Rainwater harvesting for college campus using concept of green building

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Abstract:- Ancient method of damming river and transporting water to urban area has its own issues of eternal troubles of social and political. In order to conserve and meet our daily demand of water requirement, we need to think for alternative cost effective and relatively easier technological methods of conserving water. Rain water harvesting is one of the best methods fulfilling those requirements. To achieve this goal, the Green Building criteria has been implemented since the beginning of the design process until the detailing process on the end of the project. Water collecting and use frameworks have been utilized since antiquated circumstances and confirmation of rooftop catchment frameworks go back to early Roman circumstances Rain water harvesting is one of the best methods fulfilling those requirements. The technical aspects of this paper are rainwater harvesting collected from rooftop which is considered to be catchment areas from Institutes departmental building at SHREE L. R. TIWARI COLLEGE CAMPUS. First of all, required data are collected i.e., catchment areas & hydrological rainfall data. Water harvesting potential for the hostels and faculty apartments was calculated, and the tank capacity with suitable design is being considered. Volume of tank has been calculated with most appropriate method of estimation. Optimum location of tank on the basis of hydrological analysis and GIS analysis was done in the campus.

Keywords:- Rainwater Harvesting, Green Building, Hydrological Data, Methods of Distribution of Rainwater Harvesting, Recycling, Water conservation, Sustainable living, Plumbing ,Treatment systems

I. INTRODUCTION

In every development activity must pay attention to balance with the surrounding environment and not cause negative impacts on the environment. Efforts to harvest rain have become an important part of the global environmental water resources management agenda in the context of tackling water imbalances in the rainy and dry seasons (lack of water), lack of clean water supply for the world's population, as well as flood and drought relief.

Currently, 69% of all water withdrawn for human use is soaked up by agriculture, whereas industry account for 42% and domestic sector account for about 19%. The global averages vary a great deal between different region of the world like Asia, Africa, and Europe. Our country uses, nearly 76.68% of total available fresh water supply for agriculture and remaining for all other purposes.

The best solution to overcome water scarcity problem is to tap the groundwater resources but very rapid depletion in the groundwater table has been observed from last five decades due to over taping. Presently, the proper management of groundwater resources is urgently required through advance water conservation and harvesting systems. Instead of developing big water systems, we people are going for smaller harvesting systems to work at the root level.

The main source of fresh water is rainwater. The rainwater collected can be used directly for lawns, toilets etc. It can also be used for drinking purposes after proper treatment. The most valuable aspect could be its use directly to recharge groundwater Rainwater harvesting technique or also known as rain water harvesting is defined as a way to collect or collect rainwater or surface runoff during high rainfall for later use when rainwater is low. Judging from the scope of its implementation, this technique can be classified into 2 (two) categories: rainwater harvesting techniques with the roof of the building (roof top rain water harvesting), and rainwater harvesting techniques (and surface runoff) with reservoir buildings.

II. WHAT IS RAINWATER HARVESTING?

Rain water harvesting can be classified based on time such as, traditional and modern methods Traditional method were used in past time for the collection of rainwater such as Kund in thar desert, temple tanks

method. Modern methods are divided into two categories of artificial recharge and rainwater harvesting.

Artificial recharge could be done by adopting pit method, Absorption well method, well cum bore method and Recharge trench cum injection well method. Modern scientific methods for recharging of groundwater by rainwater could be applied on individual houses and grouped houses. Individual houses can be design for rainwater harvesting with the Percolation pit, bore well with settling tank, Open well and Percolation pit with bore method.

This study has been done by using the bore well method. In this method both recharging as well as utilization of rainwater is done. It requires less space as compared to open well for installation of rainwater harvesting system. In this method, rainwater falling of the terrace of building is collected through pipes and then diverted to bore well which work as a settlement and filter tank. A percolation pit has been provided in the nearby area to divert excess flow of rainwater.

III. WHAT ARE GREEN BUILDING TECHNIQUES?

The goal of green buildings or sustainable building is to use resources more efficiently and reduce negative impact of building while construction and during life cycle. Rain water harvesting (RWH) achieves one key of green building goal by reducing the water requirements and recharging ground water

1. Reduces urban flooding.
2. Ease in constructing system in less time.
3. There is a growing trend for green buildings all over the world including India.
4. Economically cheaper in construction compared to other sources, i.e., dams, diversion, etc.

IV. LITERATURE REVIEW

- Latif Shaikh {2018}- The author used (RWH) and achieves one key of green building goal by reducing the water requirement and recharging ground water. It is necessary to adopt various approaches towards green building to protect health and environment and reduce the pollution. There are various methods of rain water harvesting which are explained above as per their suitability by adopting proper method, we can put one step to protect environment and healthy lifestyle.
- Ranjit Kumar Sharma {2019}- He finally concluded that implementation of RAINWATER HARVESTING PROJECT to the campus of N.I.T. Rourkela will be the best approach to fight with present scenario of water scarcity in all aspects, whether it is from financial point of view or from optimum utilization of land surface.
- M.K. Kaushik: Rain Water Harvesting {2021}- Using of green buildings for the apartment buildings it's very important for water saving, can be done with rain water harvesting or utilization of rain water as a flushing or watering plants. Total water needs of the apartment is 182.031 m3/days, after doing the conservation water saving of 175.695 m3/days.
- Christopher Kloss {December 2008}- Disinfection of rainwater for reuse has been the standard, but recent research and policies should encourage jurisdictions to evaluate lesser requirements for nonportable uses in water closets and urinals. The simplification of the on-site treatment process and associated cost savings could broaden the use of rainwater harvesting without increasing exposure risks.
- Tiara Anantika, Eka Wardhani, Nico Halomoan. {2019}-Using of green buildings for the apartment buildings it's very important for water saving, can be done with rain water harvesting or utilization of rain water as a flushing or watering plants. Total water needs of the apartment is 182.031 m3 /days, after doing the conservation water saving of 175.695 m3 /days. Of utilization rain water that needs to be done water quality testing with reference to applicable standards. There is further research on efficiency and requires a large enough area for the treatment of rainwater. So, it requires other alternatives that are more efficient in terms of cost, processing and land area needed is not large.
- Mohd Farooq a, Manpreet Singh Bedi b and M.K. Kaushik c {2016}- Rainwater harvesting is a cost-effective method of conserving water there by solving the water crisis. The Indian town planners and civil authorities need to make rainwater harvesting compulsory in all new structures.

Typically, this will save up to 50% domestic water consumption. The conservation of fresh water resources must be therefore required to improved world. Wide to ensure that clean drinking water does not become a luxury product.

V. COMPONENTS OF RAINWATER HARVESTING

The aim of this paper is investigation of the rainwater potential to be harvested to meet the water requirement of th rainwater harvesting and green building in shree l.r Tiwari college campus.

- Catchment: Any surface can act as the catchment for rainwater harvesting. The amount of water or "yield" that the catchment area will provide depends on the size of the catchment area and its surface texture. Catchments areas are made of concrete, asphalt, or brick paving. Smooth-surfaced roofing materials provide high yields whereas bare soil surfaces provide medium yield. Compared all of the soil types, compacted clay soil have the highest yield. Planted areas, such as grasser or covered areas offer the lowest yields because the plants hold the water for longer time allowing it to infiltrate into the soil.
- Conveyance: System With a roof catchment system the gutter and downspouts are the means of conveyance that direct the water from the catchment area to the storage tank. Gutters and rainwater pipes are either concealed inside the walls of buildings or attached to the exterior of the building. These can be added to the outside of a building any time. Proper size of gutters is important to collect the maximum rainfall possible.
- Storage: Water is utilized whenever needed and storage allows full utilization of excess rainfall. Storage of rain water can be done underground or above ground. In many cases, the soil profile may also permit artificial recharge of rainwater to open wells and bore wells, where water can be stored to be retrieved later for productive use.
- Distribution System: The distribution device can be a hose, constructed channels, pipes, perforated pipes, or a manual drip system that directs the water from the storage tank to landscaped areas. Gates and diverters can be used to control flow rate and flow direction. A manual valve or motorized ball valve located near by the storage tank can assist gravity fed irrigation. If gravity flow is not possible, an in line electric pump hooked to a hose can be used.

VI. REUSE OF WATER

Water is a natural resource that many people all over the world often take for granted. The good news is that more awareness is being spread about the limited supply of this essential natural resource and the importance of its conservation. Rain water harvesting or recycling is an effective way to collect and store water to be used later. The water from the roof is collected in tanks and used for different purposes. You too can conserve water and save on water bills by harvesting rain water.

VII. MAINTENANCE FOR RAINWATER HARVESTING STRUCTURES

The following points are kept in mind for the maintenance of the rainwater harvesting (Thomas et al., 2005).

1. Always keep the surroundings of the tank clean and fully hygienic.
2. Remove Algae from the roof tiles and asbestos sheets before the monsoon.
3. Drain the tank completely and clean from inside thoroughly before the monsoon.
4. Avoid first 15 or 20 minutes of rainfall depending on the intensity of rain.
5. Use the first flush arrangement to drain off this first rainwater.
6. The tap should have lock system so that pilferage or wastage of water is avoided
7. Heavy loads should not be applied on the lid; particularly many people should not stand on the lid.
8. Leakage of cracks in the Ferro cement storage tank shall be immediately attended to by cement
9. Withdraw water from the system at the rate of 5 liters/head/day. This will ensure availability of water throughout the water scarcity period.
10. Clean the water channels (gutters) often during rainy season and definitely before the first monsoon rain.

VIII. DATA REQUIREMENT

1) Survey on college building
2) Data collection from metrological department
3) Rating the building plumbing systems
4) Researching different green building techniques in rain water harvesting
5) Studying the surrounded environment of college.

Designing the capacity of tank

IX. DESIGNING OF RAINWATER HARVESTING SYSTEM COMPONENT

Problem Statement:

Determine the storage capacity of tank:

Given:

- Runoff coefficient = 0.55
- Average annual rainfall = 266.84 mm = 0.266m
- Catchment area of college building = 1101.88m^2

Finding the quantity of rain water yield in year i.e., 4 months

By the given formula,

Harvesting potential or Volume of water Received (m^3)

= Area of Catchment (m^2) X Amount of rainfall (mm) X Runoff coefficient

V = 1101.88 * 0.266 * 0.55

= 175.86 m^3

1m^3=1000 litres

Hence,

175.86*1000 =175860 litres

Therefore,

175860* 75%

= 131895 litres

Storage capacity

Considering storage and assuming rainfall as,

I'=18.8mm (assumed Mira Road) = 0.018 m

V'= 1101.88* 0.018 * 0.55

= 11.90m^3 * 1000

= 11900 litres

Hence given below the complete design of all the components of rainwater harvesting of M.S.S. HALL whose dimensions are mentioned and tank size is 4 X 5 X 12

Sl no	Particular	Quantity	Rate	Cost(Rs)
1	Earthwork in excavation	319.232 m^3	100 Rs/m^3	31923.2
2	Cement concrete 1:3:6 in foundation with brick ballast	22.27 m^3	2700 Rs/m^3	60129
3	I class brickwork 1:3 cement mortar	42.24 m^3	3000 Rs/m^3	126720
4	R.C.C work for slab cover	14.112 m^3	2700 Rs/m^3	38102.4
5	12mm plastering with 1:2 cement mortar	136 m^3	2700 Rs/m^3	367200
			Total	624074.6
6	Contingency + work charges establishment	(3% + 2 % = 5 %)	--	31203.73
7	Engineering profit	10%	--	62407.46
			Grand Total	717685.80

Sl. No.	Particular	No.	Length(m)	Breadth(m)	Height/depth(m)	Quantity(m^3)
1	earth work in excavation	1	12.80	5.80	4.3	319.232
2	Cement concrete 1:3:6 in foundation	1	12.80	5.80	0.3	22.27
3	I class brick work in 1:4 cement mortar					
	i. Long wall	2	12.60	0.30	4	30.24
	II.short wall	2	5.0	0.30	4	12
					Total	42.24
4	R.C.C work for slab cover	1	12.60	5.60	0.20	14.112
5	12mm plastering inside with 1:2 cement mortar					
	i.long wall	2	12	-	4	96
	ii.short wall	2	5	-	4	40
					Total (Rs)	136

X. CONCLUSION

The other component of the harvesting systems such as Guttering, First-Flush, and Filtration mechanism have also been reviewed.

Hence it was finally concluded that implementation of RAINWATER HARVESTING PROJECT to the campus of SLRTCE will be the best approach to fight with present scenario of water scarcity in all aspects, whether it is from financial point of view or from optimum utilization of land surface. Therefore, water is highly a precious natural resource which is always in high demand in the campus of SLRTCE and thus, RAINWATER HARVESTING AT Shree L R Tiwari campus is highly recommended.

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