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Estimation and Design of Rainwater Harvesting Structures to Siddharth Group of Institutions, Puttur

Veluru Sailaja[1], Dr. S. Siddi Raju[2]

[1]Assistant Professor, Dept of Civil Engineering, Siddharth Institute of Engineering and Technology, Puttur, A.P 517583, India
[2]Professor, Dept of Civil Engineering, Siddharth Institute of Engineering and Technology, Puttur, A.P 517583, India

Abstract: ***The present scenarios of groundwater tables are falling at a rapid rate. This is because withdrawn of groundwater is much more than the recharge of rain water. Artificial recharge of rainwater during rainy season will help the prevention of groundwater tables. An attempt is made to harvest the roof top rain water at Siddharth group of institutions. There were eleven blocks in the campus covering roof area of 1.11995279 hectors. The harvest water from roof tops by PVC Pipes are emptied into open channels and finally connected to existing bore wells (4.no) prior to letting into the bore wells, the roof top waters are treated by sand filtration to remove suspended solids being present in the roof top water. The total estimation of water harvesting from roof tops is RS 2.51 lakhs. The system will recharge around 23.627219x10^3 cubic meters per year.***

Keywords: Rain water harvesting, aquifer**,** sand filtration, open channels

1. Introduction

Siddharth group of institutions is located at 13º42`7 north latitude and 79º57`3 East longitude above the sea level in the extreme western part Chittoor district. It is 3 kms away from the puttur and at a distance of 40 kms to Tirupathi a well known pilgrim center and a distance of 96 kms from Chittoor town which is the district head quarter.

An ever increasing urban population in puttur has thrown up a problem shortage of drinking water. There is no perineal rivers in and around of puttur own at a distance of 100 kms. The main source of the water supply is ground water only.

Water is one of the most important constituents of life. Over 70% of the Earth's surface is covered with water, of which 97.5% is salt water and only 2.5% is fresh water. We can use a mere 0.3 of the water available, though water covers 70% of the Earth's surface. Salt water in the oceans and fresh water polar ice caps account for the bulk of water. Besides us, a number of other life forms need a share of that 0.3% water. Of late due to increase in urban population and unscientific exploitation of fresh water resources, availability of potable water for human consumption is reducing and will be one of the greatest challenges our society is going to face in future. Raju, KCB (1988) Importance of Recharging Depleted Aquifers: State of the art Artificial Recharge in India. Journal of the Geological Society of India 51 429-454 (Price, M (1996, Rekeya, M & Bedmar, AP (1995).

1.1Need for Rainwater Harvesting

Water is one of the most essential requirements for existence of living beings. Surface water and ground water are two major sources of water. Due to over population and higher usage levels of water in urban areas, water supply agencies are unable to cope up demand from surface sources like dams, reservoirs, rivers etc. This has led to digging of individual tube wells by house owners. Even water supply agencies have resorted to ground water sources by digging tube-wells in order augment the water supply. Replenishment of ground water is drastically reduced due to paving of open areas. Indiscriminate exploitation of ground water results in lowering of water table rendering many bore-wells dry. To overcome this situation bore wells are drilled to greater depths.

1.3 Methods of Harvesting Rain Water:

There are three methods of harvesting rain water as given below:

(a) Storing rain water for direct use.
(b) Recharging ground water aquifers, from roof top run off.
(c) Recharging ground water aquifers with runoff from ground area

1.4 Methodology

Recharging ground water aquifers, from roof top run off method is most economical design when compared to other methods where the roofs of building are flat. This method is so simple to execute on the field. At Siddhartha region the following are the structures whose roofs are flat. The main objective of our design is to connect the collected water to the nearby bore line to improve ground aquifire. There are a total of 4 bore holes out of which we are connecting to 3 of them. The other is not in working condition. the designing of pipe line from the building to the bore holes depends upon the catchment area and the discharge of runoff water from the roof tops based on this discharge the diameter of the pipe line and the depth of the filter near the bore holes are designed to improve the ground water aquifer in bore hole regions there by the ground water level near the bore will improve gradually by this methodology.

Structural Designs

Table 1: Details of Blocks

S. No	*College*	*Blocks*
1	Siddarth Institute Of Engineering And Technology	A
2	Siddarth Institute Of Engineering And Technology	B
3	Siddarth Institute Of Engineering And Technology	C
4	Siddarth Institute Of Engineering And Technology	D
5	Siddarth Institute Of Engineering And Technology	E
6	Siddartha Institute Of Science And Technology	A
7	Siddartha Institute Of Science And Technology	B
8	Siddartha Hostels	Boys
9	Siddartha Hostels	Girls
10	**Seminar Hall**	
11	**Class Rooms**	

The discharge calculation of all the blocks of Siddharth institute is shown:

For example consider A BLOCK:
Block-A Calculations:

Area = 803.3439m^2 (area obtained from cadd designs)
Convert area into hectors = 803.3439/10000
= 0.0803439 hec

Table 3: Diameter of pipe lines in Siddharth college

Blocks	*Discharge (Cusec)*	*Velocity (m/s)*	*Area ($m^{2)}$*	*Diameter (m)*
A(SIETK)	0.0621	1.6	0.0390	0.22
B(SIETK)	0.0699	1.6	0.0436	0.24
C(SIETK)	0.0743	1.6	0.0460	0.24
D(SIETK)	0.1506	1.6	0.0940	0.34
E(SIETK)	0.0168	1.6	0.0105	0.11
A(SISTK)	0.0984	1.6	0.0615	0.28
B(SISTK)	0.0672	1.6	0.0420	0.23
BOYS(HOSTEL)	0.0848	1.6	0.0530	0.26
GIRLS(HOSTEL)	0.0879	1.6	0.0540	0.26
SEMINORHALL	0.0848	1.6	0.0530	0.26
ROOMS	0.0640	1.6	0.0400	0.22

1.6 Information about Boreholes

At Siddharth institutions there are a total of 5 boreholes available among them 4 boreholes are in working condition remaining one is failure in recent days. Now we concentrate to improve the ground aquifer in these boreholes by Roof top rainwater harvesting method.

In Indian standards usage of by each student for a day in collage is 5to10lit. nearly4000+students in Siddharth institutions it means nearly 40000lit, daily usage

Formula for discharge (Q) = AIR/360
Where A = catchment area
I = inundation factor (constant) = 0.985
R = maximum rainfall obtained from past 30 years of rain fall data.
= 8
Q = (0.080333399)*(0.985)*(8)/360
Q= $1.7584*10^{-3}$

Similarly the calculation are carried out for all the blocks of this institute

Table 2: Details of blocks

S. No	*Block*	*Area*	*Hectares*	*Discharge*
1	A(SIETK)	803.339	0.08033439	$1.7584*10^{-3}$
2	B(SIETK)	905.19	0.090519	$1.9813*10^{-3}$
3	C(SIETK)	982.453	0.0982453	$2.1504*10^{-3}$
4	D(SIETK)	1948.6248	0.19862480	$4.2653*10^{-3}$
5	E(SIETK)	218.154	0.0218154	$4.7751*10^{-4}$
6	A(SISTK)	1273.9050	0.1273905	$2.7884*10^{-3}$
7	B(SISTK)	869.85	0.086985	$1.9040*10^{-3}$
8	BOYS HOSTEL	1097.4076	0.10974076	$2.4021*10^{-3}$
9	GIRLS HOSTEL	1137.2364	0.11372364	$2.4021*10^{-3}$
10	SEMINOR HALL	828.150	0.0828150	$2.40252*10^{-3}$
11	CLASS ROOM	1097.599	0.1097599	$1.81217*10^{-3}$

additionally gardening, college managed hostels, canteen, water service for collage buses and miscellaneous usages. So totally 50000to60000lit water required for Siddharth collage daily

This 4 boreholes providing daily required water that's why water table in boreholes region decreases gradually day by day. So we implement rain water harvesting method to developing underground water table.

Excavation Work for Pipe Line Design:

Figure 2: Pipe line layout in Siddharth College

Table 4: Diameter of pipe final cost of pipe line from blocks to bore hole-3

S. No	*Joint*	*Volume (m^3)*	*Cost Per($1m^3$)*	*Final Cost*
1	A to G	12.769	250	3193/-
2	B to G	13.381	250	3496/-
3	C to G	9.444	250	2361/-
4	G to borehole	130.89	250	32723/-
5	Girls hostel to borehole	5.985	250	1497/-
6	TOTAL	172.46	250	43270/-

Table 5: Final cost of pipe line from blocks to bore hole-3 final cost of pipe line from blocks to bore hole-2

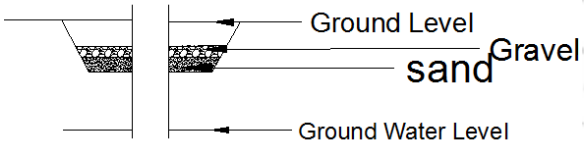
S. No	Joint	Volume (m^3)	Cost Per ($1m^3$)	Final Cost
1	Seminar hall, block D & E To joint G2	109.405	250	27352/-
2	G2 to G3	141.16	250	35291/-
3	G3 to borehole2	267.17	250	66793/-
TOTAL	Seminorhall,blockD,E,G2& G3 to borehole2	217.735	250	129436/-

Table 6: Final cost of pipe line from blocks to bore hole-2: Final cost of pipe line from blocks to bore hole-1

S. No	Block	Volume (m^3)	Cost Per ($1m^3$)	Final Cost
1	Auditorium to boreholr1	96.633	250	24159/-

Table 6 shows final cost of pipe line from blocks to bore hole-1.

1.7 Design of Sand Filler around the Bore Hole:



Before entering the water into bore hole a sand filler bed is placed to filter the suspended impurities in roof top water. This bed is subdivided into two courses of sand and gravel.

Sand Bed:

The top layer of filter medium is filled with sand with a depth of 50 cms.

Properties:

Youngs modulus of sand = 1 to 1.2mm
Uniformity coefficient =1.25 to 1.5
Depth of sand layer = 50cm

Gravel Bed:

The preceding layer of sand is continued by a gravel bed. This bed is extended up to the bottom of the filler. Gravels are in four layers.

Table 7: Size and depth of the gravel layers

S. No	*Layer*	*Size of Gravel (mm)*	*Depth (cm)*
1	Layer-1	2-6	10
2	Layer-2	6-12	10
3	Layer-3	12-18	10
4	18-25		10

Specification of Bore Hole:

Filler bed depth=1.0m to 1.5m
Provide 8 number of 10mm diameter of holes around the bore hole.

Table 8: Total Cost of Excavation

S. No	*Connection*	*Volume (m^3)*	*Cost Per ($1m^3$)*	*Final Cost*
1	Block A,B, C &Girls hostel to Borehole3	172.46	250	43270/-
2	Auditorium to boreholr1	96.633	250	24159/-
3	Seminorhall,blockD,E,G2&G 3 to borehole2	217.735	250	129436/-
4	Workshop to borehole4	27.48	250	6870/-
Total		514.308	250	203735/-

1.8 Estimation and Cost of Pipe:

Required lengths of pipes are two sizes

i) 0.2m
ii) 0.25m

0.2metres diameter of pipe length =570m
0.25metres diameter of pipe length =110m
Cost for 1metre length of 0.2metre diameter pipe is =50RS.
Cost for 1metre length of 0.25metre diameter pipe is =60RS.

Total cost for 0.2metre diameter pipe RS
=570×50
=28500
Total cost for 0.25metre diameter pipe RS
=110×60
=6600
Total cost of pipe RS
=28500+6600
=35100
Add 5% of total price as miscellaneous works = (Total

excavation cost+ Total pipe cost)×(5/100)
= (203735+35100) × (5/1000)
=11942Rs

Total estimation price for both excavation and pipe installation **=250777/-**

2. Conclusion

As per the water consumption standards in India an average of 50,000 lits are consuming per day in Siddharth region. cost spent for purchasing 50,000 lits is approximately from 7,000/- to 10,000/-by this harvesting system we can save money every day and it is Environmental Friendly Here we are using the Rain Water Harvesting System it doesn't affect the environment and addition to it improves ground water by providing sufficient water to the population with this It is Economical to ordinary person Why because as per standards plumbing takes 8% of the total building cost. Our total project estimation satisfies the in this range. So our project economical to the every ordinary person, it should be aesthetically looking good. Our design of the building is not effects the beauty of the building.

References

[1] Agarwal,A(2001) Drought Try Capture the Rain. Briefing Paper for Member of Parliament and State Legislature. An occasional paper from center for science and environment.
[2] Raju, KCB (1988) Importance of Recharging Depleted Aquifers: State of the art Artificial Recharge in India. Journal of the Geological Society of India 51 429-454
[3] Rekeya, M & Bedmar, AP (1995) Ground Water artificial Recharge by Treated Water in Tunisia in Water Resources Management in Arid Countries, Muscat, Sultanate of Oman, March 1995
[4] Price, M (1996) Introducing Groundwater. 2nd edition. Stanley Thomas (Publishers) Ltd.
[5] Nigam, A; Gujja, B; Bandyopadhyay, J & Talbolt, R (1997). Fresh Water for India's children: A Draft Report Based on Local Studies. WWF/UNICEF India