Rainwater Harvesting System

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Abstract. In this paper we present a new system for Rainwater Harvesting. This report describes a system design for Linimar's CAMTAC plant that rainwater from the roof to storage tanks inside the plant itself. The design consists of 11 drains 1 on the roof which connect to a series of pipes that act as a gravity network. The pipes eventually take the rainwater to two 5000 gallon storage tanks on the second floor of the plant. The design was simulated and the results show that our system can produce up to 26% of CAMTAC's water needs. The total set up cost of this system will come to $10500 with $6800 in savings within the first year. The estimated payback period is estimated at 1.5 years.

Key words: Rainwater Harvesting, Re-using water, Water Engineering, Water Harvesting.

1 Introduction

As it stands the CAMTAC plant uses 1300 m^3 of water per month, primarily for manufacturing processes. This water is drawn from the City of Guelph municipal potted water supply, at a cost of approximately $2000/month. With reducing the city water consumption, this has the potential to significantly increase savings to the CAMTAC plant. The concept of our design based an estimated return on investment for the CAMTAC plant within 1.5 years. Our goal is to set up a system where atleast 25% of CAMTACs monthly water usage would be coming from a free rainwater source. The purposed designs incorporate a rainwater harvesting system that collects rainwater from the existing plant roof. Most current Rainwater Harvesting systems incorporate pumps to move the water from the source to the storage. Problems often arise as the pumps require constant maintenance. Our system encompasses a gravity network which reduces costs and provides for a simple low-maintenance solution.

2 Conceptual Design/Methodology

2.1 Overall design

Figure 1 shows the gravity network which collects water from 11 roof drains. 11 drains were selected because they gather 10,000 gal of water precipitation event based on our calculated 5mm average. The collection system is made from an angle tee, standard tee and two 4" - 2"in reducer. This collection system is very suitable to this design because it uses the exiting drains as the overflow system and is very cost effective.

2.2 Piping

The decision to go with 2"in diameter pipe came from the equation 1

$$Q = \frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}},$$

- Q flow rate in cfs
- n Mannings roughness coefficient
- A Cross sectional area
- R Pipe Radius
- S Slope in percentage

This equation gives you the amount of water that will flow through a pipe when gravity is the only driving force. With a 2"in pipe with a slope of 0.5% the flow works out to be 13000 gallons per hour. There are three runs of 2"in pipe emptying into the reservoir on the 2nd floor. This allows the overall system to provide a peak flow of 40000 gallons per hour; which works out to a 22mm/hr rainfall intensity. For the simple reason that this flow rate can fill the reservoir in 15 minutes.

3 Detailed Design

3.1 Piping/Overflow system

The collection assembly as seen in Figure 2 shows how the water will be collected. Water will bypass the existing drain and flow into the 2 pipe network and then to the reservoir tanks. This will happen until the rain stops or until the tanks are full, at which point the water level will rise and the additional water will start to flow down the pre-existing drain pipe.

4 Core Design Discussion

The water treatment process incorporates a 25 micron washable filter, which is located between the reservoir tank and the existing R.O unit. The location is between the reservoir and the R.O unit because there is a pump which provides the R.O with water but will also increase the pressure and help force the water through the filter housing. The decision to go with a 25 micron filter was dictated by CAMTACs water quality demands. There existing system only requires particles greater then 25 microns to be removed.

The storage area is located on the 2nd floor in the mixing room. In this room there will be two 5000gal

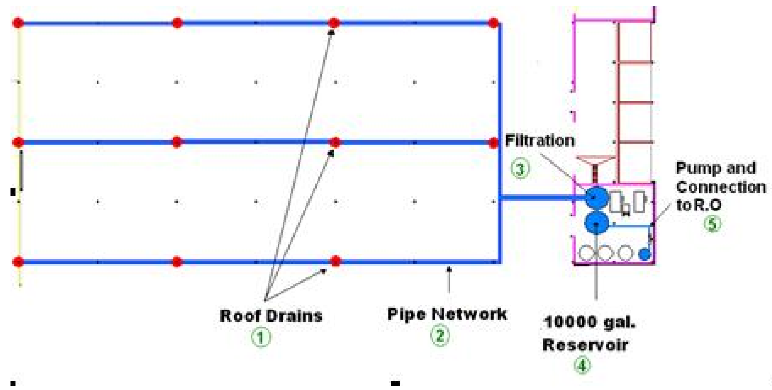

Fig. 1. Figure 1: Gravity Network floor plan

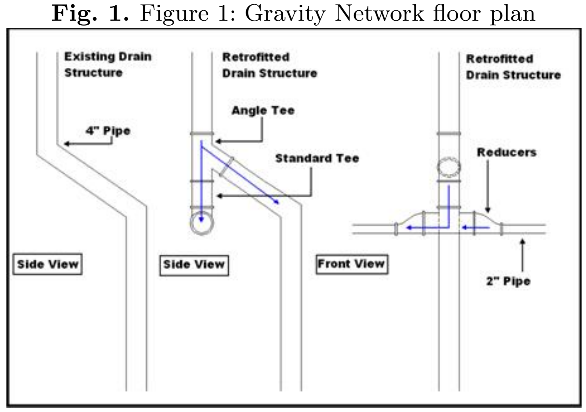

Fig. 2. Figure 2: Water Collection/overflow System

tanks (141"in dia. x 86"in H). The decision to go with two 5000gal tanks was because of the dimensions of the storage area. This particular area could not handle the diameter of a single 10,000gal tank. The area could also not accommodate four 2500gal tanks, which is unfortunate because this proved to be the most cost effective way to store 10,000gal.

The final section of the plan involves a pump which will provide Linamars R.O unit with the water collected from the roof. The reason for the pump is because of the need to pressurize the water to the same pressure as the city water. The pump used here has not been selected yet. However due to the fact that it only needs to provide a flow of 5 gallons per hour it will be a small pump. The spring loaded Y-valve will allow the R.O unit two receive water from two sources, with a single inlet.

4.1 we with are

The Engineering Design process for this particular project proved to be quite challenging due to the criteria and constraints presented. The most difficult task proved to be meeting the one year payback period as required by Linimar. Preliminary designs were discarded after realizing digging outside was prohibited. Similarly, outside storage was forbidden not only as government regulation but also because it proves to be a bad idea due to extreme weather conditions. In the future, implementation should be kept in mind during the brainstorming phase to avoid problems down the road.

Acknowledgement

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