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A STUDY OF RAINWATER HARVESTING FOR GEC BUILDING, K.R.PET

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ABSTRACT

The aim of this study is to examine the feasibility of rainwater harvesting system in G.E.C Building, K.R.Pet by making a demand availability analysis. The demand has been estimated through a survey of daily consumption of water used in college. The G.E.C main building has a land area of 10 acres (4.047 hectare), out of which the roof area is 1048.18 m^2The average annual rainfall of K.R.Pet is 638mm. The total quantity of rainwater available from G.E.C building alone is 540m^3 per year. But there is no sufficient space for constructing huge tanks for storing this quantity of rainwater. Also the cost of providing huge tanks would be high. Hence this paper highlights the design and economical use of rainwater harvesting system in GEC campus, K.R.Pet, mandya.

Keywords: *Rainwater harvesting, Filtration tanks, Earth excavation, PVC pipes, Storage tanks*

I. INTRODUCTION

It is a simple, efficient and effective technology of collecting and using precipitation from a catchments surface that has been practiced by our ancestors, since centuries. Rain is the first form of water that we know in the hydrological cycle, hence is a primary source of water for us. Rivers, lakes and groundwater are all secondary sources of water. In present times, we depend entirely on such secondary sources of water. In the process, it is forgotten that rain is the ultimate source that feeds all these secondary sources and remain ignorant of it's value. Water harvesting means to understand the value of rain, and to make optimum use of rainwater at the place where it falls.

The G.E.C College of Engineering is situated in K.R.Pet, The Sugar city. The campus has a land area of about 10 acres (4 Hectares). It has got 4 branches of engineering study. There is main buildings in the campus with a total built-up land area of about 0.25acres (0.104 hectares). All these features demand water for their maintenance. Other than these the Environmental laboratory, Chemistry laboratory have a great potential for rainwater for utilization as pure distilled water. Also it has it's demand as pure drinking water with more mineral contents, which would increase our sustenance and other life supporting systems. The water demand of our campus could be summarized by the table 1 given below.

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Sl no	Purpose	Consumption
1.	Drinking	6000lts/day
2.	Sanitary	1200lts/day
3.	Gardening	25000lts/day

Table. 1: Water demand of GEC Campus

From this table it could be seen that the available water is insufficient to satisfy the above purpose completely without interruption. Hence there is a great demand of water to carry out these activities without interruption daily.

Also, the available major sources of water in our campus are 2 bore wells. These are capable of yielding sufficient amount of water and contribute 85% of water to carryout the various daily activities. But during summer days, the campus experiences scarcity of water. So in order to reduce this it is better to employ Rainwater Harvesting system.

II. NEED FOR RAINWATER HARVESTING SYSTEMS IN THE CAMPUS

The system of Rainwater Harvesting has its vital importance in the urban areas, where too much of groundwater is being harnessed. The system has potential of being used in public buildings including schools, colleges, hospitals, hotels, industries, etc. The purpose of present study is to investigate the feasibility of Rainwater Harvesting system in the G.E.C campus of K.R.Pet mandya. This study intends to find to what extent the water available through harvesting would be useful in meeting the needs of the consumption and what would be the appropriate costs for their installation.

The total roof area of the building i.e., about 1048.18m^2 can produce 6813.04m^3 of runoff from rainwater annually. This huge amount of storm water is being presently let into the drains, which ultimately join a sewage pond downstream.

Further, treating water and making it reusable for gardening, sanitary and such other purposes and even sometimes for recharging the groundwater, this will cost high once the water gets mixed with sewage. These all aspects involve finance, which will be over burdening the financial exchequer in turn taxing the common man. On the other hand, it will load the treatment units, which makes the process either delayed or not confirming to the standard of let out water.

III. RAINFALL ANALYSIS

Rainfall in K.R.pet mandya occurs during 3 seasons namely premonsoon (Mungaru-Poorva), Southeast monsoon (Mungaru) and Northeast monsoon (Hingaru). Pre-monsoon occurs between March to May whereas the Southeast monsoon is concentrated between June to September and the Northeast monsoon occurs between October to December.

The factors influencing the availability of water are the magnitude of rainfall and availability of space for its storage. Hence the present study has been carried out by analyzing.the rainfall data of a particular station i.e., K.R.Pet and by knowing the demand of water of our campus and space availability for storage of rainwater.

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But it is obvious that the rainfall distribution is not uniform throughout the year, also from year to year. It varies greatly from year to year due to ecological imbalance. Hence it's not possible to carry out the analysis just by considering data of a particular year. This in turn affects the feasibility of Rainwater Harvesting system. This implies that it's necessary to obtain information concerning a typical year, which can be obtained by using an appropriate stochastic model, which generates the rainfall series for a typical year.

IV. STORAGE-VOLUME CALCULATION

The tanks designed in our campus are underground tanks. The factors to be considered in the design of tanks are,

- Rate of consumption of water.
- Available roof area and the open space.
- Distribution of rainfall.
- Quantity of rainwater procurable.

The quantity of rainwater procurable (in liters) may be obtained by the product of roof area (m^2), intensity of rainfall (mm) and the runoff co-efficient. The runoff co-efficient may be taken as 0.8 for rooftops.

The rainfall intensities have been obtained by considering the average annual rainfall of K.R.Pet station as 638mm. Further the tank designs greatly depend on availability of open spaces. If the available roof area is more and if there is no sufficient space for providing storage tanks, then the storage capacity must be restricted. Same is the problem in case of uneven distribution of rainfall.

Quantity of rainwater (Its) = Rooftop area (m^2) X Rainfall intensity (mm) X Runoff co-efficient

V. PLANNING AND DESIGNING OF RAINWATER HARVESTING SYSTEM

The cost aspect is the main factor, which is very much necessary in adopting a rainwater harvesting project. It's necessary to know about the initial investments and the overall cost of the project. By knowing them we can decide whether to afford the system or not. Hence it's necessary to have at least a preliminary design of the system to have an idea about the cost aspect. So majority of the investment is mainly on the storage tanks, which form an integral component of a rainwater harvesting system. Hence determination of the capacity of the tank forms the first step of the cost analysis.

VI. STORAGE TANK CAPACITY

The average annual rainfall of K.R.Pet ranges between 430mm to 700mm and it is taken as 638mm. It is spread over about 60 to 90 days per year. The demand of water per day in the G.E.C main building is about 125m^3/day including that required for gardening. This water is yielded by the bore well of our campus.

The G.E.C main building has a roof area of about 1048.18 m^2 From this area the quantity of rainwater that can be obtained is 540m^3 per year with an annual rainfall of 638mm and runoff co-efficient of 0.8. The roof area of the main building has been given below.

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Total Roof Area **1048.18m^2**

VII. DESIGN OF TANKS

7.1. For A Block

Roof Area = 524.09 m^2.

Proposed to provide Underground Tank.

Volume of rainwater available =524.09X0.8X0.638 = 267.496m^3 ≈270 or 270000 ltrs.

So we are collecting 270m^3 of rainwater and allow the remaining quantity of rainwater for recharge by providing recharge pits. Hence the tank capacity = 270 m^3 or 270000 Lakh Liters. Tank dimension = 9X8X4 m.

SL NO	PIPES	NO	RATE	AMOUNT
1	6" PVC Pipes	9	1500	13500.00
2	6" PVC Pipes (T)	7	220	1540.00
3	6" PVC Bend	4	140	560.00
4	Solvent	1/2kg	390	195.00
5	Labour cost		L.S	4500.00
			TOTAL	**20295.00**

Table. 2: Estimation of plumbing parts of "A" block

Table-3 below gives the abstract of cost estimation of tank construction for "A" block

SI No.	Particulars	Unit	Quantity m^3/m^2	Rate Rs Ps	Amount Rs Ps
1.	Earthwork excavation	m^3	364.143	112/ m^3	40784.016
2.	Providing and laying 1 :4:8 CC bed for foundation	m^3	16.006	3396/ m^3	54356.376
3.	Providing and laying 1 :2:4 CC flooring	m^3	16.006	4404/ m^3	70490.424
4.	Providing and constructing BBM in CM 1:6	m^3	32.97	3811/ m^3	125648.67
5.	Providing and plastering inside to masonry in CM 1:6	m^2	136	270.80/m^2	36828.80
6.	Providing and laying CC 1 :2:4 Roof slab	m^3	12.004	5120.20/ m^3	61462.880
7.	Providing and laying CC 1 :2:4 for beams	m^3	5.118	5380/ m^3	27537.91
8.	Providing and constructing BBM in CM 1:6 for filtration tank	m^3	2.484	3811/ m^3	9466.524
9.	Providing and plastering to masonry inside in CM 1:6	m^2	7.49	80.5/ m^2	602.945

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	for filtration tank				
10. Ss	Providing and plastering to masonry outside in CM 1:6 for filtration tank	m^2	10.80	80.5/ m^2	869.40
11.	Providing and laying PVC pipes	-	-	L.S	20295.00
12.	Providing and fabricating steel	MT	2	35152	70304.00
13.	Provision of covering for filtration tank	-	-	L.S	10000.00
14.	Miscellaneous and unforeseen works and water proofing agent	-	-	L.S	12000.00
				TOTAL	**540646.11**

7.2.For B Block:

Roof Area = 524.09 m^2.

Proposed to provide Underground Tank.

Volume of rainwater available = 524.09X .8X .638 = 267.496m^3 ≈270 or 270000 Lts.

So we are collecting 270m^3 of rainwater and allow the remaining quantity of rainwater for recharge by providing recharge pits. Hence the tank capacity = 270 m^3 or 270000 Lakh Litrs. Tank dimension = 9X8X4m.

Table. 4: Estimation of plumbing parts of "B" block

SL NO	**PIPES**	**NO**	**RATE**	**AMOUNT**
1	6" PVC Pipes	9	1500	13500.00
2	6" PVC Pipes (T)	7	220	1540.00
3	6" PVC Bend	4	140	560.00
4	Solvent	1/2kg	390	195.00
5	Labour cost		L.S	4500.00
		TOTAL	**20295.00**	

Table. 5 below gives the abstract of cost estimation of tank construction for B block

SI No.	**Particulars**	**Unit**	**Quantity m^3/m^2**	**Rate Rs Ps**	**Amount Rs Ps**
1.	Earthwork excavation	m^3	364.143	112/ m^3	40784.016
2.	Providing and laying 1 :4:8 CC bed for foundation	m^3	16.006	3396/ m^3	54356.376
3.	Providing and laying 1 :2:4 CC flooring	m^3	16.006	4404/ m^3	70490.424
4.	Providing and constructing BBM in CM 1:6	m^3	32.97	3811/ m^3	125648.67

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5. A	Providing and plastering inside to masonry in CM 1:6	m^2	136	270.80/m^2	36828.80
6.	Providing and laying CC 1 :2:4 Roof slab	m^3	12.004	5120.20/ m^3	61462.880
7.	Providing and laying CC 1 :2:4 for beams	m^3	5.118	5380/ m^3	27534.84
8.	Providing and constructing BBM in CM 1:6 for filtration tank	m^3	2.484	3811/ m^3	9466.524
9.	Providing and plastering to masonry inside in CM 1:6 for filtration tank	m^2	7.49	80.5/ m^2	602.945
10.	Providing and plastering to masonry outside in CM 1:6 for filtration tank	m^2	10.80	80.5/ m^2	869.40
11.	Providing and laying PVC pipes	-	-	L.S	20295.00
12.	Providing and fabricating steel	MT	2	35152	70304.00
13.	Provision of covering for filtration tank	-	-	L.S	10000.00
14.	Miscellaneous and unforeseen works and water proofing agent	-	-	L.S	12000.00

TOTAL 540646.11

VIII. CONCLUSION

The application of an appropriate Rainwater Harvesting technology can make possible the utilization of rainwater as a valuable and in many cases, necessary water resource.

The total cost of proposed rain water harvesting project is Rs. 11,50,000. Though we might feel that the cost of installation of Rainwater Harvesting system in our campus is high, it has got various utilities, which could be summarized as follows.

- To provide pure distilled water for Environmental and Chemistry laboratory purpose
- Provide pure water for drinking purpose for staff and students.
- For watering lawns and gardens.
- To serve the need of service station near the Automobile department.
- We can give complete rest for bore well during rainy days.
- It will be a model for visitors.
- We are proud ourselves by utilizing rainwater and saving some quantity of water in our campus.

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Even though, an investment of this extent may not be acceptable if only the economic returns are considered, an engineering college should take up the installation of this system since Rainwater Harvesting has many intangible benefits, as described earlier.

Hence it is suggested that a further study may be taken up to plan the actual system, which may be implemented, giving more importance to the design aspects and utilize the same water.

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BIOGRAPHAICAL DATA :

Prof. Mahadeva M is working as assistant professor in civil engineering department form last 2 years and he also worked as assistant professor in K S institute of technology. He received is **B E** in **civil engineering** and **M.Tech** with specialization in **CAD structures** from Visvesvaraya technological university. He is member of MISTE. He is national advisory board member for international conference and he secured "***Active Young Research Award"*** in international journals for his continuous contribution in research field. His research interest is in the field of soil structure interaction, structural engineering, earth quake engineering and water resources.

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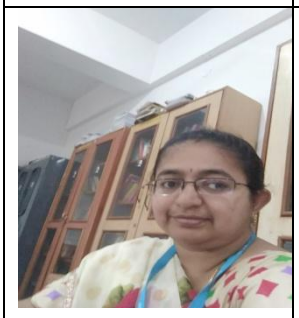

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