

## RAINWATER HARVESTING BY ROOFTOP METHOD

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**Abstract** - One of the foremost vital resources for living of creature is 'Water' as much as food, air and ground water is the primary source of freshwater, however terribly few efforts are made to save these important resources. As a result of over pumping of underground water and tremendous water wastage the water table is going deep down. Many parts of world are already facing shortage of water and if attention is not paid to this problem then it will go on increasing and cause severe scarcity of water since we cannot generate artificial water. Rainfall is the prime source of water hence it should be harvested at individual level to minimize scarcity of water. This is the best way to reduce water problem in areas of water scarcity and insufficiency. In the present study attempt has been made to study the importance, necessity of rainwater harvesting system, various advantages of having rainwater harvesting system. Also an attempt has been made to examine the present status of water requirement and proposed rooftop RWH potential in the College Building and Hostels of Government Polytechnic Sakoli located in main tahsil of Bhandara district has been undertaken for the present investigation. This study is wholly made based on primary data and secondary data. Primary data collected from field work and secondary data is collected from District Statistical Abstract of Bhandara, District Gazetteer and also data have been collected from various published and unpublished thesis, articles, books. Rooftop rainwater harvesting method is used in the present study. The annual, daily and monthly water requirement has been calculated in litres. Results obtained from the present study suggested that rooftop rainwater harvesting method is more applicable in college campus located in Bhandara district of Maharashtra and it will help in providing water required to certain level.

**Key Words:** Rooftop rainwater, scarcity, harvesting, conservation.

### 1. INTRODUCTION

Water is essential for all forms of life on earth including human, animal and vegetation. It is therefore important that adequate supplies of water be developed to sustain in such life. New source of water should be looked for in the areas where water is inaccessible, inadequate or is too salty or cannot be consumed. In the areas that have regular rainfall, the most appropriate alternative is the collection of rainwater, called rainwater harvesting. Rain water harvesting is a method of collection and storage of rain water in surface or sub surface aquifer. Hence it is catching of rain water when it falls and storing to use during the

non rainy season. Generally the water is collected from the roofs of the buildings and stored in water tanks. Water can be collected in dams from rain falling on the ground and producing runoff. Water is also collected through infiltration through ground. Rainwater harvesting is very old method but now has become an important one as a modern and simple technology of conservation of water. This method is classified into 2 categories i.e. 1. Land based, 2. Roof based. In land based rainwater harvesting runoff from land surfaces is collected in ponds, tanks and reservoirs etc. Roofbased rainwater harvesting includes collection of rain water from roof which gives much cleaner water for drinking.

### 1.1 Components of Rooftop System

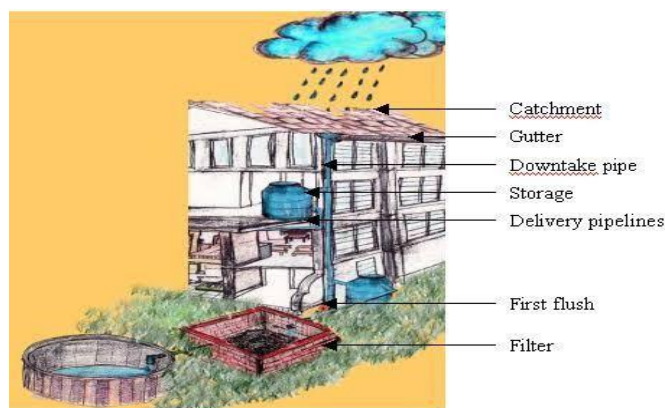


Figure : Component of Rooftop System

#### 1. CATCHMENT

The surface or structure which collects rainfall is called catchment of rainwater harvesting. The catchment can be open ground, flat or sloping terrace of any building or courtyard etc.

#### 2. CONVEYANCE (PIPE)

Conveyance system consists of pipes that are used to convey rainwater from rooftop to storage system of harvesting system. Water pipes should be durable and weather resistance. Gutters or downtake pipes are provided with wire mesh to prevent entry of floating matter into conveyance system.

### 3. FIRST FLUSH

First flush is a plumbing assembly used to flush off the water received in first shower and divert it from storage tank. In dry season it also helps to clean any type of deposits or silt materials on roof.

### 4. GUTTERS AND DOWNSPOUTS

These are the conveyance channels from catchment surface to storage. These have to be designed depending on site, rainfall characteristics and roof characteristics.

**5. LEAF SCREENS AND ROOF WASHERS** The device that remove debris and contaminants. At first, a rain separator has to be put in place to divert and manage the first 2.5 mm of rain.

### 1.2. Advantages of Rainwater Harvesting

- Rainwater is a comparatively clean and free source of water.
- It provides water at place of water scarcity or where water is needed.
- It provides self-sufficiency and also helps to conserve water resources.
- Rainwater can be used for landscaping plants and gardens.
- It reduces storm water runoff, pollution.
- It uses simple technologies that are easy to maintain. • Provides safe water for human consumption after proper treatment. • Low operation costs.

## 2. METHODOLOGY

### 2.1 Study Area

The campus area of GOVERNMENT POLYTECHNIC, SAKOLI (dist.- Bhandara) is selected. The premises of the GPS are spread over the vast area of 19 acres of land encircled by lush green tall trees, and a lovely garden. Along with the academic building with intake of 300 students per year it also provides accommodation facility for 178 boys and 88 girls in separate hostels and accommodation facility to staff and faculty. The existing maps of campus were studied and the dead boundaries for the area in which work is to be executed were fixed. The visual study of total area was done.

### 2.2 Rainfall Data Acquisition

The rainfall data for Bhandara District was collected from "Irrigation Department Bhandara". We can use this data for the purpose of calculation of total rainfall intensity and total discharge. The rainfall data which we have collected is on yearly basis.

Average Annual Rainfall = 1288.37mm

Average Monthly Rainfall in Monsoon Period =  $1288.37/4 = 322.09$  mm

Average Daily Rainfall in Monsoon Period =  $322.09/30 = 10.73$ mm = 0.01073 m

### 2.3 Area Calculation

This is the second stage of the project in which we had measured the area of selected region. The measurement of the area is done with the help of measuring tape. The measuring tape we used for the measurement was linen. We calculated roof area of Academic Building, Girl's Hostel and Boy's Hostel Building.

**Table -1:** Area Calculation

Building	Area
Academic Building	4600
Girls Hostel	427.38
Boys Hostel	1504.94

The water capacity of the school and number of users is collected from the school .which we can utilise for the further use in project work for design of storage tank.

### 2.4 Design

According to the survey we have observed that the open wells and bore wells in the area of the G.P. campus are dry. Because of this reason there is no open well provided for the proposed building. Hence we can provide a water storage tank for collection of roof rain water for RRWH of campus. **1 Design of Storage Tank**

Cylindrical storage tank was assumed. A) Academic Building:

- Volume of water over Academic building= Roof Area x Daily Rainfall =  $4600 \times 0.01073 = 49.358$  cu.m/day.

- Assuming 75% of water will be harvested.

Total water to be harvested=  $0.75 \times 49.358 = 37.01$  cu.m/day

- Assuming depth of storage tank as 1 meter. Volume of water to be harvested = Volume of storage tank  $37.01 = ((\pi/4) \times D^2) \times$  assumed depth Diameter of storage tank  $D = 6.86m = 6.9m$ 
  - Per day rainfall from Academic Building =  $37.01 \text{ cu.m /day} = 37.01 \times 1000 = 370110 \text{ Litres}$  Therefore provide actual depth of storage tank =

1.1m

- Volume of storage tank = Actual area of tank x actual depth of tank

$$= (\pi/4) \times 6.9^2 \times 1.1 = 41.132 \text{ cu.m.} = 41132 \text{ Litres}$$

B) Girls Hostel :

- Volume of water over Girls Hostel Building = Roof Area x Daily Rainfall =  $427.38 \times 001073 = 4.585 \text{ cu.m/day}$ .

- Assuming 75% of water will be harvested. Total water to be harvested =  $0.75 \times 4.585 = 3.43 \text{ cu.m/day}$ 
  - Assuming depth of storage tank as 1 meter. Volume of water to be harvested = Volume of storage tank  $3.43 = ((\pi/4) \times D^2) \times$  assumed depth Diameter of storage tank  $D = 2.08 \text{ m} = 2.1m$ 
    - Per day rainfall from girls hostel =  $4.585 \text{ cu.m /day} = 4.585 \times 1000 = 4585 \text{ Litres}$

Therefore provide actual depth of storage tank =

1.5m

- Volume of storage tank = Actual area of tank x actual depth of tank =  $(\pi/4) \times 2.1^2 \times 1.5 = 5.195 \text{ cu.m.} = 5195 \text{ Litres}$

C) Boys Hostel

- Volume of water over Boys Hostel building = Roof Area x Daily Rainfall =  $1504.94 \times 001073 = 16.148 \text{ cu.m/day}$ .

- Assuming 75% of water will be harvested. Total water to be harvested =  $0.75 \times 16.148 = 12.111 \text{ cu.m/day}$

- Assuming depth of storage tank as 1 meter. Volume of water to be harvested = Volume of storage tank  $12.111 = ((\pi/4) \times D^2) \times$  assumed depth Diameter of storage tank  $D = 3.92m = 4m$ 
  - Per day rainfall from boys hostel =  $16.148 \text{ cu.m /day} = 16.148 \times 1000 = 16148 \text{ Litres}$

Therefore provide actual depth of storage tank =

1.5m

- Volume of storage tank = Actual area of tank x actual depth of tank =  $(\pi/4) \times 4^2 \times 1.5 = 4.71$

cu.m. = 4710 Litres

## 2. Design of Pipes

As the pipes used for collection of water should have proper size so that during the storm period they should carry the excess amount of water through them without causing any disturbance ( breaking of pipes, leakage) in the work.

Volume of water = 42.33 cu.m.

Considering time of 1 day i.e. 12 hrs.

Time =  $12 \times 60 \text{ sec} \times 60 \text{ sec}$ .

Calculating discharge  $Q = \text{Volume} / \text{Time} =$

$$42.33 / (12 \times 60 \times 60) = 0.00097$$

$$Q = 0.001 \text{ (say)}$$

Intensity of rainfall = 10.93 mm/day.

As per IS 15797:2008 , the pipes should be designed for rainfall intensity 5 times greater. Increased rainfall intensity =  $10.93 \times 5 = 54.65 \text{ mm/day}$  Therefore for easy drain out of water from terrace by referring IS 15797:2008, 2 pipes of diameter 250mm each should be provided on each building terrace

## 3. CONCLUSION

The growing population and the rising demand for water have put a great deal of pressure on the natural resources. Underground water is depleting at a very fast rate. If artificial methods are adopted then this problem can be solved. The existing water supply arrangement for the entire G.P. campus including academic building, boys hostel building, girls hostel building are dependent on two tube wells. Continuous lifting of bore well water has made the implementation of the rain water harvesting scheme necessary for Government Polytechnic Campus. The direct use of rain water during monsoon after filtration will reduce the load on ground water storage. The huge amount of precipitation occurring on the ground can be harvested and utilized for different purposes using this method. So collecting rain water is cost effective and a best alternative to the scarcity for world wide. From the case study and experimental work till date we can conclude that the rainwater in itself is not capable of augmenting the ground water table. So we need to employ rain water harvesting structures.

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