Roof Top Rain Water Harvesting System for Svspm Campus Almala Ausa

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***Abstract*—Many Colleges in water-scarce developing countries have insufficient and unreliable water supplies. This is being exacerbated by climate change and aging and poorly maintained water infrastructure. A lack of clean water increases the risks of diarrheal disease and concerns about health can result in colleges closures, affecting education outcomes as valuable teaching and learning time is lost.**

In these situations, rainwater harvesting systems can provide an alternative clean water supply that enables Colleges to continue to operate safely. However, there is limited research and guidance on school rainwater harvesting systems. In addition, there are also misconceptions about rainwater harvesting. These include that rainwater harvesting systems cannot provide sufficient water to meet needs,

water produced is dirty and systems are unaffordable. This chapter addresses this context by showing how rainwater harvesting can provide sufficient, and affordable water supplies to colleges in water-scarce areas. It may be of interest to colleges governing bodies, teachers, design professionals and government officials who want to develop rainwater harvesting systems in colleges.

I. INTRODCUTION

The artificial recharge to ground water is a process by which the ground water reservoir is augmented at a rate exceeding that obtained under natural conditions of replenishment. Any man-made scheme or facility that adds water to an aquifer may be considered to be an artificial recharge system, theoretically this will imply that the vertical hydraulic conductivity is high, while the horizontal hydraulic conductivity is moderate.

In Artificial recharge techniques normally address the following issues

- To enhance the sustainable yield in areas where over development has depleted the aquifer.
- To utilize the rainfall runoff, which is going to sewer or storm water drain.
- Conservation and storage of excess surface water for future requirements
- Surface water is inadequate to meet our demand and we have to depend on ground water.
- Due to rapid urbanization, infiltration of rainwater into the sub soil has decreased drastically
- To reduce or balance salt water intrusion.
- To improve the vegetation cover and reduce flood hazard.
- To raise the water levels in wells and bore wells that are drying up. To remove bacteriological and other impurities from sewage and waste water so that water is suitable for reuse.

II. OBJECTIVE & SCOPE

Objectives

- To Design Detailed Pipe Network for Rainwater harvesting system.
- To Design the Artificial Recharge System for Borewells.
- To Estimate the Cost Associated with The Entire Project.
- To create simple and economical rainwater harvesting system for big campuses like educational institutes.
- To store rain water for water scarcity period.

- To design and provide economical, strong and specious water tank with minimum dimensions.
- To minimize cost on Municipal corporation water by reducing its demand.

Scope

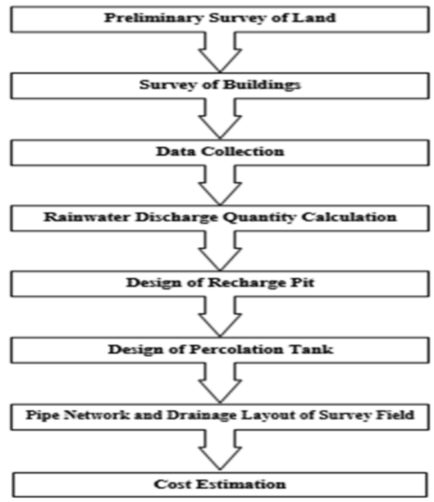
• Building parameters surveyed include ground level, floor area, projected roof area, and building height for pipe network layout design.

• Data collection includes water demand calculation, rainfall data analysis over the last decade (2014 to 2024), and inventory of existing rainwater harvesting infrastructure.

• Rainwater discharge quantity was calculated to determine the volume of rooftop water.

• In-situ permeability test conducted on existing borewells to design recharge pit for groundwater replenishment

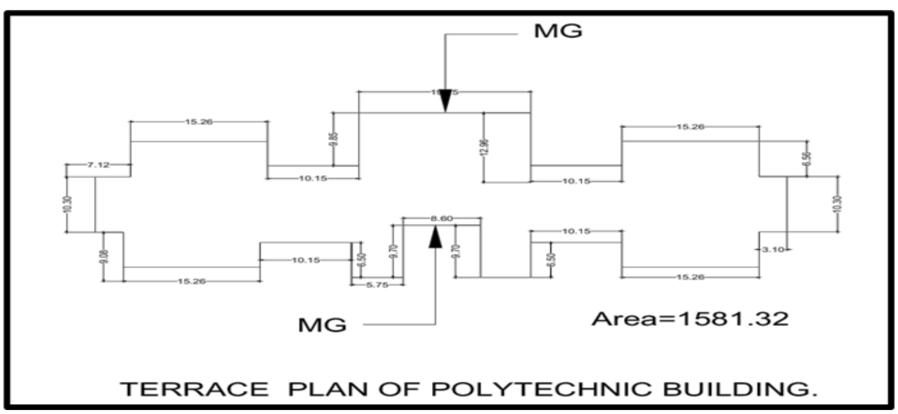
III. METHODOLOGY



Building Survey, Data Collection, Discharge Quantity Calculation

Building Survey –

This involved measuring both ground level and floor level for all buildings situated within the campus premises. The survey was conducted using a dumpy level instrument in conjunction with a leveling staff to determine the reduced levels of various points across the college campus.



Building Area

Roof Area of all Buildings in SVSPM Campus –

S.N.	BUILDING NAME	ROOF AREA (m^2)	Height (m)
01	VAPM Polytechnic	1581	10.5
02	SCOP Pharmacy	2509	12.5
03	BBIS School	2767	7.2

Rainfall data of the last 10 years (2014-2024)

The rainfall data, sourced from the https://www.weatherapi.com/history/january/q/ausa-1106177 , spans a comprehensive period from 2014 to 2024, encompassing a total duration of 10 years, providing a robust and extensive dataset for meteorological analysis and water resource management in the region shown in Table.

RAINFALL DATA FOR ALMALA AUSA

JANUARY		FEBRUARY		MARCH	
Year	Rainfall	Year	Rainfall	Year	Rainfall
2014	0.20 mm / 0.01 In	2014	21.00 mm / 0.83 In	2014	84.30 mm / 3.32 In
2015	4.41 mm / 0.17 In	2015	0.00 mm / 0.00 In	2015	34.10 mm / 1.34 In
2016	0.00 mm / 0.00 In	2016	10.13 mm / 0.40 In	2016	10.20 mm / 0.40 In
2017	0.20 mm / 0.01 In	2017	0.00 mm / 0.00 In	2017	9.10 mm / 0.36 In
2018	0.00 mm / 0.00 In	2018	5.60 mm / 0.22 In	2018	1.00 mm / 0.04 In
2019	0.40 mm / 0.02 In	2019	0.10 mm / 0.00 In	2019	1.40 mm / 0.06 In
2020	8.50 mm / 0.33 In	2020	1.40 mm / 0.06 In	2020	14.00 mm / 0.55 In
2021	0.40 mm / 0.02 In	2021	14.70 mm / 0.58 In	2021	2.20 mm / 0.09 In
2022	3.80 mm / 0.15 In	2022	0.00 mm / 0.00 In	2022	0.50 mm / 0.02 In
2023	0.20 mm / 0.01 In	2023	0.00 mm / 0.00 In	2023	4.30 mm / 0.17 In
2024	0.04 mm / 0.00 In	2024	0.09 mm / 0.00 In	2024	0.09 mm / 0.00 In
2025	0.01 mm / 0.00 In	2025	0.00 mm / 0.00 In	2025	0.68 mm / 0.03 In

RAINFALL DATA FOR ALMALA AUSA

OCTOBER		NOVEMBER		DECEMBER	
Year	Rainfall	Year	Rainfall	Year	Rainfall
2014	48.26 mm / 1.90 In	2014	31.10 mm / 1.22 In	2014	8.20 mm / 0.32 In
2015	52.43 mm / 2.06 In	2015	5.10 mm / 0.20 In	2015	0.00 mm / 0.00 In
2016	96.49 mm / 3.80 In	2016	0.30 mm / 0.01 In	2016	0.70 mm / 0.03 In
2017	112.01 mm / 4.41 In	2017	1.60 mm / 0.06 In	2017	0.00 mm / 0.00 In
2018	2.60 mm / 0.10 In	2018	4.90 mm / 0.19 In	2018	2.10 mm / 0.08 In
2019	261.32 mm / 10.29 In	2019	36.23 mm / 1.43 In	2019	8.00 mm / 0.31 In
2020	181.21 mm / 7.13 In	2020	0.30 mm / 0.01 In	2020	0.40 mm / 0.02 In
2021	52.80 mm / 2.08 In	2021	23.80 mm / 0.94 In	2021	3.20 mm / 0.13 In
2022	169.50 mm / 6.67 In	2022	0.10 mm / 0.00 In	2022	9.10 mm / 0.36 In
2023	10.41 mm / 0.41 In	2023	44.96 mm / 1.77 In	2023	5.70 mm / 0.22 In
2024	5.87 mm / 0.23 In	2024	0.75 mm / 0.03 In	2024	24.34 mm / 0.96 In
2025		2025		2025	

Maximum Rainfall in last Decades – 2021 july – 642.03 mm/month Convert in to m = 0.642 m

Rainwater Discharge Quantity Calculation

The quantity of rainwater discharge is computed to ascertain the volume of rainwater collected from the rooftop of buildings. Rational Method is the simplest method to determine the rainwater discharge which is given by: -

$Q = C \times I \times A$ Where,

Q = Discharge from roofs due to rainfall (m^3/year)

C = Runoff Coefficient = 0.8

I = Intensity of Rainfall (m/year) = 0.642 m

A = Area of Catchment (m2)

Rainwater Discharge Quantity

S.N.	BUILDING NAME	ROOF AREA (m^2)	Runoff Coeff (I)	Evap. Constant	Rainfall	Quantity (m3)
01	VAPM Polytechnic	1581	0.8	0.9	0.642	733.57
02	SCOP Pharmacy	2509	0.8	0.9	0.642	1159.76
03	BBIS School	2767	0.8	0.9	0.642	1279.01
Total Quantity of rainwater Discharge						3172.34

Volume of water Collected = 3172.34 m3

= 3172.34 x 10^3

= 31.7234 Lakh liters per year

Diameter of Pipe as per IS 15797 – 2008 Table3 Clause 6.1.b

d = 160 mm = 0.16 m

Estimation & Costing of Rainwater system – VAPM BUILDING

S.N.	Particulars	L	B	H	Qty	Rate	Amount
01	Total Length of Required 0.160 m diameter	270.42	-	-	270.42 M	774	209306
02	No of Elbows	32			32	161	5152
03	No of Tees	37			37	197	7289
04	No of Vertical Pipes	15		10.5	157.5 m	774	121905
05	Length of pipe up to filter tank	23.4			23.4	774	18112
06	Fitting , Clamps, Nails etc	-	-	-	-	2000	2000
07	Filter tank						
	Excav	3.02	-	1.8	5.44	365	1986
	PCC	4.49	0.53	0.15	0.36	7104	2558
	BBM	4.49	0.23	1.53	1.58	11311	11872
	Filter media		1.13	0.45	0.51	15105	7704
	Pcc Bed	3.01		0.15	0.452	7104	3212
				Total			391096

Results - Summary of Estimation & Costing for SVSPM Campus –

S.N.	BUILDING NAME	Cost
01	VAPM Polytechnic	391096 /-
02	SCOP Pharmacy	336869 /-
03	BBIS School	341162 /-
	Total Cost for RWH	1069127 /-

In Word - Ten lakh sixty-nine thousand one hundred twenty-Seven Only

IV. Conclusion

This study was aimed at designing a rooftop rainwater harvesting structure for the SVSPM campus. This will help in artificial recharge of groundwater in this area in addition to fulfilling water scarcity conditions. The main building was selected as the required catchment area for rainwater harvesting considering the water demand in svspm campus and the supply. Further, different parts of the RWH system were designed based on standard guidelines It was observed from the analysis that implementation of RWH system in svspm campus can resolve the water scarcity problems during non-monsoon season by storing a huge quantity of 3172 m3 in a year in the SVSPM campus. This initiative can increase the water supply for construction work, gardening and also will help in artificial recharge of ground water thus enriching both the surface and the ground water resources.

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