Rain Water Harvesting for Shivaji University, Kolhapur

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ABSTRACT:

Effective use of rainwater has become essential aspect of Green Campus. Shivaji University, Kolhapur is having about 853 acres of land and many education and residential buildings on it's campus. Continuous attempt is being made to convert this campus into a Green one.

Prior to implementation of water harvesting system the water was supplied by the Municipal Corporation of Kolhapur during monsoon also and was costing substantially high. A system was therefore adopted to collect rainwater during monsoon and to recycle it for University Building in that period. The excess quantity is used for harvesting.

In the present paper details regarding methodology adopted for design, estimates of runoff, estimate of civil work required for necessary changes for collection of a rain water, data regarding water collected and recycled and its cost analysis related to Municipal Water Supply is given.

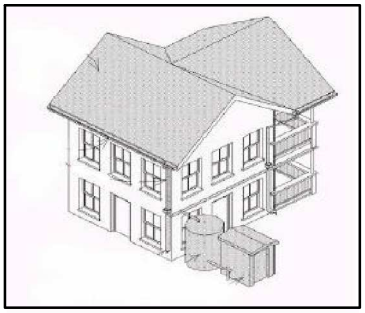
KEY WORDS: **Rain water, runoff, roof, and cost.**

INTRODUCTION:

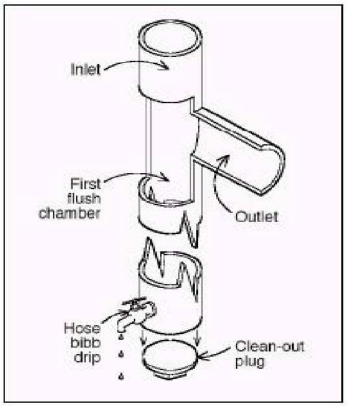
Rainwater harvesting is an ancient technique enjoying a revival in popularity due to the inherent quality of rainwater and interest in reducing consumption of treated water. Rainwater is valued for its purity and softness. It has a nearly neutral pH, and is free from disinfection by salts, minerals, products and other natural and man-made contaminants. Appliances last longer when free from the corrosive or scale effects of hard water. Users with potable systems prefer the superior taste and cleansing properties of rainwater.

Archeological evidence attests to the capture of rainwater as far back as 4,000 years ago, and the concept of rainwater harvesting in China may date back 6,000 years. Ruins of cisterns built as early as 2000 B. C. for storing runoff from hillsides for agricultural and domestic purposes are still standing in Israel.

Advantages and benefits of rainwater harvesting are numerous. The water is free; the only cost is for collection and use. The end use of harvested water is located close to the source, eliminating the need for complex and costly distribution systems. Rainwater provides a water source when groundwater is unacceptable or unavailable, or it can augment limited groundwater supplies.

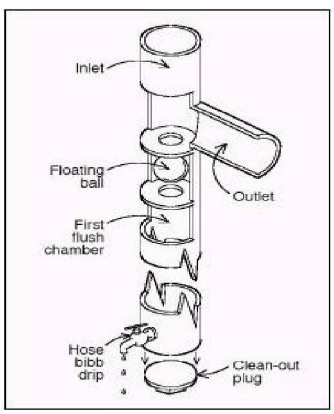


The zero hardness of rainwater helps prevent scale on appliances, extending their use; rainwater eliminates the need for a water softener and the salts added during the softening process.
Rainwater is sodium-free, important for persons on low-sodium diets. Rainwater is superior for landscape irrigation. Rainwater harvesting reduces flow to storm water drains and also reduces non-point source pollution. Rainwater harvesting helps utilities reduce the summer demand peak and delay expansion of existing water treatment plants.
Rainwater harvesting reduces consumers' utility bills. Perhaps one of the most interesting aspects of rainwater harvesting is learning about the methods of capture, storage, and use of this natural resource at the place it occurs. This natural synergy excludes at least a portion of water use from the water distribution infrastructure: the centralized treatment facility, storage structures, pumps, mains, and laterals. Rainwater harvesting also includes land-based systems with man-made landscape features to channel and concentrate Rainwater in either storage basins or planted areas.



When assessing the health risks of drinking rainwater, consider the path taken by the raindrop through a watershed into a reservoir, through public drinking water treatment and distribution systems to the end user. Being the universal solvent, water absorbs contaminants and minerals on its travel to the reservoir.

While in the reservoir, the water can come in contact with all kinds of foreign materials: oil, animal wastes, chemical and pharmaceutical wastes, organic compounds, industrial outflows, and trash. It is the job of the water treatment plant to remove harmful contaminants and to kill pathogens. Unfortunately, when chlorine is used for disinfection, it also degrades into disinfection byproducts, notably trihalomethanes, which may pose health risks. In contrast, the raindrop harvested on site will travel down a roof via a gutter to a storage tank. Before it can be used for drinking, a relatively simple process with equipment that occupies about 9 cubic feet of space will treat it. Rainwater harvesting can reduce the volume of storm water, thereby lessening the impact on erosion and decreasing the load on storm sewers. Decreasing storm water volume also helps keep potential storm water pollutants, such as pesticides, fertilizers, and petroleum products, out of rivers and groundwater Rainwater harvesting, in its essence, is the collection, conveyance, and storage of rainwater.



The scope, method, technologies, system complexity, purpose, and end uses vary from rain barrels for garden irrigation in urban areas, to large-scale collection of rainwater for all domestic uses. Rainwater harvesting is practical only when the volume and frequency of rainfall and size of the catchment surface can generate sufficient water for the intended purpose. With a very large catchment surface, such as that of big commercial building, the volume of rainwater, when captured and stored, can cost-effectively serve several end uses, such as landscape irrigation and toilet flushing.

Standpipe:-The simplest first-flush diverter is a 6- or 8-inch PVC standpipe. The diverter fillswith water first, backs up, and then allows water to flow into the main collection piping. These standpipes usually have a clean out fitting at the bottom, and must be emptied and cleaned out after each rainfall event. The water from the standpipe may be routed to a planted area. A pinhole drilled at the bottom of the pipe or a hose bibb fixture left slightly open (shown)allows water to gradually leak out .If you are using 3” diameter PVC or similar pipe, allow 33” length of pipe per gallon; 4”diameter pipe needs only 18” of length per gallon; and a little over 8” of 6” diameter pipe is needed to catch a gallon of water.

Standpipe with ball valve :-The standpipe with ball valve is a variation of the standpipe filter. The drawing shows the ball valve. As the chamber fills, the ball floats up and seals on the seat, trapping first-flush water and routing the balance of the water to the tank.

The Shivaji University get supply of water from Kolhapur Municipal Corporation at Rs 16 /- per thousand litrs. It was required to pay around Rs. 2,00,000.00 per months towards water charges to the Kolhapur Municipal Corporation. Considering this huge amount required to pay to the KMC, a proposal was submitted to the University authorities to collect and use the rainwater at least in monsoon period probably around four months of the year so as to save at least Rs. 84727.80/- rupees annually for five buildings initially with minor alterations in the present rainwater disposal system. The additional quantity of water available than daily requirement was used for harvesting purpose.

In the first phase this system was adopted to following buildings on University Campus, Main Administrative Building, Examination Building, Environmental Dept., Zoology Dept., Chemistry Dept., etc.

2. WATER DISTRIBUTION NETWORK :

Prior to implementation of water harvesting system, the University Buildings were supplied with the water collected from sump tank near western boundary of the University and this was supplied to ground water tanks constructed near individual building through an elevated reservoir. The water from ground water tank is lifted to the overhead tank of that building with the help of electrical pump.

The same network was used during monsoon except instead of taking water from KMC and supplying it to ground water tank, the water collected from roof of individual building was taken to the ground water tank. The additional quantity of rainwater collected from rooftop was used for enriching the ground water resources.

3. RESULT AND DISCUSSION :

Average Rainfall On University Campus – 966mm (50% Dependent)

(On the basis of rainwater data at rainguage station near Rajaram Lake)

DETAILS OF EXISTING GROUND WATER TANK AND ITS CAPACITY

Building	L	B	H	Total m^3
Main Administrative Bld.	2 x 7.50	5.50	1.00	82.50
Examination Bldg.	4.00	2.00	1.30	10.4
Environmental Dept.	6.30 Dia.		1.50	46.76
Zoology Dept.	4.00	2.75	1.10	12.1
Chemistry Dept.	16000 lit. – (Circular)			

Average Rainfall On University Campus – 966mm (50% Dependent)

Duration Of Rain fall During rainy season – 75 days

Yield of rainfall (For R.C.C. flat slab)- 75%

Net Yield (For R.C.C. flat slab) – 966 mm x 0.75 = 0.724mtr.

Yield of rainfall (For A.C. Sheet)- 80%

Net Yield (For A.C. Sheet) - 966 mm x 0.80 = 0.77mtr.

Building	Roof Area (m^2)	Net Yield Of Rainfall	Estimated Runoff m^3 (for 75 days)	Ave. Water Available Per Day (Litrs.)	Cost Incurred For civil & plumbing work
Administrative Bldg. (R.C.C. slab)	2224.10	0.724	1610.24	21469.86	Rs. 74799.00
Administrative Bldg. (A.C. roof sheet)	625.00	0.77	481.25	6410.66	
Examination Bldg.	652.45	0.724	472.37	6298.26	Rs. 24544.00
Env. Science Bldg.	1036.38	0.724	750.33	10004.40	Rs. 147896.00
Zoology dept. Bldg.	850.68	0.724	615.89	8211.86	Rs. 33765.00
Chemistry Bldg.	1886.50	0.724	1365.82	18211.01	Rs. 57937.00
TOTAL			**5295.90**	**70606.14**	**Rs. 338941.00**

It is seen from the above table that the cost incurred for making necessary changes in case of 5 major buildings on University Campus is Rs. 338941.00 The daily average water available during the monsoon period for 75 days at least (from the record available) is 70000 ltrs.

DETAILS OF EXISTING GROUND WATER TANK AND ITS CAPACITY

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Main Administrative Bld.	2 x 7.50	5.50	1.00	82500.00
Examination Bldg.	4.00	2.00	1.30	10400.00
Environmental Dept.	6.30 Dia.		1.50	46734.00
Zoology Dept.	4.00	2.75	1.10	12100.00
Chemistry Dept.	16000 lit. – (Circular)			16000.00

The capacity of existing water tank is more than that of average daily rainfall hence even if the daily runoff is spread over a longer period water requirement can be met with.

The University receives water at Rs. 16.00 per 1000 ltrs. from Kolhapur Municipal Corporation. Even if annual dependent rainfall is considered for 75 days in year, University could save Rs. 84727.80 (excluding pumping cost from sump tank in front of SIBER to the concern building). The total Municipal Water Supply during monsoon period of year 2005 (year at which this system was constructed) for those buildings. And the University saved minimum Rs. 84727.80during year 2005 to words water bill charges. It can be seen that the amount invested for making the changes can be recouped back within a period of 4 years & the water of good quality can be used through out the life of the building. However care need be taken to clean the terraces prior to monsoon and arrangement of traps as per figures shown in th introduction part need be made.

CONCLUSION :

Year	Water collected (lts.)	Cumulative water saved (lts.)	Cost Saved (Rs.)
0-1	5295487.50	5295487.50	84727.80
1-2	5295487.50	10590975.00	169455.60
2-3	5295487.50	15886462.50	254183.40
3-4	5295487.50	21181950.00	338911.20
4-5	5295487.50	26477437.50	423639.00

Considering large catchment area from the roof was available for institutional buildings of Shivaji University substantial quantity of water was recycled during rainy season resulting into substantial cost saving, promotion of such type of systems shall be encouraged for public, institutional large residential building complexes.

For Shivaji University, it was required to make changes in the existing rainwater disposal system costing Rs. 338941.00 it is therefore recommend that while constricting new institutional buildings due care shall be taken for such a recycling system right from the planning stage itself. This incurred cost could be recovered within a span of 4 years and there will be saving in cost of pumping required from main sump well to the ground water tank of the concerned building.

Constriction of filter beds prior to sump tank will improve quality of rainwater collected.

In case of chemistry/environmental science building of the University, the water collected helped in reducing the cost of sterilized water required for experimentation.

The water, which was available during monsoon period for 75 days, was absolutely free; the only cost is for collection and use. As the end use of harvested water was located close to the source, eliminating the need for complex and costly distribution system by making necessary changes in the present rainwater disposal system.

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