

## **WATER CONSERVATION & RAINWATER HARVESTING FOR BRIHANMUMBAI**

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### ***Brihan Mumbai - A special city***

Brihan Mumbai consists of old Island City of Mumbai & its suburbs. The island city comprises of original seven Islands & reclaimed areas in between these islands & along the coasts. The suburban area is formed of old villages & their reclaimed extensions. The city & suburbs together admeasure appx. 437.74 Sq. Km. City is having a resident population of @ 12 millions and supports "daily commuting" Population of 20 lakhs. Every day @ 350 new families enter into the city. There are 2,51,212 assessed properties in Mumbai. Approx. 55 % of Mumbai's population stays in slums. The city is commercial capital of India. Stamp duty of more than Rs. 1000 Cr. is 'collected in Mumbai every year.

### **Water Supply of Mumbai.**

The responsibility of water supply & sanitation is fully borne by Municipal Corporation of Brihanmumbai. Earlier City had many Wells & Tanks. These Talaos not only met City's water demand but also helped in maintaining Ground Water Table & quality of water in wells. With Urbanization the tanks were filled, well water was no longer of desired quality. Yet many wells in City & Suburbs have good quality water which is available in Tankers.

Before independence the city was supplied 494 MLD water from Tulsi, Vihar & Tansa lakes. Today City receives additional water supply of 2400 MLD from Vaitarana, Upper Vaitarana & Bhatsa dams. The scheme of bringing further 80 MLD water is being commissioned, which involves work of raising height of Pise weir and pumping of additional water into the Conveyance system. The transmission network consists of trunk mains of length 650 kms. having dia. between 1800 mm to 3000 mm. The city is divided into 109 water supply zones, which receive water at specified hours. The distribution network comprises of water mains of various diameters ranging from 2500 mm to 150 mm & total length of 4000 kms. 910 MLD water from Bhatsa source is treated at Pise Panjrapur complex & 1910 MLD water from Tansa, Vaitarna & partly from Bhatsa source is treated at Bhandup Complex. Mumbai supplies the best quality water ( as per world standards) to the citizens, which is utilized for all purposes including flushing, gardening, cars & compound washing etc.

### **Water Stress**

The present water demand of Mumbai is 3400 MLD against supply of 2900 MLD. This difference was expected to grow much higher in 2021 when the projected demand would be 5400 MLD for a projected population of 15.60 millions. But this population is almost there today itself & the city is facing water shortage in some areas.

Middle Vaitarana a 455 MLD project costing @ Rs. 1250 Cr. (At 2000 prices) is among the future plans, waiting environmental clearances. After commencement, the project is likely to take 7 years for completion.

The water transmission & distribution system of city is quite old. It undergoes cracks / damages at many places. As it is not possible to replace these lines totally various strengthening measures like mortar lining are being used. Cost of maintenance & repairs is therefore very high & which will inflate with time.

## **Precautionary Measures.**

They can be divided into two categories.

**Category A** - Minimise the use by change in our habits of using water conservatively.

**Category B** - Augment the supply by developing alternate sources like reuse of water, recycling, desalination & rainwater harvesting.

## **Different methods of water conservation.**

Water conservation starts from our simple habits. When we serve or take one glass of water (@ 200 - 300 ml) hardly any body is able to consume it. The balance water is just put into drains. We can use small glasses or adopt conventional glass & lota system. The unused drinking water cannot go back into main storage vessel but it can be stored in a small bucket, which can be used for gardening plants or dipping clothes for washing.

People throwaway water filled yesterday saying it is stale water. The water does not become stale if you have stored properly. Does Gangajal we store in our houses for years together become stale? If you feel psychologically uncomfortable using the water please visit the overhead & suction tanks in the buildings where water is stored for a day before supplying it to you. If you can afford to drink that water on a particular day, you can consume it on the next day also. At least start using that water for other uses including bathing. After all we require only 5 - 10 lit. of water per person for drinking & cooking, rest all is non consumable demand.

It was unfortunate to know that there are some people in city having bath tubs who throwaway filled up water from bath tubs saying that it is unused yesterdays water. In rural area one full family will meet its daily or maybe weekly requirement from this water.

We keep the taps continuously open when we brush, go for toilet, clean utensils, wash clothes, use showers when we bathe & so on. Is it all-essential? Never open the taps completely, open them half or 3/4th. Can we not use bucket & mug for brushing, bathing, cloth washing & so on.

It is possible to have dual capacity flushing cisterns (5/10 lit.) for toilets where the output is adjusted as per requirement. At least two filled up closed water bottles can be put in the flushing tank to reduce its capacity. The mineral water bottles, which are headache for disposal, have this reuse.

Ceramic cartridges are available to fit in our taps, which give desired results even with reduced quantity of the flow. A plastic nozzle costing @ Re.1 can also do this work.

Please promptly repair water taps, pipelines, prevent overflowing of tanks, clean vehicles just by a cloth & bucket of water. Balconies & floors can just be swabbed, not necessary to wash them by pouring lot of water.

The garden can be watered or the car~, the staircases' & common passages can be cleaned with well water wherever it is available. Output of washing machines can be used as water for flushing, water for rinsing the second lot of clothes. In fact if we make habit of utilizing full capacity of machine for every lot and washing two lots together we save wash water upto 30%.

Once we start thinking many more thoughts will come to our mind. Water conservation is saving water for our future & not for anybody else.

**How can a common man help M.C.G.M. ?**

- Do not waste water.
- Stop leakages in the premises.
- Minimise water requirement by using appropriate plumbing fixtures.
- Please lodge complaint for leaking water mains on 23776294/97 (City), 26146852/26184173 (W.S.) 25153258/72(E.S.)
- Introduce water conservation and reuse in our daily habits.
- Use recycled water, harvested rain water wherever possible.

**Adopting alternate sources.**

Creating new impoundage and water supply networks, extracting more & more ground water, recycling waste water, desalination in case of coastal areas and water shed development with rain water harvesting are various alternate sources that can be developed to meet the growing water demand. For Mumbai proposal of creating new impoundage at Middle Vaitarna is being planned to augment the water supply but other alternatives also need to be explored.

**Advantages & Disadvantages of each alternative:-**

**a) Use of ground water** - This results in lowering of ground water table. requiring more & more energy to lift the water. The natural reserve of water is dried off causing ecological imbalances. Moreover there is a great danger of sea water ingress in fresh water zone for coastal cities. We have practiced this all over the world and are facing its consequences now.

**b) Desalination** - This is a centralized system of supply, where a treatment plant will have to be set up at one location and then distribute treated water over the locality through a network of pipelines. Apart from technical limitations like efficiency of plant, treatment cost & setting up a new network for distribution, the system comes with inherited problems of any centralised water supply system.

**c) Recycling** - This is a decentralised method where the recycling plants for grey or black water are set up either on individual plots or for a locality. However there has to be a system for facilitating further use of treated water. For locality based plants, unless there is a large requirement for garden, it becomes essential to set up a completely separate flushing network ( i.e. separate tanks, supply lines etc.). Generally there is a mental block to use this water for flushing. Moreover the technology has to be imported. The operation & maintenance requires involvement of technically competent persons especially when reasonable variation in quality of effluent is expected. The system requires regular maintenance from a skilled person. in case of Non functioning / system failures unhygienic conditions will be generated.

**d) Rain Water Harvesting** :- It is the simplest, indigenous technology being practiced in India for centuries. The concept involves collection of rain water by individual plot owner, either in artificial tanks and / or in natural reservoir i.e. aquifers. It helps Self Sufficiency. Raises Ground water Table. Improves Quality of Ground Water. Reduces Soil Erosion. Any body can do it. It is less expensive and easy to maintain & most important is that it prevents Sea Water Ingression. The only disadvantage is it requires periodic / pre monsoon maintenance and involvement of user for monitoring.

Hence Mumbai Municipal Corporation has made Rain Water Harvesting (RWH) mandatory to the properties having plot area more than 1000 sq. mts. coming for development after 1st oct. 2002. The condition is also being extended for the properties, which started development earlier, but are being completed now. This condition will also be made applicable to existing buildings in near future. Recycling has been made compulsory for buildings having centralized (water cooled) A.C. plants. Henceforth M.C.G.M. would grant residential water connections at 90 lpcd i.e. no municipal water for flushing requirement. The properties are expected to generate the flushing water either by RWH or by recycling.

### **Rain water harvesting Methods.**

Following techniques are used for Urban rain water harvesting.

- I. Storage in artificial above or underground tanks.
- II. Recharging aquifer directly through existing dug up wells & bore wells.
- III. Recharging aquifer by percolation / soakage into the ground.
- IV. Pumping (putting under pressure) rainwater into the soil to prevent sea water ingress.

### **Who can harvest rain water?**

Rainwater harvesting is for any person.

He / She can be planning to build a house or who is in the process of building a house on an independent plot. Persons with already built houses can also harvest rainwater by 'retrofitting' necessary for rainwater harvesting.

Persons in apartments can also harvest rainwater, but a community approach may be required in such cases.

In individual/row houses, it is possible to store roof top rain water without much work / extra cost.

Industries and factories can easily harvest rainwater, since large roof areas are usually available in such constructions.

People who are purchasing water from private water tankers can harvest rainwater to lessen their financial outflow.

Corporations, Government Organisations, Technical institutes can take up RWH to meet certain % of their demand & be trendsetters.

### **Why RWH is required in Mumbai ?**

To meet today's as well as future demands.

It is observed that some of the wells especially bore wells, which had sweet water initially turn saline after use for some time. This is because of fall in the level of fresh water, due to excessive drawing. The fresh water barrier which restricts sea water from coming into the land is disturbed. Fresh water level is lowered than the sea water level & sea water rushes into the land. The sea water now comes in contact with the pile foundations which can endanger structures in future. By harvesting rain water we can maintain this barrier & prevent sea water ingress.

### **Rain Water Harvesting Potential of Mumbai :**

This broadly works out as under:-

Area of Mumbai @ 437 Sq.Kmts.  
Annual Avg. Rainfall @ 2000 mm  
Total rain water falling over Mumbai  
= 437 x 1000000 x 2000 lit.  
= 874000000000 lit.  
= 874090 million litre  
= 2394. 52 mld  
Present water supply = 2900 mld

Even if we assume 70% of the area to be developed, 50% of it to be roofed and we collect 70% of the water falling over it, the quantity of rain water that can be harvested works out to 589.34 MLD. This is a sizeable quantity compared to the water supply of Mumbai. It may also be reminded that our Middle Vaitarna project is for 455 MLD. Therefore it is duty of citizens to resort to RWH & help Corporation as well as themselves for a better tomorrow. Interested citizens can contact Rain Water Harvesting Cell at 3<sup>rd</sup> floor Municipal H.O. Annex Bldg. or Tel. 22620251 ext.2309.

### **Use of Harvested Rain water:**

Rain water is purest form of water available on earth. It gets contaminated during its travel through the atmosphere (Air Pollution) and on the surface (land Contamination). It is soft, low in salt contents, impurities. Therefore, it is easily possible to use rainwater for gardening, car washing, washing clothes, floors, bathing, toilet-flushing, house swabbing and such other domestic and all non-potable purposes including fire fighting and beautification.

One can even use the harvested rainwater for all potable purposes including drinking and cooking. But it is a must to filter, boil and check the quality before its use. People in Chennai, Dewas do use rain water for all purposes but in Mumbai M.C.G.M. expects citizens only to meet their flushing requirement by RWH.

### **Whether it is really possible to harvest rain water in Mumbai?**

Yes. Rain water harvesting by different techniques is possible in different parts of Mumbai, only the appropriate method has to be selected after site studies. Greater Mumbai is occupied by basaltic lava flows, alluvium, marshy swamps and mud plains. The ground water occurs in fractures & vesicular joints and in weathered zones of the basalt. It is generally felt that Mumbai is a coastal city, so much ground water will not be available. But as per the available data dug up as well as bore wells are located in all wards of Mumbai. They are in abundance generally in the old island of Mumbai, Salsette, Trombay and the old villages, which occupy measure area of Mumbai. Dug up wells & bore wells in Mumbai together number more than 7000. Revival of abandoned wells & replenishing dug up & bore wells by RWH will also help in improving quality of ground water.

Though there is a concrete Jungle, we still have some green areas, some open spaces, some water courses and good aquifers in certain parts of city, where soil/ground water table can be used as storage. In reclaimed areas artificial tanks will have to be used to store the rain water.

But prior to adopting any of these methodologies teaching oneself holistic approach i.e. water reuse, recycling and water conservation is a must.

## **Warning.**

It is necessary to ensure that the ground water is not contaminated by mixing of sewage / sullage or any other impurities e.g. chemical/biological etc. So there should not be any leakages in the premises, where RWH system is to be installed. Societies should maintain their premises clean. Terraces should be cleaned prior to monsoon & be kept locked during monsoon. Pets should not be permitted there. Similarly street flood water in monsoon is contaminated. So it also should not be mixed with RWH system. Please note that mistake made by one person directly charging the aquifer, can affect number of persons at a time & there is no easy solution to clean the contaminated ground water.

## **Paving**

In urban area people adopt paved open spaces, which do not require regular maintenance and facilitates car parking. But it leaves no scope for water to percolate. Moreover to have paving material i.e stone, we cut mountains, which means trees, leading to soil erosion, speedy run-off –flooding & choking of swds, which again have to be desilted by spending money. Wherever not essential paving is to be avoided. To meet the requirements of paving & percolation, one can use porous pavements made with higher % of coarse aggregate. It can also have a geo textile layer at bottom for directing the water to a particular location. Pre-cast tiles with holes in center, set on sand bedding will also allow good percolation.

## **Forest.**

It is necessary to understand relation between soil, water & forest to have better results. Diverse varieties of trees, growing to different heights increase "time of concentration". It is due to obstructions created by leaves, branches at various levels to travel of rain drop. Old branches lying on the ground also obstruct path of water. Humus, which is generated from dry leaves & decomposed organic matter releases water very slowly. Forests also arrests soil erosion. Therefore streams in the area having a forest cover have water for a longer period. To conserve both soil & water umbrella of forest is a must. So please plant as many indigenous varieties of plants as possible. They help in maintaining ecosystem too.

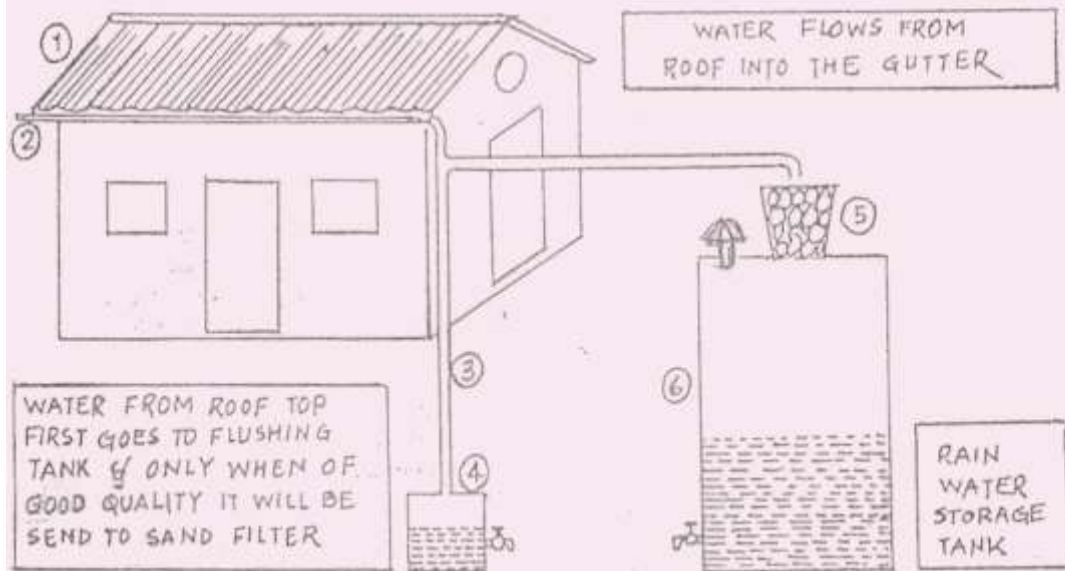
## **Basic Recharging Principle**

- GIVE WATER TIME TO PERCOLATE
- IF IT IS RUNNING MAKE IT WALK, IF IT IS WALKING, MAKE IT STAND
- IF IT IS STANDING MAKE IT SIT, IF IT IS SITTING MAKE IT SLEEP
- WATER WAITS, PERCOLATES & GETS COLLECTED

## **RWH models for Mumbai.**

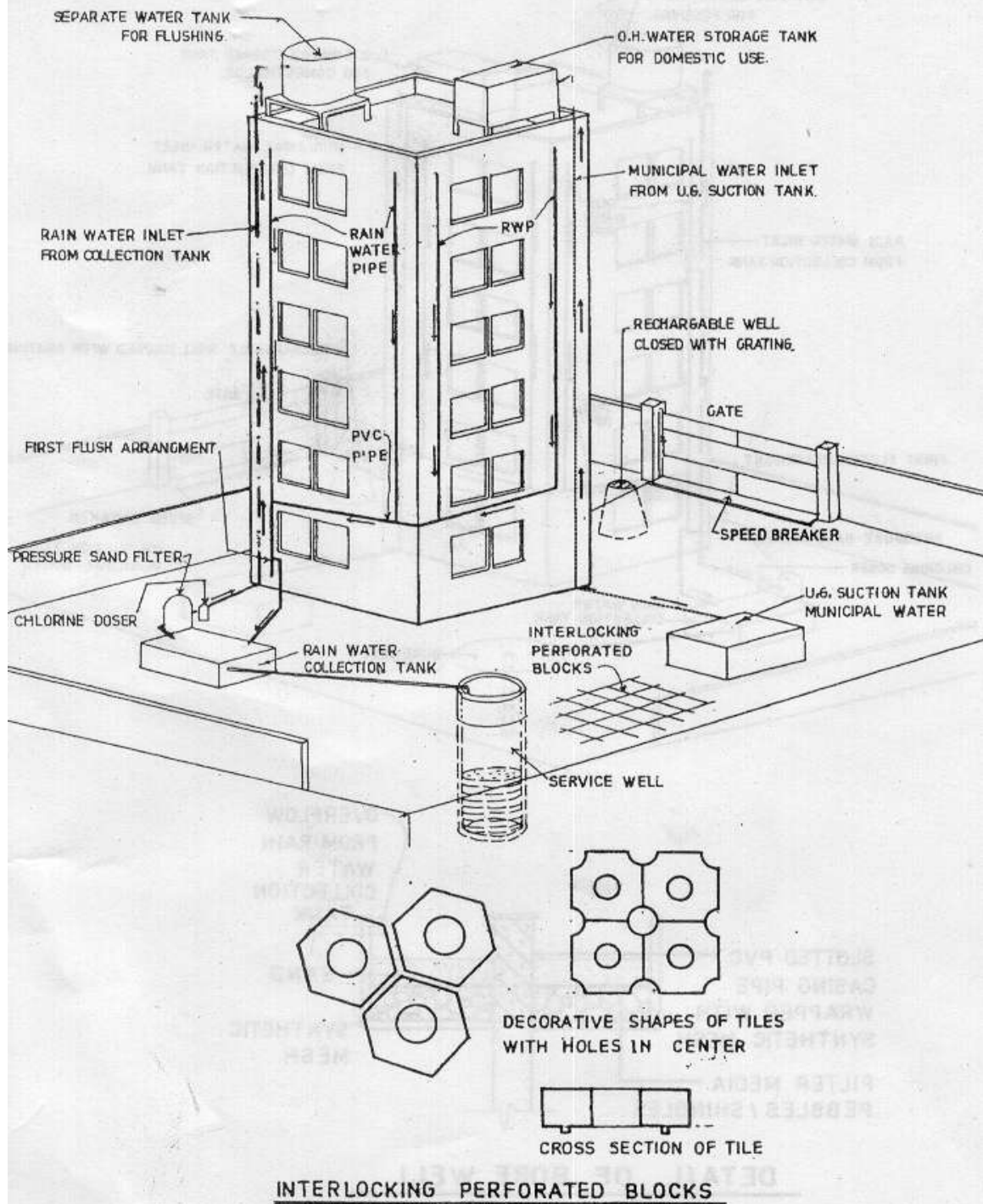
Cities like Delhi, Ahmedabad use purely recharging techniques while Chennai, Bangalore tend to store their roof water in sumps & recharge soil with surface run-off. In places like Porbandar entire roof top rainfall is stored in tanks. But in Mumbai anyone of this method cannot serve as a complete model. We have to use combinations depending upon site condition & water requirement. Mumbai generally receives rainfall by large intensity showers followed by dry spells. When it rains heavily the soil may not be able to absorb water at the rate of rainfall. Hence large quantity of water will be wasted. Therefore it is advisable to collect roof top runoff in artificial tanks, which would suffice flushing demand of a few days & overflow from these tanks & surface runoff can be used for recharging of ground water with proper precautions. Some sketches for RWH schemes for existing & new buildings are enclosed.

## ROOF TOP RAIN WATER HARVESTING (USING ARTIFICIAL TANK)



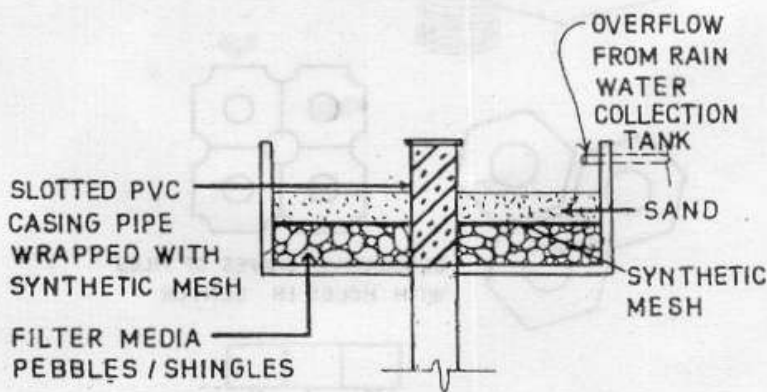
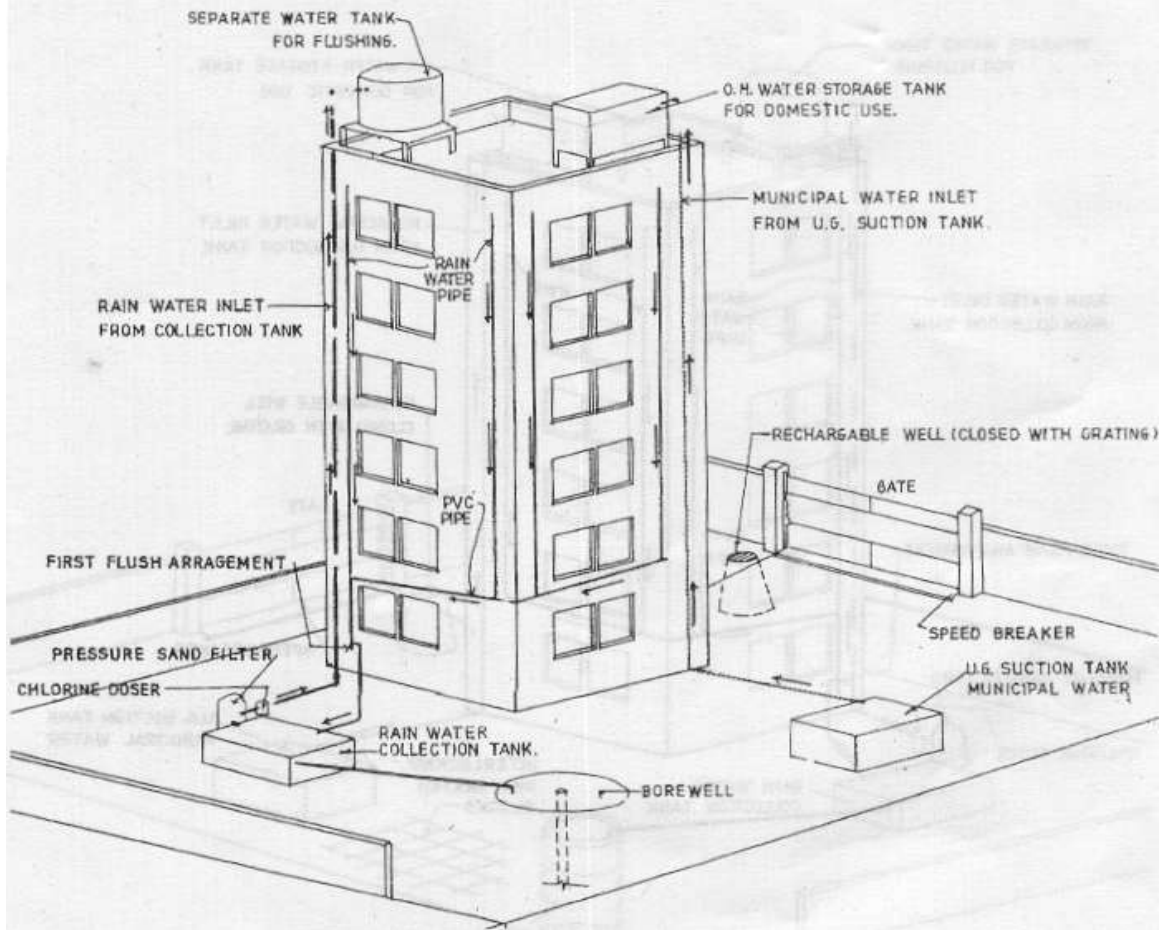
- |                  |                |
|------------------|----------------|
| ① ROOF           | ④ FLUSH TANK   |
| ② GUTTER         | ⑤ FILTER TANK  |
| ③ DOWN TAKE PIPE | ⑥ STORAGE TANK |

**TYPICAL RWH SCHEME FOR RECHARGING EXISTING DUG UP WELLS**



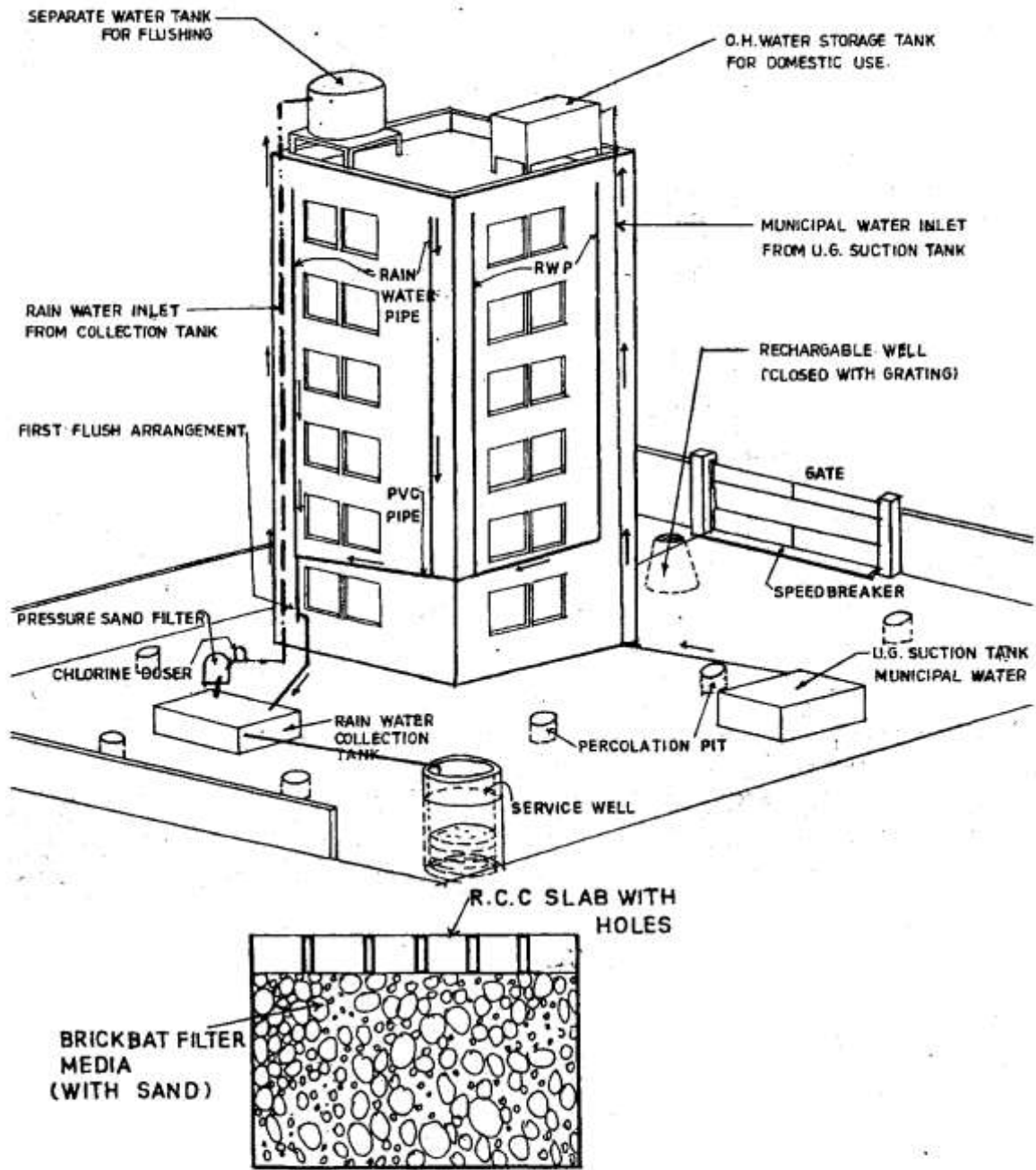


TYPICAL RWH SCHEME FOR RECHARGING EXISTING BOREWELL



DETAIL OF BORE WELL

TYPICAL GROUND WATER RECHARGE BY PERCOLATION PITS



DETAIL OF PERCOLATION PIT

# GROUND WATER RECHARGE BY TRENCH WITH BORE

