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Application of Water Conservation Technique to Low Income Group Housing

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Abstract – *Water shortage has been recognized as one of the key issues faced in developing countries like India. Water demand is increasing due to population growth. Due to scarcity of water; the water tariff is increasing at an alarming rate leading to the increased domestic water bills. Population of low income group cannot bear higher tariffs of using water. Rainwater harvesting scheme plays an important role in saving water. The present paper is focussed towards the design of the rainwater harvesting scheme for low income group housing. The design methodology for the rainwater harvesting scheme has been elaborated with recourse to a case study for low income group housing at Nagpur (M.S.). The economics involved and potential water saving has also been demonstrated. Usefulness of study in water management and prospective sustainable development is highlighted.*

Key Words: *Rainwater; harvesting; low income group housing*

1. INTRODUCTION

Water is a finite resource. Water shortage is becoming largest problem in the world today. Current and future plans must strive to maintain or improve available quality of water, while utilizing the available water resources as efficiently as possible. Since only 2.5% of the world's water is fresh water, it is essential to ensure that this small amount of available water is utilized efficiently, maintaining its quality [1]. This is becoming even more important as population increase worldwide. Due to increasing demand for public water supplies, groundwater levels are declining and municipal treatment plants are struggling to supply current demands while dealing with declining infrastructures. Practicing water conservation techniques is essential for sustainable development. For future water management, rainwater harvesting is one of the techniques which can reduce demand of potable water, if recycled after treatment. Rainwater harvesting offers an alternative and sustainable water resource. It offers an affordable, simple, sustainable and reliable alternative water source. Not only does rainwater harvesting supply water for indoor and outdoor use, it protects the environment from detrimental nonpoint source pollution by reducing rooftop runoff. It is ideal for low income group housing, which can reduce water bills, reduce pressure on potable water. Rainwater harvesting is going to be mandatory for building permits in the future. Rooftop rainwater harvesting requires relatively less treatment. Rainwater can be used for toilet flushing, landscape irrigation. Plumbing for potable and non potable rainwater sources must be separate systems. 95% of rain - water can be recycled after allowing 5% of rainwater for first flush [1].

2. METHODOLOGY

The illustrative design of the basic components of rooftop rainwater harvesting system is given in the following typical schematic diagram [2].

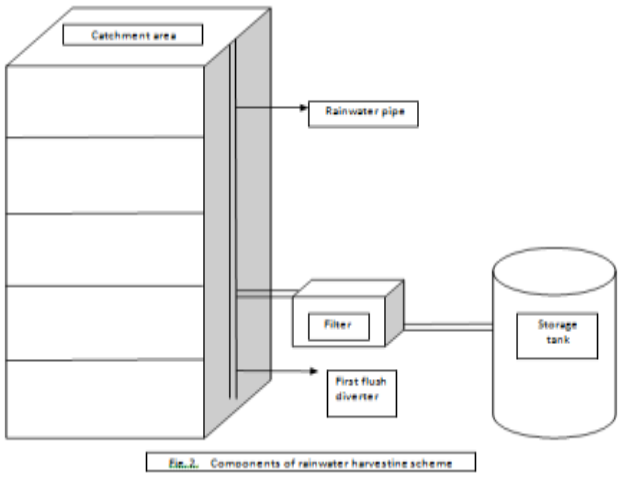

Fig...2. Components of rainwater harvesting scheme

The system mainly constitutes of following sub components:

- Catchment
- Coarse mesh
- Transportation
- First flush
- Filter

The surface that receives rainfall directly is the catchment of rainwater harvesting system. It may be terrace, courtyard, or paved or unpaved open ground. The terrace may be flat RCC/stone roof or sloping roof. Therefore the catchment is the area, which actually contributes rainwater to the harvesting system. Transportation of rainwater from rooftop should be carried through down take water pipes or drains to the storage/harvesting system. Water pipes should be UV resistant PVC pipes of required the capacity. Water from sloping roofs could be caught through gutters and down take the pipe. At terraces, mouth of the each drain should have wire mesh to restrict floating material. First Flush is a device used to flush off the water received in first shower. The first shower of rains needs to be flushed-off to avoid contaminating storable/rechargeable water by the

probable contaminants in the atmosphere and the catchment roof. It will also help in cleaning of silt and other material deposited on the roof during dry seasons. Provisions of first rain separator should be made at the outlet of each drainpipe. Filters are used for treatment of water to effectively remove turbidity, colour and micro-organisms. After first flushing of rainfall, water should pass through filters. There are different types of filters in practice like sand, gravel, charcoal filter, PVC pipe filter, sponge filter. The basic function of filter is to purify water [3, 4].There are various methods of adopting rainwater harvesting.

Storage of Direct use

In this method rain water collected from the roof of the building is diverted to a storage tank. The storage tank has to be designed according to the water requirements, rainfall and catchment availability. Each drain pipe should have a mesh filter at mouth and first flush device followed by filtration system before connecting to the storage tank. It is advisable that each tank should have excess water overflow system. Excess water could be diverted to recharge system. Water from storage tank can be used for secondary purposes such as toilet flushing, washing and gardening, etc. This is the most cost effective way of rainwater harvesting. The main advantage of collecting and using the rainwater during the rainy season is not only to save water from conventional sources, but also to save energy incurred on transportation and distribution of water at the doorstep. This also conserves groundwater, if it is being extracted to meet the demand when rains are on.

Recharging ground water aquifers

Ground water aquifers can be recharged by various kinds of structures to ensure percolation of rainwater in the ground instead of draining away from the surface. Commonly used recharging methods are:-

- Recharging of bore wells
- Recharging of dug wells.
- Recharge pits
- Recharge Trenches
- Soak ways or Recharge Shafts
- Percolation Tanks

Sizing rainwater harvesting system

When sizing rainwater harvesting system, the following factors must be considered [5].

- Diameter of rainwater pipe
- Rainfall amount
- Roof area
- Filter type
- Available room on plot for store
- Water consumption
- Intended use

Table 1 gives an idea about the diameter of pipe required for draining out rainwater based on rainfall intensity and roof area:

Table 1

Diameter of pipe (mm)	Average rate of rainfall in mm/h					
	50	75	100	125	150	200
50	13.4	8.9	6.6	5.3	4.4	3.3
65	24.1	16	12.0	9.6	8.0	6.0
75	40.8	27	20.4	16.3	13.6	10.2
100	85.4	57	42.7	34.2	28.5	21.3
125	-	-	80.5	64.3	53.5	40.0
150	-	-			83.6	62.7

Source: National building code

Potential of rainwater =A_R*Roof area*Runoff coefficient

Runoff coefficient is selected from Table 2 depending upon the type of catchment.

Table 2

Roof catchment	Runoff coefficient
Tiles	0.8-0.9
Corrugated metal sheets	0.7-0.9
Concrete surface	0.6-0.8

The standard design of a filter is as below (Fig. 2):

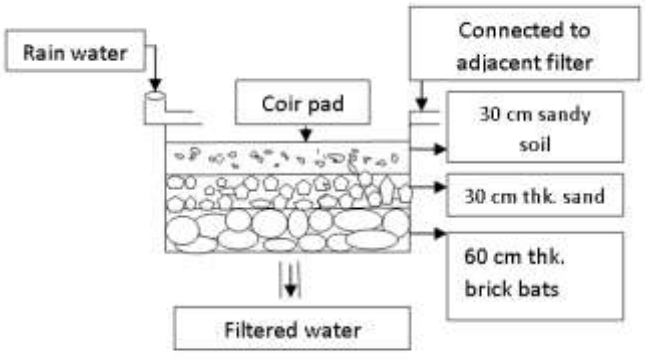

Fig.2.

In these filters easily available materials such as brick, gravel, coal, coarse sand, and fine sand are used as filtering mediums. This kind of filter removes all physical and biological impurities from the rain water. The filter can be one single unit or any number of multiple units joined together through flexible pipes.

Storage tanks of various materials and sizes are readily available. Commonly used are out of PVC, polyethylene, metal (galvanised iron), ferrocement, masonry or reinforced cement concrete. Size of underground R.C.C.

storage tank can be calculated assuming depth of tank which depends upon depth of ground water at site.

2.1 A CASE STUDY

A case study of a low income group housing situated at Kalamna, Nagpur (M.S.) has been carried out for rainwater harvesting system to be implemented. It consists of 14, G+3 buildings, each building having 36 flats. Total number of flats is 504. Cost of this project is INR 22.68 Crores. Total available area of terrace in this group housing is 14374.81 m^2.Hence potential of rainwater is 44, 00000 liters. This water can be recycled for flushing of toilets. A separate plumbing system for municipal water supply and rainwater after filtration using graded filter material i.e boulder, metal and sand is used. The amount required for G.I. pipeline of 25 mm diameter for recycling of rainwater is INR 11,600. Above ground storage tanks of PVC and PVC pipes for conveyance are found economical, lightweight and maintenance free. It requires INR1crore 30 lakhs and INR 3, 99,000 respectively. Filters cost INR 2, 80,000. Overhead PVC tanks require INR1, 05,000. Metal strainers cost INR 25,200 and centrifugal pumps require an amount of INR 3, 92,000. Total cost of system of rain water harvesting requires INR1, 42, 12,800 [6, 7].

2.2 RESULT

Pressure on potable water gets reduced by a substantial quantity of 44, 00000 liters using techno-efficient cost effective system of rainwater harvesting. This system of rain water harvesting also takes care of storm-water runoff. An additional cost of 6.2% of the total cost of the project is needed for installing a system of rainwater harvesting.

3. CONCLUSION

Sustainable technology of rainwater harvesting is an effective water conservation technique and can save a considerable amount of fresh drinking water in group housing and can reduce water bills of people staying in low income houses. Though additional amount is required for installation and maintenance of rainwater harvesting system, it is shared by a number of users in group housing, reducing the cost of facility per consumer.

REFERENCES

1. The Texas Manual on Rainwater Harvesting, Texas Water Development Board, 3rd edition, 2005, Austin Texas.
2. Li z., Boyle F., Reynolds A., Rainwater Harvesting and Greywater Treatment System for Domestic Application in Ireland, Desalination 260 (2010), 1-8.
3. http://mppcp.nic.in/RWH.htm
4. Nolde E., Possibilities of Rainwater Utilization in Densely Populated Areas Including Precipitation Runoffs from Traffic Surfaces, Desalination 215(2007)1-11.
5. Rainwaterharvesting.org
6. Philip C. Reidy, P.E., Integrating Rainwater Harvesting and Storm water Management Infrastructure: Double Benefit-Single Cost, Conference Proceeding paper, 2011.
7. Current Schedule of rates, India, 2012.

BIOGRAPHIES

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