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Rain Water Harvesting at NIFT Campus Delhi: A Case study

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Abstract- *Potable water being one of the essential substances for life. The call for conservation of water has always been important for research point of view. Delhi, a dense populated capital state situated in India is facing huge potable water crisis in present and urgent need of multiple solution to fulfill adequate water demand. To reduce unbalanced water budget equation, rain water harvesting has a pre-eminent role to play and sites the collection and utilization of rainwater and thereby, reducing runoff. A lot of research works and publications dealing with these technologies have been insightful. Reducing overdraft, preserving surface runoff, and expanding the amount of ground water accessible require adopting reservoir water storage practices and appropriate recharging strategies are strategic key of rain water harvesting technique. Primary objective of this study is to find the rainwater potential and to calculate the runoff from NIFT and find out the number of recharging structures needed for the NIFT campus, Hauz Khas, New Delhi with its feasibility.*

Keywords— Rain water Harvesting, Ground Water Recharge.

I. INTRODUCTION

Potable water crises are a growing concern worldwide, with many regions facing shortages of clean drinking water. In response to this challenge, rainwater harvesting has emerged as a sustainable solution to collect and store rainwater for future use. By capturing rainwater from rooftops or other surfaces, individuals and communities can reduce their reliance on groundwater sources that are depleting at an alarming rate. Delhi is a bustling city with a crazy amount of people! With a population of over 20 million residents, the demand for water in Delhi is seriously off the charts. The city's water supply comes from sources like the Yamuna River and underground aquifers, but groundwater levels are depleting rapidly due to excessive pumping. To try and meet the skyrocketing water demand, authorities have implemented measures like rainwater harvesting and water conservation campaigns. Additionally, rainwater harvesting helps recharge groundwater levels by allowing water to infiltrate into the soil and replenish aquifers. This practice not only provides a reliable source of potable water but also helps mitigate the impacts of droughts and climate change. With proper infrastructure and management, rainwater harvesting can play a significant role in addressing potable water crises and promoting sustainability in water resource management.

II. OBJECTIVE

The broad objectives of the study for rainwater harvesting in Delhi is all about capturing and storing rainwater for future use. The objective is to reduce the strain on traditional water sources and alleviate water scarcity issues in the city. People are getting creative with their water storage structures, like underground tanks or rooftop containers, to make the most of this natural resource. In a city where water shortages are a common occurrence, rainwater harvesting is becoming more popular as an eco-friendly solution to help conserve and manage water effectively. Plus, it's a great way to save money on your water bill and contribute to environmental sustainability. So next time it rains, maybe consider setting up a rainwater harvesting system at your place too!

III. METHODOLOGY AND DESIGN

There are two major techniques of rainwater harvesting.

- Surface runoff harvesting. In this method, rainwater flows away as surface runoff and can be stored for future use.
- Groundwater recharge. Groundwater recharge is a hydrologic process where water moves downward from surface water to groundwater.

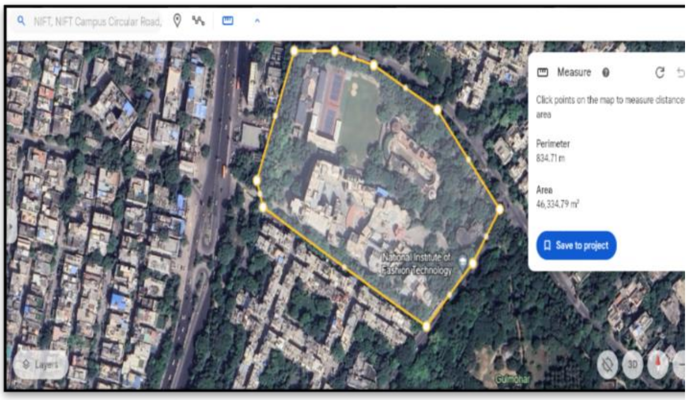

Figure 1.. Hauz Khas, Delhi: study area

There is an office of the National Institute of Fashion Technology at Hauz Khas, New Delhi. The total area of the office building is approx. 3250 sqm and open area is approx. 8750sqm. In first phase, the rain water harvesting has been implemented in left wing of the hostel, covering a roof top area of 465 sqm and open area of 788 sqm. For rain water harvesting, a deep bore well of 32m. depth and 150mm dia. has been bored.

Concrete tanks can be built above or below the ground. Concrete is durable and long-lasting, but is subject to cracking. An advantage of concrete cisterns is their ability to decrease the corrosiveness of rainwater by allowing the dissolution of calcium carbonate from the walls and floors. Each tank must have an overflow system for situations when excess water enters the tank. The overflow can be connected to the drainage system.

Design and construction of reinforced cement concrete tanks shall comply with the requirements of IS 3370 (part-I)-1965 and IS 456-1964. Accordingly, the mix of cement concrete shall not be leaner than 1:2:4 (stone aggregates of 20 mm nominal size)

Depth to water level of Delhi

- The water table rises up and down according to the time of the month. Before monsoons it is lower and after monsoons it is higher.
- Pre-monsoon Depth to water level during 2011:20.58 mbgl
- Post-monsoon Depth to water level during 2011:19.95 mbgl
- The fluctuation in pre-monsoon and post monsoon ground water level is approximately 0.6mbgl.

For designing the optimum capacity of the settlement tank, the following parameters need to be considered –

(a) Size of the catchment
(b) Intensity of rain fall
(c) Rate of recharge

The capacity of the tank should be enough to retain the runoff occurring from conditions of peak rainfall intensity. The rate of recharge in comparison to runoff is a critical factor. The capacity of recharge tank is designed to retain runoff from at least 15 minutes of rainfall of peak intensity.

For example, for Delhi peak hourly rainfall is 90mm (based on 25 years frequency) and 15 minutes peak rainfall is 22.5 mm say 25mm.

Area of roof top catchment (A) = 100 sqm. Peak rain fall in 15 min (r) = 25mm (0.025m) Runoff coefficient (C) = 0.85
Then, capacity of settlement tank = A x r x C
= 100 x 0.025 x 0.85 = 2.125 cum
or 2,125 liters

The annual rainfall (R) in Delhi is approx. 715mm. Considering a roof top area (A) of 465 sqm and runoff coefficient (C) of 0.85, the rain water harvesting potential from roof top is
=AxRxC
= 465 x 0.715 x 0.85
= 282.604 cum or 2,82,604 liters

The open area from which runoff is to be collected is approx. 788 sqm. Considering a runoff coefficient (C) of 0.55 for open areas, the rain water harvesting potential from open area is
=AxRxC
= 788 x 0.715 x 0.55
= 309.881 cu.m. or 3,09,881 liters

Total rain water harvesting potential annually is 5,92,485 liters from the roof top and open area.

The runoff from roof top is collected through down take pipes / conduits of 100mm dia. After collection through conduits, the collected water is channelized through a network of drains (underground) having 250/150mm dia. RCC pipes to a settlement tank cum filter. Similarly, the runoff from open area is also collected through series of chambers constructed along the drains and channelized to settlement tank cum filter.

The capacity of filter cum settlement tank is 8400 liters, which is sufficient to retain runoff from at least 15 minutes rainfall of peak intensity. After passing through the filter media, the filtered water enters into the 150mm diameter 32m deep borewell, bored specifically for this purpose i.e. for recharging ground water aquifer.

Rainfall Data of Delhi

Month	Mean monthly temp(max.)(°C)	Mean Montly temp (min.)(°C)	Mean monthly rainfall (mm).
January	21	7	25
February	24	10	22
March	30	15	17
April	36	21	7
May	41	27	8
June	40	29	65
July	35	27	211
August	34	26	173
September	34	25	150
October	35	19	31
November	29	12	1
December	23	8	5
Total annual rainfall			715

Table 1: Rainfall data

The overflow from settlement tank/filter enters into the municipal sewer through the connection provided. The total cost of implementation of the project in NIFT hostel is approximately Rs. 22,55,000.

VI. CONCLUSION

The following point wise conclusions are drawn from this research are as under:-

i. Waste plastic, which is available everywhere, can be effectively used in brick/tile making.
ii. The compressive strength of sample 2 with a 1:2 ratio comes to 11N/mm^2

Hence we concluded that plastic-sand bricks are very useful for the construction industry when we compare them with Fly Ash bricks and 3 rd. class clay bricks.

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