Rainwater Harvesting: A Case Study on DIEMS Campus

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Abstract **- Rainwater harvesting (RWH) is an excellent technique of water conservation for future needs and also to recharge groundwater. Due to the alarming population burden, climate change, uneven distribution of rainfall and abrupt variation of meteorological parameters, the surface and ground water resources are continuously depleting in India. Hence adoption of different water conservation techniques at individual, institute and community level has become imperative to cater to the needs. This study was aimed at designing a rooftop rainwater harvesting structure for the Deogiri College of Engineering and Management Studies, Aurangbad. Located in Maharashtra state of India. Out of the possible catchment areas, the main building was selected as the required catchment area for rainwater harvesting considering the water demand in university campus and the supply. Further, different parts of the RWH system were designed based on standard guidelines It was observed from the analysis that implementation of RWH system in Deogiri College of Engineering and Management Studies, Aurangbad campus can resolve the water scarcity problems during non-monsoon season .This initiative can increase the water supply for construction work, gardening and also will help in artificial recharge of ground water thus enriching both the surface and the ground water resources.**

Index Terms **- Rainwater, Water, Conservation, Groundwater, Rain.**

1.INTRODUCTION

Rapid urbanization has lead to concentrated population density in many regions which has resulted in surface water scarcity as well as uneven drying of ground water. This has resulted in drought and drying up of river beds in the regions where industrial and domestic consumption of water is high. In order to reduce the risk of scarcity of water to the future population, rain water collection and storm water harvesting from runoff would be an effective way. The best way for rainwater harvesting is to recharge the ground water and also, if rainwater collected in natural ponds or artificial tanks is unused, the same can be used to charge the natural aquifer thus boosting the ground water level . The technique by which the rainwater is collected from rooftop catchments is termed as roof top rain harvesting . In order to cater the domestic needs, harvested rainwater can be stored in sub-surface ground water reservoir by using artificial recharge techniques by storing in tanks. Though harvesting rainwater is vital for sustainable water saving system for both rural and urban regions, the major challenge in the design is to estimate the area for storing water. The required catchment area should be designed effectively to collect rainfall for required purpose

Deogiri College of Engineering and Management Studies, Aurangbadis a widespread educational campus with a vast area. There are around 1000 students studying in the main campus, whose daily requirement has to be served. Due to this fact there can be a possible water shortage in the future. The nearby water-tables are being exploited daily at a fast pace. And there are fields in the nearby area which require this water. So this create a situation here of the usage of the rainwater. This huge area can be utilized for the purpose of harvesting rainwater. Receiving an annual rainfall of around 668.05 mm and an intensity of 30 mm per hour in this area of Aurangabad provides good opportunities to harvest the rainwater.

1.1 Study Area

DIEMS College is located in the district of Aurangabad in Maharashtra in Marathwada Division.

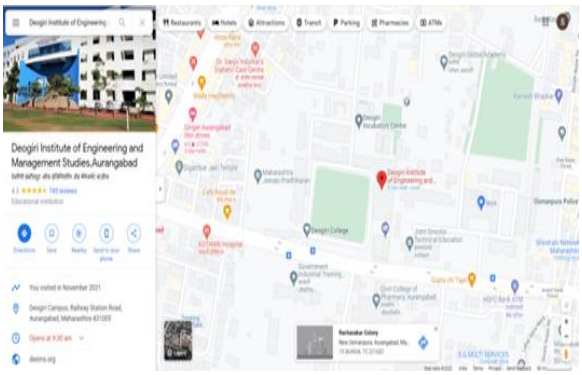

Fig -1: Location of DIEMS

2.METHODOLOGY

For this study, rainfall data for a period of (2016-2021) of the study area was collected from the Indian Meteorological Department and analyzed. It was observed that the average of annual rainfall of the area under study was 688.05 mm. The step wise procedure adopted to design rainwater harvesting steps is mentioned here:

1. Determination of catchment area
2. Estimation of water harvesting potential
3. Calculation of discharge
4. Estimation of water demand
5. Selection of catchment area based on demand
6. Calculation of diameter of pipes
7. Design of Recharge well

The total area height of the buildings were calculated from the building plan details and cross check manually. The total rainwater harvesting potential was estimated using rational formula and total water demand was calculated. Based on these two parameters final catchment area was selected for design purpose

3. DESIGN AND CALCULATIONS

Roof Area = 2948.66 Sq.m
Annual Rainfall of Aurangbad = 688.05mm
From,
Table -1 , B-2 Class (Rainwater Harvesting and Conservation Manual Govt. of India)
STEP 1 :-
Volume of Rainfall Over Roof = Area of Roof X Height of Rainfall
= 2948.66 X 0.68805
= 2028.82 Cu.m.
Rainwater Endowment of that = 2028825.513 Lit.
Area in Liters
Roof Catchment is Concrete Surface
Hence, Runoff Coefficient = 0.70
Coefficient for Evaporation Spillage & First Flush Wastage = 0.80
STEP 2 :
Statistically & Approximately Only Effectively harvested water may be considered as
=Rainwater Endowment of that Area X 0.80 X 0.70
= 2028825.513 X 0.80 X 0.70
= 1136142.284 Liters
STEP 3 :
Liters Per Person Per Day = (1136142.284) / (1000 X 365)
= 3.11 Lit/Capita/Day
Hence,Which is Equal to Average Drinking Water Requirement /person/day.
STEP 4 :
Calculation Of Discharge
Q = CIA
Where, C = Constant
I = Intensity of Rainfall i.e 30mm / Hr
Q = 0.8 X (30/3600000) X 2948.66
Q = 0.019 Cu.m / Sec
STEP 5 :
Calculation Of Number of Pipes
Q = N X π / 4 X d^2 X V
Where, N = Number Of Pipes
d = Diameter Of Pipe Assume 10 cm.
V = Velocity as per CGWB Guideline
0.019 = N X 3.144 / 4 X (0.1)^2 X 0.1
N = 25 Nos.

4. ESTIMATE OF RAINWATER HARVESTING

Sr. NO	Particulars	Quantity	Unit	Rate	Amount
1	SWR pipe 4inch	135	No's	710	95850
2	Elbow 4inch	20	No's	150	3000
3	Pipe Fitting (Labour)	1350	Run feet	20	27000
4	Sand	1.2	Cu.m	2880	3456
5	Aggregate & Boulders	10.8	Cu.m	1440	15552
6	Excavation	12	Cu.m	85	1020
7	Filling & Compaction	12	Cu.m	200	2400
Total Amount					148278
Contingences 5%					7413.9
Grand Total					155691.9

5 .RECHARGE PIT

Provide Recharge Pit of Size = 2 X 2 X 3 m (As Per Rainwater Harvesting and Conservation Manual Government of India)

6. CONCLUSIONS

This project deals with aspect of improving the rainwater availability in the DIEMS, Aurangbad by implementing rainwater harvesting (RWH). This implementation of RWH system can last for many years providing water for drinking and other uses. A little maintenance and manual work is needed to clean the catchment area, storage tanks and Filters

This work focused on implementing rainwater harvesting (RWH) for the Engineering Building Which Consist around 1000 students every year.

- Catchment area for DIEMS was calculated as 2948.66 Sq.m.
- Rainwater endowment for the area has been computed to be 2028825.51 Lit
- List of parts have been identified and cost estimation was made.
- -The total cost for implementing RWH system worked out to be Rs.155691
- -Considering the amount of water collected annually through the rainwater harvesting system, annual savings is found to be Rs.2,43,459.

It is a worthwhile investment .it is strongly recommended for implementation of RWHS project which will result in monitory savings and will help in increasing the water availability and recharging the ground water.

This percentage can be higher if there is a greater rainfall in the year than the average.

The water can be effectively used for non potable uses which does not need any further treatment. also more catchment area can be brought into use by considering other buildings such as Library Building, Deogiri Arts, Commerce &Science Building. This will improve the overall rainwater harvesting potential of the institution. This project does not require power for its operation or maintenance.

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