Case Study: Rainwater Harvesting (RWH) at Rizvi College of Engineering (RCOE)

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Abstract: Rain Water harvesting is one of the easiest and economical method to collect and store rain water using simple mechanisms. As rains are one of the largest source of soft water, we can harvest rain water and utilize it for our day to day needs to meet with the scarcity of water faced in urban densely populated cities. Our paper here displays a case study which we have designed and proposed to our esteemed institute Rizvi College of Engineering situated at Bandra, Mumbai to help and meet with the daily consumption of water in the campus. We have calculated the annual demand of water in the campus and tried to meet with the demand using rain water harvesting techniques. Our design incorporates a circuit which will collect water into a storage tank and the overflow of the water will further help to replenish the ground water level once the tank is full.

Key Words: Rain Water Harvesting, Cost Effective, Terrace, Annual Water Demand, Recharge Pit, etc.

1 INTRODUCTION

Water is one of the most commonly used substances on our earth. We need water for all our activities in day-to-day life. Water supply in urban area is always short against the total demand. Surface water is inadequate to meet our demand and we must depend on ground water. Due to rapid urbanization, infiltration of rainwater into the subsoil has decreased drastically and recharging of ground water has diminished. This scenario requires an alternative source to bridge the gap between demand and supply. Rainwater, which is easily available and is the purest form of water, would be an immediate source to augment the existing water supply by "catching water wherever it falls".

Rainwater Harvesting has emerged as a viable alternative to traditional perennial sources of water in hilly areas, in places where the level of fluoride and arsenic is above permissible limits and in urban areas facing water shortage and flooding during monsoons.

Rainwater Harvesting (RWH) is the process of collecting and storing rainwater in a scientific and controlled manner for future use[1]. Rainwater Harvesting in urban areas include

1. Roof top rainwater harvesting
2. Rainwater harvesting in paved and un-paved areas (open fields, parks, pavement landscapes etc.)
3. Rainwater Harvesting in large areas with open ponds, lakes, tanks etc.
2 PROPOSED DESIGN FOR RAIN WATER HARVESTING SYSTEM

The design of the proposed RWH system looks like below. The institute has 2 types of terraces. The first type of terrace is of 200 m² area and is there on 3 sides of the building. The second type is a large 400 m² area which is located at the center of the building. The figures of the set ups proposed are shown below.

Each terrace is coupled with a drain manifolds and V type parapet which collects the water and guides it to the drains during the rains. We have proposed a U-shaped piping channel which will guide the water from the parapet to the storage tank which will be situated at the ground floor. The U channel is indicated and shown in the figure in Blue color.

Once the water is collected in the tank it can be used for various needs in the institute. If the tank is full, we have designed a recharge ground water system which helps to improve the ground water levels and use them later during the year.

1. 3 Terraces with following area

![Diagram of Terrace 1]

- **Terrace 1**
  - 200 m²
  - Drain Outlets
  - C Shape Pipe
  - Parapets

2. 1 Roof with following area
3. Front view of the proposed design

DESIGN OF RECHARGE PIT

The design of the recharge pit is as shown in the Figure below [2]. From the bottom, start filling the pit with different materials as shown. Connect the overflow outlet of the rainwater harvesting tank with the inlet to the recharge pit. One can also direct the slope of the floor to allow the rain water to collect in the recharge pit.
3 RAIN WATER HARVESTING DEMAND, POTENTIAL AND COST

Rain water harvesting for the Rizvi College of Engineering (RCOE) Campus is explained in detail below:

3.1 WATER DEMAND CALCULATION

<table>
<thead>
<tr>
<th>NO</th>
<th>ITEMS</th>
<th>AVAILABLE POPULATION</th>
<th>TOTAL WORKING DAYS</th>
<th>NON-WORKING DAYS</th>
<th>NET WORKING DAYS</th>
<th>WATER DEMAND LIT/HEAD/DAY</th>
<th>TOTAL WATER DEMAND LIT/HEAD/DAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Semester</td>
<td>1680</td>
<td>210</td>
<td>56</td>
<td>154</td>
<td>5</td>
<td>1293600</td>
</tr>
<tr>
<td>2</td>
<td>Examination</td>
<td>1680</td>
<td>90</td>
<td>24</td>
<td>66</td>
<td>3</td>
<td>332640</td>
</tr>
</tbody>
</table>

TOTAL WATER DEMAND FOR ENGG DEGREE BLDG IN 1 ACADEMIC YR (IN LITERS) 1626240

TOTAL WATER DEMAND FOR ENGG DEGREE BLDG IN 1 WEEK (IN LITERS) 54208

TOTAL WATER DEMAND FOR ENGG DEGREE BLDG PER DAY (IN LITERS) 10842

3.2 CALCULATIONS OF WATER HARVESTING POTENTIAL

<table>
<thead>
<tr>
<th>SR NO</th>
<th>BUILDING DESCRIPTION</th>
<th>CATCHMENT AREA (SQ.M)</th>
<th>AVERAGE HEIGHT OF RAINFALL (M)</th>
<th>RUNOFF COEFFICIENT</th>
<th>COLLECTED VOLUME OF RAINFALL (CU.M)</th>
<th>COLLECTED VOLUME OF RAINFALL WITH 20% LOSS (LITRES)</th>
</tr>
</thead>
</table>


3.3 COST OF WATER PER LITER

<table>
<thead>
<tr>
<th>SR NO</th>
<th>BUILDING DESCRIPTION</th>
<th>LENGTH OF U-CHANNEL REQUIRED (m)</th>
<th>COST OF U-CHANNEL</th>
<th>COST OF 10000 Liter TANK</th>
<th>COST OF RECHARGE PIT</th>
<th>LABOR AND MISCELLANEOUS COST</th>
<th>COST OF HARVESTING RAINWATER PER LITER/PER HEAD/PER DAY</th>
</tr>
</thead>
</table>
| 1     | ENGG DEGREE BUILDING TERRACE + ROOF | 40 x 3 (TERRACES) + 60 x 1 (ROOF) | 4500 (@ Rs 250 per meter) | 80000 | 50000 | 15500 (including labor, cost of brackets, octroi, transportation) | \(~12\) paise per liter
\[= 150000/(1680 x 10840 x 0.773)\] |

CONCLUSIONS

The proposed design and methodology is very simple and requires minimal changes in the existing infrastructure. Also, the rain water harvested will be useful to meet the demands of the campus for 78% of the time. The cost of the project is very reasonable, and it has a huge ROI and also a very small break-even time period.

ACKNOWLEDGEMENTS

We would like to express deepest appreciation towards Dr. Varsha Shah, Principal RCOE, Mumbai and Prof. Sujata Rout, Head of Mechanical Department whose invaluable guidance supported us in this project. At last we must express my sincere heartfelt gratitude to all the staff members of Mechanical Engineering Department who helped us directly or indirectly during this course of work.

REFERENCES

[2] https://www.youtube.com/watch?v=Sx3Zd1p-XrA How to construct a RWH recharge pit for a home