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Reviw Paper on Comparision of Elevated Water Tank with Different Type of Bracing for Wind and Seismic Load

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ABSTRACT
Overhead water tank is a water storage facility supported by a tower and constructed at an elevation to provide useful storage and pressure for a water distribution system. Safety as well as working of such structures is considered as very crucial during earthquakes, since they put up for necessities like drinking water, firefighting during fire accidents. This seismic analysis of overhead water tank structure cannot be carried out on the basis of maximum value of ground acceleration because of nonavailability of ground acceleration data at every location. Hence for seismic analysis of overhead water tank, earthquake response spectrum analysis is widely used.

While using this method, smooth design spectra is used to determine the value of displacement and forces in members at every mode of vibration. Hence for seismic analysis of overhead water tank, earthquake response spectrum analysis is widely used. While using this method, smooth design spectra is used to determine the value of bracing are used to analyze the structure under all seismic zones. Also observed the behavior of tank for cyclonic region where wind load is increased by 30%. Analyzed the overhead water tanks of same capacity for different bottom dome deviation angles and concluded. The commercial software STAAD.PRO is used for structural analysis.

Keywords: Bracing frame system, STAAD-PRO, Water Tank Bracing.

1. INTRODUCTION
In this thesis we are going to analyse elevated water tank and their different type of bracing which is usually required for water tank frame structure and in this structure we are calculating the load calculation on overall tank with frame and different types of bracing which is suitable of structure for earthquake load and wind load according to IS codes for the water tank structure for seismic and wind loads we will analyses by response spectrum method on STAAD pro software. We will also design horizontal beams on bottom side of water tank for better stability with different types of bracings and will calculate the loads accordingly.

All over the world, liquid storage tanks are widely used by municipalities and industries for water supply, 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 behavior 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 and wind analysis.

2. LITERATURE REVIEW
Venkata Raju Badanapuri [1] (2021) examined the Analysis and Design of Elevated Water Tank
based on Normal Frame Staging Subjected to Seismic Loading by Using Staad Pro Software. The seismic analysis of elevated tank is designed for population of around 5,926 people. 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. The moments are high for the tank with full water condition in seismic Zone IV, compare to another for tank with full water condition in seismic zone III.hese structures have large mass concentrated at the top of slender supporting structure hence these structures are especially vulnerable to horizontal forces due to earthquake. In this research by performing the seismic analysis of Intez elevated tank, what is deflection shape due to hydrostatic pressure then stresses, are analyses. Elevated Intez water tanks that are inadequately analyzed and designed have suffered extensive damage during past earthquakes record. It is observed that the Limit State Design of Reinforced Concrete Elevated Intez water tank by using STAAD PRO Software. The moments are high for the tank with full water condition in seismic Zone IV, compare to another for tank with full water condition in seismic zone III. failure modes of axial force are dominant in this reservoir Elevated Intez tanks allow the natural force of gravity to produce consistent water pressure throughout the system.

Soheil Soroushnia1, Sh. Tavousi Tafreshi2, F. Omidinasab3, N. Beheshtian4 , Sajad Soroushnia [2] (2021) Research compares the Seismic Performance of RC Elevated Water Tanks with Frame Staging and Exhibition Damage Pattern in In this paper, a sample of a reinforced concrete elevated water tank, with 900 cubic meters under one earthquake record have been studied and analyzed using dynamic time history analysis. It was determined which failure modes of shear forces in beams and also, failure modes of axial force are dominant in this reservoir.it specified that the failure modes of reinforced concrete elevated tanks with frame staging are shear and bending modes in beams, axial mode in columns, cracks in joints and torsion mode. The different paths of load transferring and beam to column connections integrating cause which this sort of column has a good seismic behavior. In designing such columns, it must

prevent creating plastic hinges. By numerical studies in a reinforced concrete elevated tank with a capacity of 900 cubic meters, it was determined which failure modes of shear forces in beams and also, the failure mode of axial force are dominant in this reservoir. The results showed that there is a good implementation of numerical studies with field studies.

Kulvendra Patel [3] (2018) The thesis of Wind and Seismic Analysis of Elevated Tank using Staad Pro for elevated water - Any project of water tanks is subject to live load, dead load and wind load or seismic load according to IS codes of conduct. In this study the wind forces and the seismic force acting on the raised water tank are studied. The standard code of India IS 1893-2000 and IS 875 (part 3) 2003 for seismic and wind effects is used in this study. Most often, tanks are designed for wind forces and the result outcome this literature, In this work we tested the analysis and design (Response Spectrum Analysis and Time History Analysis) of a high water tank using STAAD.Pro V The project involves the analysis of the entire structure by STAAD.Pro and the analysis of the response spectrum provides the displacement, the bending moment, the axial force, the torsion values and the cutting force. The quantity of concrete and steel required for construction of frame type staging is less than shaft type staging. The Eigen solution thus obtained helps to determine the base shear, conclusions (for Response Spectrum Analysis, Time History Analysis) are based on research and analysis performed by STAAD.Pro software, and get the result about wind and seismic analysis.

Ayush, Dr. Amritpal Singh [4] (2014) performed Performance study of Different Staging Patterns on Elevated Intze Tank according to IS 1893 (Part –II) 2014. This research paper compares the performance of Elevated Intze water tanks with the different staging patterns in context of their 1] Base shear 2] Overturning moments 3] Stress variations 4] Area of Steel. The design basis furnished in IS 1893-1984 for elevated water tanks are based on one-mass idealization of elevated water tanks which is not appropriate for large (large width to depth ratio) and partially filled tanks. Also the design features of this standard lead to very weak and slender support system which renders the superstructure quite vulnerable in the high seismic area. Also the seismic forces so suggested by this standard are the same as that for the most ductile building framing system..By numerical studies in a reinforced concrete elevated tank with a capacity of 900 cubic meters, it was determined which failure modes of shear forces in beams and also, the failure mode of axial force are dominant in this reservoir. The results showed that there is a good implementation of numerical studies with field studies. The increment in base shear is much higher in case of combined loading for all the three type of tanks.

Shubham Gotavade, Sankesh Gawade, Rahul Dhuri, Jamaluddin Maghrabi, Priyanka Salunkhe [5] (2021) For storage of large quantities of liquids like water, oil, petroleum, acid and sometime gases also, containers or tanks are required. These structures are made of masonry, steel, reinforced concrete and pre-stressed concrete. Out of these, masonry and steel tanks are used for smaller capacities. The cost of steel tanks is high and hence they are rarely used for water storage. Reinforced concrete tanks are very popular because, besides the construction and design being simple, they are cheap, monolithic in nature and can be made leak proof, Since, the quantity of concrete and steel required for construction of frame type staging is less, the total cost of materials will be ultimately lesser than shaft type staging. Hence, frame type staging being the economical type of staging system. 3. Base shear for tank supported on concrete shaft staging is more than that of tank supported on frame type staging. 4. Base moment is also greater in case of tank supported on shaft type staging. The Intze tank will be supported on two different types of staging viz. shaft type staging and frame type staging. Both the designs will be carried out manually. The concrete design is done as per codal provision of IS 3370-2(2009) taking seismic and wind loads into account as per IS 1893-1(2002) and IS 873 part-3.This paper deals with the designing, analysis and construction cost estimation of RCC elevated service reservoir (Intze type) with two different types of staging system viz. frame type staging and shaft type staging system. Hence, in region of higher seismic intensity, shaft type staging is more vulnerable than frame type staging.

Affan M, Ashfak Aakhunji, Keval L Vanpariya [6] (2019) In this paper, at first by studying the losses occurred in water tanks during past earthquakes and the reasons for these occurred damages, the analysis was done for different staging patterns to overcome these damages in these structure in coming future. It was determined while comparing different staging patterns that X type of frame staging have shown better seismic behavior to the resistance against lateral loads as they reduces most of displacement and time period but it increases the base shear due to the increase in volume of concrete.The external staging to be used in our study are as follows; 1) Without External Bracing, 2) “X” type Bracing, 3) Diagonal Bracing, 4) Chevron Bracing, 5) Global Bracing, 6) “K” Type Bracing, 7) “V” Type Bracing.The parametric study shows that ‘X’ type of bracing system is most effective to reduce top storey displacement, where Chevron type is least effective for same parameters, in case of 6-storey tank. – Similarly, in case of 5-storey tank, ‘X’ type is most effective and ‘V’ type is least effective to reduce top storey displacement. – Study of time period parameters shows that ‘X’ type is most effective to reduce time period and ‘V’ type is least effective to reduce time period in case of 6-storey tank and 5-storey tank.

Nyabuto Onderi Andrew, Siphila Wanjiku Mumenya [7] (2022) This paper Effect of Shaft Height on Base Shear of Elevated Intze Water Tanks The dynamic wind pressure analysis was carried out as per the American Institute stand ASCE-7, 2010 in which the impulse and convective pressure vary and are assumed hydro statically on tank walls. The tank RCC analysis was also done in STAAD.Pro. V8i as per Indian standard IS:456 for reinforced concrete works. Variation in the base shear forces was observed for both tanks to increase from 289.94 kN to 362.98 kN for 10 m to 16 m shaft height. Many scholars have presented the literature on reinforced concrete in technical papers for staging fluid towers. Distribution is the key interest in the required head for distribution of liquids as is fairly achievable by using gravity. Dynamic and static analyses are both subjected to framed and shaft supported towers establishing the liquid sloshing effect response Increasing staging of an elevated Intze Tank shaft results in a direct increase in base shear hence foundation design should change relatively. ii) The change in base shear is non-linear despite the defined height interval increase in the

shaft height. iii) The equivalent static analysis does not provide clear distinctions of seismic, wind and hydro static pressure in analysis thus idealize on dynamic analysis.

Gaurav s. Atalkar , anand m.Gharad [8] (2014) The main aim of this study is (i) to understand the behavior of different staging, under different loading conditions (ii) to strengthen the conventional type of staging during earthquake. Seismic coefficient method, for five different types of bracing patterns, is applied to the staging of elevated circular water tank in zone IV, is carried out using STAAD Pro. V8i. In this paper, emphasis is given on the study of the inbuilt feature of solving seismic coefficient method in STAAD.pro V8i.

This method provides the values of base shear, which are much agreement with the values of the manually Comparison of base / storey shear and nodal displacements of the container of circular water tank for empty, half filled and full condition is done. Alternate diagonal bracing pattern for staging, yields the optimum value of base shear and displacement, compared to other patterns that are studied. To understand the behavior of different staging, under different loading conditions, to strengthen the conventional type of stagings. It is clear that the base shear value, reduces for alternate bracing pattern in staging. This is apparent because of the reduction of overall stiffness of the structure. Though it is evident that alternate cross bracing pattern gives the minimum value of displacement, but from the construction point of view and economy of overall construction,

Tejaswini. R. Mamatha. A. [9] (2020) There is Design and Analysis of Elevated Water Tank The Elevated rectangular RC water tank designed under limit state design method and analysis carried out for the empty tank, full tank condition using linear static analysis (equivalent static method) and linear dynamic analysis (response spectrum method) using ETABS Software. As per the results the area of steel required for the structure increases in limit state method. The limit state method provides more effective reinforcement and it is economical. Water tanks are widely used for storing potable drinking water. In the current situation there is more emphasis on the water storage project around the world due to lack of water that is spreading. Water plays a very important role in everyday life, so water storage is very important. Axial forces are increased in the fully tank condition compare with the empty tank conditions. the increased values in full tank condition are very small varying compare to empty tank. 5. The critical response of elevated water tanks does not always occur the same conditions as mentioned above, it may vary also due to depending on the earthquake characteristics. From the results we conclude that base shear and base moment for empty tank condition is more compare to full tank condition. Because of water tank is empty hence no water pressure from inside, only earthquake forces are acting from outer side only. Hence more base shear and base moment in empty tank condition.

Yash Chouha]n , Dr. Swati Ambadkar [10] (2021) Comparative Analysis of Water Tank with Varying Container Shape We all know that water is the most vital requirement of human being for better livelihood. As the population is growing day by day in our country with rapid speed it is the need of time to study on storage capacity and shapes of storage tanks. Present study deals with the Comparative analysis and design of three basic shapes of water tank, Square, Circular and Rectangular. After analyzing all models it is found that Square and Rectangular shape tank gives better results than circular shape tank. The performance of elevated water tanks during earthquakes is of much interest to engineers, not only because of the important of these tanks in controlling fires, but also because the simple structure of an elevated tank is relatively easy to analyse In high seismic zone square and rectangular tank behaves better than circular tank both square and rectangular shape tank gives lower values of displacement, base shear and quantity of reinforcement compared to circular shaped tank Framing Building without any load resisting system shows highest drift on conventional frame structure / bare frame building, when compared to diagrid system. They give sufficient efficiency to lateral loads considering the fact that all vertical columns have

_____ been eliminated as compared to the bare frame. The diagrid structural system exhibits superior lateral load resistance as a result of its diagonal columns of building situated on the periphery.

In traditional construction, the inner and outer columns are engineered to withstand both vertical and horizontal forces. Then the conclude that's the diagrid building frame structure give more aesthetic look and gives more interior space due to less columns and façade of the building can also be planned more efficiently. Diagrid buildings exhibit superior aesthetic when compared to traditional buildings making them a crucial for high-rise structures.

3. CONCLUSION

The literature review presented above demonstrates a comparative analysis n low seismic Zone square and rectangular tank gives better results than circular shape water tank 2) In high seismic zone square and rectangular tank behaves better than circular tank 3) both square and rectangular shape tank gives lower values of displacement, base shear and quantity of reinforcement compared to circular shaped tank

• In parametric study for 6-storey & 5-storey structure, both type of structure shows the same behaviours for increasing base shear and decreasing top storey displacement and time periods, from that study it is advisable to make 5-storey structure with suitable bracing patterns.

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