International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 04 | Apr 2022 www.irjet.net p-ISSN: 2395-0072

"Wind Analysis on Elevated Steel Water Tank with Different Shape Tanks"

Ritu V. Markam[1], Prof. V. D. Vaidya[2]

[1]M.Tech student, KDK college of Engineering, Nagpur, Maharashtra, India
[2]Assistant Professor, KDK college of engineering, Nagpur, Maharashtra, India

---

Abstract - *Elevated steel water tanks are one of the most important in the daily requirement. They are vital component in municipal water system, firefighting systems and in many industrial facilities for storage of water. Present study deals with the comparative analysis of two basic shapes of water tank, Square and Circular shape tank. The parametric study suggests that the elevated circular tanks perform better than elevated square tank. Objective of this paper is to understand the behavior of elevate steel water tanks under wind loading.*

Key Words: **Elevated steel water tank, Circular, Square, Wind Analysis, STAAD- PRO**

1. INTRODUCTION

An elevated water tank is a large water storage container constructed for the purpose of holding water supply at certain height to provide sufficient pressure in the water distribution system. The elevated water tank is also known as a water tower. The function of water tower is to pressurize water for distribution. The columns and braces are critical parts so this has to be designed carefully for the wind and earthquake loads. It mainly depends upon the soil condition and dynamic characteristics of the structure. An elevated water tank is important structural aspect used for the water resources for distribution of water with high pressure. It is very necessary for the industrial and factories for the storage of liquid especially in chemical factories.

The steel tank remains totally water tight, when appropriately caulked, while the tank will ceaselessly give inconvenience by spilling. The life of the steel water tank is more than two -fold that of wooden tank. The water tank contains the foundation, column tank and water. The load of water is supported by tank and there both load supported by columns and all these elements will depend on the foundation. The standard code of India IS 875 (part -3) 2015 is used.

1.1 Definition of elevated water tank

An elevated water tank is a container for storing water. The need of a water storage tank is as old as civilization. Providing storage of water for drinking water, agricultural, farming, irrigation agriculture, fire suppression, chemical manufacturing, food preparation as well as many other applications.

1.2 Configuration of tank

An elevated water tank is like exposed structure. Its super structure suitably shaped, dimensioned and designed to sustain the external loads acting on the tanks of the super structure itself. The super structure elevated water tank has a tank supporting with columns and ring beam. The load of water is supported by columns and all these elements will depend on foundation.

Two types of tanks considered for same height as given below

- Square Tank
- Circular Tank

1.3 Aim and Objectives

The aim of the study is to analyse the behaviour of elevated steel water tank with different shape and same height subjected to wind loading.

1. The different shapes like square and circular shapes of water tank are done at medium soil condition.
2. The height of tank is 2.5m considered same for both tanks.
3. To perform wind analysis for square and circular elevated steel water tank for seismic zone III.
4. To compare various parameters such as axial force, shear force and bending moment.
5. To compare the results between square and circular elevated water tank.
6. To find the most efficient container shape.

2. LITERATURE REVIEW

Various Literatures have been studied related to present topic from all this literature study it is found that there is a need of more study to be performed on tank shape based on their geometric shapes. Various literature have been studied and referred are listed in reference section.

3. METHODOLOGY

In this research, STAAD-PRO software is used for the modelling and analysis of elevated steel water tank in medium soil subjected to wind load.

4. LOADS CONSIDERED

4.1 Dead Load

The dead load in a tank includes the self-weight of the structure and all other superimposed dead loads.

4.2 Water Pressure

The water pressure is triangular or uniformly varying load which is zero at the top and maximum at the bottom of the water tank.

4.3 Wind Load

Wind load calculations as per IS 875-part3-2015
Basic wind speed (Vb) = 39m/s
Probability factor (k1) =0.97
Terrain category & height factor (k2) =1
Topography factor (k3) = 1
Cyclone factor (k4) =1
Design wind speed (Vz) = Vb*k1*k2*k3*k4 = 37.83 m/s
Design wind pressure (Pz) = 0.6*(Vz)2 = 0.8586 KN/m2

5. MODEL DESCRIPTION

1. Structure - water tank
2. Types - Square and Circular
3. Height – 2.5m
4. Capacity – 70,000 Liters
5. Soil Type – Medium soil
6. Unit weight of Water (Density) – 10 kN/m3
7. No. of columns – Square -4, Circular – 6
8. Staging height – 8.34 m
9. Bracings – Cross Bracings
10. Material – Steel
11. Supports – Fixed support
12. Thickness of tank plates – 16mm

Square water tank having the dimension 5.3m x 5.3m with height 2.5m. Similarly Circular water tank having the diameter 5.96m with height 2.5m respectively. The 3D model is done for the analysis and it is considered load pattern accordingly to Indian standards with dead load and water load.

Following are the 3D view of Square elevated water tank and Circular elevated water tank.

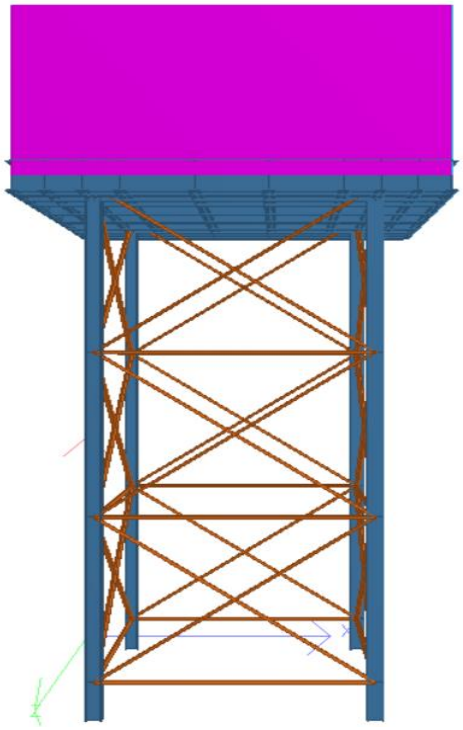

Fig. 01 3D view of Square tank

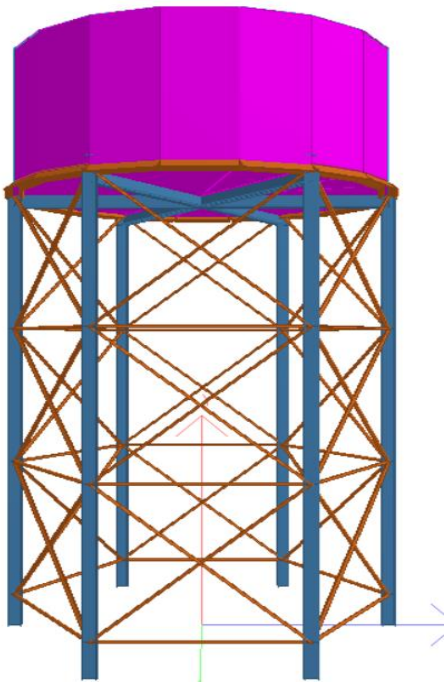

Fig. 02 3D view of Circular tank

6. RESULTS AND COMPARISON

After analysis various models following results were obtained.

Table -1: Result comparison of all models in zone- III

Sr. no.	Model	Max Axial force (kN)	Max Shear force (kN)	Max Bending Moment (kN-m)
1	Square	411.553	178.753	150.22
2	Circular	282.544	11.78	27.921

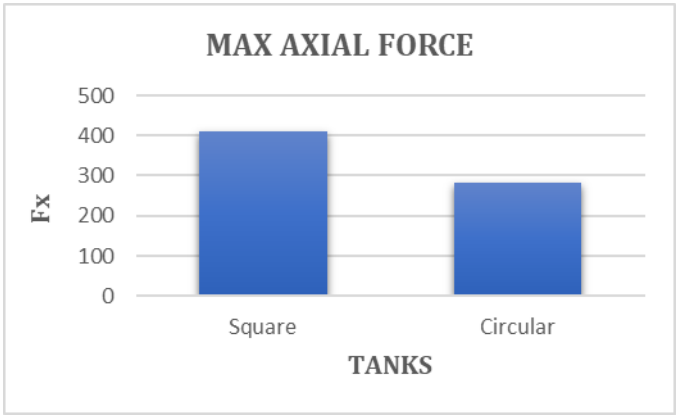

Fig. 03 Comparison of max axial force

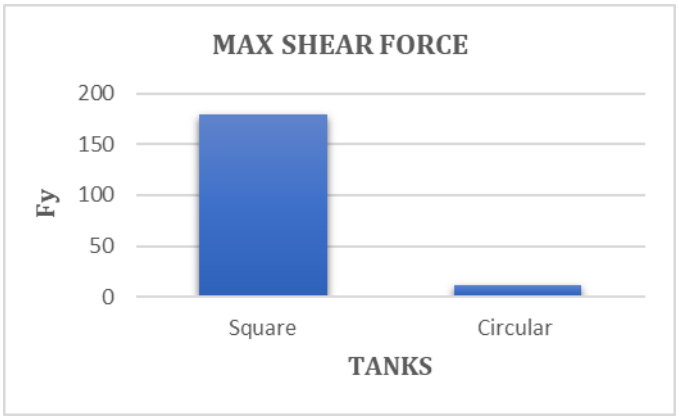

Fig. 04 Comparison of max shear force

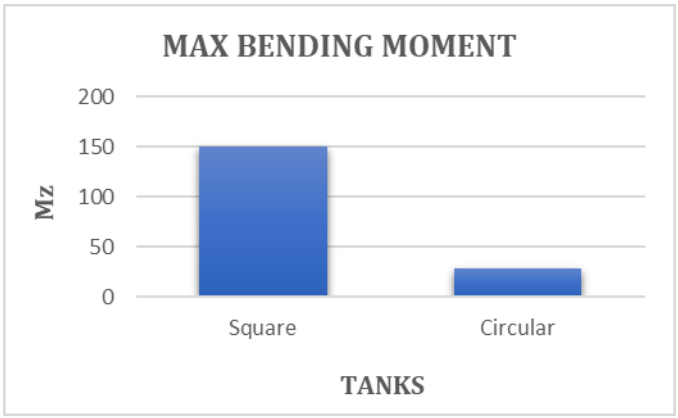

Fig. 05 Comparison of max bending moment

7. CONCLUSIONS

The conclusions are drawn by studying the graphs of the comparison between square and circular tanks. The following observation are made based on the results.

Wind analysis results shows that, when compared to square tank & circular tanks shows minimum axial force, shear force & bending moment. It indicates circular tank is more effective than square tank.

REFERENCES

[1] Book refer by – Ramchandra (pg.no. 400)

[2] IS 800:2007, "Code of practice for General Construction in Steel Structures"

[3] IS 875 (part 1):1987 "Code of practice for design loads (other than earthquake) for buildings and structures", dead loads

[4] IS 875 (part 2):1987 "Code of practice for design loads (other than earthquake) for buildings and structures", imposed loads

[5] IS 875 (part 3):2015 "Code of practice for design loads (other than earthquake) for buildings and structure", wind loads-

[6] IS 1893 (part 1):2016, "Criteria for Earthquake Resistant Design of Structures"

[7] Kuldevendra Patel "Wind and seismic analysis of elevated water tank using staad pro" international research journals of engineering and technology published on Oct 2018.

[8] Okonkwo V.O, Udemba J. N, Eze J.E. "Comparative analysis of different design models of overhead strorage steel tank (30,000litres) capacity" International Journal of Advance Engineering and Research Development published on Nov 2016.

[9] Aatish Kumar, R.K. Pandey, C.S. Mishra "Wind Effects on Overhead Tank under Different Soil Parameters" International Journal of Engineering and Advanced Technology published on Aug 2013.

[10] Dona Rose K J, Sreekumar M, Anumod A S "A Study of Overhead Water Tanks Subjected to Dynamic Loads" International Journal of Engineering Trends and Technology published in Oct 2015.

[11] Gaikwad Madhukar V., Prof. Mangulkar Madhuri N. "Comparison between Static and Dynamic Analysis of Elevated Water Tank" International Journal of Scientific & Engineering Research published in Jun 2013.

[12] Gaikwad Madhukar V., Prof. Mangulkar Madhuri N. "Comparison between Static and Dynamic Analysis of Elevated Water Tank" International Journal of Scientific & Engineering Research published in Jun 2013.

[13] Yash Chouhan, Dr. Swati Ambadkar "Comparative analysis of water tank with varying container shape" international research journals of engineering & technology published on July 2021.

[14] Mrs. Kalyani Ravindra Bachhav, Dr. D.P. Joshi "Dyanamic analysis of elevated water tanks" international journal of research in Engineering and technology published on Oct 2020.

[15] Tejaswini R, Mamatha A "Design and analysis of elevated water tank" international research journals in engineering and technology published on Aug 2020.