RESEARCH PAPER | Engineering | Volume : 5 | Issue : 1 | Jan 2015 | ISSN - 2249-555X

Design of Rooftop Rainwater Harvesting System for The Administrative Block of V.v.c.e., Mysore

KEYWORDS: rain, water, harvesting, rooftop, analysis.

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ABSTRACT *The demand for fresh drinking water is continuously rising with the passing years as a direct effect of population explosion. This hence warrants a situation that necessitates conservation and augmentation of fresh water from every possible sector. In the present study, Rain water harvesting as a technique to preserve fresh water has been advented for the study area of Vidya Vardhaka College of Engineering (V.V.C.E.), located to the west of Mysore. The study quantifies the extractable quantity of rooftop water to supplement public supply system. Precipitation data was collected for 11 years from 1997 to 2007. For the given rooftop area of 11107 sq.m., about 706 cubic metre of rainwater was found with a collection efficiency of 90%. The results of the qualitative analysis carried forward the study in terms of provision of necessary treatments in the form of two slow sand filters.*

INTRODUCTION

India receives highest rainfall among countries comparable to its size. Its land mass has perennial rivers on one side and on the other side India has continued to experience alarming drought conditions regularly. If the water management is not accorded the importance it deserves, the country can very much expect to find itself in troubled waters as the years roll by.

SCOPE OF RESEARCH

According to the Central Ground Water Board, the reservoir of underground waters will dry up entirely by 2025. As more than 50% of the Indian population is expected to shift to cities, consequently fresh drinking water is anticipated to become scarcer. To overcome the potential water scarcity and to become self-sufficient, better water management techniques need to be adopted.

In this context application of rainwater harvesting can serve as one of the promising methods for conservation of water.

Rain water harvesting is a process of capturing rainwater where it falls or capturing the runoff and taking measures to keep that water clean by not allowing pollution to take place in the catchments.

STUDY AREA

The present research is carried out at Vidya Vardhaka College of Engineering (VVCE), located in western part of Mysore district, Karnataka. The district receives an average annual rainfall of around 782mm along with the temperature varying between 11°C to 38°C. The main focus is on the administrative block of VVCE wherein the students and staff mainly depend on the public water supply system. The top roof plan of the administrative block is as shown in Figure 1.

Figure 1: AutoCAD drawing of top roof plan of the Administrative Block.

METHODOLOGY

The current study is intended to make provisions of an alternate source of water supply by adopting rooftop rainwater harvesting system.

Figure 2: Photograph of Developed Composite Rain Water Harvesting Unit.

The research methodology was carried out in the following sequential steps. Primarily the current consumption of water in the administrative block of VVCE was studied.

This was achieved by taking into account the count of individuals residing in the study area alongside with the per capita consumption. The assessment of the rainfall receptive area was next undertaken. Further, the quality of rainwater collected on the roof top area of the administrative block was analyzed for physico-chemical and biological parameters, by referring to 'Standard Methods'.

The design of the composite unit (Figure 2) was then arrived based on the rainfall data from nearby rainfall gauges and then by applying empirical relationships in the field of rainfall analysis and hydrology. This was then subjected to ascertain cost estimation and eventually the cost benefit was analyzed for the rooftop rainwater harvesting system.

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RESULTS AND DISCUSSIONS

Based on standard assumptions from BIS, the average daily water requirement for the administrative block of VVCE was found to be 3020 litres.

Based on the research of decadal rainfall data, the average rainfall around the study area was found to be 708mm. Assuming 90% runoff will be available from the rooftop, for the available roof catchment area of 1107m^2, the expected runoff was 7,06,000 litres. Hence for the derived theoretical data, the volume of storage tank (Figure 3) was found to be 706m^3 and the effective surface area as 23.6m^2. Consequently the diameter and effective depth inclusive of freeboard was arrived to be 5.5m and 3.3m respectively for the cylindrical enclosure. In case rectangular tank is used the length, breadth and depth of the proposed tank would be 6.8m, 3.4m and 3.3m respectively (Figure 4).

Further, cost estimation was done for the provision of PVC pipe connections from the roof top to the composite rainwater harvesting unit. From the research the cost benefit ratio was found to be 1.53. The qualitative analysis confirmed that all the major parameters such as colour, odour, taste, turbidity, pH, alkalinity, hardness, calcium, chloride, TDS etc. were well within limits, whereas Suspended and Total Solids were found to be more than the standards.

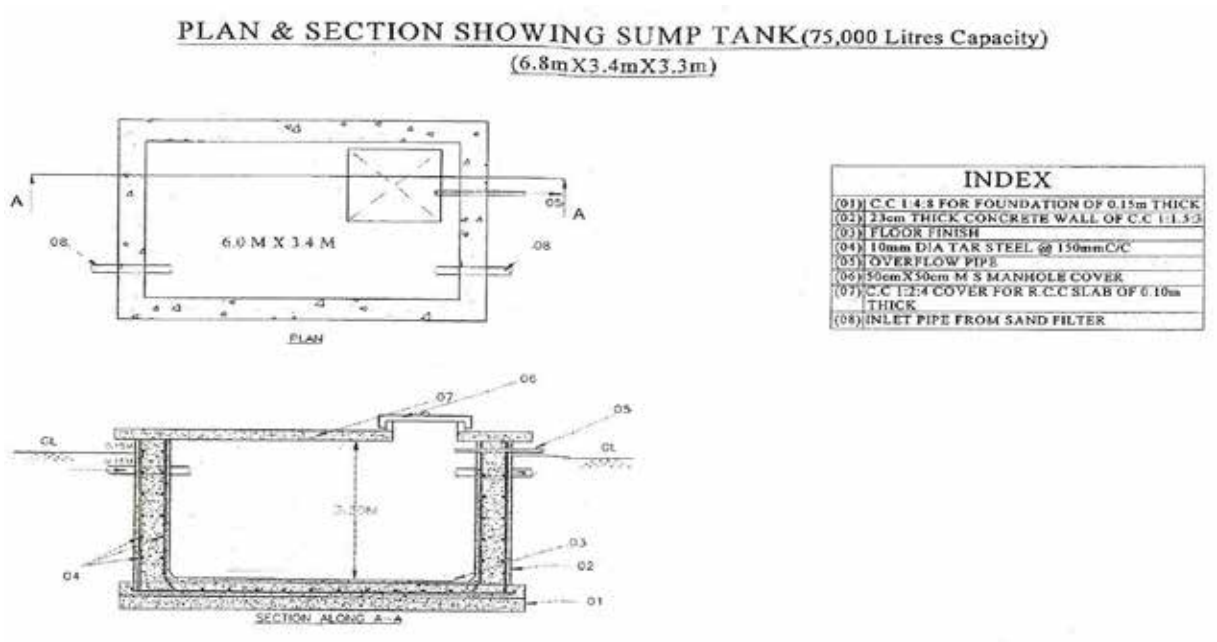

Figure 3: AutoCAD drawing of Plan and Cross-section of proposed Sump Tank.

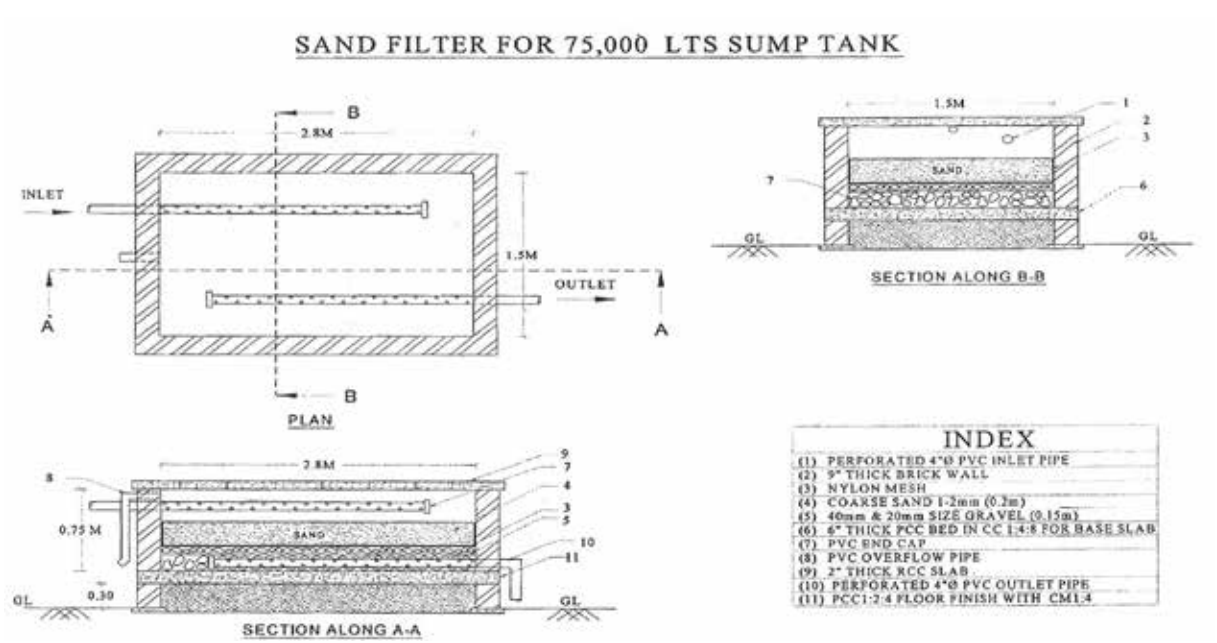

Figure 4: AutoCAD drawing of Plan and Cross-section of proposed Sand filter.

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CONCLUSIONS

The harvested rainwater can be used for non-potable purposes after employing filtration from the designed composite rainwater harvesting unit. When the quality aspects of main source of drinking water is looked into, rainwater harvesting is an economical option to overcome dependency on water supply. Also the rainwater quality assessment indicates it's relatively pollution free, indicating considerably economical treatment. The cost benefit ratio of 1.53 indicates the research as a favorable and viable proposition.

FUTURE SCOPE OF STUDY AND LIMITATIONS

The present study was carried out at micro-level, and hence detailed studies can be advocated at macro-level, keeping in mind pre & post monsoon seasons, rate of evaporation, runoff coefficient and velocity of flow. The present study can be further expanded to the paved surfaces.

ACKNOWLEDGMENT

The author wish to acknowledge the assistance of Manoj Patel B., Sumashree M. and Yadunandnan M. L. along with whom this work was carried out.

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