

Design of Cylindrical Overhead Water Tank by STAAD Pro Software

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Abstract- In India more than 68% of its total population lives in rural area. Domestic water is major problem in this area, So as to solve this problem innovative design and solutions to existing problem is essential hence for that study of Elevated Storage Reservoir (ESR) is undertaken. There are so many case studies and report on failure during and post construction of ESR. The purpose of study of the ESR is to design and analysis safe ESR, Where in the damage to the structure and it's structural components even by natural hazard such as earthquake can be minimized. Indian standard for the design of liquid retaining structures have been revised in 2009. This revised edition Incorporated limits state design method. Limit state design method for water retaining structure was not adopted so far as liquid retaining structure should be crack free. However, This edition of Indian standard adopts limit state method mainly considering two aspects. Firstly it limits the stresses in steel so that concrete is not over stressed and in second aspect it limits the cracking width. This project gives in brief, The theory behind the design of liquid retaining structure (Elevated Circular Water Tank) using Limit state method with reference to IS 3370(2009) and IS 456:2000

I- INTRODUCTION

Water tanks are liquid storage containers. These containers are usually storing water for human consumption, irrigation, fire, agricultural farming chemical manufacturing, food preparation, rainwater harvesting as well as many other possible solutions. Water plays a predominant role in day to day life so water storage is necessary to store the water. The main objectives in design of water tanks are to provide safe drinkable water after storing for a long time, optimizing cost strength, service life, and performance during a

special situation like earthquakes. The other objectives are to maintain pH of the water and to prevent the growth of the microorganism. Water is susceptible to a number of ambient negative influences, including bacteria, viruses, algae, change in pH and accumulation of minerals accumulated gas. A design of water tanks or container should do not harm to the water.

Water tanks parameters include the general design of the tank and choice of construction materials, linings. Reinforced concrete water tank design is based on IS code. The design depends on the location of tank i.e, overhead, on the ground or underground water tanks. Tanks can be made of RCC or even of steel. The overhead tanks are usually elevated from the ground level using a number of column and beams. On the other hand, the underground tanks rest below the ground level.

Water tanks are classified into two types based on position and shape of tanks: -Based on Location the water tanks are classified into three ways: -

- Underground water tanks
- Tanks are resting on the ground
- Elevated or overhead water tanks

Also, the water tanks are classified based on the shapes:

- Circular tanks
- Rectangular tanks
- Intze tanks
- Circular tanks with conical bottom
- Square tanks

II- OBJECTIVES

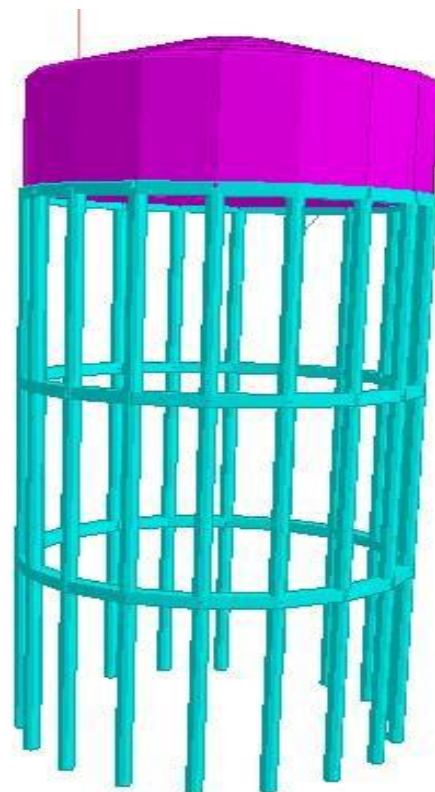
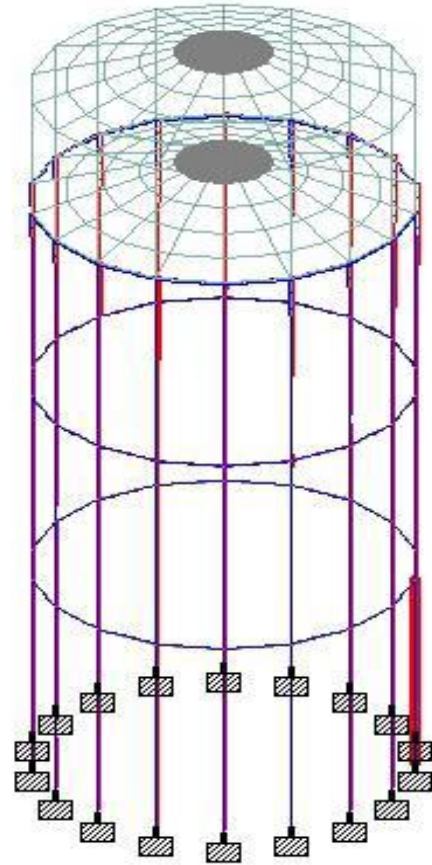
- To make a study about the design and analysis of water tanks.

- To make a study about the guidelines for the design of liquid retaining structure according to IS code.
- To know about the design Philosophy for the safe and economical design of water tanks.
- To study the various forces acting on a water tank. Understanding the most important factors that play role in designing of water tanks.
- Preparing a water tanks design which is economical and safe, providing proper steel reinforcement in concrete and studying its safety according to various code.

III-METHODOLOGY

- Cylindrical overhead tank is selected for the study. Two models are to be prepared having different staging configurations. The following model are generated with varying height of water tank example 5m, 10, 20m, with empty, half, full water level condition.
- Model I - Overhead circular water tank with reinforced cement concrete frame system (Ex. 5 m, 10 m, 20 m) with tank empty, half, full tank conditions.
- Model II - Overhead cylindrical shaped water tank with shear wall on six side (ex. 5 m, 10 m, 20 m ,) with tank empty, half, full tank conditions.
- The analysis of the structure that is determination of the internal forces like Bending moment, shear force, etc in the component members, for which these members have to be designed, under the action of given external loads. It consist of number of beams and columns built monolithically, framing a network.
- A frame is subjected to both vertical as well as horizontal loads.
 1. The vertical load consists of dead weight of the structure components such as beams, slabs, columns, etc. and live load.
 - 2 .The horizontal load consists of wind forces and earthquake forces.

When connections of beam and columns are fully rigid, the structure as a whole is capable of resisting lateral force acting on the structure.



IV-DESIGN CALCULATION

Let assume we will design an overhead circular water tank for a colony, where total number of people is 800 peoples are living in these colony,

So,

$$\begin{aligned} \text{Per capita water demand} &= \text{daily demand} \times \text{population} \\ &= 160 \times 800 \\ &= 128000 \text{ litres} \end{aligned}$$

$$\begin{aligned} \text{Fire demand} &= 100\sqrt{P} \\ &= 100 \times \sqrt{800} \\ &= 2828.42 \text{ litres} \end{aligned}$$

$$\begin{aligned} \text{Total requirement of water} &= 128000 + 2828.42 \\ &= 130828.42 \text{ litres} \end{aligned}$$

Let assume dimension of circular overhead water tank :

- a) Radius of circular tank (r) = 4m
- b) Height of circular tank (h) = 3m

$$\begin{aligned} \text{Area of tank (A)} &= \pi r^2 \\ (A) &= \pi \times 4^2 \\ (A) &= 50.265 \text{ m}^2 \end{aligned}$$

$$\begin{aligned} \text{Volume of tank (V)} &= \pi r^2 h \\ (V) &= \pi \times 4^2 \times 3 \\ (V) &= 150.796 \text{ m}^3 \\ (V) &= 150796 \text{ litres} > 130828.42 \text{ litres} \end{aligned}$$

Ok

V-CONCLUSION

From this designs it is showed that corner stresses and maximum shear and bending stresses are found to be less in case of circular tanks than remaining other designs and the shapes of water tank plays vital role in the stress distribution and overall economy . By using STAAD PRO, the results obtained will be very accurate than conventional results .

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