ANALYSIS AND DESIGN OF INTZE WATER TANK BY USING STAAD PRO

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Abstract:

This study focuses on the design and analysis of Intze water tanks for different seismic zones using Staad Pro. Intze tanks are commonly used for storing water in areas with limited space, and their unique design makes them well-suited to withstand seismic loads. However, designing Intze tanks for seismic zones requires careful consideration of the design parameters, material properties, seismic coefficients, and response spectra. The study outlines the design process for Intze tanks using Staad Pro, including selecting the appropriate material, determining the seismic zone, performing the structural analysis, designing the tank, checking for stability, and detailing the reinforcement. The specific considerations for designing Intze tanks for different seismic zones are also discussed, such as choosing appropriate material properties, selecting appropriate response spectra, considering soil properties, and designing for ductility. A safe and durable Intze tank can be constructed for different seismic zones by following a rigorous design process and accounting for all relevant factors. The study provides valuable insights into the design and analysis of Intze tanks using Staad Pro, which can be useful for engineers and designers involved in water storage projects.

INTRODUCTION:

General

Overhead tanks and storage reservoirs are used to store water, liquid petroleum and similar liquids. The reservoir is a general term used for liquid storage structure and it can be below or above the ground level. Reservoirs below the ground level are normally built to store large quantities of water. The overhead tanks are supported by the column which acts as a stage. These elevated water tanks are built for the direct distribution of water by gravity flow and are usually of smaller capacity. It is also essential to ensure that, requirements such as water supply is not hampered during an earthquake and should remain functional in the post-earthquake period. In such situations, the elevated tanks may prove most handy tool for the purpose of water distribution and fire protection. In the construction of concrete structure for the storage of waterand other liquids the imperviousness of concrete is most essential. Thepermeability of any uniform and thoroughly compacted concrete of given mix proportions is mainly dependent on water cement ratio. The increase in water cement ratio results in increase in the permeability. The decrease in water cement ratio will therefore be desirable to decrease the permeability, but very much reduced water cement ratio may cause compaction difficulties and prove to be harmful also. The profile of water tanks begins with the application parameters, thus the type of materials used and the design of water tank was dictated by these variables: 1. Location of the water tank (indoors, outdoors, above ground or underground). 2. Volume of water tank need to hold. 3. Temperature of area where will be stored, concern for freezing. 4. Pressure required delivering water. 5. The water distribution to be delivers to the water tank. 6. Wind and earthquake design considerations allow water tanks to survive seismicand high wind events. Throughout history, wood, ceramic and stone have been used as water tanks. These were all naturally occurring and manmade and some tanks are still in service. There are many custom configurations that include various rectangular cubes shaped tanks, A functional water tank/container should do no harm to the water is susceptible to a number of ambient negative influences, including bacteria, viruses, algae, changes in pH, and accumulation of minerals. 2 Correctly designed water tank systems work to mitigate these negative effects. Intze type tank is commonly used overhead water tank in India. INTZ type water tank is one such water tank which has circular shape with a spherical top and conical slab with spherical dome at the bottom. In this type of water tank, the inward forces coming from the conical slab counteract the outward forces coming from the bottom dome which result less stress on the concrete bottom slab of the water tank. Due to lesser stresses, the thickness of the concrete bottom slab reduces and reducing the amount of concrete required which has direct influence on the cost of the water tank. Presently large number of overhead water tanks is used to distribute the water for public utility. They often become landmarks on the landscape. It is therefore important that the shape and form of the container and the supporting structure must receive due attention from the point of aesthetics. Water storage tanks should remain functional in the post-earthquake period to ensure potable water supply to earthquake affected regions and to cater the need for fire-fighting demand. Industrial liquid containing tanks may contain highly toxic and inflammable liquids and these tanks should not lose their contents during the earthquake. During the earthquakes, a number of large elevated water tanks were severely damaged whereas others survived without damage. An analysis of the dynamic behavior of such tanks must take into account the motion of the water relative to the tank as well as the motion of the tank relative to the ground. 1. Determine the design parameters: The first step is to determine the design parameters such as the capacity of the tank, the height of the tank, and the diameter of the tank. 2. Select the appropriate material: The material used for the construction of the Intze tank should be chosen based on the design parameters and the seismic zone. Common materials used for Intze tanks include reinforced concrete, steel, and masonry. 3. Determine the seismic zone: The seismic zone in which the tank will be constructed should be determined based on the location of the tank. Different seismic zones have different seismic coefficients and response spectra that should be considered during the design process. 4. Perform the structural analysis: Using Staad Pro, perform a structural analysis of the tank for the selected seismic zone. The analysis should include the dead load, live load, and seismic load on the tank. 5. Design the tank: Based on the results of the structural analysis, design the Intze tank. The design should take into account the material used, the seismic zone, and any other relevant factors. 6. Check for stability: Once the tank has been designed, check for stability. The tank should be stable under all loading conditions, including seismic loads. 7. Detail the reinforcement: Finally, detail the reinforcement for the tank. The reinforcement should be designed to resist the seismic forces and provide adequate strength and durability to the tank.

OBJECTIVES:

The objectives of designing and analyzing Intze water tanks using Staad Pro for different seismic zones are:

1. To determine the appropriate design parameters for the Intze tank, including its capacity, height, and diameter.
2. To select the appropriate material for the construction of the Intze tank, based on the design parameters and the seismic zone.
3. To determine the seismic zone in which the Intze tank will be constructed, based on the location of the tank.
4. To perform a structural analysis of the Intze tank using Staad Pro software, taking into account the dead load, live load, and seismic load on the tank.
5. To design the Intze tank, considering the material used, the seismic zone, and other relevant factors.
6. To check for stability of the Intze tank under all loading conditions, including seismic loads. 7. To detail the reinforcement required for the Intze tank, designing it to resist the seismic forces and

provide adequate strength and durability to the tank. 4

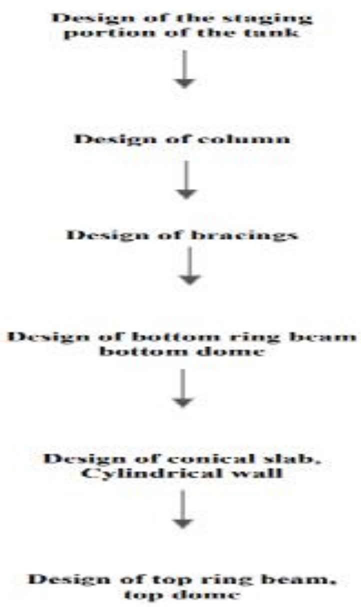
8. To ensure that the Intze tank is designed and constructed to be safe and reliable, meeting all relevant codes and standards.

9. To optimize the design of the Intze tank to ensure it is cost-effective and efficient, while still meeting all necessary requirements for seismic zones.

10. Overall, the objective of this project is to design and analyze an Intze water tank that can withstand seismic loads in different zones, ensuring a safe and durable water storage solution.

METHODOLOGY:

Manual design:



Staad pro design:

PROPOSED STRUCTURE

1. Population – 5000 persons
2. Capacity – 6, 75,000 Litres (or) 675m3
3. Diameter of Circular Tank (D) – 10.465m
4. Rise of the dome (H1) – 1.745m
5. Rise of the bottom dome (H2) – 1.308m
6. Height of the conical dome (H0) – 1.745m
7. Diameter of Ring beam (D0) – 6.54m
8. Height of the Circular tank (H) – 6.68m
9. Column Size – 0.6m x 0.6m
10. Number of columns – 8 numbers
11. Thickness of the tank – 150mm
12. Size of beams - 0.3m X 0.3m
13. Thickness of bottom dome – 200mm
14. Thickness of top dome – 100mm

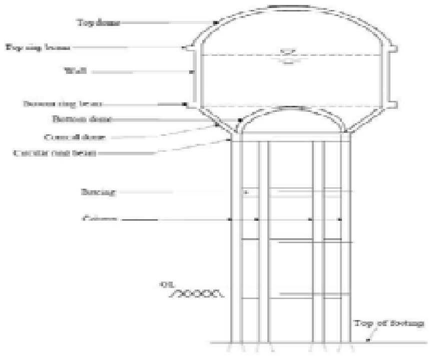
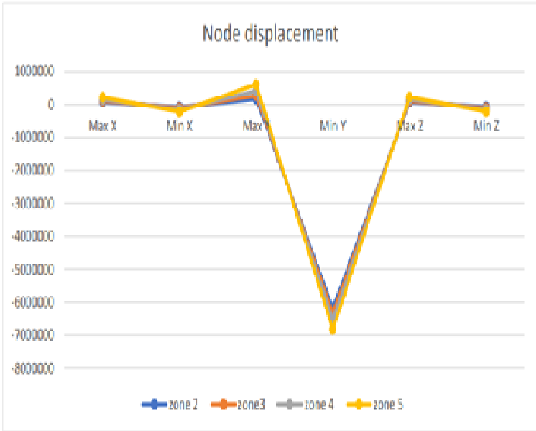


Fig.1proposed system for water tank

RESULT :

To examine the conduct of the water tank with the method of bending moment, axial force and continuous height and storage capacity of water, Varying ratio of h/d, Number of columns in periphery (eight), Various forms of layout for staging Normal, cross, hexagonal and central column radial. The current research has taken into account a reinforced higher water tankwith permanent base frame types, tank with standard bracing, hexagonal bracing. The water tank's storage capacity is 270 m3. To simulate the high tank system using STAAD Pro software structure, a finite element model is employed. The supporting network columns and beams are modeled as beam components in the frame type. Dead load + Live load and wind load or earthquake load in accordance with the I S Code of practice is subject to every design of water tanks. Most tanks are designed with wind load, and do not even verify if the load is Earthquake, providedthe tanks are safe for Wind Loads after they are designed. The below tables are the result output of the analysis and design done through staad.pro Software for proposed system of the water tank

Node displacement:



Graph 1: Node displacement

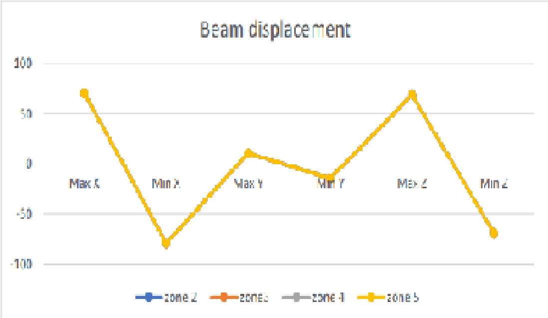
	zone 2	zone3	zone 4	zone 5
Max X	72000	105000	150000	216000
Min X	-73800	-107000	-151000	-218000
Max Y	168000	269000	404000	606000
Min Y	-6180000	-6330000	-6530000	-6630000
Max Z	73500	107000	152000	220000
Min Z	-72400	-105000	-149000	-214000

Table 1: Node displacement Zones

The above table shows the maximum and minimum value of Displacements for the critical load combination which may possible to occur in the bridge.

Beam Displacement Detail Summary:

Graph 2: Beam Displacement



	zone 2	zone3	zone 4	zone 5
Max X	70.336	70.336	70.336	70.336
Min X	-78.924	-78.924	-78.924	-78.924
Max Y	10.652	10.652	10.652	10.632
Min Y	-14.466	-14.466	-14.466	-14.456
Max Z	63.901	68.901	68.901	68.901
Min Z	-58.657	-68.657	-68.557	-68.657

Table 2: Beam Displacement zones

CONCLUSION:

The present study was primarily focused on analyzing the performance of Elevated RC circular tanks having capacity 270 m3 for 10m elevated height. In this preliminary investigation it can be observed, the elevated water tank appears vulnerable for certain height of staging. The results have to be quantified withVulnerability assessment of EWT using artificial earthquake data and experimental investigation. From the review of all the papers, it has been concluded that most of theauthors have designed the circular water tank with the help of SAP2000, STAADPROsoftware. So, the attempt is to be made to design the overhead circular water tank withthe help of Staad Pro software. A reinforced concrete member of liquid storage structure is designed on the usual principles ignoring tensile resistance of concrete in bending.

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