TO PLAN & DESIGN RAINWATER HARVESTING SYSTEM FOR D.Y PATIL COLLEGE OF ENGINEERING, AKURDI

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ABSTRACT

The technical aspects of this project are rainwater harvesting collected from rooftop which is considered to be catchment areas from institute building at D. Y. P. C. O. E Akurdi campus. First of all required data are collected i.e catchment areas & hydrological rainfall data. Water harvesting potential for the college building was calculated, and the tank capacity with suitable design is considered. Volume of tank has been calculated with the most appropriate method of estimation. Optimum location of tank was decided and finally pipeline design, gravity chamber and filtration mechanism are also dealt with in detail. The result shows that the RWH system which will be applied in future, for a catchment area of 4225.6 m^2, will be effective for an annual discharge of 1068.06 cubic metre per year. The developed system satisfies the social requirements and can be implemented in rural areas by considering almost all the technical aspects.

Keywords— Rainwater harvesting, Roof water system, pipeline conveyance, underground RCC tank, sand filter.

I. INTRODUCTION

Rainwater harvesting consists of intercepting rainfall where it occurs, saving the water in various storage structures, which can be natural or manmade, percolating it in ground to raise water table level, prevention of losses through evaporation & and beneficially using stored water locally. The reasoning is that water that runs off in streams towards the oceans is wasted, and that it makes sense to capture the water forthwith, for beneficialuse.

In the universe, life is known to exist nowhere except the Earth. Modern science unequivocally believes that life cannot exist without water. Life has sustained on our Earth for 3.5 billion years because of some extraordinary attributes of the Earth. One such attribute is the hydrological cycle, by which a small fraction of one per cent of all freshwater in the Earth is circulated over and over again. One part of rain falling on land flows in rivers and streams towards the ocean, and one part of it goes back to atmosphere as evaporation, and as transpiration by plants. The remaining part circulates underground as soil water and groundwater. It is within this simple, and yet profound framework that rain harvest needs to beunderstood.

RWH is the need of time today for following reasons :

- GrowingPopulation
- Modernization / Industrialisation and ill effects associated withit
- Global warming, abnormal changes in hydrologicalcycle
- Growing difference between availability and requirement of water globally. Cherapunji in Assam which receives the highest rain fall in India to the tune of 11000 mm per year also suffer from acute shortage of drinking water not because rain water is not consumed but allowed to be drained away. This has also resulted into overexploitation of surface sources like wells for drinking and industrial use, resulting to dropping of water levels and drying up of borewells.

Any rainwater harvesting system will typically have following four elements:

1) Catchmentarea
2) Conduits
2) Settlement Tank
3) Recharge facility or storagefacility.

II. STUDIES CARRIED OUT GLOBALLY

Today due to rising population & economical growth rate, demands for the surface water is increasing exponentially. Rainwater harvesting is seeming to be a perfect replacement for surface & ground water as later is concerned with the rising cost as well as ecological problems. Thus, rainwater harvesting is a cost effective and relatively lesser complex way of managing our limited resources ensuring sustained long-term supply of water to the community. In order to fight with the water scarcity, many countries started harvesting rain. Major players are Germany (Biggest harvesting system in Germany is at Frankfurt Airport, collecting water from roofs of the new terminal which has a large catchment area of 26,800 m2), Singapore (as average annual rainfall of Singapore is 2400 mm, which is very high and best suited for rainwater harvesting application), Tokyo (as RWH system reserves water which can be utilized for emergency water demands for seismic disaster), etc.

- In China, Argentina, and Brazil, rooftop rainwater harvesting is being practiced for providing drinking water, domestic water, water for livestock, water for small irrigation, and a way to replenish groundwater levels. Gansu province in China and semiarid northeast Brazil have the largest rooftop rainwater harvesting projects going on.
- In Bermuda, the law requires all new construction to include rainwater harvesting adequate for the residents
- A number of Canadians have started implementing rainwater harvesting systems for use in stormwater reduction, irrigation, laundry, and lavatory plumbing. Bylaws and local municipal codes often regulate rainwater harvesting.
- Although New Zealand has plentiful rainfall in the West and South, for much of the country, rainwater harvesting is the normal practice for most rural housing and is encouraged by most councils.

III. STUDIES CARRIED OUT IN INDIA

Today, only 2.5 per cent of the entire world"s water is fresh, which is fit for human consumption, agriculture and industry. In several parts of the world, however, water is being used at a much faster rate than can be refilled by rainfall. In 2025, the per capita water availability in India will be reduced to 1500 cubic meters from 5000 in 1950. The United Nations warns that this shortage of freshwater could be the most serious obstacle to producing enough food for a growing world population, reducing poverty and protecting the environment. Hence the water scarcity is going to be a critical problem if it is not treated now in its peanut stage. Some of the major city where rainwater harvesting has already implemented is Delhi (Centre for Science and Environment's (CSE) designs sixteen model projects in Delhi to setup rainwater harvesting structures in different colonies and institutions), Bangalore (Rainwater harvesting at EscortsMahle-Goetze, Designed by S.Vishwanath, Rainwater club, http://www.rainwaterharvesting.org/People/innovators-urban.htm#svis), Indore (Indore Municipal Corporation (IMC) has announced a rebate of 6 per cent on property tax for those who have implemented the rainwater harvesting work in their house/bungalow/building).

- In Andhra Pradesh, the ground water table is generally below 7 meters from the ground level. By various methods of rainwater harvesting, if the ground water table is raised by 4 meters by using the adequate rainfall available during the monsoon season, crops can be grown throughout the year using the ground water without facing water shortage.
- Tamil Nadu was the first state to make rainwater harvesting compulsory for every building to avoid groundwater depletion. The scheme was launched in 2001 and has been implemented in all rural areas of Tamil Nadu. Posters all over Tamil Nadu including rural areas create awareness about harvesting rainwater TN Govt site. It gave excellent results within five years, and slowly every state took it as a role model. Since its implementation, Chennai had a 50% rise in water level in five years and the water quality significantly improved.
- In Rajasthan, rainwater harvesting has traditionally been practised by the people of the Thar Desert. Many ancient water harvesting systems in Rajasthan have now been revived. Water harvesting systems are widely used in other areas of Rajasthan, as well, for example the *chauka* system from the Jaipur district.

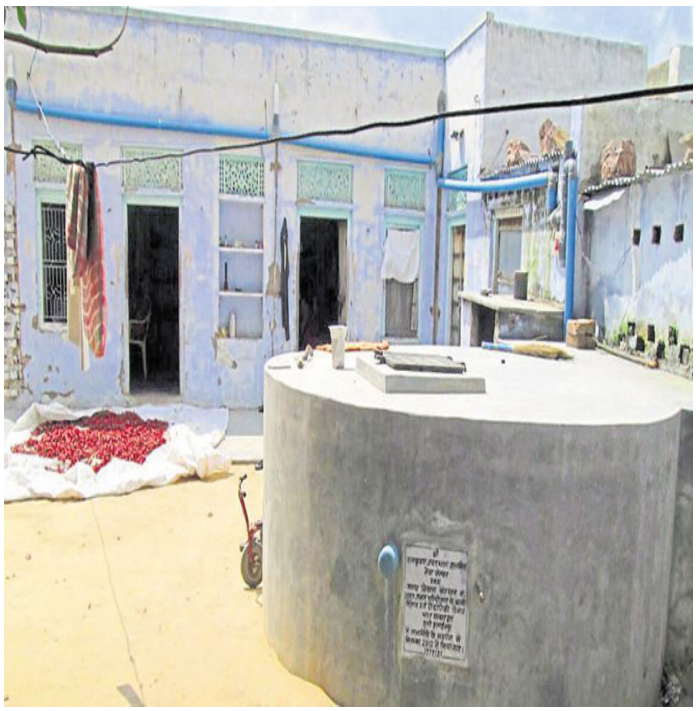
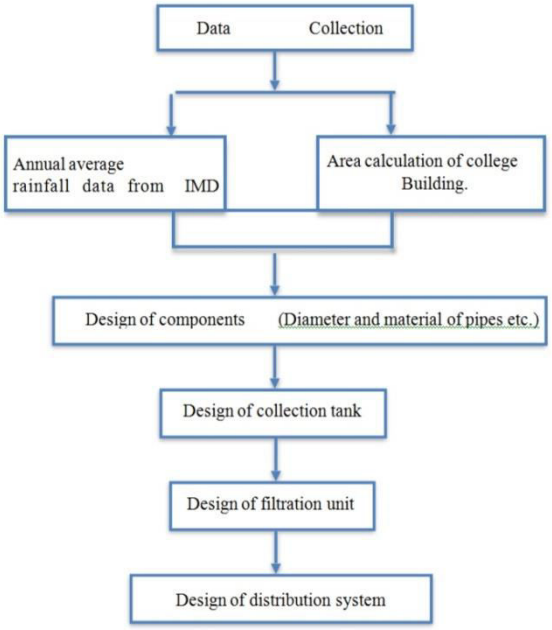


Figure- RWH System in Rajasthan

IV. METHODOLOGY



V. COMPONENTS OF RAINWATER HARVESTING

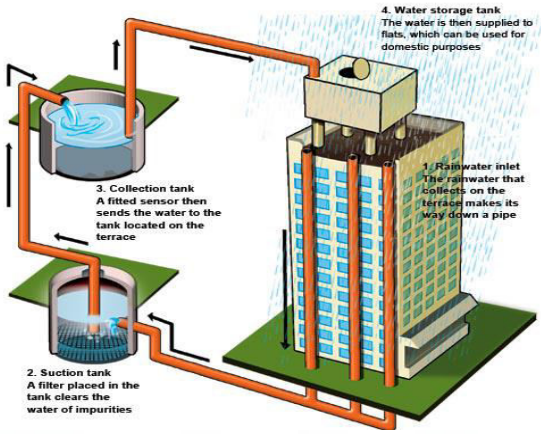
A rainwater harvesting system comprises of components for - transporting rainwater through pipes or drains, filtration, and tanks for storage of harvested water. The common components of a rainwater harvesting system are:

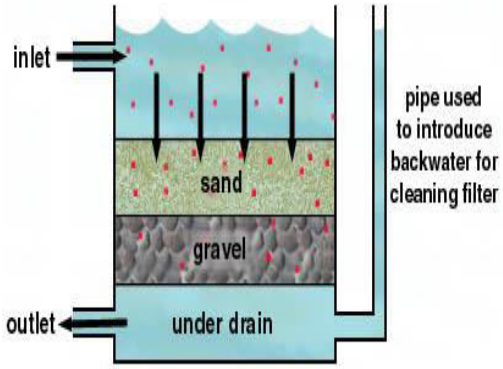
- **Catchment:**The surface which directly receives the Rainfall and provides water to the system iscalled catchment area. It can be a pavedarea like a terrace or courtyard of a building,or an unpaved area like a lawn or open ground.A roof made of reinforced cement concrete (RCC),galvanized iron or corrugated sheets can also be used for water harvesting.
- **Coarse Mesh:**It prevents the passage of debris, provided in the roof.
- **Pipeline:**Channels which surrounds edge of a sloping roof to collect and transport rainwater to the storage tank. Pipeline can be semi-circular or rectangular and mostly made locally from plain galvanized iron sheet. Pipelines need to be supported so they do not sag or fall off when loaded with water. The way in which pipelines are fixed mainly depends on the construction of the house, mostly iron or timber brackets are fixed into the walls.
- **Gravity Sand Filter:**The filter is used to remove suspended pollutants from rainwater collected from rooftop water. The Various types of filters generally used for commercial purpose are Charcoal water filter, Sand filters, Horizontal roughing filter and slow sand filter.
- **Storage Facility:**There are various options available for the construction of these tanks with respect to the shape, size, material of construction and the position of tank and they are:-

Shape: Rectangular.

Material of construction: Reinforced cement concrete(RCC), masonry, Ferro-cement etc.

Position of tank: Depending on land space availability these tanks could be constructed above ground, partly underground or fully underground. Some maintenance measures like disinfection and cleaning are required to ensure the quality of water stored in the container. If harvested water is decided to recharge the underground aquifer/reservoir, then some of the structures mentioned below are used.





Components of Rainwater Harvesting SystemGravity sand filter

VI. DATABASE AND RESULTS:

The harvested water will be used for watering the lawns and for flushing purpose. Therefore, considering the total areas and demand of water, 2 storage tanks have been designed at

suitable locations where the roof water will be collected through pipelines after going through the filtration units, i.e. Gravity Sand Filter (designed according to the Manual on water supply and treatement,1999).

Area of lawn: 11059.93 m^2(divided in two equal parts and will be watered in alternate days)
Total water required per day for gardening= $7m^3$
No. Of people using flushes per day= 3000
Water consumption per day for flushing= $30m^3$
Total water demand= 37 m^3
Total catchment area= 4225.6 m^2
Annual average rainfall= 1002.393mm
Average daily rainfall= 35.6 m^3
This daily rainfall will be collected in **two** equal underground tanks of following specifications which have been designed according to the standard codes in the most economical way:
Underground Storage tank dimensions:
Length= 5m
Breadth= 2m
Height= 2m
Each Tank capacity= $20m^3$

VII. COST ESTIMATION

Total cost of pipeline structure is **1,64,722 INR**
Total construction cost of underground water tank is **1,71,072.86 INR**
Total cost of filtration unit is **10,900 INR**
Therefore, total cost of rainwater harvesting system for our college(including 2 storage tanks, 2 filtration units &)
= **(10,900+ 1,71,072.86)*2 + 1,64,722=5,28,667.72**

VIII. BENEFITS OF RAINWATER HARVESTING

Rainwater harvesting is a simple and primary technique of collecting water from natural rainfall. At the time of a water crisis, it would be the most easily adaptable method of mitigating water scarcity. The system is applicable for both critical and normal situations. It is an environmentally friendly technique that includes efficient collection and storage that greatly helps local people. The associated advantages of rainwater harvesting are that
(i) it can curtail the burden on the public water supply, which is the main source of city water;
(ii) it can be used in case of an emergency (i.e., fire);
(iii) it is solely cost effective as installation cost is low, and it can reduce expense that one has to pay for water bills;
(iv) it extends soil moisture levels for development of vegetation.
(v) groundwater level is highly recharged during rainfall;
(vi) it can prove to be very efficient as a supplement in the areas like PCMC, where the corporation supplies water in alternate days.

IX. CONCLUSION

This project dealt with all aspect of improving the water scarcity problem in DYPCOE, AKURDI campus by implementing ancient old technique of rainwater Harvesting. Hence from the result, we can draw out a conclusion that a huge amount of water got collected from the rooftop surface of all the entire building. And if, this project is being done seriously and implemented to the campus then it has a huge harvesting potential. Two collection tanks should be build for the storage of 20 m^3 of water each. Hence this project has huge capacity of getting rainwater and on proper storage, this tank can supply water for almost 3 months and 16 days to 3000 consumers having a consuming rate of 10litre/day as calculated previously.
It is concluded that RCC tanks which are to be constructed should be underground ones, so that upper surface of the tank can be utilized economically for any land purpose such as parking space or cycle stands or any such small structure.
Cost analysis has been done for the tank. And it was concluded that cost of construction was not so high, if it is compared with problems which will be faced by the students and staffs inside the campus due to water scarcity. The other component of the harvesting systems such as piping, chlorination and slow sand Filtration have also been reviewed and designed for DYPCOE,Ak campus building in details.
Hence it was finally concluded that implementation of RAINWATER HARVESTING PROJECT to the campus of DYPCOE,Ak will be the best approach to fight with future 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 and thus, RAINWATER HARVESTING AT DYPCOE,Ak campus is highly recommended.

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