ISSN 2277 – 5528
Impact Factor- 4.015

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & MANAGEMENT

A REVIEW PAPER ON ANALYSIS OF ELEVATED WATER TANK IN HIGH SEISMIC ZONE BY USING STAAD PRO SOFTWARE

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ABSTRACT
Elevated water tanks are one of the most important structures in earthquake high regions. In major cities and also in rural areas elevated or overhead water tanks forms an integral part of water supply scheme. These structures has large mass concentrated at the top of slender supporting structure hence these structures are especially vulnerable to horizontal forces due to earthquake. Elevated water tanks that are inadequately analyzed and designed have suffered extensive damage during past earthquakes record. Hence it is important to check the severity of these earthquake forces for particular region. In this project presents the study of seismic performance of the elevated water tanks for high intensity seismic zones of India for various section of elevated water tanks for different circular shape(dome concrete floor, flat concrete floor). The effect of height of water tank in earthquake zones and section of tank on earthquake forces have been presented with the help of STAAD PRO software. We have comparatively analysis of various section of elevated water tank in the high intensity earthquakes zone and find the which section are most suitable in this region according to behavior of structure. And also consider the various type of forces on elevated tank and varius effect like that sloshing effect by using STAAD PRO software

Keywords: *seismic coefficient, staadpro*

I. INTRODUCTION
Elevated water tanks are used extensively by municipalities and industries for water supply, firefighting automatic systems, inflammable liquids and chemicals plant. Thus Water tanks plays a vital role for public utility as well as industrial structure having basic purpose to secure constant water supply from longer or shorter distance with sufficient static head to the desired location under the effect of gravitational force. With the rapid increase of human population, demand for drinking water has increased by many field. Also due to shortage of electricity at many places in India and around the developing nations, it is not possible to supply water through pumps at peak hours. In such situations elevated water tanks become an important part of life. India is highly vulnerable to natural disasters like earthquake, draughts, floods, cyclones etc. Majority of Indian states and union territories are prone to one or multiple disasters. These natural calamities are causing many causalities and huge natural property loss every year. According to seismic code IS 1893(Part-1):2000, more than 60% of India is prone to earthquakes. The main reason for life loss is collapse of structures It is said that natural calamities itself never kills people; it is badly constructed structure that kill or damaged property. Hence it is important to analyze the structure properly for different natural calamities like earthquake, cyclones, floods and typhoons etc. Past experiences revealed that elevated water tanks were heavily damaged or collapsed during earthquakes and this might be due to the lack of knowledge about the proper behaviour of supporting system of the tank against dynamic effect and also due to improper geometrical selection of staging patterns. Lateral force is more in tank full condition when compared to tank empty condition and hence tank full case is considered for seismic analysis. seismic analysis of liquid storage tanks and brought two main aspects such as, i) due consideration to sloshing effects and seismic effect of liquid and flexibility of container wall in evaluating seismic forces on tanks and ii) less or medium ductility and low energy absorbing capacity and redundancy of water tanks in comparison to conventional building systems. The main reason for life loss during earthquakes is the collapse of structures that aren't designed to resist the earthquakes of intensity that struck the region. Since the elevated tanks are frequently used in seismically active regions also, their seismic behaviour of has to be investigated in detail by using STAAD PRO software.

The maximum value of forces and moments obtained from STAAD Pro tells the maximum load to which the tank is subjected and thus critical. The check for critical members from STAAD Pro also reveals that the tank is stable for maximum forces and moments. Analysis of the structure means to determination of the internal forces like axial compression bending moment, shear force etc. in the component member for which the member are to be designed under the action of given external load and various effect of earthquake.

ISSN 2277 – 5528
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Objectives of Study

- To check which section are suitable for high intensity seismic zone .
- To check conduct of safety height of elevated water tank in earthquake zone.
- To check conduct of Effect of Seismic Zone on Base ShearTo check conduct of Effect of Seismic Zone on Base Moment
- To check Effect of Seismic Zone on Hydrodynamic Pressure
- To find out the which section are achieve economy

II. METHODOLOGY

Structural Layouts

The circular and circular with four compartment walls were considered to be propped cantilevers. Each of the propped cantilevers was made rigid fixed to it's base slab and was expected to be drawn inward at the top by the wall/top slab connecting reinforcements, in response to the outward hydrostatic loading on the wall. That was provide in view based on the fact that continuity reinforcement must be provided at corners and at member-junctions to prevent cracking. The base slabs was typically a double overhanging single-spanned continuous slab, with wall point load and its applied fixed end moment at each overhang end. And the top slabs was laid out to be either two-way spanning or simply supported as stated by Anchor (1992 and 1981). The tank dimensions was deduce by application related to the formula for solid shapes volume calculations, Therefore (π x R^2 x H) for cylinder was applied for the circular water tank; where, H and R, Breadth, Height and Radius respectively.

Wall Loading

The avg water force and load, P in kN / meter width of the rectangular tank walls under flexural tension was derived as a point concentrated load by calculating the areas of the pressure diagrams of the water tank content on the walls, to be (ρH) x H/2, where ρ is the water density. By the centroid consideration of loading of the pressure diagram, one-third distance from the base, up each wall, was chosen as the point of application of the concentrated load. The circular water tank wall would be clearly in a state of simple hoop tension and its amount in kN per meter height of wall would be (ρH) x D/2. And it would still act at one-third distance from the base up each wall. The wall total working loads for both options were assumed purely hydrostatic. And the inclusion of wind load in the working load was purely made to be dependent on tank elevation above the ground level, but would always be applicable in the design of its support. The wind loads application point, if considered, would be at one-half the tank"s height and acting against the lateral water force. Hence, the resultant lateral force, from the combination of the water force and wind force; if applicable, would be one-half way between the two forces, that is, five-twelfth of the tank"s height. For the purpose of this study, tanks elevated at 12 m and above were considered to be influenced by wind load.**2.3**

Base Slab Loading

For every of the elevated water tank options, the base slab characteristic serviceability uniformly distribute load in kN/m per meter was the sum of its dead load, theself-weight concrete and its finish, and its live load, that is, the weight of water to be contained. And the serviceability point load in kN / meter, acting on each of the base slabs, at the extremes of the overhangs was derived by adding up the wall dead load that is the base projection weight and a calculated fraction of the top slab load. But some notice difference may be experience in the calculations of the fractions of the loads from the circularwater tank top slabs.

Top Slab Loading

The top slab uniformly distributed load, in kN/m per meter run is calculate by adding up its combination of dead load, that is self weight concrete, waterproof finish and its live load, to derive the characteristic serviceability load. Factors of safety of 1.4 and 1.6 was apply to the combination of dead and live loads respectively before their sum is make to achieve the require ultimate design load of top slab.

III. DESIGN AND ANALYSIS OF WATER TANK

Numerical statement

A RC circular water container of *100* m3 capacity has outer diameter of *6* m and height of *3* m (including freeboard of *0.3* m). It is supported on RC staging consisting of *6* columns of *300* mm dia. with horizontal bracings of *300x300* mm at mid levels. Staging columns have isolated rectangular footings at a depth of 2m from ground level. Tank is

 ISSN 2277 – 5528
Impact Factor- 4.015

located on medium soil in seismic zone V. Grade of staging concrete and steel are M25 and Fe415, respectively. Density of concrete is *25* KN/m3. Analyze the tank for High seismic loads.

Solution:-Tank must be analysed for full water filled condition. Consider Zones V (as per IS 18*93:2002*) for analysis.

Tab. 1Constants Which Are Considered For Calculation

Sr. No.	Constant	Values	Remarks
1	Z	0.1	Structure assumed in Zone V
2	I	1.5	Importance Factor
3	R	5	Response Reduction Factor
4	M25		Grade of Concrete
5	Fe415		Grade of Steel

Tab. 2 Property for tank

Component	Size(mm)
RoofSlab	100thick
Wall	200thick
FloorSlab	200thick
Top slab Beam	150 x 150
Floor slab Beams	300x 500
Braces	300x 300
Columns	300dia.

Proposed Model For Elevated Water Tank With and Without Compartment

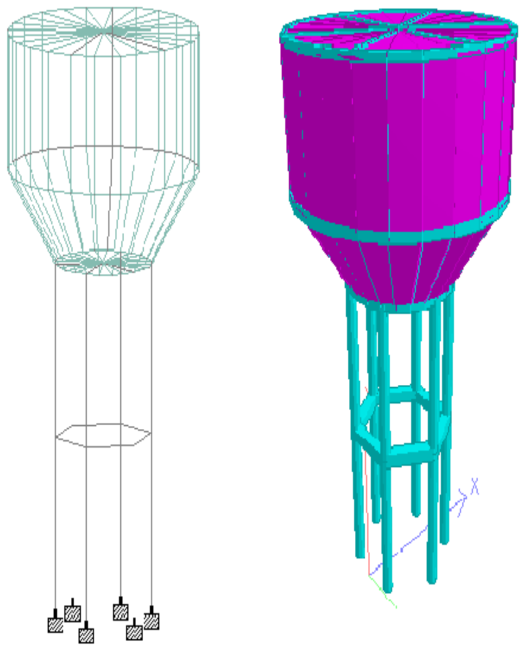

Fig.1. Proposed model for elevated water tank without compartment

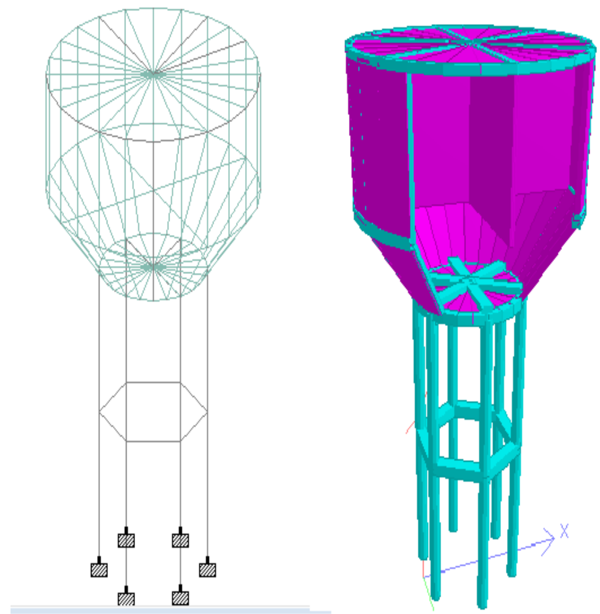

Fig. 2 Circular elevated tank model with compartment

IV RESULT AND COMPARISON

Stress In Member For Elevated Water Tank

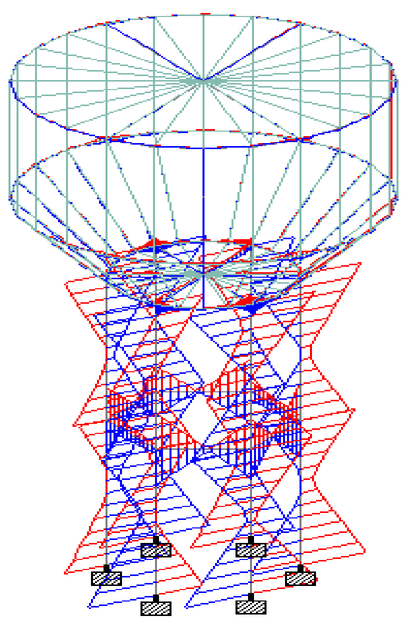

Fig. 3. Stress diagram for elevated water tank

ISSN 2277 – 5528
Impact Factor- 4.015

Tab. 3 Stress In Member For Elevated Water Tank

Stress In Column Due To Earthquke(223)	**Max. Compression(N/MM2)**	**Max.Tention (N/MM2)**
EQX+	8.989	-7.369
EQX-	7.369	-8.989
EQZ+	9.540	-8.605
EQZ-	8.605	-9.540
Stress In Bottom Slab Beam Due To Earthquke(53)	**Max. Compression(N/MM2)**	**Max.Tention (N/MM2)**
EQX+	0.803	-0.865
EQX-	0.865	-0.803
EQZ+	0.475	-0.437
EQZ-	0.437	-0.475
Stress In Top Slab Beam Due To Earthquke(140)	**Max. Compression(N/MM2)**	**Max.Tention (N/MM2)**
EQX+	0.006	-0.007
EQX-	0.007	-0.006
EQZ+	0.014	-0.014
EQZ-	0.014	-0.014

Displacement In Member For Elevated Water Tank

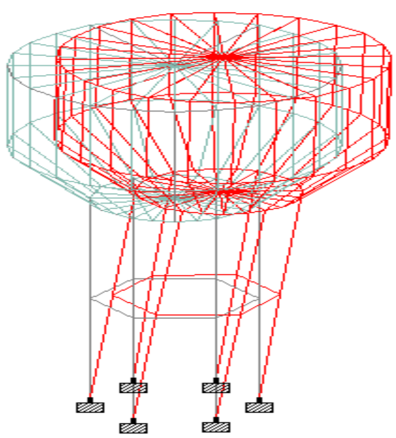

Fig.4 Displacement diagram for elevated water tank

ISSN 2277 – 5528
Impact Factor- 4.015

Tab. 4Stress In Member For Elevated Water Tank

Displacement In Column Due To Earthquke(223)	**Circular Tank**	**Circular Tank With Compartment**
	Displacement (Mm)	**Displacement (Mm)**
EQX+	0.805	0.750
EQX-	0.805	0.750
EQZ+	0.748	0.703
EQZ-	0.748	0.703
Displacement In Bottom Slab Beam Due To Earthquke(53)	**Displacement (Mm)**	**Displacement (Mm)**
EQX+	0.023	0.020
EQX-	0.023	0.020
EQZ+	0.015	0.014
EQZ-	0.015	0.014
Displacement in top slab beam due to earthquke(140)	**Displacement (mm)**	**Displacement (mm)**
EQX+	0.008	0.007
EQX-	0.008	0.007
EQZ+	0.004	0.004
EQZ-	0.004	0.004

V. CONCLUSION

Generally if the elevated water tank is excited due to seismic ground motion the displacement of water in the tank depends upon the volume of water contained in it. Elevated water tank with compartment reduce the sloshing effect & stress, deflection, deformations of the tank. In this project, emphasis is given on the study of the in-built feature of solving seismic coefficient method in STAAD.pro V8i. This method provide the values of moment and base shear, which are very much in agreement and correctly with the values of the manually calculated results.

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