STUDY ON
OPTIMIZATION OF RECTANGULAR TYPE GROUND RESERVOIRS

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Abstract

At present, there is very few published literature for optimizing of rectangular type ground reservoirs. National Water Supply & Drainage Board (NWSDB) is the prime national organization responsible for providing safe drinking water to public in the country. Therefore NWSDB has the vested interest to optimize the cost of structures utilized for the water supply schemes in order to give more benefits to the public. Hence it was decided to carry out this research work and to utilize the outcome of the research for the National Water supply & Drainage Board. Rectangular type ground reservoir was selected in this research as it is the most common type of ground reservoir.

About sixteen numbers of ground reservoirs of four capacities with varying height were analyzed and designed for three cases, namely, tank full without soil pressure, tank empty with soil pressure and tank full with soil pressure acting. In optimizing the tank, roof slab thickness, column spacing, wall thickness and the dimensions of wall base for each and every capacity of ground reservoir were analyzed in order to obtain optimum solution. Costing was done considering cost of materials, i.e, reinforcements, formwork, concrete and labour for the construction of ground reservoirs. Cost estimates were prepared using the rates given in the NWSDB rate book for 2009.

Selection of capacities were mainly based on the past records of the NWSDB. Data collected from the NW,SDB shows that most of the ground reservoirs are of capacity between 100 m' to 1000m3 and therefore research was limited to the capacity up to 1000 rrr'. Four different capacities (i.e 1000 nr', 750 m', 450 m3 and 225 rrr') were selected for the analysis because NWSDB use the ground reservoir of these capacities in their water supply schemes.

The structural arrangement of-the ground reservoir considered consists of cantilevered walls, isolated tank base and flat slab roof.

Tank base was designed as -an-isolated base which bears the water load on it and transfer to the ground. As per the BS 8007, reinforcement steel was provided only to the top zone.

By reviewing the data collected and analyzing the dimensions of the ground reservoirs, it was found that square type ground reservoir has lesser perimeter for a given height than that of rectangular reservoir for the same height. Therefore square ground reservoirs are economical than rectangular ground reservoir.

By analyzing the column spacing for the flat slab roof, it was found that maximum column spacing is 4.25 m for the 200 mm thick slab to satisfy the deflection criteria. Tank wall was designed as a cantilever wall and thickness of wall was decided based on the deflection criteria and checked for shear force.

Wall base was optimized to satisfy the conditions of overturning, no negative stresses to develop at the base and not to exceed the maximum bearing capacity of soil and this gives the location of wall on the wall base and the dimensions of the wall base. Stability of tank wall with respect to sliding and rotation were also checked. Where necessary tie bars were provided to take the balance sliding forces.

The analysis of wall base shows that the length of wall base within the tank is (toe length) smaller than the length outside (Heel length) the tank when tank is full with water and soil pressure is not acting. When tank is empty and soil pressure acting on the wall, the wall base within the tank is higher than that of outer.

Costing was done for concreting, form work, reinforcements and labour. It was found that when height increases, the cost decrease upto a certain height and then increases with the increase of height. Minimum cost was obtained when reservoir heights were 4.0 m,).ZLm, 3.45 m and 2.75 m for 1000 m', 750 m', 450 m' and 225 m3 respectively. Costing was done based on the rates provided in the NWSDB rate book for year 2009.

The findings of this study are useful in design process to decide on the cost optimized ground reservoirs. These findings can be used for the ground reservoirs in the water supply schemes.

STUDY ON
OPTIMIZATION OF COST OF RECTANGULAR TYPE GROUND RESERVOIRS

By Eng. U.C Pathiranage

This thesis is submitted to the Department of Civil Engineering of the University of Moratuwa, Sri Lanka, in partial fulfillment of the requirements of the Degree of Master of Engineering in Structural Engineering Design.

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DECLARATION

I hereby declare that the work included in this thesis, in part or whole has not been submitted for any other academic qualification at any institution.

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TABLE OF CONTENTS

CHAPTER TITLE

LIST OF TABLES

LIST OF FIGURES