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Conservation of Water Using Rain Water Harvesting In SRTT Campus

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Abstract:

When faced with a water shortage, a community or a country must either develop new water resources or reduce demand. This study tries best to contribute to rising water problem in SRTTC College in summer season by revealing students' knowledge and natural behavior towards water conservation. With continued population growth of students each year and increasing basic demands on water resources; natural conservation has an increasing role for terrain behind our college campus SRTTC, Khamshet, Pune. Economizing on water use will be an important aspect of any effective response. Naturally recharge groundwater techniques offer possibilities for more extensive use of water within the campus area. Study will help to reduce over exploitation of water resources due to increase in demand. It is hoped that the information gathered through this project may be used to take inform decisions regarding water conservation efforts for institution itself. Implementation of natural rain water collection system will help to increasing ground water table, which will very beneficial to fulfill the institutional water requirements in summer season.

Keywords — **Water conservation, Rainwater harvesting, Groundwater, Water collection system**

I. INTRODUCTION

Rainwater harvesting is the accumulation and deposition of rainwater for reuse before it reaches the aquifer. Uses include water for garden, water for livestock, water for irrigation, etc. In many places the water collected is just redirected to a deep pit with percolation. The harvested water can be used for drinking water as well if the storage is a tank that can be accessed and cleaned when needed.

Rainwater harvesting provides an independent water supply during regional water restrictions and in developed countries is often used to supplement the main supply. It provides water when there is a drought, prevents flooding of low-lying areas, replenishes the ground water table, and enables dug wells and bore wells to yield in a sustained manner. It also helps in the availability of clean water by reducing the salinity and the presence of iron salts.

Makes use of a natural resource and reduces flooding, storm water runoff, erosion, and contamination of surface water with pesticides, sediment, metals, and fertilizers. Excellent source of water for landscape irrigation, with no chemicals such as fluoride and chlorine, and no dissolved salts and minerals from the soil. Home systems can be relatively simple to install and operate May reduce your water bill. Promotes both water and energy conservation. No filtration system required for landscape irrigation.

II. SCOPE OF STUDY

Information gained from this work and implementation of it will allow maximum use of hilly region & rainwater in the benefit of mankind. This study will help to naturally collect, conserve and utilize rainwater for the future needs. By studying the past results of rainfall on terrain behind our college campus Pune region water can

be supplied even if municipalities cutoff the water supply which usually happens in summer season. Also this research will be beneficial for landscaping which will improve the aesthetics of surrounding area as well as fulfill the water demand.

1) Information gained from this work and continuation of it should allow SRTTC to make changes that will have significant effects on its water uses in future.
2) It is hoped that the information gathered through this project may be used to take inform decisions regarding water conservation efforts in our college.
3) This project will helps to reduce the cost and time spends on changes that will have minimum effects on water uses in campus.
4) This project is important to guarantee adequate supply for future needs.
5) Adjusting attitude and behavior: overcoming the mentality water is too cheap and there for not valuable.
6) To reduce over exploitation of water resources due to increase in demand.
7) Implementation of RWH system helps to increasing ground water table (GWT), which will very beneficial to fulfill the future needs.
8) The conserve water can be used for landscaping which will improve the aesthetics of surrounding area of college campus.

III. PROBLEM STATEMENTS

The large amount of rain water is rain off which is flowing from the hills and our campus. So we have to design water system to fulfill the demands of institutional needs of our college as well as will help in ground water recharge.

1) Sometimes there is insufficient water in washroom – because of insufficient water available for flushing, for washbasin & it cause unhygienic conditions.
2) There insufficient water available in the laboratories – it cause difficulty in performing experiments, it cause delay in performing the practical's which are related to water.
3) Sometimes there is insufficient water for gardening – it cause unaesthetic view to the institute.
4) In summer season there is low ground water – it cause need of water of the surrounding area is increase.

IV. OBJECTIVES

1) Increase ground water table in coming future.
2) Effective utilization of topographical features of campus for maximum collection of water.
3) Effective planning for optimization of water use.
4) Design system through natural resources.
5) To analyze the present status of roof top and its contribution in rain water harvesting potential in the college campus.
6) To plan and design the rainwater harvesting system for the Suman Ramesh Tulsiani Technical campus as well.
7) To meet the increasing demand of water.
8) Supplements domestic water needs.
9) To increase the available water during dry season.

V. OPERATIONAL PROCEDURE

1) Water demand calculation:

Calculation of water demand according to water bill for SRTT College Campus is as follows:

Rate of water = 70 for 1000 liters
= 0.070 for 1 liter
Amount to pay = 49000 for 1 average month
= 49000 for 1 month

Amount of water used in liters, $= \frac{49000}{0.070}$
= 700000 liters
= 700 cu.m

2) Precipitation within study are:

Precipitation is water released from clouds in the form of rain, freezing rain, sleet, snow, or hail. It is the primary connection in the water cycle that provides for the delivery of atmospheric water to the earth. Most precipitation falls as rain. In metrology precipitation is any product of the

condensation of atmospheric water vapour that falls under gravity.

Information referred from Indian meteorological department (IMD) about rainfall in our Study Area.

TABLE 1
Rainfall Data For Maval Region

Sr. No	Year	Rainfall (mm)
1	2005	338.5
2	2006	367
3	2007	264.5
4	2008	360.4
5	2009	298.3
6	2010	277.4
7	2011	138.5
8	2012	209.2
9	2013	155.6
10	2014	323
11	2015	329.4
Average rainfall		251.87

Average Annual Rainfall = 251.87 mm
Minimum Average Rainfall = 200 mm

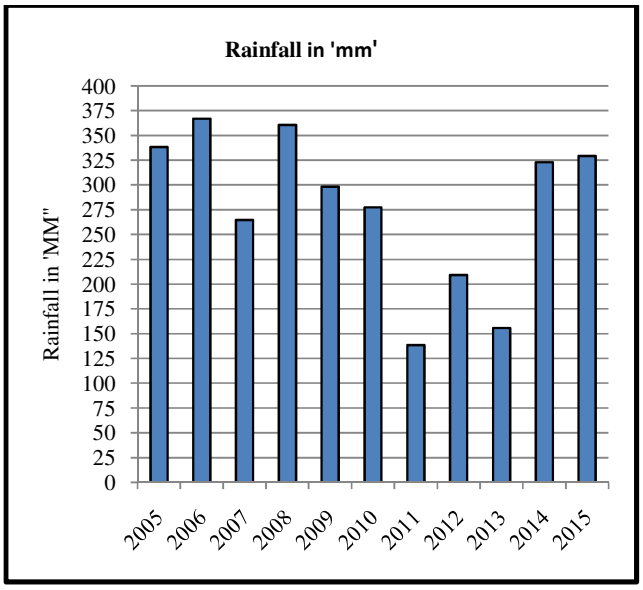

Fig.1 Hydrograph showing rainfall data

3) Mapping and zoning of study area:

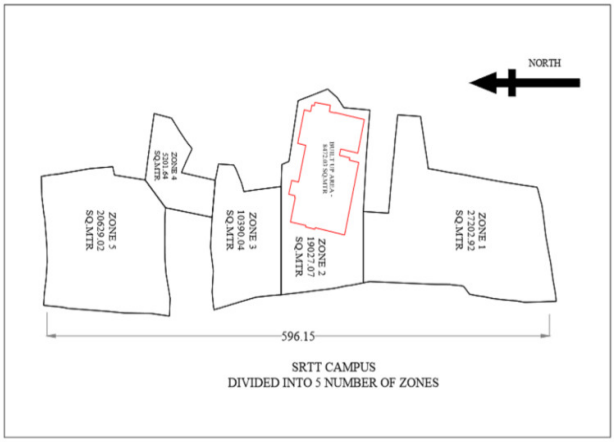

Fig.2 Zoning of SRTT Campus

TABLE 2
Area of Various Zones in SRTT Campus

Sr.No.	Description	Area
1	Zone No - 1	27202.92 sq.m
2	Zone No - 2	19027.07 sq.m
3	Zone No - 3	10390.04 sq.m
4	Zone No - 4	5201.64 sq.m
5	Zone No - 5	20629.02 sq.m

TABLE 3
Showing Roof top area

Sr. No	Building	Roof area
1	AB	2400 sq.m
2	C	2300 sq.m
3	D	1200 sq.m

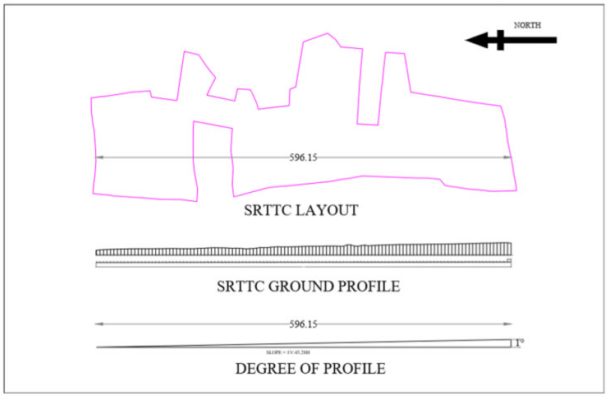

Fig.3 Ground profile and slope of SRTT Campus

Average slope of campus is 1degree.

4) Details of necessary structures and equipment's are:

i. Dimensions of storage tank:

Volume of storage tank = 15 lakh lit.
Assuming water depth = 3.8 m
Water depth including free board = 4 m
Volume conversion $= \frac{1500000}{1000}$
= 1500 cu.m
To find the area of tank $= \frac{1500}{3.8}$
= 394.7 sq.m
To find the Side dimensions = √area
= √394.7
= 9.87 ≅ 20 m
Sides of tank =20 m

ii. Rapid sand filter:

Rate of filtration =3000 lit/hr/sq.m
Break through index $= 1\times10^{-3}$
Rate of water supply = 56000 lit/day
Design Steps:
1. To find daily discharge:
Rate of water supply = 56000 lit/hr/day
2. To find hourly discharge:
Hourly demand = daily discharge/24
= 56000/24
= 2333.33 ≈ 2500
3. To find area of filter:
Filtration rate = 3000lit/hr/sq.m
Area of filter = hr. Discharge/filtration rate
$= \frac{2500}{3000}$
= 0.83sq.m
But we consider 3 sq.m as 2 × 1.5
4. To find the dimension of filter unit:
Assuming size of filter as 2 m × 1.5 m
5. To find minimum depth of sand (L):

$$L = \frac{Qd^3h}{29323\times Bi}$$
$$= \frac{3\times1^3\times2.5}{29323\times10^{-3}}$$
= 0.191sq.m
= 0.44m ≈ 0.5 m
= 50cm
Provide 50cm depth of sand
6. To find the total depth of filter basin:
Total depth of filter basin = depth of under drain + gravel depth + sand depth + water Depth + free board
=50 + 40 + 50 + 70 + 20
= 230 cm
= 2.3 m
Provide 1 unit of size 2×1.5×2.3

7. To find quantity of wash water:
Quantity of water = 2% filtered quantity used for back washing
= 2% daily discharge
$= \frac{100}{100}\times56000$
= 1120 lit/day

iii. Details of pump set required:
HP: 5 HP pump
Type of pump: centrifugal pump
Capacity: 25 KL/hr
Pipe size: 100mm
Strainer: stainless steel
Total head: 12 m (min.)

iv. PVC pipe filter:

Conduits are pipelines or drains that carry rainwater from the catchment or rooftop area to the harvesting system. Conduits can be of any material like polyvinyl chloride (PVC) or galvanized iron (GI), materials that are commonly available.
The following table gives an idea about the diameter of pipe required for draining out rainwater based on rainfall intensity and roof area

Fig.4 PVC Pipe filter

TABLE 4

Sizing of rainwater pipe for roof drainage

Diameter Of pipe (mm)	Average rate of rainfall in mm/h					
	50	75	100	125	150	200
50	13.4	8.9	6.6	5.3	4.4	3.3
65	24.1	16.0	12.0	9.6	8.0	6.0
75	40.8	27.0	20.4	16.3	13.6	10.2
100	85.4	57.0	42.7	34.2	28.5	21.3
125	-	-	80.5	64.3	53.5	40.0
150	-	-	-	-	83.6	62.7

VI. RESULTS AND DISCUSSION

After analyzing the collected rainfall data we got to know the average rainfall intensity in our region is 251.87 millimeters and the minimum average rainfall in our region is 200 millimeters.

After analyzing the contour map of our campus we got the gradient of our campus which is 1 degree slope from the back to the gate of our campus. This slope is good for the flow of rainwater towards the gate therefore the location of the tank for the collection of the rain water can be located near the gate of our campus.

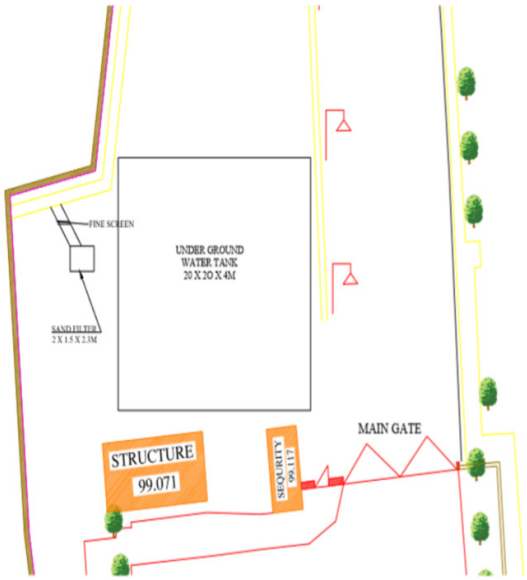

Fig.5 Location of storage tank

1) Tank for surface rainwater harvesting:

We can suggest an underground storage tank to store rain water during rainy season. The dimensions of the storage tank to be kept as:

Length = 20 meters
Width = 20 meters
Depth = 4 meters

With such dimensions of storage tank can store 15.2 lakh liters of water in it. Our campus needs 7 lakh liters of water per month by average, so with this tank water can be stored covering the water demand for 2 months and more. During rainy seasons it will fulfill the water demands for at least 3 months and the rest of stored water can be used after the rainy season whenever required.

2) Filter media for rainwater harvesting:

A rapid sand filter can be provided to filter the surface rain water from dirt's and silts having the chamber dimensions as:

Length = 2.0 meters
Width = 1.5 meters
Depth = 2.3 meters

This can have a gravel bed of depth 0.40 meters and sand bed of depth 0.50 meters having filtration rate 3000 liters/hr/sq.m.

3) Pumps and tools required for water supply:

These waters can be transferred from the under-ground storage tank to overhead storage tank on our college building. This will need a 5 HP centrifugal pump which gives the discharge of 25 KL/hr, 100 mm pipes can be used to connect the water line.

4) Tank for roof-top rain water harvesting:

An additional Circular Elevated Storage Reservoir (ESR) can be made to store the waters collected by roof-top rain water harvesting. The dimensions of the ESR can be kept as:

Diameter = 15 meters
Depth = 4.0 meters

The water from ESR can also be used for drinking purpose if proper filter media is installed at the intake of the ESR. This tank can store 6.71 lakh liters of rooftop rain water

5) Overall point of view:

The amount of water to be stored in the underground water tank and the ESR can fulfill the water demand for 6 months which can reduce the water bill upto 3 lakh Rupees.

VII. CONCLUSION

1) It is a very use-full process during rainy season and during scarcity of water.
2) By doing this process we can save water for domestic purpose, drinking purpose and for future needs.
3) It is very simple and affordable process.
4) This project would reduce the cost of convention water supply

VIII. ACKNOWLEDGEMENT

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IX. AUTHOR CONTRIBUTION

Overall implementation of research including model set-up, experiment conducting, data analysis and manuscript preparation were done by students of Suman Ramesh Tulsiani Technical Campus, Faculty of Engineering, kamshet and were guided by professors of the said institute

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