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Rainwater harvesting at JDCOEM, Nagpur, India

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ABSTRACT

As we know our population is increasing one comes in which it will replace the china in population this is also the reason that our most valuable natural resource that is water is going to decrease water reservoir has its own issue. In the Ancient method, water is enough for people because the population is in control but now days are changed. We are trying to save water on our campus so that we can use that water easily we can full fill the daily requirement of water. We need better technique than this but till then this is a cost-effective technique and we need to think for alternative cost-effective technique but anyway Rainwater harvesting is one of the best methods of fulfilling water requirements. In that project we are calculating the water from the rooftop and consider as the catchment area of our institutional building of JDCOEM campus we also design a tank for collecting the water The average rainfall in Nagpur is 896 mm in 2018 and that much quantity of water is going waste. With the help of rainwater harvesting, we can save water.

Keywords— *Rainwater harvesting, Water reservoir, Natural resource, Water requirements*

1. INTRODUCTION

The JD College of engineering and management campus placed in Nagpur city over an area of 0.162 km^2 about (40 acres) of land. There is two building on the campus of the engineering department (phase 1 and phase 2), poly building, management building, auditorium, and canteen. Rainwater harvesting is a technique of collection and storage of rainwater into natural reservoir or tanks or infiltration of surface water into the surface aquifer.

One method of rainwater harvesting is rooftop harvesting. Also, rainwater harvesting is a simple technique of catching and holding rainwater. We store water in tanks reservoir and we used for recharging of groundwater and we increase groundwater.

(a) The main objective of rainwater harvesting is to increase crop production
(b) To reduce using of groundwater thus increase in the level
(c) It involves collecting, filtering and storing rainwater tanks and reservoir for irrigation and another purpose
(d) To meet the increasing demand for water, to reduce the runoff, to avoid the flooding of road, to raise the underground water table, to reduce groundwater pollution.

In this time where the population goes on the increase so that using water is also increase but our surface water goes on decrease and groundwater as well. So that rainwater harvesting is the lesser complex way of managing our water. In nowadays Nagpur suffering from water problem. If we use this technique in our college so that our college never suffer from a water problem.

2. METHODOLOGY

The modern methods of rainwater harvesting are categorized under two types, Artificial Recharging, and rainwater harvesting. After that it is classified into an absorption pit method, absorption well method, and well cum bore method and recharge trench cum injection well.

The latter is classified into some other types of individual houses and grouped houses which are also further classified into percolation pit method, bore well with settlement tank, an open good method with filter bed sump and percolation pit with bore method. Technically there are two types of rain water harvesting:

- Rationing method
- Rapid depletion method

To know about both the methods, let's apply to any building say WORKSHOP. The detailed calculation is carried out to get the answer.

2.1 Rationing method

In this method distributes stored rainwater to the people in such a way that it full fill the requirement for the maximum time period. Suppose we supply the water to the student which is equal to 10lt/day capita water demand.
Assume no. of people in workshop = 50
Then total amount of water consumed per day = 50 × 0.1 = 0.5m^3/day
How many days we can use the stored water =stored good demand

For workshop building, Volume of water stored into tank is approximate =150m^3
Hence, no. of days =150/0.5 = 300 days

2.2 Rapid depletion method

In rapid depletion method, there is no restriction on a person to use water from harvested rainwater. A person can use the water up to its maximum requirement resulting the less no. of day water can store.

For example, If we assume per person water demand =20lt/day
Amount of water consumed = 50 × 0.02 =1 m^3/day
Preserved water can be utilized = stored water/water demand
= 150/1
=1 days

Analysis, in our campus lots 0f water is waste so that we are adapting the method of rainwater harvesting in JDCOEM campus.

3. DATA COLLECTION OF RAINFALL IN JDCOEM

JD College of Engineering and Management College situated at 78.98 E in Nagpur district Maharashtra of about 219 meters above the mean sea level. In JDCOEM campus there is high rainfall at monsoon season (June –Aug.). The average annual rainfall is 100 – 110 cm.

Table 1: Monthly rainfall data of JDCOEM

Month	Rainfall (mm)
January	7
February	9
March	9
April	6
May	6
June	103
July	296
August	284
September	112
October	40
November	11
December	13
Total	896

Table 2: Calculation of rooftop area of all building

Building	Rooftop area (m^2)
Admin building	1771.26
Phase 1	2236.31
Phase 2	2313.06
Polytechnic building	3131.08
Total area	9485.75

Computation of volume of water runoff per year
As we know the formula for runoff from campus

$$Volume\ of\ water\ received\ (m3) = area\ of\ catchment \times amount\ of\ rainfall$$
$$= 9485.75 \times 896$$
$$= 8499.23\ m^3/year$$

Design of tank,
In campus total amount of water in one year =8499.23 m^3/year
Taking the height of tank = 5 m
Area of base =8499.23/5 =1699.84 m^2.

As water is stored in the monthly size of the tank will be equal to the excess amount of water left over after consumption. Most of the water is collected during June –August.
Assuming the amount of water consumed per month =2550m^3
Water collected during July and august =2807.8+2693.9 =5501.7m^3
Water consumed during these two months = 2 ×2550 =5100m^3

Hence, the total amount of water to be stored = size of tank = 5501.7-5100 =401.7m^3

Height of tank is 5m
Base area =401.7/5 =80.34m^2

By all calculations, we can say that base dimension of the tank is 9×9 m

Hence, the final dimension of the tank is 5×10×10 m which is economical with a factor of safety.

4. RESULT AND DISCUSSION

In this section, we have to find out the best location for the storage tank so that water can be stored easily.
The location of the tank we decide that south part of the campus because it was found that surface of that area is downstream so that all the surface run of will naturally roll down to this region due to gravitation. So that we consider the area for an artificial tank of storage is the best for recharging the groundwater.

5. CONCLUSION

By this paper, we improving the water shortage problem in JDCOEM campus by implementing this technique of recharging the groundwater table. Two methods have been suggested for tank design which depends upon our consumption of water. These results are clearly given table this reservoir should have to build for the storage of 400 m^3 of water.

This tank can supply almost throughout the year for about 2500 consumers at the rate of 10lt/day as calculated by the rational method.

Table 3: Result

Reservoir capacity (m^3)	No. of the day of potential by rational methods	No. of days of potential by rapid depletion method
400	800	400

It is concluded that the RCC tank which is constructed is should be underground so that the upper surface of the tank is used for the other works.

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