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STORM-WATER RECLAMATION CISTERN FOR HOUSEHOLDS

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Abstract

Flooding has become a trend after rainstorms. This has been happening time and again due to water-logging. After each rain, the water remains stagnant in the area due to urbanization where most land has been cemented or tarred and water percolation has been reduced or the soil has passed its saturation limit. Whilst all this water cannot be fully channeled into the nearest waterbody, the next solution is the reclamation of rainwater. This way, the water is collected and used, thereby avoiding the scenario of water-logging and its ill-effects. This is overcome to a favorable extent with the installation of underground cisterns in households. The approach is such that the cistern shall be built with a permeable foundation enhancing seepage of water into the soil. The data regarding the depth at which the water-table is for the plot under consideration is analyzed and depending upon it, the depth of cistern is to be taken. The soil type as well as the problem of settlement shall also be taken into account. The permeable nature of the foundation of the cistern shall also be discussed.

The developing nature of our country and the escalating population has resulted in the depletion of forest land and has also turned these into building sites with much part of the unused land being concreted or tarred. This has also contributed to the water-logging after heavy rains eventually leading to flooding of the area. A proper storm-water conveyance system connecting an entire district or bigger has not been adopted in our state considering the high budget that will be required.

As discussed in reference [1], approaches and technologies surrounding the drainage system in all localities must evolve with time. The latter resulting in slow extermination of the area making it uninhabitable. With time, improvisation must be adopted and old methods if necessary must be abandoned. Much like the sponge cities that are discussed, the cistern is a LID (Low Impact Development) design, combining retention, infiltration, storage and use to a single entity.

This cistern design aims at reducing water logging in areas of poor permeability after heavy persisting rains; also intends to provide a structure that withstands settlement to a good extent. It deals with the proper management of surplus water that will be flushed out when the soil reaches full saturation. Overall concern of this design is to increase the ground water while also channeling the excess to where ever required.

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The methodology involves four steps, namely-identification of project site, soil-type identification at site, soil stabilization techniques ventured when necessary, water reclamation procedure in cistern. The site of construction and most apt location for the construction of a cistern, will be one of the lowest points in the plot and at an optimum distance above the water table of the area. The soil type is identified using Atterberg's limit test. With that, one can surmise the possibility of settlement that may be likely to occur in the future. Stabilization will be provided in case of clayey soil, to improve CBR of soil prior to construction. Introduction of additives such as bitumen, fly ash, lime, etc., to increase bond strength and hence the cohesion between soil particles (from reference [2]).

The cistern under consideration is a 2-chamber cistern, as shown in Fig 1., each chamber provided with individual lids that open into manholes provided with meshes, having nominal opening of 1 inch(25.4mm) immediately and with 0.5 inches (12.7mm) aperture further down. The cistern designed will be for a smaller scale while also keeping up with the need of being cost effective. The front sectional view of the cistern is shown in Fig.1. The construction will demand highly skilled workmanship. RCC will be used with HYSD bars (Fe415). This will cover for the reinforcement. Locally used raw materials can be used. The two factors on which its strength shall depend are aggregate/cement ratio and additional reinforcements provided. The proportion for the pervious concrete mid-region of foundation- cement: FA: fly ash – 1: 3.288: 0.11 (from reference [3]). The mix design proportion adopted for the walls of the cistern- cement: FA: CA – 1: 1.43: 2.68.

The most important objective of the installation of an underground cistern having a permeable mid-region in its foundation is to enhance the seepage of water quickly into the soil. This will prevent water-logging in the area once all the households install it. They can all be further connected by a pipe network and allowed to flow into the nearest water bodies. For areas experiencing heavy rainfall straight for a couple of days and not receiving any rainfall at all during other times, this technique is advantageous since groundwater level will be nearly at its peak.

Settlement in clayey soil will also be dealt with. The two-chamber cistern will be provided with wire meshes at every inlet to prevent inflow of larger dirt particles. These meshes can be removed and cleaned once blocked by impurities. The openings/manholes with their respective lids, along with the various meshes can be seen in Fig.2. It shows the sectional elevation of the upper part of cistern. The pipelines run from the collecting tank and the water collected flows into the purifier and then pumped into household. This water can be directly used for household requirements.

If in a locality, most houses are closely spaced, a common cistern with pump and filter with pipelines running into each household can be provided.

Key words: permeable foundations, settlement, underground storm-water cisterns

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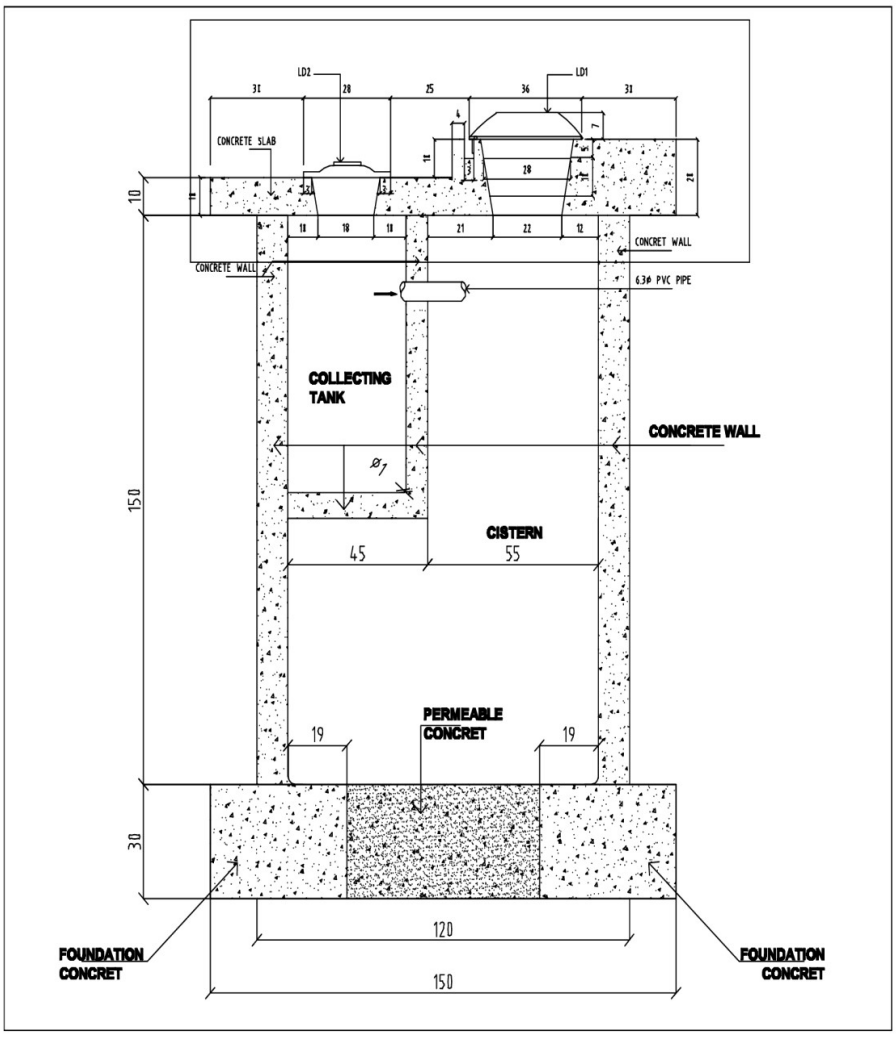

Fig 1. Sectional Elevation of Cistern

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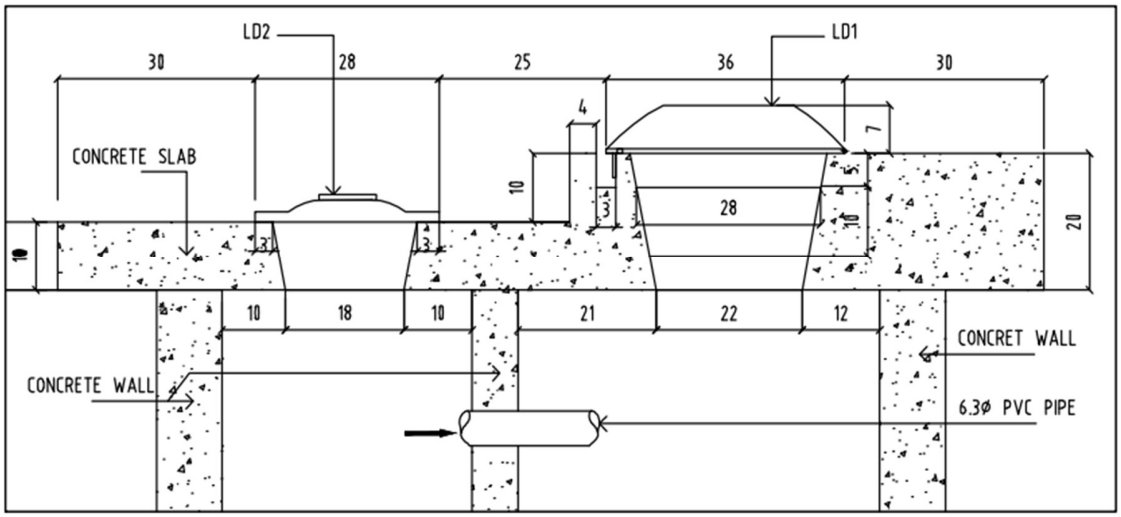

Fig 2. Sectional Elevation of Covers of the Cistern

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