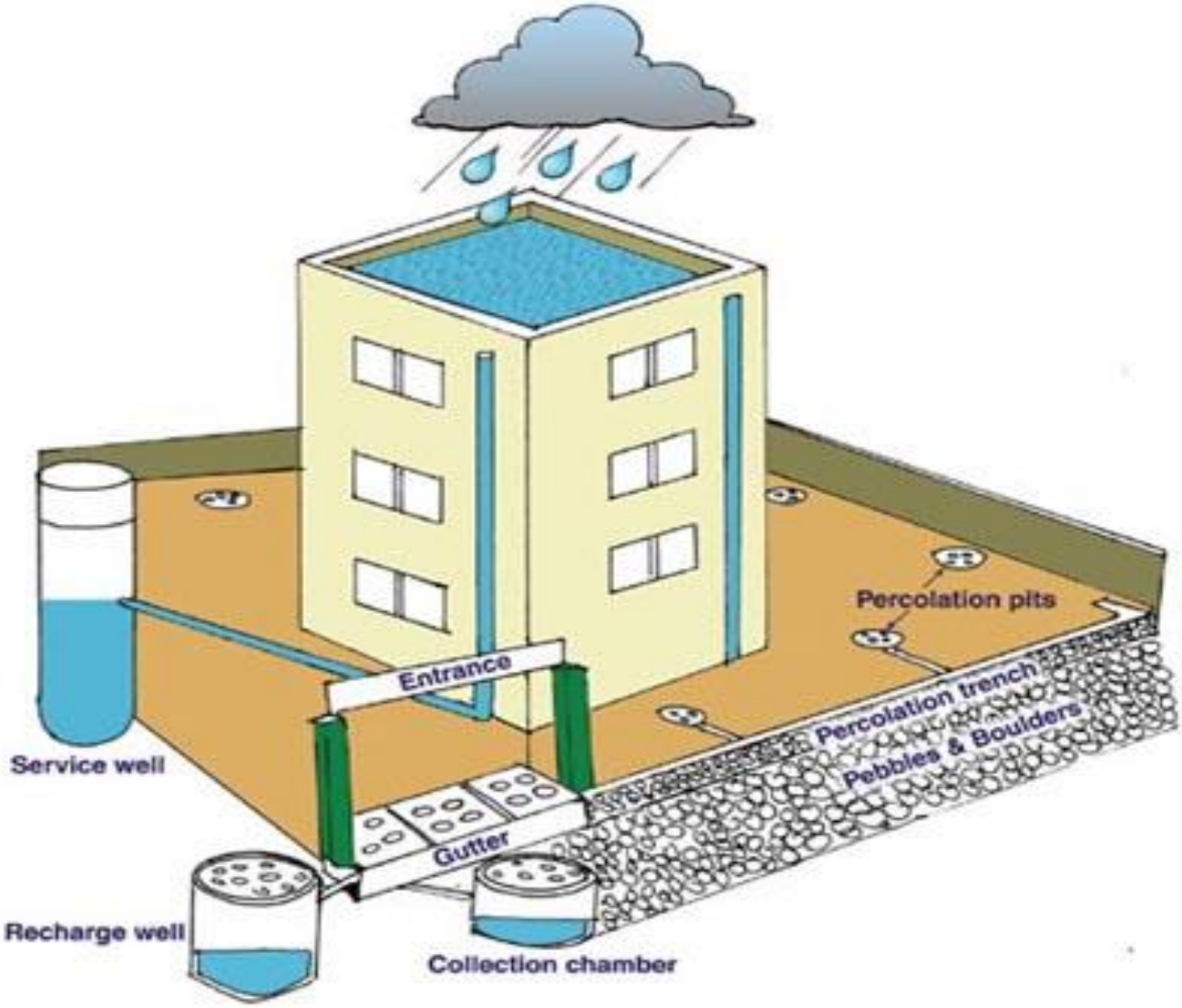
So we store bare minimum & try to percolate maximum water to underground aquifer.
In case of rural area we do not have much of water from paved or terrace area, but we have major quantity from surface runoff.
So we do contour terracing of land & rain water is held at intermediate intervals for percolation.
Finally it is diverted to deep wells / ponds.

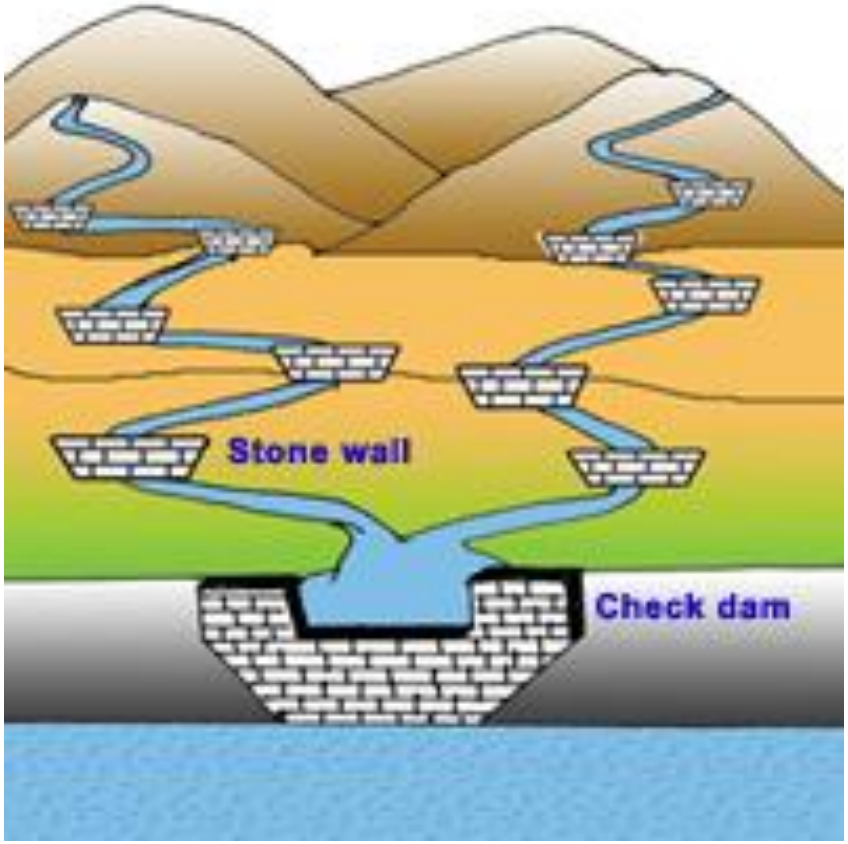
Rain water recharge-percolation in ground

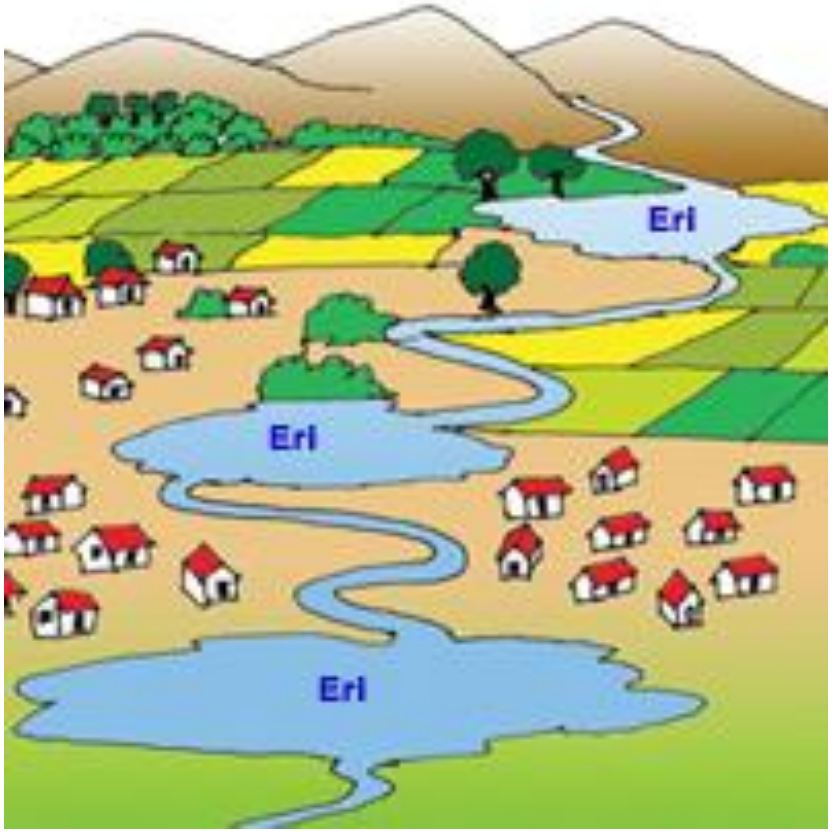


Rain water storage for direct use (non-potable)




Percolation pits
Entrance
Service well
Percolation trench
Pebbles & Boulders
Gutter
Recharge well
Collection chamber


Stone wall
Check dam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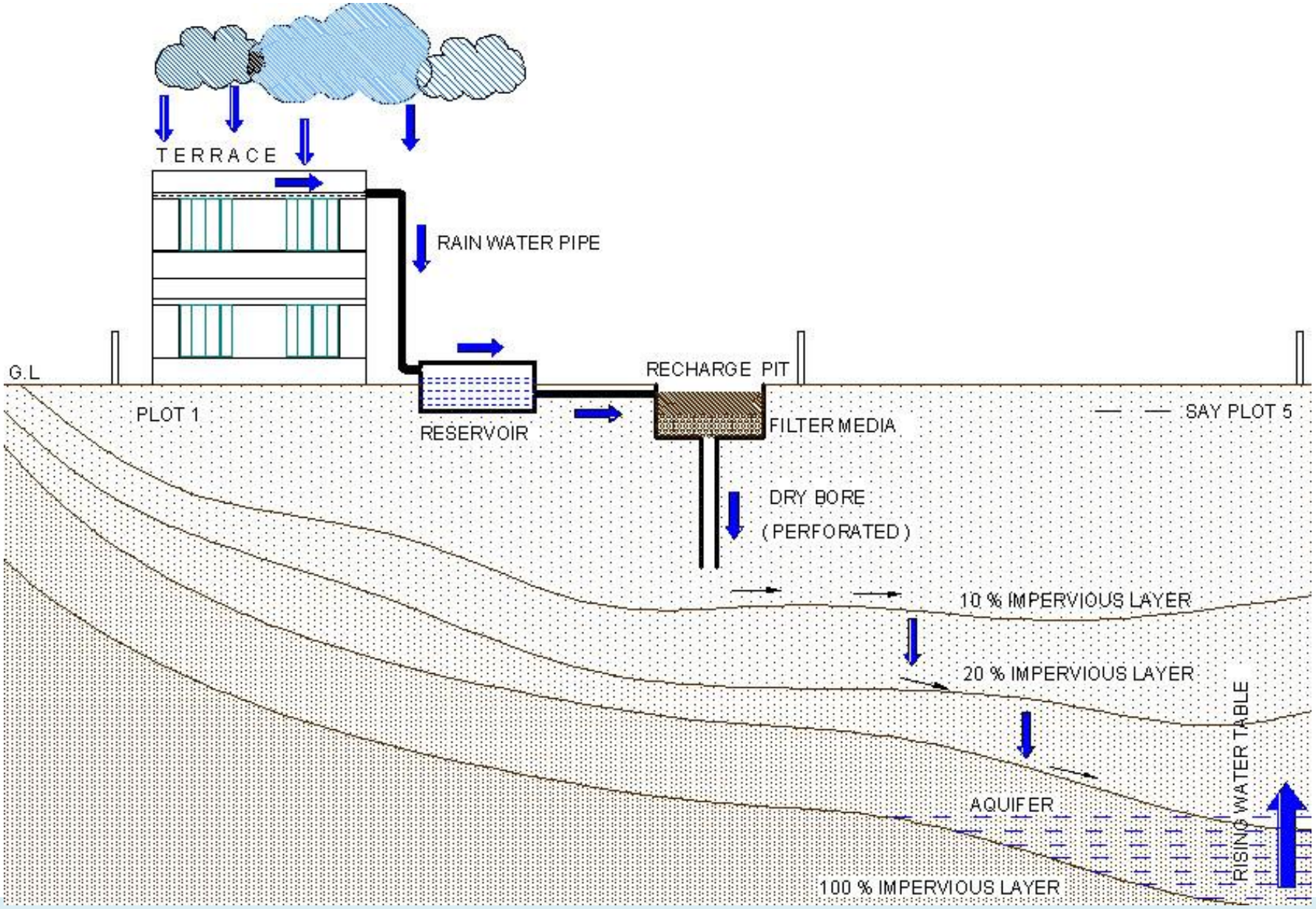

TERRACE
RAIN WATER PIPE
G.L
PLOT 1
RESERVOIR
RECHARGE PIT
FILTER MEDIA
SAY PLOT 5
DRY BORE
(PERFORATED)
10 % IMPERVIOUS LAYER
20 % IMPERVIOUS LAYER
AQUIFER
RISING WATER TABLE
100 % IMPERVIOUS LAYER

Advantages & Disadvantages of RWH :-

We have seen above the different methods of RWH, now let us see Pro & Cons of Rain Water Harvesting.

Advantages are as below :-

1)Water which will runoff & join ocean is not useful directly for human consumption; with the help of RWH we can use this water for mankind.

2) We can not generate water artificially on such large scale, RWH is the best way one can capture large volume of water.

3) Hot & arid places like Rajasthan in India where there is huge scarcity of water. Whatever rain falls in desert is absorbed in soil or evaporates, in such circumstances RWH is a boon.

4) RWH provided of self sufficiency of water supply.

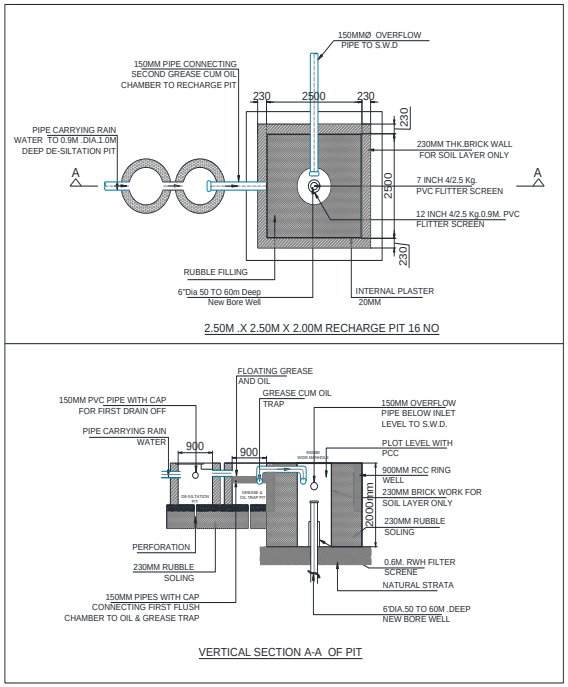
Disadvantages are as below :-

1)RWH on a very large scale will reduce the flow of streams to river, which plays important role in transporting sediments & nutrients as well as sustaining the habitats of many plants and animals, collectively referred to as ecosystems. This also has an ill-effect on hydrological cycle.

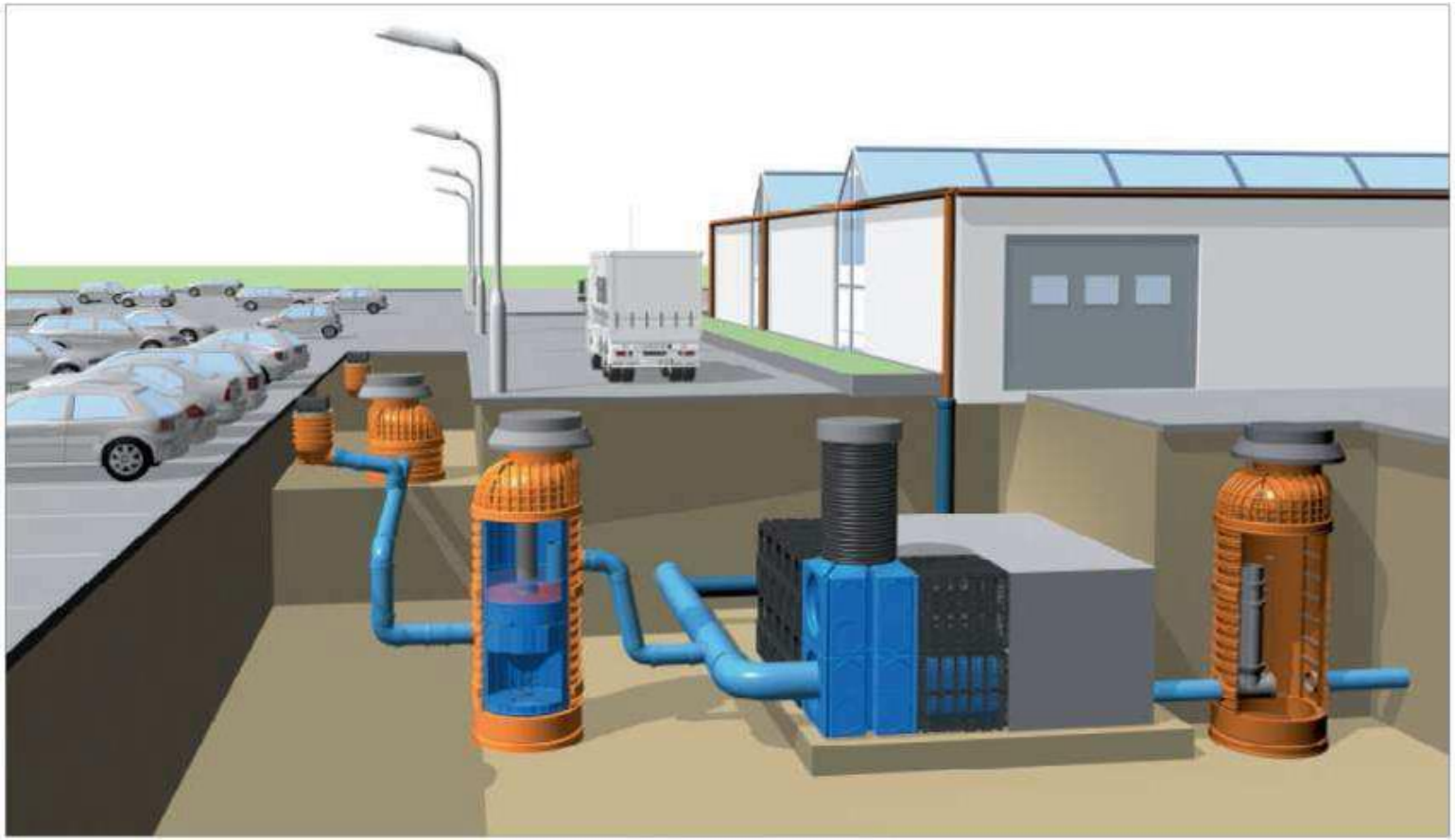
2) If the catchments area is polluted with any biological / chemical material then it will have major impact on quality of underground water storage. Also it takes many years to purify these underground resources by natural means.

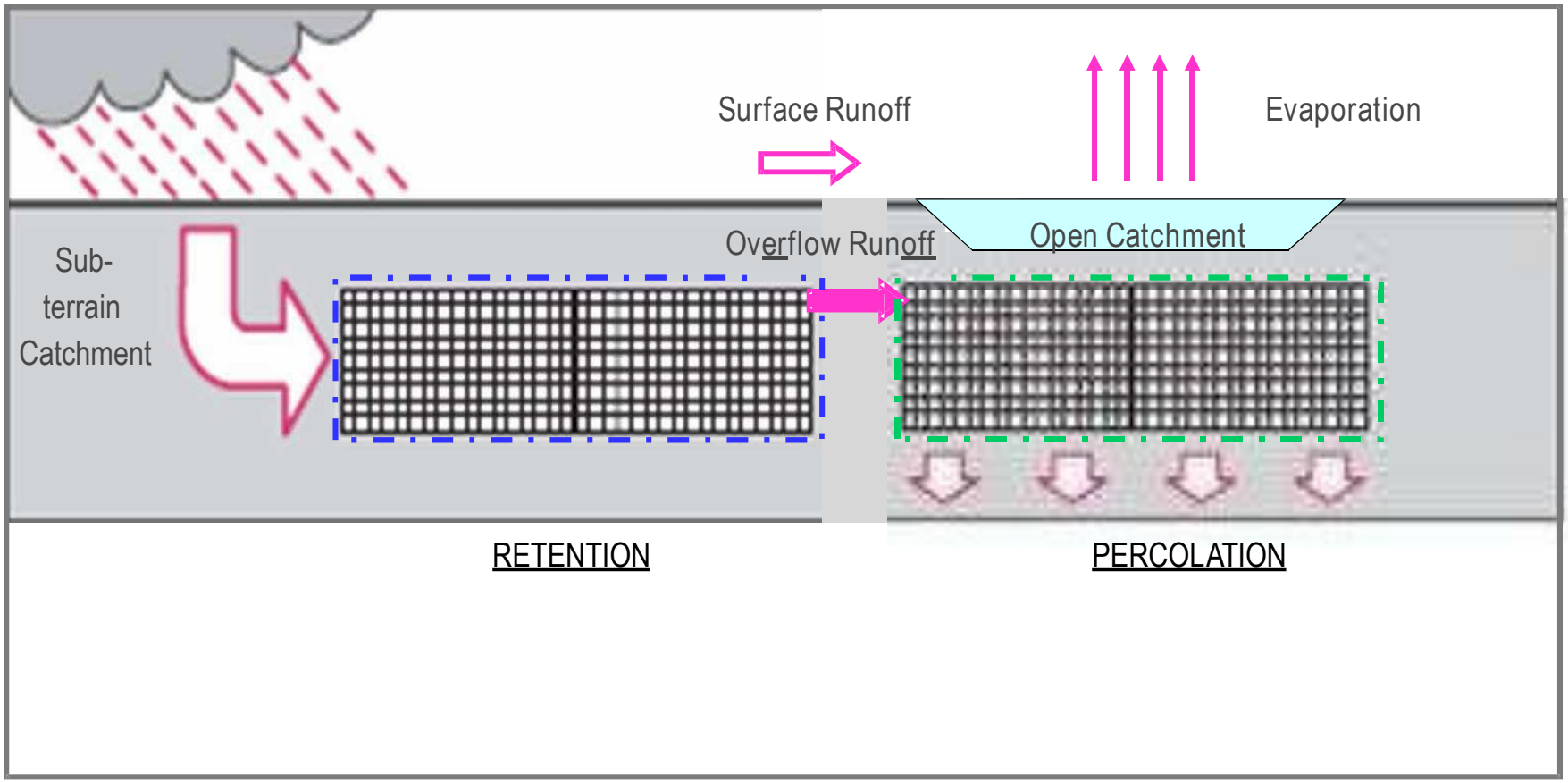
Some time overflow of septic tank is not properly connected to nalla or sullage line. In such cases, during rains sullage water gets mixed with storm water & pollute under ground water.

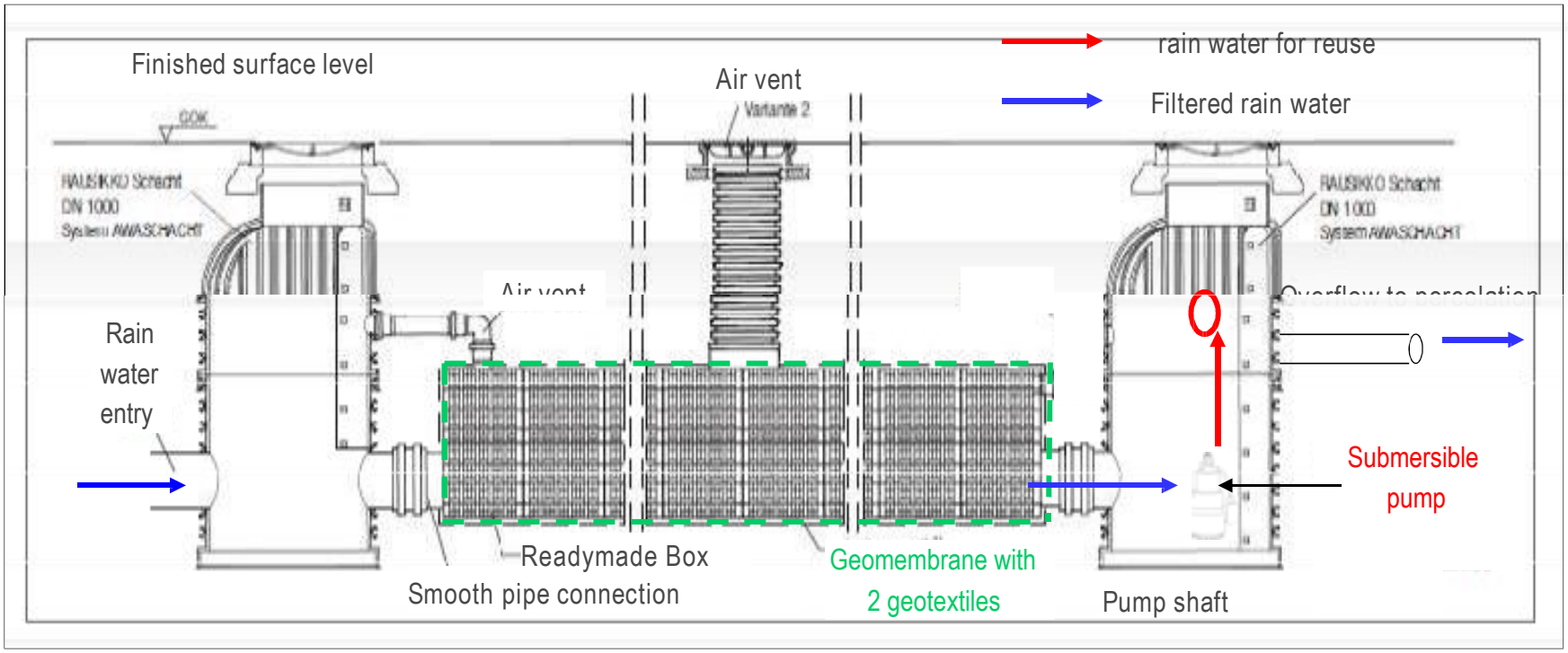
Typical details of RWH Percolation Pit



New Construction technique for RWH Pits in readymade boxes.




Surface Runoff
Evaporation
Open Catchment
Overflow Runoff
Sub-
terrain
Catchment
RETENTION
PERCOLATION



The rain water may be collected and storaged in a readymade basin/ storm cell storage completely sealed using a geomembrane such as HDPE. The extraction of water is done in pump shaft outside the basin. A filter is use before introduction of the rain water in the basin.

Case study storage of rain water for secondary use

Installation of the geomembrane on top of the protection geotextile
Photos during the construction and installation

Case study storage of rain water for secondary use

Detail of the connection, covering with the geomembrane

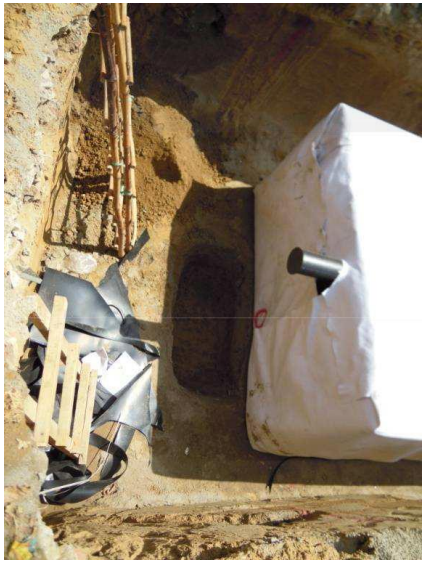
Photos during the construction and installation

Case study storage of rain water for secondary use

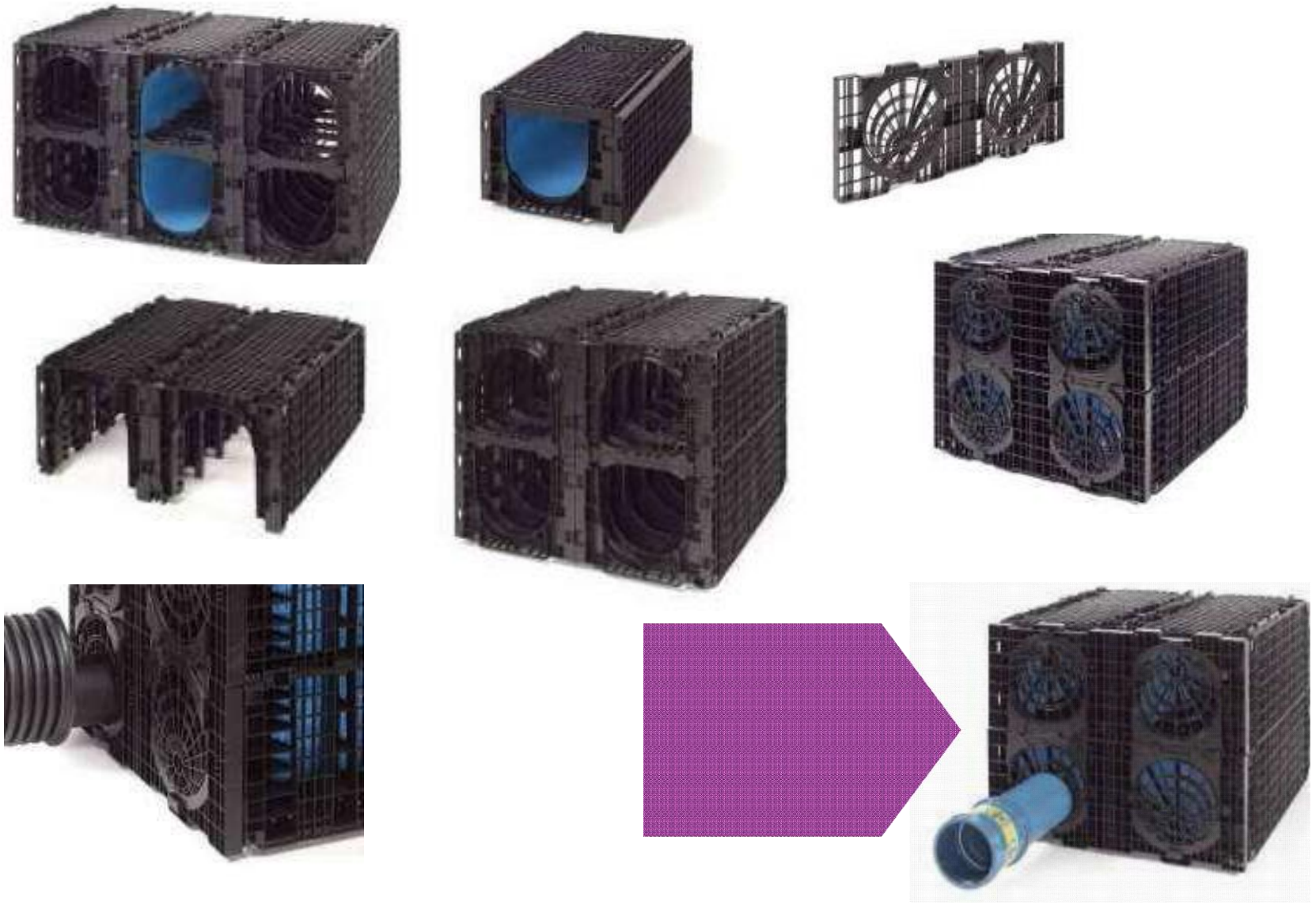
End of the box installation and covering of the basin with the geosynthetics

Photos during the construction and installation

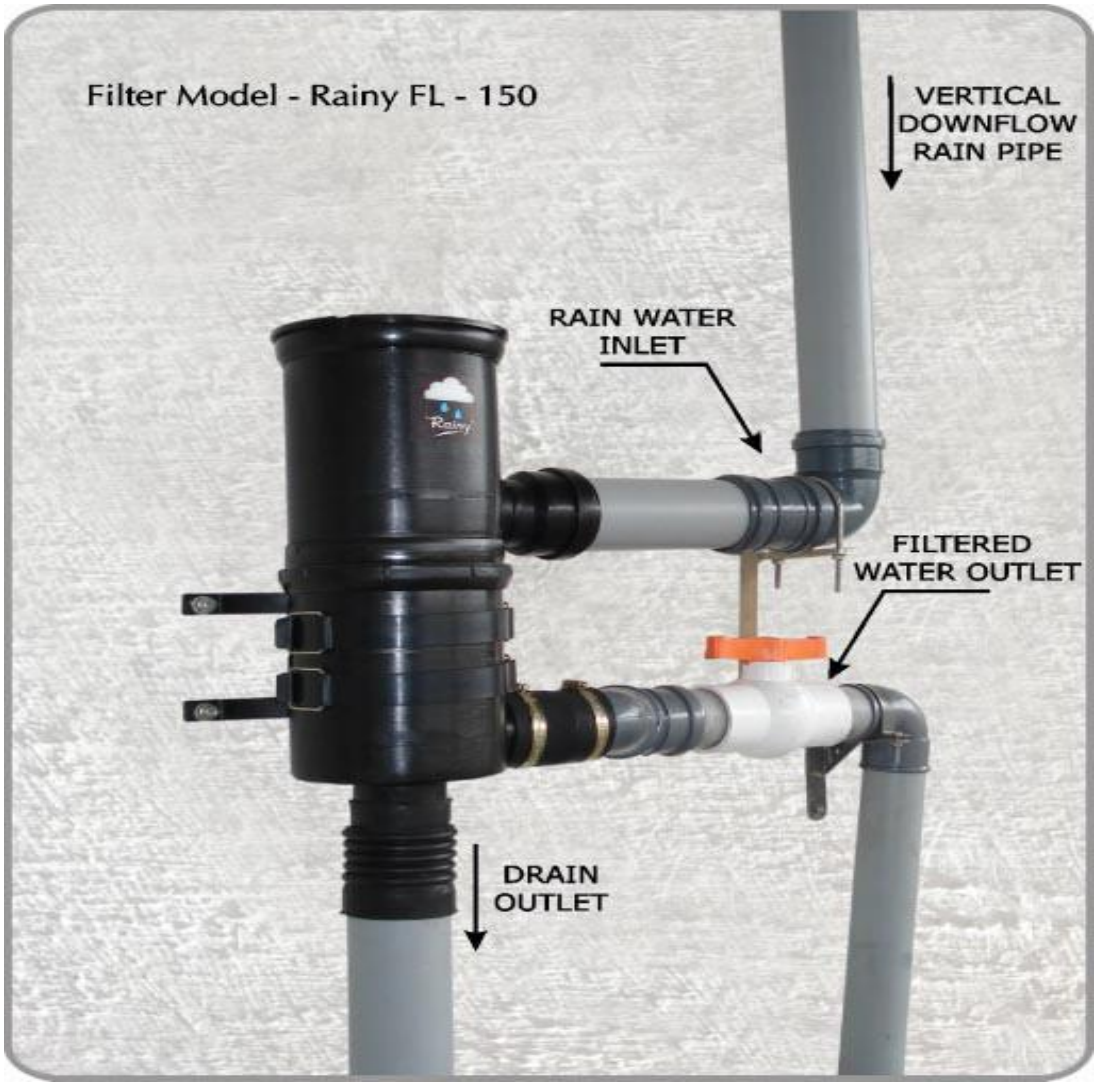
Storage of rain water for secondary use

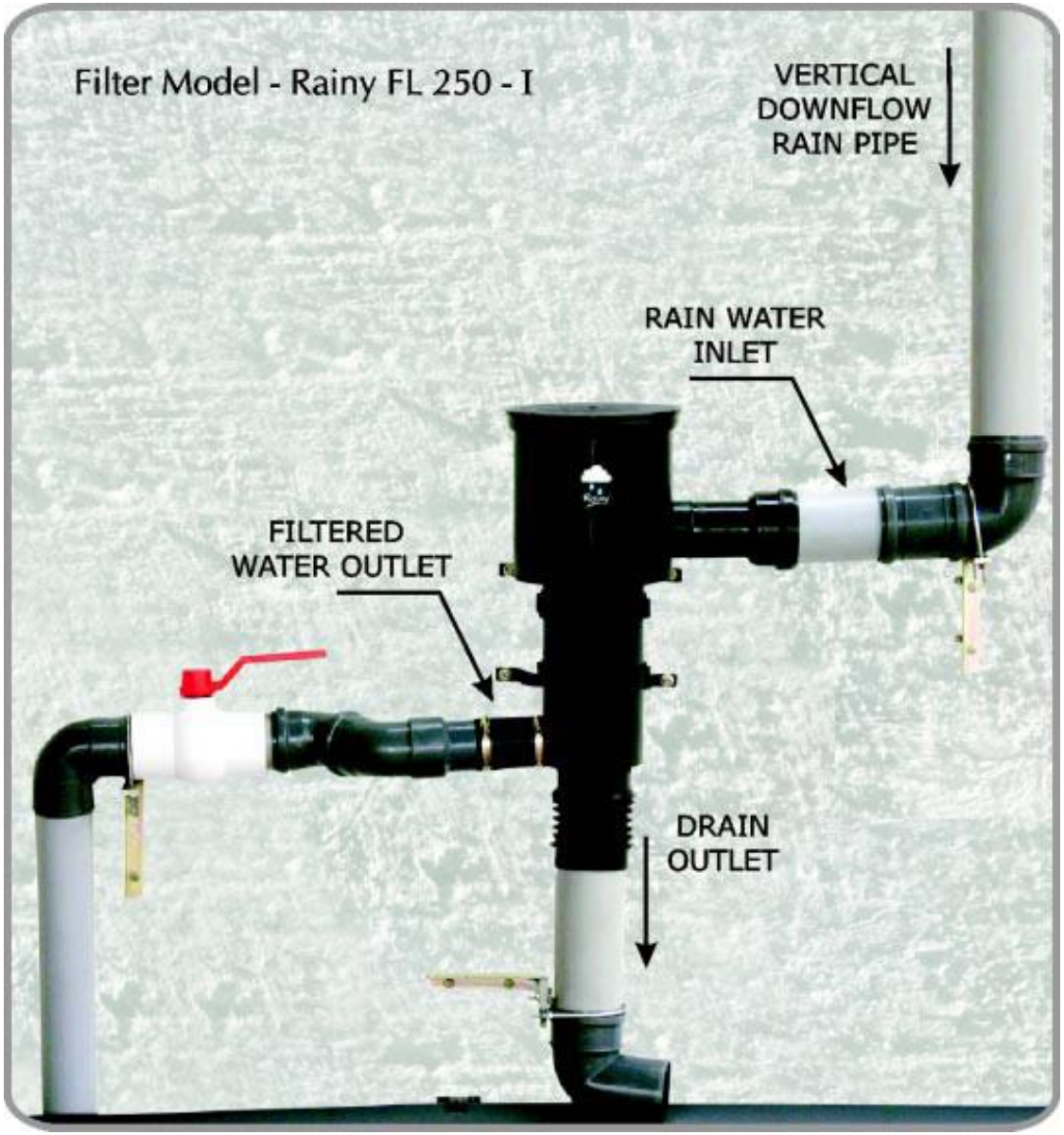



The SHAFT is for Control, Cleaning and Connection. It may be integrated within the basin structure. It allows a connection of pipe inside the structure till DN 500.



Typical details of online Rain water filters




Filter Model - Rainy FL 250 - I
VERTICAL DOWNFLOW RAIN PIPE
RAIN WATER INLET
FILTERED WATER OUTLET
DRAIN OUTLET

Rain Water Calculation for project at Pune					
	Total rainfall per year	800	mm		
	Total rainy days in a year	50			
	Avg rainfall per day	16	mm/day		
Runoff after development					
Sr.No.	Type of area	Area in m2	'C' value	Avg Rain fall	Discharge
				mm/day	m3/day
1	Building roof	5000	0.95	16	76.00
2	Paved area	2500	0.80	16	32.00
3	Concrete Road Area	3000	0.95	16	45.60
4	Open space Area	3500	0.50	16	28.00
5	Ground Landscape area	1500	0.3	16	6.00
	Total of area	15500			
	Total rain water discharge in m3/day				188
Runoff before development					
Sr.No.	Type of area	Area in m2	'C' value	Avg Rain fall	Discharge
				mm/day	m3/day
1	total plot area with heavy countour	15500	0.550	16	136.40
	impact caused due to development	51.2000	m3/day		

Thank you

Any Questions?

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