"SEISMIC PERFORMANCE OF ELEVATED CIRCULAR WATER TANK FOR DIFFERENT CAPACITY AND ZONES"

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Abstract-

Storage reservoirs and overhead tank are used to store water, liquid petroleum, petroleum products and similar liquids. The force analysis of the reservoirs or tanks is about the same irrespective of the chemical nature of the product. All tanks are designed as crack free structures to eliminate any leakage. Due to these reasons this type of structures which are special in construction and in function from engineering point of view must be constructed well to be resistant against earthquakes.

For this purpose circular elevated water tanks of capacities 75 thousand and 1 lakh are considered to analyse under seismic forces. Heights of staging considered is 12m circular tanks for all the capacities. All the models are analysed for zoneII zone III, zone IV and zone V using Staad.Pro v8i software to study the seismic behavior of all the tanks the response parameters selected are lateral displacement, bending moments and base shear. Observation shows that the provision of circular water tank is suitable for low intensity zone. From the analysis result parameters deflection, bending moments and base shear of the water tanks increases from lower to higher zones because the magnitude of intensity will be more for higher zones. Present work provides good information on the result parameters deflection and base shear in the water tanks having different capacity.

Key Words:.

Water Tank, Square, Circular, Deflection, Base Shear

1.INTRODUCTION

Water tanks are used to provide storage of water for use in many applications, drinking water, irrigation agriculture, fire suppression, agricultural farming, both for plants and livestock, chemical manufacturing, food preparation as well as many other uses. Water tank parameters include the general design of the tank, and choice of construction materials, linings.

In certain area sufficient water distribution depends on the design of a water tank. Water supply depends on overhead water tanks for storage in our country as the required pressure in water supply process is obtained by gravity in elevated tanks rather than the need of heavy pumping facilities. Due to natural disasters like earthquakes, draughts, floods, cyclones etc Indian sub-continent is highly vulnerable. According to seismic code IS: 1893 (Part 1)-2002, more than 60% of India is prone to earthquakes. During earthquake for the failure of elevated water tanks it is most critical consideration that huge water mass is at top of a slender staging. Since, the elevated tanks are frequently used in seismic active regions also hence their seismic behavior has to be investigated in detail.

Based on the location of tank in a building, tanks can be classified into three categories

1. Tanks resting on ground
2. Underground tanks
3. Overhead tanks

Overheaded tank having the following types

1. circular
2. rectangular
3. intz

SEISMIC ZONES IN INDIA

The problem of designing economical earthquake-resistant structures rests heavily on the determination of reliable quantitative estimates of expected earthquake intensities in particular region. However, it is not possible to predict with any certainty when and where earthquake will occur, how strong they will be, and what characteristics the ground motions will have. Therefore, an Engineer must estimate the ground shaking. A simple method is to use a seismic zone map, where in the area is sub divided into regions, each associated with a known or assigned seismic probability or risk. To serve as a useful basis for the implementation of code provisions on earthquake resistant design. The present earthquake zoning map used in India shows the country divided into four zones of approximately equal seismic probability, depending upon the local hazards.

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2.PROBLEM FORMULATION & ANALYSIS

The object of the present work is to compare the seismic behaviour of elevated square and circular RCC water tanks having different capacities of storage. For this purpose square and circular elevated water tanks of capacities 75 thousand and 2 lakhs liters are considered to analyse under seismic forces. Heights of staging considered is 12m.All the models are analysed for zone I zone III, zone IV and zone V using Staad.Pro v8i software. To study the seismic behavior of both the tanks the response parameters selected are lateral displacement bending moments and base shear. Structural details of all the models are as follows: Size of circular water tank of capacity 75 thousand is diameter 6m and depth 3.5m. Size of circular water tank of capacity 1 lakhs is diameter and depth 3.5m.

Thickness of wall is 200mm.

Size of columns is 400mm x 400mm.

Size of beam at bottom of the tank is 400mm x 600mm. Size of tie beams is 300mm x 500mm at interval of 3m. Grade of concrete is M-30. Grade of steel is Fe-500.

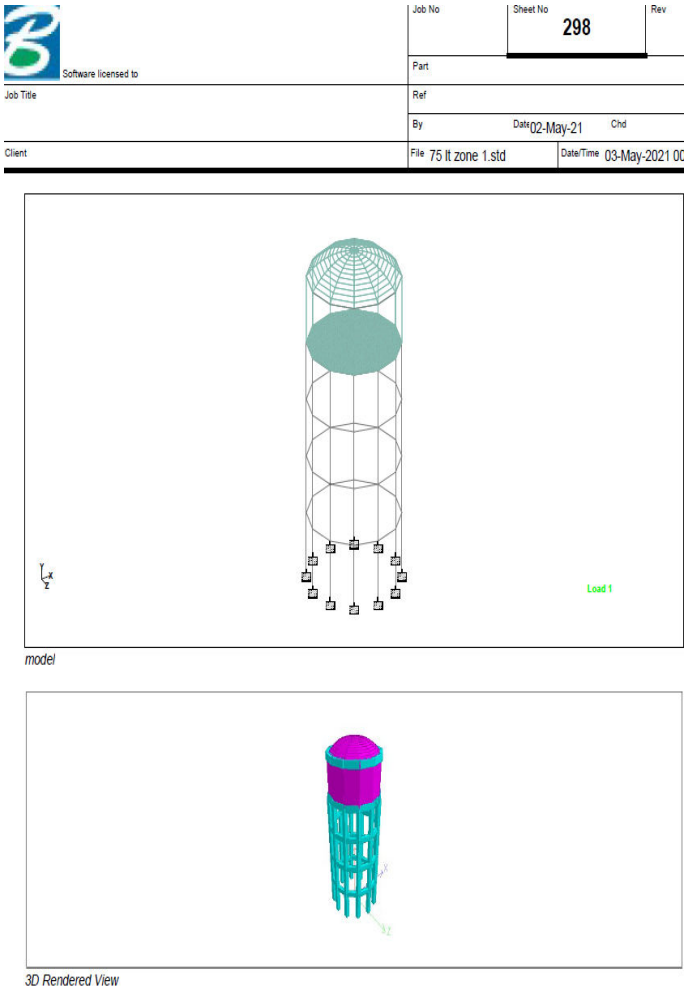

Fig. model and 3D rendered view

3. RESULTS AND DISCUSSIONS

The study examines the performance of circular water tanks having different storage capacities for seismic forces in zone II, zone III, zone IV and zone V. The results obtained from analysis are analysed and presented in graphical form. To study the effectiveness of all these models, the deflection, bending moments and base shear

A. ANALYSIS RESULTS OF 75 Lit. CAPACITY OF TANK.

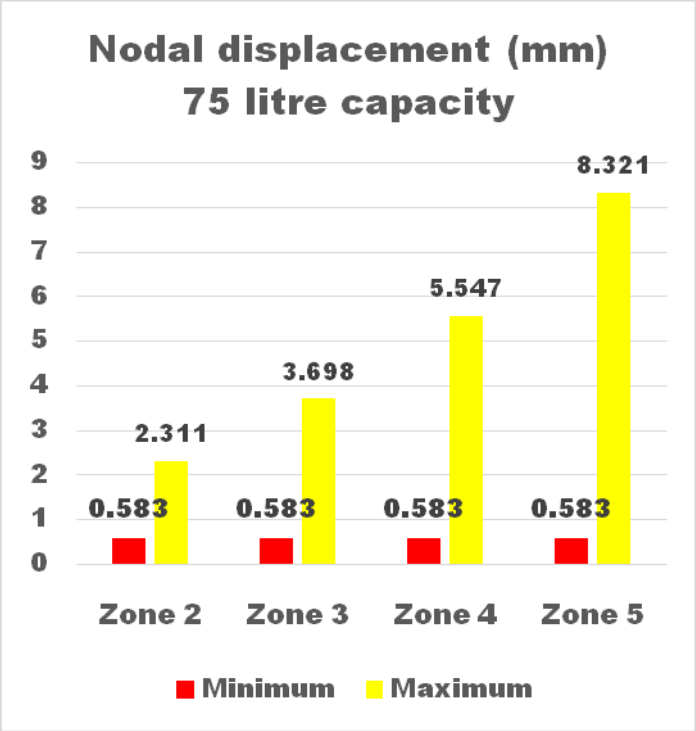

Fig1. Resultant nodal displacement of 75thousand capacity of tank

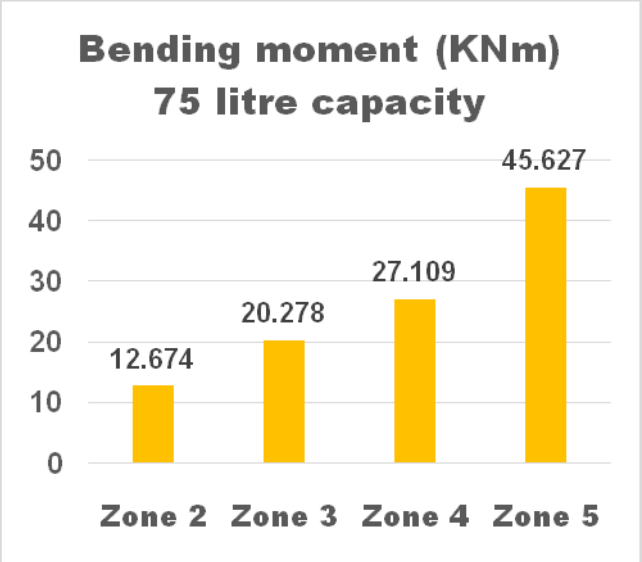

Fig3. Maximum bending moments of 75thousand capacity of tank

B. **ANALYSIS RESULTS OF 1 LAKH Lit. CAPACITY OF TANK**.

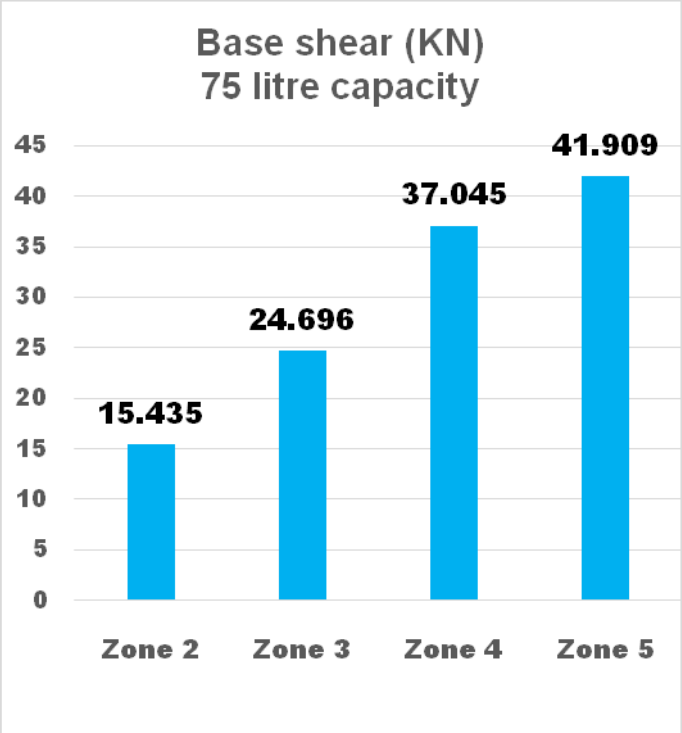

Fig2. Maximum base shear of 75thousand capacity of tank

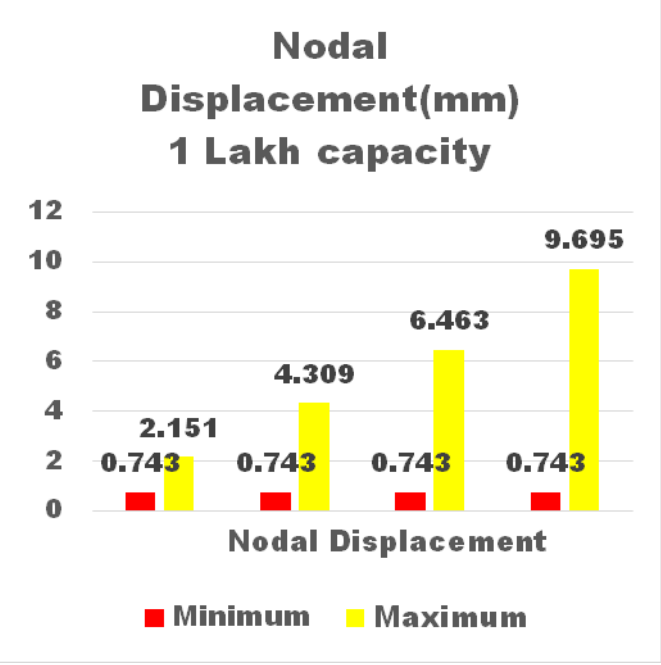

Fig4. Resultant nodal displacement of 1 lakh capacity of tank

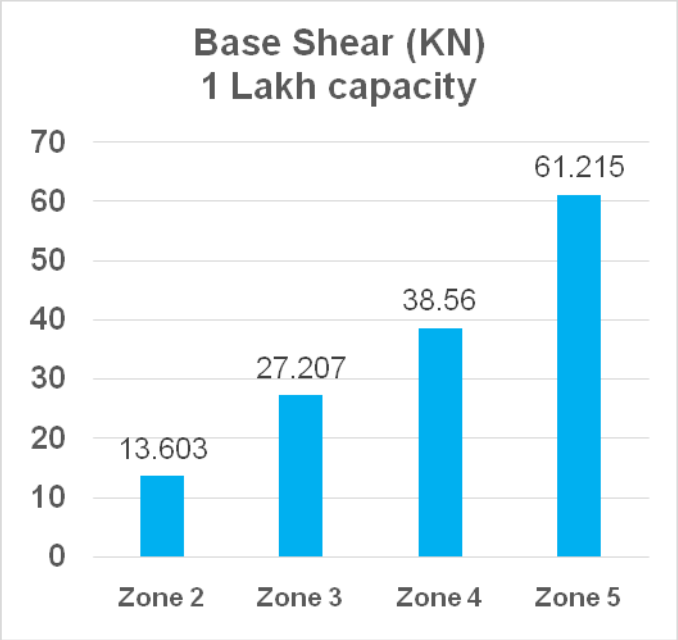

Fig5. Maximum base shear of 1 lakh capacity of tank

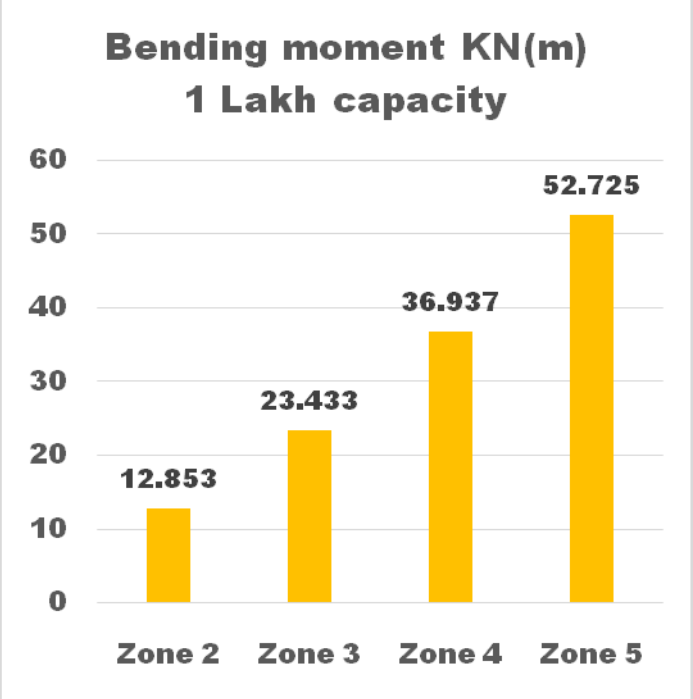

Fig6. Maximum bending moments of 1 lakh capacity of tank.

4. CONCLUSIONS

Within the scope of present work following conclusions are drawn :

1. For all the models deflection values, bending moment and base shear are less for lower zones and it goes on increases for higher zones.
2. 2.It is experienced in all the models for all zones that values of deflection and base shear are increasing as the capacity increases from 75 thousand litre to 1 lakhs litre.
3. The base shears and base moments increase with increasing zone factors.
4. Design of water tank is a very tedious method. Particularly design of elevated cylindrical water tank involves lots of mathematical formulae and calculation. It is also time consuming. Hence Staad – pro gives all results such as base shear, nodal displacement etc. from the analysis immediately.
5. Above all the models of analysis the mimimum nodel displacement is almost same but the maximum displacement is increases according to the zone.

REFERENCES :

1) 2010, Malhotra, Praveen, Wenk, Thomas, Wieland, Martin, “Simple procedure for seismic analysis of liquid-storage tanks”.

2) 2011, Konstantin Meskouris, Britta Holtschoppen, Christoph Butenweg, Julia Rosin, "Seismic Analysis of Liquid Storage Tanks".

3) 2012, Ayazhussain M. Jabar1, H. S. Patel, "Seismic Behaviour of RC Elevated Water Tank Under Different Staging Pattern And Earthquake Characteristics".

4) Gaikwad, M.V. (2013). "Comparison between static and dynamic analysis of elevated water tank". International Journal of Civil Engineering and Technology, 4(3), 2043-2052.

5) Gaikwad, M.V. (2013)."Seismic performance of Circular Elevated Water Tank with Framed Staging". International Journal of advanced research in Engineering and Technology, 4(4), 159-167.

6) 2013, L. Kalani Sarokolayi, B. Navayi Neya, J. Vaseghi Amiri and H. R. Tavakoli, "Seismic Analysis of Elevated Water Storage Tanks Subjected to Six Correlated Ground Motion Components".

7) 2013, Syed Saif Uddin, "Seismic Analysis of Liquid Storage Tanks".

8) 2014, S. K. Jangave, Dr. P. B. Murnal, "Structural Assessment of Circular Overhead Water Tank Based on Frame Staging Subjected to Seismic Loading".

9) 2015, Jay Lakhanakiya, Prof. Hemal J. Shah, "A Parametric Study of an Intze Tank Supported On Different Stagings".

10) 2015, Pradnya V. Sambary, D.M. Joshi, "Seismic Analysis of RC Elevated Water Tanks"

11) 2015, Rupachandra J. Aware, Dr. Vageesha S. Mathada, "Seismic Analysis of Cylindrical Liquid Storage Tank".

12) 2016, Ankush N. Asati, Dr.Mahendra S.Kadu, Dr. S. R. Asati, "Seismic Analysis and Optimization of RC Elevated Water Tank Using Various Staging Patterns".

13) 2016, Sivy Martin, Musil Milos, "Seismic Resistance of Storage Tanks Containing Liquid in Accordance With Principles of EUROCODE 8 Standard".

14) 2017, A. C. Chougule, P. A. Chougule, S. A. Patil, "Study of Seismic Analysis of Water Tank at Ground Level".

15) 2017, Mayank Gopal Manwani1, Deepa P. Telang, "Review on Seismic Analysis of Elevated Water Tank with Variations of H/D Ratio and Container Shape".

16) 2017, Nimmy Sen Sebastian, Dr.Abey.E.Thomas, Jency Sara Kurian, "Seismic Analysis of Elevated Water Tank In A Framed Building".

19) IS 456-2000 Code for plain and reinforced concrete.

20) IS 3370-1965 Code for concrete structures for the storage of liquids

21) IS: 11682 -1985."Criteria for Design Of Rcc Staging For Overhead Water

Tanks", Bureau of Indian Standards, New Delhi.

22) IS:1893(Part-2)-2002."Criteria for Earthquake Resistant Design of Structures Part 2 Liquid Retaining Tanks", Bureau of Indian Standards, New Delhi.