ROOF TOP RAIN WATER HARVESTING SYSTEM

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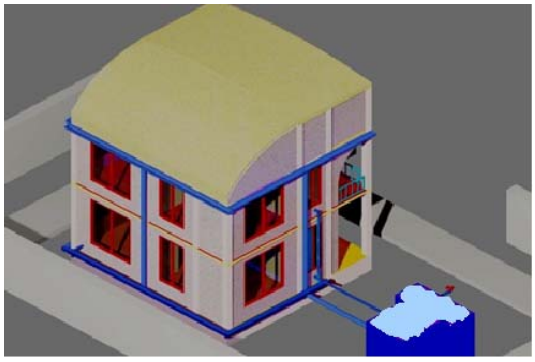
Stress on land and water resources is gradually increasing due to rapid urbanization. Consequently many of its adverse effects have been surfacing over the recent times. Frequent occurrence of floods is one of the major problems in urban centres endowed with heavy rainfall such as Guwahati and the nuisance it creates has been very much evident. However in winters these urban centres face acute shortage of water.

In such a scenario, implementing roof top rain water harvesting system (RTRWH) in urban households can be a smart option.



Definition

Rain water harvesting is a technique of collection and storage of rain water in surface (storage tanks) or sub surface aquifer before it is lost as surface runoff.

Why adopt rain water harvesting system?

- Reduces the runoff volume and the peak flow, hence mitigate floods.
- Recharges ground water thus is a solution to water shortage problem in winters.
- Reduces the cost per litre of water since a large amount of power that is consumed while pumping water from subsurface aquifers can be saved.

Rain water harvesting scheme with its numerous individual as well as community benefits can be an effective tool in developing a sustainable urban environment.

DESIGN CONCEPT OF RTRWH

The rooftop RWH System comprises of a guttering and down pipe system to collect the rainwater from the rooftop of houses. This water can be stored in the RWH tank for daily use or can be diverted to either existing wells/ tube wells or especially designed infiltration well, i.e. percolation pits.

A flushing arrangement has to be provided for the first showers in order to drain out the accumulated unwanted materials from roof top such as dried and fallen leaves, bird's drop, etc.

A study has been conducted on a pilot watershed of Hatigarh Chariali of Guwahati in order to design rain water harvesting system (Sarma and Goswami, 2006). The maximum-intensity-duration relationship (Fig-1), developed from this study, has been used for design of RTRWH system. Size of the storage tank has been designed to accommodate maximum expected volume for a rainfall event.

Intensity- duration relationship

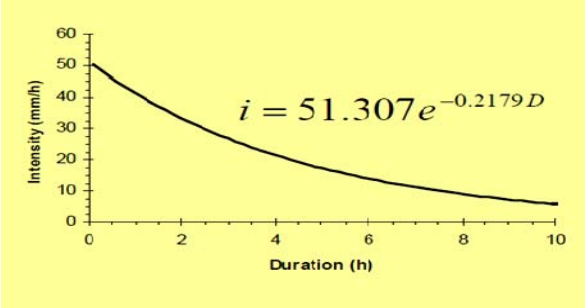


Fig-1: Maximum Intensity-Duration curve

Design storm for maximum total volume

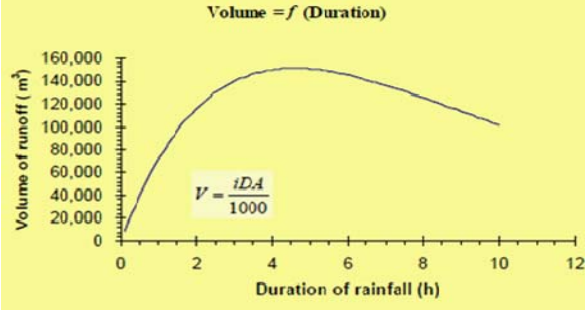


Fig-2: Volume generated by rainfall

Figure 1 shows that longer the duration of a storm event lesser is the intensity. Thus, it was necessary to know the storm that will produce maximum runoff volume from a given area. Volume generated by storm of different duration was computed to develop a relationship between duration of rainfall and volume of runoff (Fig-2). Utilizing this relationship, design storm for the purpose of deciding tank size was obtained. The duration and intensity of the design storm was found as 5 hr and 17.26mm/hr respectively.

Design summary of the rooftop rain water harvesting system

The volume of water collected at the roof of a house is given by

$$Vroof = \frac{i.A.D}{1000}$$

Where,
i=intensity of 5 hr duration rainfall = 17.26 mm/hr
A = area of roof (m^2),
D=duration of rainfall,i.e.5hr.
The quantity of water collected per square meter of roof is given by

$$\bar{V} = \frac{i.D}{1000}$$

where $\bar{V}$ = Volume collected per unit area of roof (m^3)

Design calculations

For a 5hr duration rain with intensity of 17.26 mm/hr, the quantity collected per square meter of roof is 0.09 m^3 which may be approximated as 0.10 m^3/m^2. If storage tanks of one meter depth are used to store the rainfall volume, the area of RWH tank has to be 10% of the roof top area.

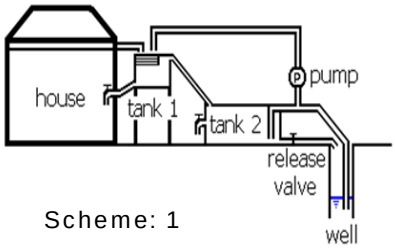
Socio-economic perspective

A socio-economic survey of the pilot watershed (Sarma et al. 2006) indicated that most of the households were profoundly interested in implementing rain water harvesting scheme, though their response regarding investment patterns was varied. Keeping in view the probable investment patterns and utility perspective six schemes are presented hereafter.

PROPOSED SCHEMES

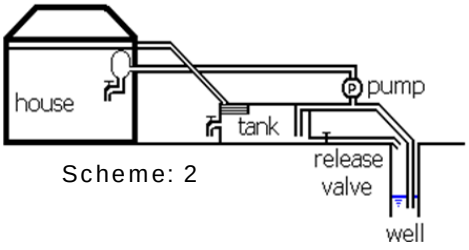
Scheme: 1

This system is proposed for those having/willing to have an elevated storage tank along with a pumping device. In this system, the first tank is placed just below the roof level to collect the rainwater from roof top through filter medium. Overflow of tank no.1 is diverted to tank no.2 that is to be constructed above ground surface in order to store the excess water for domestic use. It is also possible to release water during heavy rainfall to recharge ground water table.



Scheme: 1

Advantages	Disadvantages
Reduction of peak flow	Initial cost is more
Free use of water	
Reduction in pumping costs	
Recharge of ground water table	



Scheme: 2

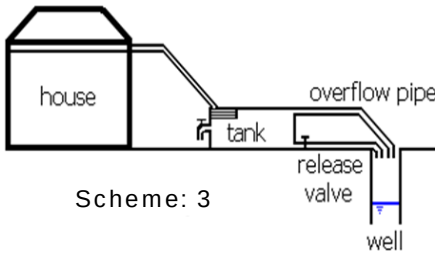
Advantages	Disadvantages
Reduction of peak flow	Pumping provision must be present.
Recharge of the ground water table	
Partial reduction in pumping costs	

Scheme: 2

In this system the RWH tank is to be constructed above the ground surface. The rainwater would be collected from the roof top by means of guttering and down pipe system through filtering medium. The water can be used for domestic purpose either directly or has to be pumped into an inside storage chamber. During heavy rainfall the release valve should be kept open for recharging the ground water.

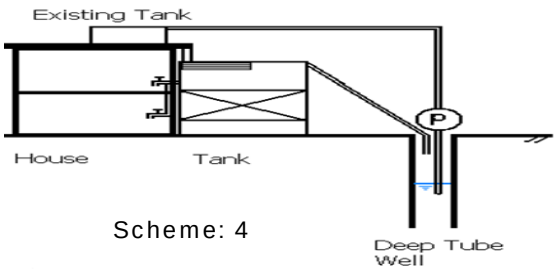
Scheme: 3

This system is proposed for those who do not have any pumping and storage system. Rainwater is to be collected from the rooftop through a filter medium in a RWH tank located a ground and can be used for domestic purpose. Provisions are to be made to divert the excess water to an existing well, nearby, for ground water recharge through overflow pipe or release valve.



Scheme: 3

Advantages	Disadvantages
Reduction of peak flow	No inside supply
Recharge of the ground water table	
Free use of water without pumping	



Scheme: 4

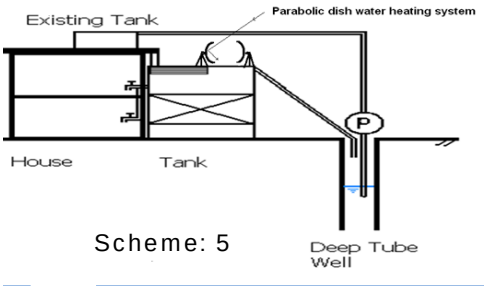
Advantages	Disadvantages
Reduction of peak flow	Higher investment in staging
Recharge of the ground water table	
Free use of water without pumping	

Scheme: 4

This is an independent RWH arrangement, which does not affect the existing pumping and storage system. The rainwater is to be collected from the rooftop, through the existing drain pipe, in an up level RWH tank through filter medium. The water from the tank can be used by gravity force instead of pumping. Overflow of the tank would be diverted to recharge the ground water table.

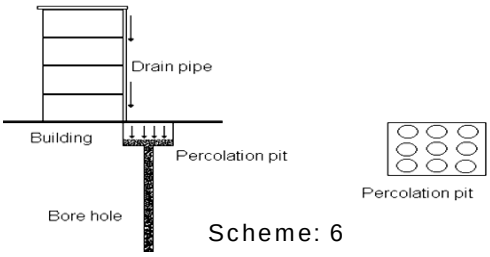
Scheme: 5

The rainwater is to be collected from the rooftop, through the existing drain pipe, in an up level RWH tank through filter medium. A parabolic dish solar heater is installed suitably above the RWH tank. The treated water which is subjected to heating can be used for domestic purpose



Scheme: 5

Advantages	Disadvantages
Reduction of peak flow	Apparently nil except initial high Investment
Recharge of the ground water table	
Power required for electrical heating system can be saved	



Scheme: 6

Advantages	Disadvantages
Reduction of peak flow	Suitable only for re-charging the ground water table
Recharge of the ground water table	
No special arrangement is needed	
Less expensive	

Scheme: 6

This system is particularly suitable for multi-storied complexes. In absence of sump, open well or deep tube well, the rainwater collected from roof top may be recharged through percolation pits. Existing drain pipe is sufficient to divert the rainwater to the percolation pits. The bottom of the pit should be in a sandy formation. A bore hole is to be drilled at the bottom of the percolation pit filled with brickbat, pebbles etc.

With a growing urge to establish harmony with nature Human minds with their capacity to reason and innovate have to devise a sustainable framework for developmental activities. Adopting practices such as rain water harvesting schemes at both individual and community level can be an effective step towards sustainability.

Guiding Raindrop Effectively Enhance Nature

With a dream for a greener tomorrow

References:

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