



## Literature Review on Design of Overhead Water Tank and Compare It with Conventional Approach

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**Abstract :** The water supply to the society is very essential after earthquake. However, the much important structure of the society, the research towards water tank design and analysis is very limited. The main focus of this study is on the linear design of elevated water tank. For this purpose, two software's are used. One is conventionally used SAP 2000 and the other is auto desk robot structural analysis (ARSAP).

In past there is a lot of study done on the damages and failure of elevated water tanks in earthquake. Different types of elevated water tanks are constructed for the supply of water, which include concrete pedestals, concrete framings and mushroom type elevated water tanks. The hydraulic head of water tank that is used in this study is 60. 2B seismic zone is considered for this study. Three different types of soil profile types are considered for the design of elevated water tank i.e. SE, SD and SC. There are different codes available in market for the design of elevated water tank, but in this study UBC 97 is used for the analysis and design. Total six number of models are being analyzed Furthermore, in this study a systematical method is used to analyze the elevated water tank on SAP 2000 and ARSAP software's.

**IndexTerms – Elevated Water tank, SAP2000, ARSAP.**

### I. INTRODUCTION

The elevated water tanks are mostly damaged during earthquake. Because water tanks contain a huge load on their top portion and their safety performance is critical in earthquakes. They must not fail during earthquake to provide of drinking water to the society. Severely damaged water tank in past earthquake due to lack of design efficiency. Soroushnia et. al[1] reported that the dominant failure of water tank is due to earthquake forces.

The past investigations shown that there are many programmings are utilized for the plan of raised water tanks. Like E-tabs, SAP 2000, SAFE and Staad pro etc. many researchers worked on these software's and compare the results of these particular designs. Eswaran et. al [2] discussed the numerical solution and compared it with different software's and concluded that these results differ in permissible limits. Barakat et. al [3] investigated Finite element method in conjunction with optimization method is used in the analysis and design of the RC water tanks and report economical and safe design of water tank. Ferrandiz et. al [4] reported the benefits of Revit architecture over the auto cad. In that study it was concluded that Revit is easy and advanced tool as compared to auto cad and other software's.

A raised water tank that is planned on the sap 2000 with a chose soil and seismic boundaries. Subsequent to planning this water tank, every one of the primary drawings will be created by utilizing auto scoundrel. Similar tank with same boundaries including tallness, water limit, soil and seismic boundaries will be planned on another product named ARSAP. Structural drawings are likewise made on Revit design. Subsequent to planning same water tank in new programming, the pressure of these two plans considered. 3 number of water tanks are planned on SAP2000 and 3 quantities of water tanks are planned on ARSAP with different properties as portrayed before.

### II. LITERATURE REVIEW

1) Issar Kapadia, purav Patel, Nilesh Dholiya and Nikunj Patel

In this research, considered 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.

Considering the design of walls by Approximate Method is broadly classified into two categories: Tanks having ratio  $L/B < 2$  and Tanks having ratio  $L/B > 2$

It was stated in paper that, the combined rectangular overhead water tank and ground water tank can minimize the loss of failure of structure. Also, it can achieve that no more danger for water tank from overturning, wind load, earthquake load. As well as it can

store more quantity of water as per population needed.

The main objective of this study is to know the deflected shape, hydrostatic pressure, stresses and B.M. For analysis dimensions are considered in STAAD Pro software and results are shown.

2) Ayazhussain M. Jabar, H. S. Patel.

In this research, the elevated water tank to be designed according to the purpose of heavily damaged or collapse during earthquake. In this study, the main aim is to understand the behaviour of supporting system which is more effective under different earthquake time history record with SAP2000 software. The tank to be designed with the proper behaviour of supporting system of the tank against dynamic responses, and selecting the proper staggered system in the column of the tank.

The main objective of this study is to analysed the critical responses of the tank with water filled and empty condition, also used of Lome Prieta Time history data and Kobe earthquake data for the analysis of the behaviour under seismic excitation.

3) Anshuman Nimade, Niraj Soni, Gautam verma.

In this studies, the underground water storage tank to be design for the purpose of collection of rainwater, storage of drinking water, and waste water collection. The main objective of this study is to find out the stress, node displacement, and the base pressure to be produced when the tank is empty or full with vary the length and width ratio with constant height. In this research, the variation of L/B ratio of the tank is considered and compare of this with shear stress, principle stress, Tresca stress, Von Mis stresses, bending moment, node displacement, and base pressure.

In this research, it is concluded that when  $L/B < 2$  then all the stress goes on negligible and whenever the  $L/B > 2$  then effect of all the stresses is increases with increasing L/B ratio.

4) N Farasat, A Farasat, AR Heysami, N Moridi

In this research, the designing of underground storage tank and non-underground storage tank were compared and it is found that the underground tanks gives better performance in terms of maximum displacement and stress against wall. In this research different parameters were studied like depth of underground tank, type of soil around the tank, the distribution of dynamic pressure by different fluids. The tension in the outer wall of the underground tank is very much low as compare to non-buried tank. Here for the seismic analysis El Centro earthquake record is applied in terms of time history. Here the dynamic pressure of the fluid is also calculated in the bottom of the tank.

From this research, the dynamic responses of the underground storage tank and above ground storage tank are used to be calculated, and underground storage tank gives better response than the above ground storage tank.

The main objective of this study is to examine the seismic response of the buried tank, half buried tank and visible tank, and also calculate the various dynamic responses of the tank.

5) Kalyani Vanjari, Dr. Prof. R. S. Talikoti

In this study, the aspect ratio is more important for the proper dimension of the water tank. In this studies the various effect of the aspect ratio of tank wall on seismic force and behavior of ground supported water tank. In this studies, the various aspect ratios to be adopted and according to the aspect ratio the dimension of tank to be decided with the same volume of tank. The static analysis and response spectrum analysis to be carried out in ETABS software. The comparison of aspect ratio with the time history on Impulsive mode and convective mode.

In this research paper, it is noticed that, as the increasing aspect ratio, the base shear value decreases, and this is happen because of reduced height of tank walls. The vertical bending moment decreases with the increase in aspect ratio of the tank so that subsequently increase the horizontal moment of the tank.

### III. OBJECTIVE

- To analyse the overhead water tank in different seismic zone condition.
- Compare the seismic analysis of overhead water tank in different software.
- To compare the design of water tanks in various loading conditions such as wind load, seismic load, water pressure load etc.
- To study the design of water tank by using IS Code 3370 (part 2) : 2009 and
- IS 1893 (part 2) : 2016
- To find out the dynamic response of these water tanks in terms of base shear, base moments, time period and maximum displacement.
- To identify hydrodynamic impact on water tank.

### IV. CONCLUSION

- Software analysis and design method approach has been proved to be best and economical approach by comparing the manual traditional approach to design a water tank.
- Soil type has a significant impact on soil-structural interaction. The softer soil cause greater stress around the walls of the tank. Soft soil show greater interaction compared to hard soil.
- Structural performance of water tanks depends a lot of factors such as fluid structure interaction, soil structure interaction, type of supports, wall flexibility, staging height, water fill conditions etc.
- The presence of soil around the tank is extremely effective in reduction of horizontal displacement and thus reduction of tension.
- Pressure inside and outside the tank leads to varying dimensions of tank.
- Economical size of tank minimizes the land area.

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