



## RESEARCH ARTICLE

### DESIGN, ANALYSIS AND STUDY OF THE COMBINED RECTANGULAR WATER TANK: COMBINATION OF THE RECTANGULAR OVERHEAD WATER TANK AND THE RECTANGULAR GROUND WATER TANK BY USING STAAD PRO SOFTWARE

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#### ABSTRACT

A water tank is a container for storing water. The need for a water tank is as old civilization, to provide storage of water for use in many applications, drinking water, irrigation agricultural, fire suppression, agricultural farming, chemical manufacturing as well as many other uses. A ground water storage tanks (or surface tanks) are used for ground storage of potable drinking water, wastewater, treated water, rainwater collection, etc. And it is designed as crack free structures to eliminate any leakage. An overhead water tank is an efficient water distribution system. The basic purpose of elevated water tanks is to secure constant water supply with sufficient flow to wide area by gravity. Commonly, For Overhead Water Tank, we mostly design against overturning so for this a Ground Water Tank provided to minimise the effect of same and this will meant (performed) as wall. From these things we may achieve more storage as at ground as well at top of water tank. So for this. In this research, considered a new idea that is Combined Rectangular Water Tank in which combination of Rectangular Surface Water tank and Rectangular Overhead Water Tank are taken as together. For the given water tank Design and Analysis is to be prepared with help of STAAD Pro. Software Also the deflected shapes, Pressure exerted are to be described as result.

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## INTRODUCTION

Surface water tank or Ground water tank is made of lined carbon steel, it may receive water from water well or from surface water allowing a large volume of water to be placed in inventory and used during peak demand cycles. Under suitable circumstances, ground level storage tanks may be used to deliver water to users by gravity flow.

### Rectangular Ground Water Tanks

- Rectangular Tanks are provided when capacity of liquid to be stored is small.
- Rectangular tanks should be preferably square in plan from point of view of economy.
- It is also desirable that longer side should not be greater than twice the smaller side.
- Moments are caused in two directions of the wall i.e., both in horizontal as well as in vertical direction

- Exact analyses are difficult and are designed by approximate methods.
- For small capacities, circular tanks are uneconomical on account of curved shuttering thus Rectangular Tanks prove to be economical in this case.
- Unlike Circular tanks, rectangular tanks occupy entire available area, so it is easy to divide the tank in compartments & design.

### Design of rectangular tanks

#### The components of a Rectangular Tank are

- Side walls
- Base Slab
- Roof Slab

#### The design of walls by Approximate Method is broadly classified into two categories

- Tanks having ratio  $L/B < 2$
- Tanks having ratio  $L/B > 2$

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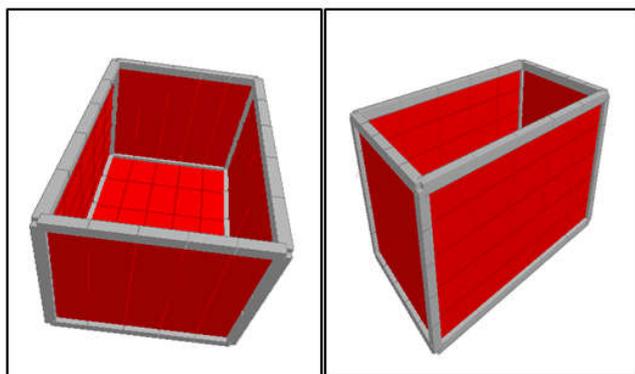


Fig 1. An Example of Ground water tank (3D view)

**Overhead water tank or E.S.R (Elevated Storage Reservoir):** Is Water Storage structure which is constructed above the ground, for an efficient water distribution system, overhead water tanks or elevated storage reservoirs are one of the most important components. The basic purpose of elevated water tanks is to secure constant water supply with sufficient flow to wide area by gravity. The height of the elevated tank depends on the area to be covered for the water supply. Wider the area to be served higher will be the required elevation of the tank. Overhead water tanks of various shapes can be used as service reservoirs, as a balancing tank in water supply schemes and for replenishing the tanks for various purposes. Reinforced concrete water towers have distinct advantages as they are not affected by climatic changes, are leak proof, provide greater rigidity and are adoptable for all shapes.

#### Components of a water tower or tank

#### Elevated or overhead Water tank consist of

- **Tank portion with**
  - Roof and roof beams (if any)
  - Sidewalls
  - Floor or bottom slab
  - Floor beams, including circular girder
  - Cylindrical portion
- **Staging portion, consisting of**
  - Columns
  - Bracings and
  - Foundations

#### Types of Overhead Water Tanks

#### This may be

- Circular tanks
- Rectangular tanks
- Intze tanks
- Circular tank with conical bottom
- Spherical tanks.

#### Types of staging

There are two types of support staging on which top part is stand

- Hollow circular shaft
- Brace column staging

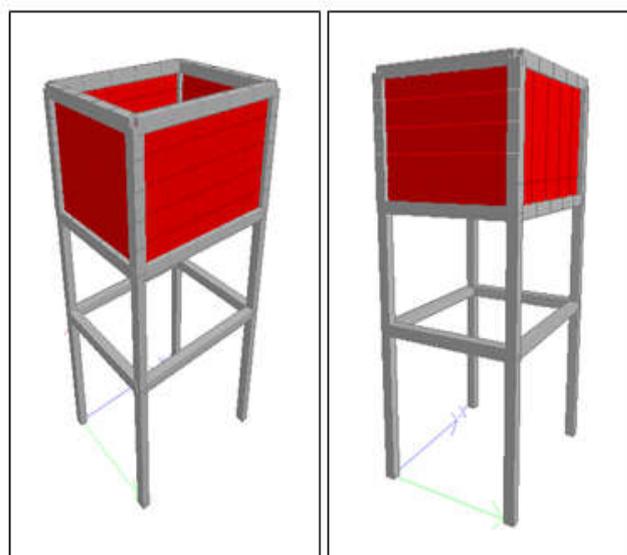


Fig 2 . Example of an Elevated water tank (3D view)

## COMBINED RECTANGULAR OVERHEAD WATER TANK AND GROUND WATER TANK

Still today we have seen that there is either overhead water tank or surface water tank separately. Now by combination of both the types of water tank, we may minimise the loss against failure of the structure and many more... by providing the combination we can just store more quantity of Aqua as per population needed.

Another most important feature is that in only overhead water tank, we have fear of overturning, loss due to wind and earthquake load but in this case of combination we achieved that is no more danger for water tank from W.L. and E.L.

#### Objectives of combined water tank

#### These are the objectives of Combined Water Tank

- To have good aesthetic look.
- To minimise the failure of water tank due to an overturning of overhead water tank.
- More storage of water as ground and overhead means. If there required to supply the water at long distance then by use of overhead water tank else ground water tank.
- Less deflection, moment as compare to that individual overhead water tank.

## MODELLING AND ANALYSIS

For the analysis of Combined Type Ground and Elevated water tank following dimensions are considered which are described below. From the study of The Combined Type Water Tank, main objective is to know deflected shape, stresses and B.M. for the same.

#### The data are to be taken as

Height of the tank – 12m  
 Staging height (linear) – 06m  
 Plate thickness for overhead tank: 250mm  
 Plate thickness for ground tank: 300mm  
 For staging: Rectangular of 300mmX300mm

Loads: 1. DL, 2. LL for Overhead and LL for Ground Tank, 3. Generated Indian Code general

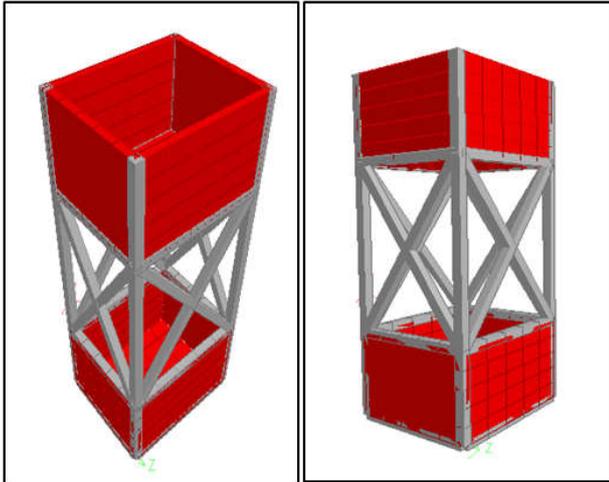


Fig 3 . 3D View of The Combined Rectangular Water Tank

Analysis Results Of The Combined Water Tank

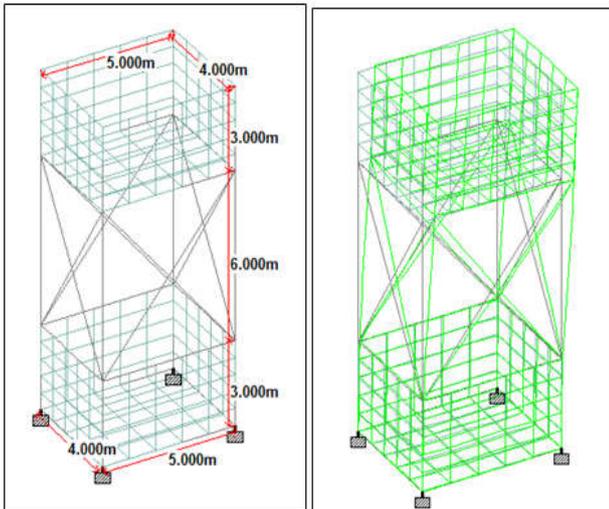


Fig 4 . Showing Dimensions and Deflected Shape respectively

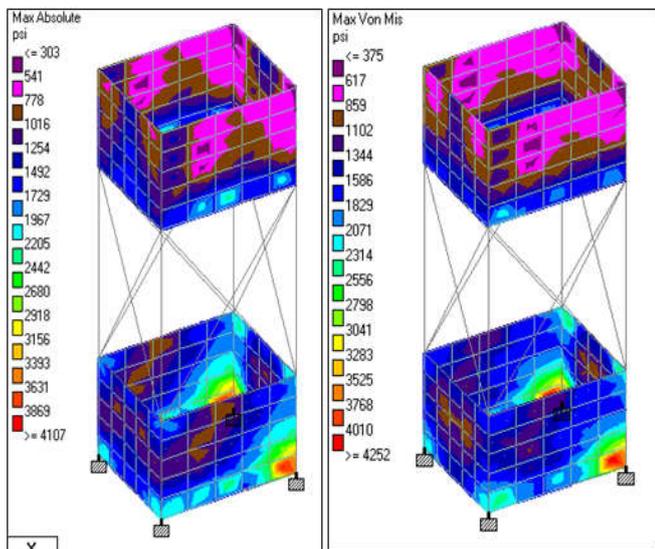


Fig 5 . Absolute Pressure and Max Von Mis stress respectively

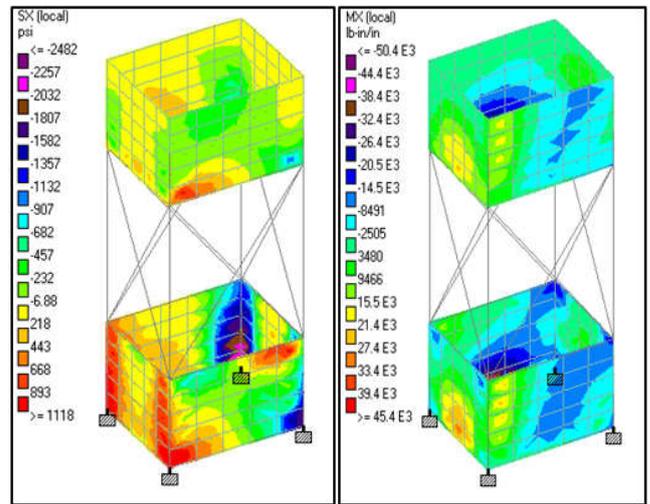


Fig 6 . Sx Local and Mx Local Respectively

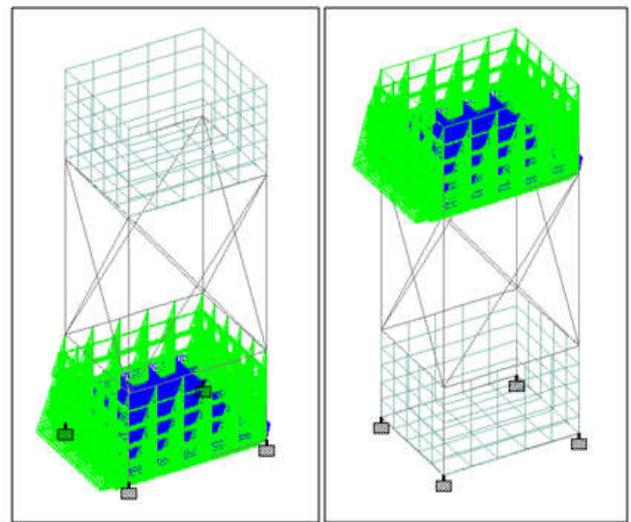


Fig 7 . Hydrostatic Pressure on water tank individually

Conclusion

- From the performances, we may know that the absolute pressure is less compare to general one.
- Here, The Hydrostatic Pressure assumed as for overhead 200kN/m<sup>3</sup> and for Ground Tank 300kN/m<sup>3</sup>.
- The deflection is less.

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