Design & Estimation of Rooftop Rainwater Harvesting System for Academic Block of College Campus, BIET (Lucknow)

Shiner Suryansh Rajpoot[1], Garima Chaurasia[2], Khushboo Tiwari[3]
[1, 2, 3] Department of Civil Engineering
[1, 2, 3] Bansal Institute Of Engineering & Technology, Lko

Abstract- *Rainwater harvesting is the excellent technique of save the water for future need and also to recharge ground water. The surface and ground water resource are continuously depleting in India. Hence, we should apply the rainwater harvesting technique at individual institute and community level has become imperative. This study is aimed to design rainwater harvesting structure for the BIET campus Lucknow out of the possible catchment areas the main building is selected as the required catchment area for rainwater harvesting considered the water demand in our collage. Further different part of the RWH system would be designed based on the standard guidelines it was observed from the analysis that implementation of RWH system in BIET campus Lucknow campus can resolve the water scarcity problem during non-monsoon season by storing a huge quantity of 1526.6 m3 water per year in the college campus.*

Keywords: rainwater, rooftop, runoff, catchment area, harvesting system.

I. INTRODUCTION

Water is most important resource on the earth. Rainwater harvesting is defined as the process of collecting natural precipitation and storing the rainwater for the later uses for the gardening, washing vehicle, flushing and ground recharge etc.activity aimed at harvesting surface and all other hydrological studied and engineering intervention and efficiently utilization of the limited Water. In many regions of the world fresh drinking water is not regularly available. They spend more money to save the fresh water & make it drinkable water by investing huge cost and expenditure. Rainwater is free source and comparatively clear and with genuine treatment it can be even utilized as a potable water source. Rainwater rescue good quality drinking water source and reduce the pressure on erosion and refilling ground water level.

II. OBJECTIVE

- ✓ To create simple and economical rainwater harvesting system for our campus like academic block.
- ✓ To store rain water for water scarcity period.
- ✓ To minimize the cost of municipal corporation water charge and its demand.
- ✓ To design and provided economical and strong water tank with minimum dimension.

Components of Rainwater Harvesting System:

Catchment surface
Delivery system
PVC gutters
Down pipe
Filter
Storage tank
Overflow pipe

III. STUDY AREA

Lucknow lies in the rain region of eastern UP. And receives the rainfall from coming monsoon in June to august. The standard rainfall precipitation in Lucknow is about 700 mm (June to august). In 2020-21 the standard rainfall has been 180 mm in June, 280 mm in July, 190mm in august, as discuss earlier in the section of introduction importance of rainwater harvesting at BIET campus. We are taking the academic building of the BIET campus for the designing the satellite image of the building is showing below.

Fig. (1) Google map image of study area

IV. METHODOLOGY

Following steps are followed in design a rainwater harvesting system.
Step-1: Determination of Catchment Area.
Step-2: Rainfall Data Collection.
Step-3: Runoff Coefficient.
Step-4: Estimation of Water Harvesting Potential.
Step-5: Estimation of Water Demand.
Step-6: Design of Storage Tank Cost Estimation.

1. Area Calculation of Roof Catchment: 7000 sq.m

Fig.2 catchment area of rooftop

2. Rainfall Data Collection

Lucknow is located at 26.8467 degree north, 80.9462 degree east in UP at the elevation of Lucknow in approximately 123 meter (404feet) above the sea level and receives minimum rainfall in June to august during southwest monsoon.

The average annual rainfall data of the area is taken from the information centre. Thus, data is related to campus is given below.

Fig.3 Monthly rainfall data of Lucknow district (source metrological department Lucknow)

3. Runoff Coefficient:

Table 3.1. Values of Run-off Coefficient (K)

Types of area,	*Values of K*
Single houses	0.3
Garden apartments	0.5
Commercial and Industrial areas	0.9
Forested areas depending on soil	0.05—0.20
Parks, farm land, pastures, etc.	0.05—0.30
Asphalt or concrete pavements	0.85

Runoff coefficient by the book of (Santosh Kumar Garg)

4. Estimation of water harvesting potential

Rainwater harvesting potential= area*rainfall*runoff coefficient
Total roof top area= 7000 sq.m
Taking runoff coefficient= 0.85
Annual rainfall= 990mm/year
=0.99m/year
Rainwater harvesting potential= 7000*0.99*0.85
=5890.6 m3/year
Maximum monthly rainfall in 1 month= 270mm
Maximum rainfall collected in 1 month= 7000*0.27*0.85
= 1607 m3/month
Including 5%loss of water =1607*5/100
= 80.35m3/month
Total water has to be stored= 1607-80.35
=1526.6m3
I.

5. Estimation of water demand

Per capita demand for collage and school=15 to 25 lit.
Total strength=3200
Total demand of water per day=15*3200*
=48000lit/day
=48m3/day
Total water consumed in 1 month= 48*30
=1440m3/month
Total water to be stored = 1526.6-1440

=87m3
So, the 100m3 water tank will be design for the storage the rest water.

Particulars	Length (feet)	Width (feet)	Height (feet)	Quantity (cubic feet)	Cost Rs.
Excavation	12	12	6	864	6000
PCC work	12	12	0.333	176	20000
Brickwork	11.8''*2	11.8''*2	10	4300	50,000
Plaster work; Inner side; Outer side	 10*2 10*2	 10*2 10*2	 10 5	 400 2150	 20000-9000
Total cost	-	-	-	-	105,000

6. Design of storage tank cost estimation:

Estimation of tank- for 1 tank
Hence total cost for the installation of four tank is =105,000*4
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= Rs. 420,000

- Total cost for installation including contingencies and water is= Rs. 600,000
- Capacity of the tank = 100m3
- Cost of construction for per sq. m=Rs.14,290
- Water charge in Lucknow per1000 liter nearly Rs.8.5
- Then per day water charge use in BIET collage is = 408 Rs.
- And per month =12240 Rs.
- And per year about 146,880 Rs.
- In this proposal the payback period is 20 years.

So, In 20 years we can save nearly 30 lakhs rupees.

Result: On the basis of calculation, the water bank is most suitable option for the storage of rainwater. And we would save about 16, 07,000 liter of drinkable water if we use rain water for the flushing, washing, and gardening. And we can also save the water charge 12,240Rs. Monthly paid the government for water which is flush out.

V. CONCLUSION

It has been observed that by implementing the rainwater harvesting in the BIET campus we can make little noble cause for rainwater conservation which is beneficial to the students of the campus. And large amount of water can we stored; our campus will become the example to others for rain water harvesting. This paper fulfilled with all aspect of improving the water scarcity problem in the BIET campus by implementing this technique.

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BIOGRAPHY:

Shiner Suryansh Rajpoot
Email: shiner5122002@gmail.com
Contact: 8726792645

Garima Chaurasia
Email: garimachaurasia101@gmail.com
Contact: 9956971531

Khushboo Tiwari
Gmail: khushbootiwari126@gmail.com
Contact: 812793821