

"Implementation of Rainwater Harvesting system in Dilkap College Campus"

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Abstract - Urbanization Over exploitation of ground water & surface water resource resulting by deterioration of water quality. While rain water harvesting system investigate a new water source. The aim of present to use rain water & thus taking close to the concept of nature conservation. In this study, the rain water harvesting system is analysed as a alternative source of water at campus of Dilkap Research Institute & Management Studies (DRIEMS), Neral. The population of college approximately 2000 & they requires Water demand 220996 Lit/day. This water demand can be fulfil by rain water harvesting project. Rooftop rainwater is used to collect the water by down-take pipe. At the down-take pipe Rainy dual Filter is provided for filtration purpose. The filtered water from the rooftop is convey by the pipe to storm water drain. Then water transmit through ring well system to underground water table. There is the filter media provided by using pebbles and coarse aggregate. The PVC mesh pipe provided under pit. The filtered water from PVC mesh is then transmit directly in the available bore well location that can be helpful to increase the ground water quality as well as ground water table. This method is suitable for this heavy rain fall, require less cost of construction.

Keywords- RWH, Roof top, Rainy dual Filter, Stormwater drain with velocity control wall, Ring well pit (bore well location), pvc mesh, perforated pipe.

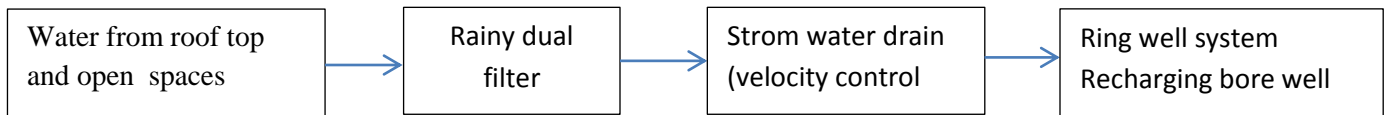
1. INTRODUCTION

Water is one of the most precious natural resources for all life forms. It is widely believed that less than 3% of water on earth is 'Potable water'. There is a pressing need to conserve water. Therefore, Rain water harvesting is one of the most effective methods of water management and water conservation. It involves collection and storage of rain water at surface or in sub-surface aquifer, before it is lost as surface runoff. Many cities in India and all over the world are dealing with depleting water supply marked by falling groundwater levels, vanishing water bodies, severe pollution and urban floods. With their own supplies drying up, cities are force to source of water that they can access to- rain. Rain water and runoff can be harvested. It can be collected and stored, or conveyed to the aquifer to recharge groundwater.

Water is the most important in our life. But large quantity of water is wasted every day, due to which there is an acute shortage of water in the cities as well as the villages at this time, saving the rain water is the only solution in front of us. For solving the water problems of present and future generation, rain water harvesting is useful tool in water management. Rain water harvesting is technology used to collect and store rain water for later use from relative clean surfaces such as roofs land surfaces or rock catchment. The collected water is stored and pumped in a separate pipe distribution. This is a very useful method for developing country like India in reducing the cost and demand of treated water and also economizing the treatment plants operations, maintenance and distribution cost. This system provides sources of soft high quality water reduces dependence on well and other sources and many contexts are cost effective. It is economical cheaper in construction compared to other sources such as well, canal, dam, diversion etc.

1.2 Component of rain water harvesting system

A Rainwater Harvesting system comprises of components for- transporting rainwater down-take pipe, rainy dual intensity filter, stormwater drain, ringewll pit, recharging bore well. The details of the component of rainwater harvesting system has shown in fig. 1



The design and installation of RWH system includes following:

1. Rainwater catchment and conveyance
2. Temporary storage tank(drain)
3. Filtration media.

With above literature it is found that the rainwater harvesting system can be developed with qualitative and quantitative approach for the case study under consideration. This paper mainly aims to explore the economic benefit in rainwater harvesting system and the methodology has been demonstrated through application to Dilkap Research Institute of Engineering & Management Studies, Neral in the state of Maharashtra, India.

2. LITERATURE REVIEW

Shubhra P. Dagwal (roof top rain water harvesting) (2016) stated that collection and storage of rain water is not only for residential purpose but also public or educational building. They apply the concept of rain water harvesting to existing building of SHIVAJIRAO S JONDHALE CLG OF ENGINEERING AND TECHNOLOGY, Asangaon. In this campus there are total 4 building, for those building water demand calculation and quantity of rain water harvesting is calculated by considering working days, holidays, population and terrace area of each building. They collect the roof top water by guttering method and this water carried out through down take pipe or drain to harvesting system. The coarse mesh provides passage for debris at roof. The first flush device is providing to flush of the water received in first shower. The first shower rain tube flush of to avoid contaminating rechargeable water by probable contaminant of atmosphere and catchment roof. They provide filter media before the water carried out the storage tank.

3. STUDY AREA



The campus of Dilkap Research Institute of Engineering & Management Studies, Neral, and Karjat is situated at 19.0323N latitude and 73.3067E longitude and is located in the Raigad district in Maharashtra.

4. CASE STUDY

The campus of this institute is situated at the basement of matheran hills. It is the tropical region having the cumulative annual rainfall above 2840 mm by taking the advantage of topography and climatic condition rain water harvesting plan can be done. The residential accommodation is provided to some faculty and student. The total strength of campus including staff people and student more than 2000. Thus with the present strength and also with the expansion, campus should also increasing is facility by keeping in a view of water conservation and the water scarcity in summer season rain water harvesting is implement.

4.1 Problem formulation

Design of rain water harvesting system of DRIEMS campus consist of catchment area of main building. Analyzed the potential of runoff from the rainfall of the catchment and determination of suitable of ring well pit location. The estimation of project cost determines.

5. METHODOLOGY

5.1 Design of rwh harvesting

Proposed location in DRIEMS campus required analysis and soil testing

Catchment 1: (calculation are for 1 storm, considering intensity of storm as 2cm/hr)

Collected data -

1.catchment area

Roof top area = 1398.42m²

Open area = 1310.3m²

2.average rainfall intensity =2cm/hr

3.runoff coefficient

Roof top area = 0.95

Open area = 0.8

4.storm duration = 1hr

Now by using rational area

From roof top area

$$Q = C \cdot I \cdot A$$

$$= 0.95 \cdot 2.84 \cdot 1398.42$$

$$= 3772.93 \text{M}^3 \quad \dots\dots\dots(1)$$

Now assuming 5% losses of equation (1) and (2) losses , accounting for evaporation

Therefore ,

$$\text{Loss} = (5/100) \cdot 3772.93$$

$$= 188.64M^3$$

Total runoff = 3772.93 - 188.64

$$= 3584.29M^3/day$$

5.2 Calculation for water requirement

1] Main building & canteen

Sr No.	Item	Population	Working duration in day	Water demand liters/head/day	Total water demand
1	Year	2000	8	45	720000

2] Hostel building

Sr No.	Item	Population	Total working duration	Water demand	Total water demand
1	Year	100	24	135	4927500

Total water demand per day = 1044000 lit

$$= 1044m^3 /day$$

5.3 Determination of filter media:

In this project, two filter media are used:

1. Rainydual intensity filter:

This filter used according to capacity of rainfall , the model FL500 is suitable. The efficiency of filter is above 90%. The life span of project 10 years. The working of filter based on principle of centrifugal and cohesive force. The operation is illustrate in below fig.

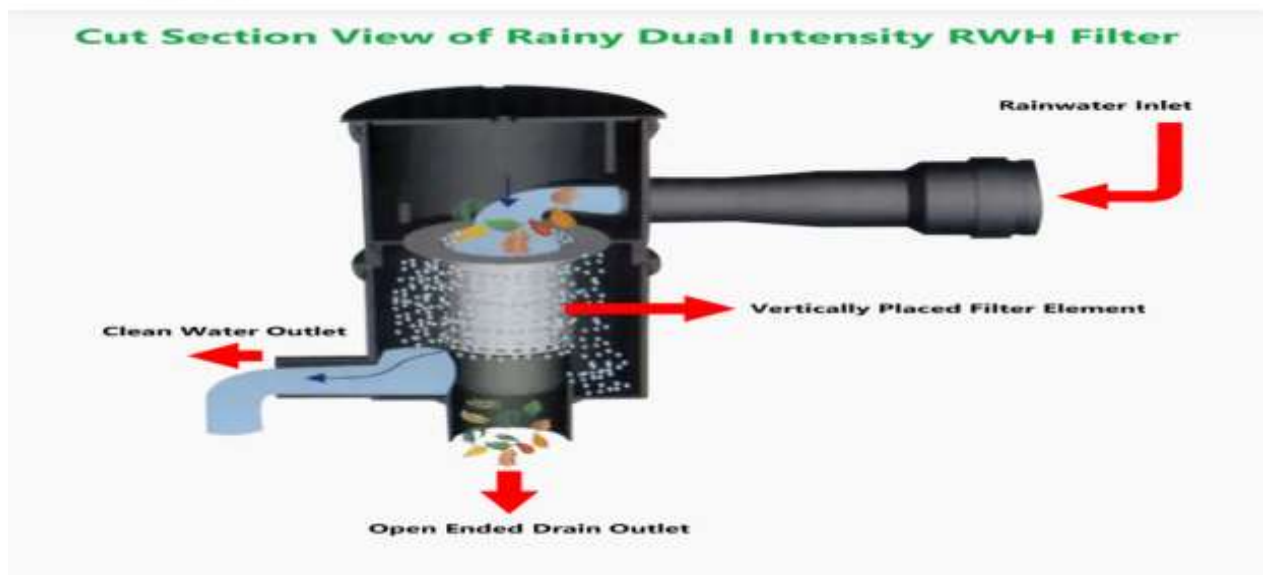


Fig.2

5.4 Determination of soil properties

To determine the soil characteristics by conducting porosity test with the help of pycnometer, core cutter equipment. According to soil characteristics water quality can be define. It gives the capacity of soil to infiltrate the water.

1. Bulk Density of Soil: by using Core Cutter Method

Table 3-1 Results of Core Cutter Test

Sr.No	Determination	1	2
1	Weight of core. W_1 (gm)	800	950
2	Weight of core + soil W_2 (gm)	1950	2100
3	Weight of soil W_3 (gm)	1150	1150
4	Bulk density (gm/cc)	1.171	1.171
5	Average bulk density	1.171	

2. Specific gravity of Soil; by using Pycnometer Method:

Table 3-2 Results of Pycnometer Test

Trial no.	1	2	3	4	5
Empty weight of pycnometer W_1	650	650	650	650	650
Weight of soil sample + pycnometer W_2	840	862	873	853	889
Weight of soil+ pycnometer + water W_3	1592	1575	1569	1584	1599
Weight of pycnometer + water W_4	1500	1500	1500	1500	1500
WSp. Gravity $G = (W_2 - W_1) / (W_2 - W_1) - (W_3 - W_4)$	1.93	1.54	1.44	1.70	1.83
Avg. sp gravity	1.688				

3. Water Content of Soil :

Table 3-3 Results of Water Content of Soil

Sr No.	Determination	
1	Weight of wet soil + container, W_1 (gm)	162.7
2	Weight of dry soil + container, W_2 (gm)	125.92
3	Water content $W = (W_2 - W_1) / W_1$	0.2264

Results

1. Dry density

$$\begin{aligned}
 \rho_d &= \rho / (1+W) \\
 &= 1.171 / (1+0.226) \\
 &= 0.95 \text{ gm/cc}
 \end{aligned}$$

2. Void ratio

$$\rho_d = G \times \rho_w / (1+e)$$

$$0.95 = 1.688 \times 9.81 / (1+e)$$

$$e = 16.43$$

3. Porosity

$$n = e / (1+e)$$

$$= 16.43 / (1 + 16.43)$$

$$= 0.942$$

$$= 94.26 \%$$

If the porosity is more infiltration is more.

6. ESTIMATION & COSTING OF RECHARGE PIT:

Sr. No.	Description	Quantity	Price
1	Rcc ring dia 91cm, upto 400cm depth excavation, Ring fill up and media fill up, total work job complete	12 nos. x 1800	21,600/-
2	Filtration Media: 1. PVC mesh filter 70cm dia 25 cm 2. Rainydual intensity filter	1Nos x 5000 7000	12,000/-
3	Filtration Media- all sizes, fine aggregate, coarse agg. 25mm x 40mm pebble, 10mm x 25 mm pebbles, 16 x 32 fine sand etc	1500kg x 12	18,000/-
4	Stormwater Drain- 2 Feet x 2 Feet including all civil work, brick work, plaster, Filtration Media etc	Lumpsum	5000/-
5	Laying for 6" Dia pipe including required fittings and Accessories Excavation (Breaking) and fitting, Concreting.	20 x 1200	24,000/-
6	Big Stone	4 Bras x 3000	12,000/-
8	Transportation charges		10,000/-
9	Labour charges		30,000/-
Total project cost			1,32,600/-

Result:

Design of rainwater harvesting system of DRIEMS campus:

1. Catchment 1:
 - Runoff potential = 3084 m³/day
 - Recharge pit size = 5*5*3.5M

2. Water Demand

Population = Above 2000

Water demand = 1044m³/day

Here the three times of water can be save than required water demand per day.

3. soil testing

Porosity of soil in this study area found 96.24% from the pycnometer, core cutter & water content test therefore infiltration capacity of soil is more.

4. Estimation & Costing

The total cost of project is about RS 1,32,600/-. This amount is less as compared to the other RWH system projects.

Conclusion:

Recharge of ground water table is a gradual process, we cannot suddenly increase the ground water table after constructing recharge structures, by constructing any type of recharge structure, and we can give our contribution in aquifer recharge. This will help to rejuvenate the depleting ground water resources. Also help to save the little amount of rain water which used to drain away from many years. Thus it is concluded that implementation of RWH system of Dilkap Research Institute of Engineering & Management Studies (DRIEMS) campus would result in the form of the best approach to deal with present scenario of water scarcity and storing huge quantity of 22,09,688 liters in a year in college campus.

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