ROOF TOP RAIN WATER HARVESTING TECHNIQUE FOR ANITS CAMPUS

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Abstract: ***Roof top rain water harvesting technique is an excellent and efficient method for collecting rain water from the roof tops of different buildings and making the water useful for any other purpose instead of getting wasted. Through this technique lot of water can be made useful for other purposes such as gardening, utility purpose and flushing tanks. This method merely works on the process of filtration but not purification. Effectiveness of filtration depends upon on the type of materials used as filter materials. Present work concentrates on constructing an efficient filter media with readily available filter materials like sand, gravel and charcoal. 10 different trial runs are performed in filtration process by constructing 10 different proportion rations of filter materials. From the present study it was observed that filter media with charcoal along with sand and gravel has better filtration when compared with filter media having only sand and gravels as filter materials. Effectiveness of filtration is inferred by water quality tests performed to the filtered water. Different properties of water like pH, Turbidity, Chlorides and Hardness are taken as reference for water quality assessment as these properties are the basic properties to be tested for any water to be used for any purpose. Dimensions of harvesting tanks have been fixed based on the amount of water that has to be collected from the roof top of that particular building.***

Index Terms - Roof top; Filtration; Purification; Water quality.

I. INTRODUCTION

Rooftop Rain Water Harvesting is the technique through which rain water is captured from the roof catchments and stored in reservoirs. Harvested rain water can be stored in sub-surface ground water reservoir by adopting artificial recharge techniques to meet the household needs through storage in tanks. Rainwater harvesting is one of the simplest and oldest methods of self-supply of water for households usually financed by the user. The main objective of rooftop rain water harvesting is to make water available for future use. Capturing and storing rain water for use is particularly important in dry land, hilly, urban and coastal areas. Although the availability of water is more but the water obtained from the rain is not properly utilized. So by considering local climatic conditions, roof top rain water harvesting method is considered as best available method for present study. Present work is concentrated around ANITS college in tagarapuvalasa which is located at 17.9281° N latitude, 83.4243° E longitude and at an elevation is about 51m (170 feet) above the mean sea level. Rain water harvesting method is designed for the quantity of rain water from the roof top of different academic blocks of ANITS campus. Water quality tests are performed to the water which was collected in the collecting tank of filter media setup in order to find out the physical and chemical properties of filtered water. Dimensions of the collecting tank for each academic block have been fixed based on the total amount of water that is required to store for conservation process. Collection tank consists of filter media set up with different layers of filter material under different proportions.

Filter Media:

Most important component of Rain water harvesting system is Filter media. This filter media consists of different layers of sand and gravel at different proportions along with Charcoal material. Function of these materials in filter media is to filter the impurities from the water which was collected through rain water harvesting technique. It should be noted that through these filter materials filtration can be done but purification cannot be done. Effectiveness of filtration depends upon the gradation of the filter materials

Water Quality Tests:

After collecting rain water from roof top through filter media it is very important to test the quality of water. By testing the quality of water a conclusion can be made about the way that filtered water can be utilized. Quality of filtered water depends upon the different physical and chemical properties of the water. Physical properties of the water represent the properties of water which can be identified by physical sensing; some of the physical properties include Color, turbidity, temperature, total solids. Chemical properties of water represent the reaction of water with different materials in the environment, some of the chemical properties include hardness, pH etc.

II. DATA COLLECTION

Anil Neerukonda Institute of Technology and Sciences in Tagarapuvalasa is located at 83.4243° E longitude and 17.9281° N latitude in Vishakhapatnam district at an elevation of about 51 meters (170 feet) above the mean sea level. Vishakhapatnam has a semi arid climate and receives Medium rainfall during Southwest monsoon (June-September) and retreating southern east monsoon (December-January). Average annual rainfall ranges between 200-300 mm/annum. The average monthly rainfall data are being taken from the Meteorological Department site of Visakhapatnam. Thus rainfall data of the area related to campus is given below in the table no.1 which is assumed to be same for the station of ANITS campus.

Table 1: Monthly Average Rain Fall Data of Visakhapatnam District

Month	Rain fall (mm)	% of Total Rainfall
January	10	11.9
February	09	10.7
March	12	14.2
April	21	25
May	52	61.9
June	106	126.1
July	136	161.9
August	147	175
September	177	210.7
October	259	308.3
November	73	86.9
December	06	7.1

III. DETERMINATION OF CATCHMENT AREA

The rooftop surface area is nothing but the catchment area which receives rainfall. Catchment areas of the different buildings are measured. This measurement was done manually with the help of tape.

***Civil Block*:**

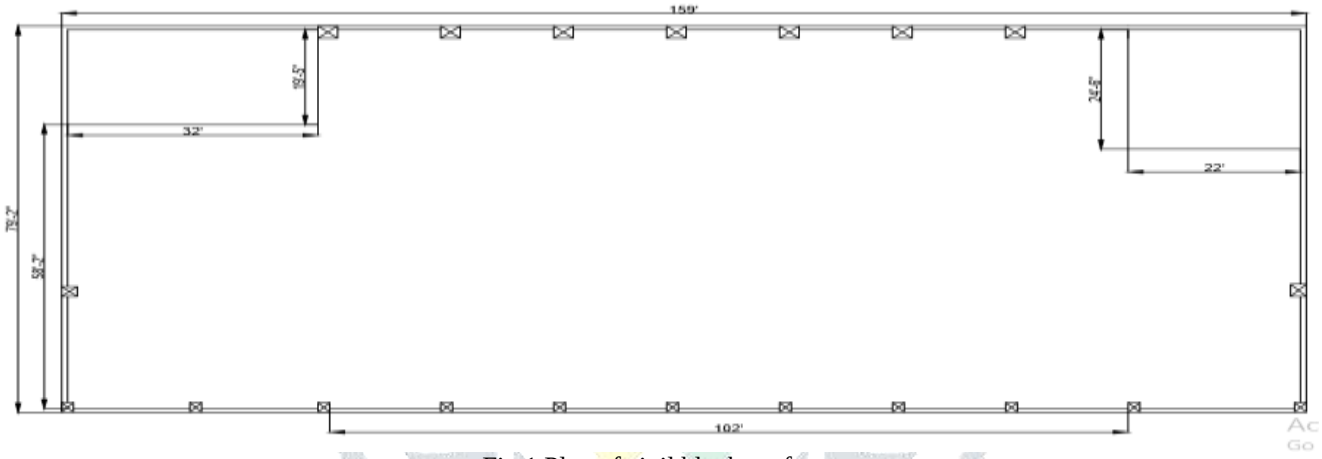

Fig 1 Plan of civil block roof top

Total area =1023.457 m^2
Runoff coefficient for concrete surface = 0.95
Volume of water to stored = Catchment Area x Runoff coefficient x Rainfall depth
= 1023.457 x 0.95 x 0.2
= 251.821m^3

In the similar way the roof top catchment areas of different academic blocks are calculated and tabulated in the given below table

Table 2: Catchment details in ANITS campus

Buildings	Area(m^2)	Volume(m^3)
Civil Block	1023.457	251.821
Mechanical Block	1157.34	284.763
CSE Block	754.71	185.696
IT Block	846.99	208.40
Chemical Block	754.71	185.696
EEE Block	781.34	192.248

ECE Block	781.34	192.248
Total	6099.887	1500.872

IV. CONSTRUCTION OF FILTER MEDIA

Construction of filter media includes preparation of small scale model of rain water harvesting tank along with filter materials. 10 different harvesting tanks are prepared by varying the proportions of filter materials. Filter materials include coarse sand, gravel and charcoal. Each harvesting tank contains different proportions of filter materials and in some harvesting tanks charcoal is used along with coarse sand and gravel as filter materials. Water collected from roof top of civil engineering block is allowed to pass through different harvesting tanks containing different proportions of filter materials. Water collected in the collection tank is tested for assessing the quality of filtration from different filter media. Water collected directly from roof top of civil engineering block is also tested in order to compare the change of water quality. A typical model of rain water harvesting tank is given below.

Fig 2 model of rain water harvesting tank with filter material

V. RESULTS AND DISCUSSION

Water Quality tests has been conducted for filtered water through all 10 different trails along with sample water that is collected by artificially flooding of water on the roof top of the Civil academic block. Different water quality tests include pH, Turbidity, Hardness and Chlorides. From the test results it was inferred that Chloride content of sample water is itself under safe limits. According to the main objective of study present work mainly concentrates on efficient use of unused rain water from the roof tops of different blocks in ANITS campus. In some tests there is an increase in chloride content in the filtered water when compared to sample raw water, this may occurs due to the formation of precipitate from the filter materials. The above mentioned tests are taken for study of water quality as they represent the basic properties of water that can be used for any purpose.

Table 3: Consolidated test results on Water quality parameters

Filter media	pH	Turbidity(NTU)	Chlorides(mg/L)	Hardness(mg/L)
Test sample	8.63	88	229.81	672
1	8.31	62.8	213.21	466
2	8.43	20.8	202.55	495
3	8.47	5.8	201.03	510
4	8.43	68	229.81	574
5	8.27	10.2	222.63	566
6	8.62	9.2	261.41	570
7	8.2	21.3	227.15	506.66

8	8.2	15.4	210.17	227.33
9	9.71	16.3	443.75	456.96
10	10.2	16.7	210.74	247.52
Permissible limits of drinking water	6.5-8.5	1-5	250-1000	200-600

Final objective of the present work is to fix the dimensions of Roof top rain water harvesting tanks along with filter media and collection tank i.e., harvesting tanks can accommodate filter materials and can collect the filtered water through the filter materials. This objective was done by trial and error method to create sufficient volume. Rain water harvesting tanks are of plain cement concrete with well finished surfaces and at each layer of filter material the bottom surface should be perforated. Suitable filter paper or cotton cloth can be used as filter media at each layer. Dimensions of the harvesting tanks for different academic blocks of the AINTS campus is tabulated s below:

Table 4: Dimensions of roof top harvesting tanks for different blocks

Buildings	**Length(m)**	**Breadth(m)**	**Height(m)**	**Volume of water (m^3)**
Civil Block	10	9	5.7	513
Mechanical Block	10	10	5.7	570
ECE- Block	9	8	5.4	388.8
EEE- Block	9	8	5.4	388.8
IT- Block	9	9	5.2	421.2
CSE- Block	9	8	5.2	374.4
Chemical- Block	9	8	5.2	374.4

V. CONCULSIONS

Among the filter media trails with filter materials like sand and gravel filter media-3 with coarse sand of 11cm thick which retained on 1.18mm sieve and passed through 2.36mm sieve, gravel layer1 of 4cm thick which retained on 4.75mm sieve and passed through 6.30mm sieve and another gravel layer2 of 10cm thick which retained on 20mm sieve and passed through 37.5mm sieve respectively gives an effective filtration of the water collected from roof top. These three layers of filter materials are placed on above the other starting from gravel layer2 at the bottom and gravel layer1on the gravel layer2 and coarse sand on the gravel layer1 respectively. Along with sand and gravel another material Charcoal is used as filter material for some of the trails it was observed that the filter medias with charcoal along with sand and gravel as filter materials has effective filtration of water when compared to filter media containing only sand and gravel as filter material and filter media-8 was found to be effective.

Properties of water like pH, Turbidity, Chlorides and Hardness are taken as basic properties to be tested for water that can be used for any purpose. The permissible limits of these properties for drinking water is taken as reference for quality check but the filtered water cannot be used directly for drinking even if the above properties are within the permissible limits because some other special treatments like Reverse Osmosis, disinfection techniques etc should be made available for water treatment to get it purified. From the Roof top rain water harvesting technique with the above filter materials the filtered water can be used for utility purpose, flushing toilets, gardening for the entire ANITS campus.

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