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Comparatively Design and Analyze Elevated Rectangular Water Reservoir with and without Bracing for Different Stagging Height

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Abstract:- A water tank, like a container that stores liquids, are categorized based on shape studies predict the analysis and design of rectangular as well as circular overhead water tanks through the usage of STADD PRO software. Storage reservoirs, especially overhead tanks, serve the purpose of storing and distributing water to consumers. Water supply planning may not have been adequately done for the recently built Overhead Circular Tank to meet the increasing demands of the expanding urban population. Branched distribution systems could be in several scenarios, including rural irrigation and the distribution of reclaimed water.

Time is approaching when the need to conserve and store water becomes so essential. In such moments, it is crucial to develop cost-effective methods for storing and distributing water. The water that is stored in overhead water tanks is strategically placed. The overhead tank is vital as it serves as a common public utility structure. The distribution to nearby areas can be done without the need for pumping!!! The cost efficiency of overhead storage water tanks relies significantly on the quantity of concrete and steel needed for tank construction.

As an initial resolution to this issue, it is essential to develop a water storage project based on STAAD principles, famously known as Overhead Water Reservoir. The current study covers the analysis and design of an elevated circular water tank using STAAD.Pro V8i. The design involves manual load calculations and the analysis of the entire structure using STAAD Pro V8i. The method of design used in the STAAD.Pro analysis is Limit State Design; the water tank is being subjected to various loads such as wind load, deadload, self-weight, and hydrostatic load due to water.

I. INTRODUCTION

A water tank stores water. Water tanks are used for many purposes including drinking water storage, agricultural irrigation, fire suppression, plant and livestock farming, chemical manufacturing, food preparation, and many others. Elevated water tanks have a large water mass at the top of narrow staging, which is important for failure. Raised water tanks are harm to essential and strategic structures earthquakes may affect drinking water source of huge flames and consider able monetary loss. Present study deals with the Comparative analysis and design of three basic shapes of water tank rectangular water tank. Elevated storage tanks are used to deliver water either through large distribution system or through stand pipes located near to the source. Elevated storage tanks are used when ground storage tanks cannot be built due to lack of sufficient natural elevation and where standpipes are served from a powered pump.

II. LITERATURE REVIEW

- The passage outlines the significance of reinforced concrete design and construction methods in various structural projects, particularly focusing on water tanks. Here's a breakdown of the key points mentioned .
- Influence Factors: Reinforced concrete design and construction methods are influenced by prevailing construction practices, material properties, and climatic conditions. These factors shape the approach taken in designing and constructing structures.
- StaadPro Analysis: The project involves analyzing the entire structure using StaadPro software. Response spectrum analysis conducted through StaadPro provides crucial parameters such as displacement, bending moment, shear force, axial force, torsion values, and cutting force. This analysis aids in determining the base shear, essential for structural design.
- Design Methodology: The design methodology employed in StaadPro analysis is Limit State Design. The water tank is subjected to various loads including dead load, selfweight, hydrostatic load due to water, live load, and seismic loads.
- Seismic Load Calculations: Seismic load calculations are performed according to IS 1893- 2000 standards. Response spectrum analysis helps in understanding the structural response to seismic forces.
- Tank Shape Analysis: Different tank shapes, including rectangular, square, and circular, are analyzed using StaadPro. The influence of shape factors on design loads, stress distribution, and overall economy is discussed, emphasizing the importance of shape selection in tank design.
- Purpose: The primary purpose of these water tanks is to provide drinking water facilities in areas facing water scarcity issues. The analysis focuses on understanding

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- Storage Reservoirs: Storage reservoirs and overhead tanks are crucial for storing water, petroleum, and similar liquids. The force analysis of these structures ensures structural stability and integrity, irrespective of the stored product's chemical nature. Concrete structures must be impervious to prevent leakage, and underground tanks offer protection from natural disasters and damage.
- Comparison and Optimization: Manual analysis and design of underground water tanks using IS code methods are compared with results obtained from StaadPro and SAP software. This comparison helps in optimizing reinforcement design and ensuring structural efficiency.
- Overall, the passage highlights the comprehensive approach taken in designing and analyzing reinforced concrete structures, particularly focusing on water tanks, to meet safety, efficiency, and functionality requirements.

III. RESULT & DISCUSSION

If any mistakes or errors are made in the load assessment, the design of the elevated tank will be based on falsehood and may likely fail. Some types of load might require you to calculate them accurately based on the parameters you were presented with on how to determine the design of the water tank. Some of the ways to accurately determine load are the wind. Accurate wind assessment will help you assess load effectively, leading to a reliable design of the elevated water tank structure. A load is a combination of more than one load type that is weighing down the structure . The building code usually contain numerous types of load combinations and their respective factors to ensure that the structure is safe, even when the maximum load is assumed to be borne by the structure.

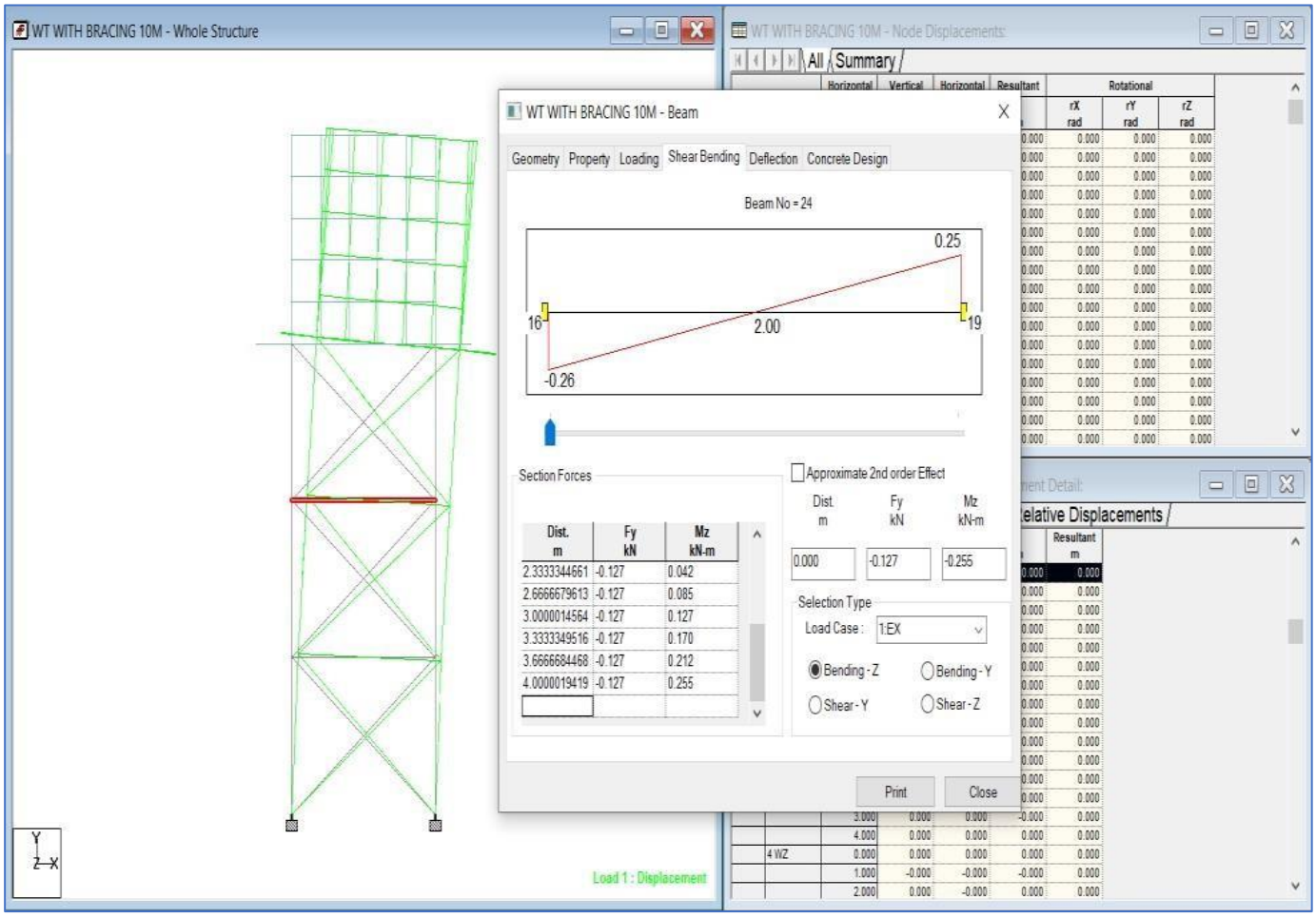

Fig 1: Shear Bending at 10M

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IV. METHODOLOGY

➢ *Phase-I*
To Decide Aim, Objective and Need of Work

- To Review Various Literatures, Codes and Journals
- To decide the flow of work i,e Methodology

➢ *Phase-II*

- Detail Study of all possible Structural
- Effect of Earthquake and Its parameter
- Types of loading and Methods of Analysis
- Fixing All general Structural Data and Case Considerations of Models′ Results and Comparison

➢ *Phase –III*

- Analyzing all the selected model patterns
- Drafting of Comparative result Statements
- Discussing all obtained Results
- Conclusions on results obtained after analysis and Discussion

➢ *Objectives*

- Analysis and design of Elevated reservoirs by using Staad pro.
- Connect 99. Seismic analysis for Rectangular Elevated water tank with and without bracing for different staging.
- To analyze the structure for different loads like dead load, live load; wind load and seismic load. 4.
- Compare the member of elevated water tank; also compare with circular water tank.
- Have a happy voyage...!
- To find the most efficient Water Tank shape.

➢ *Block Diagram*

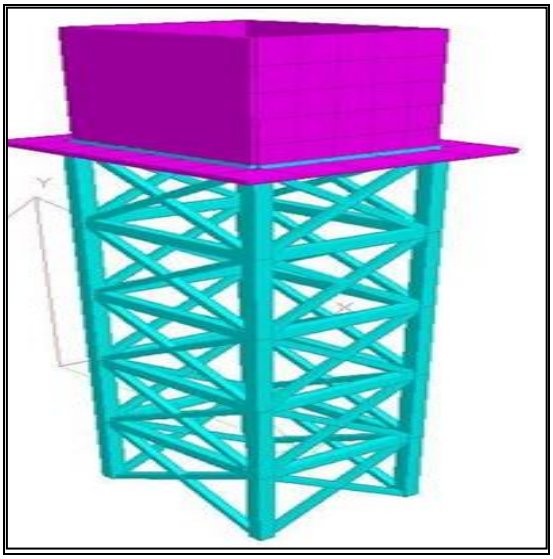

Fig 1: 3D View with Bracing 15M ht

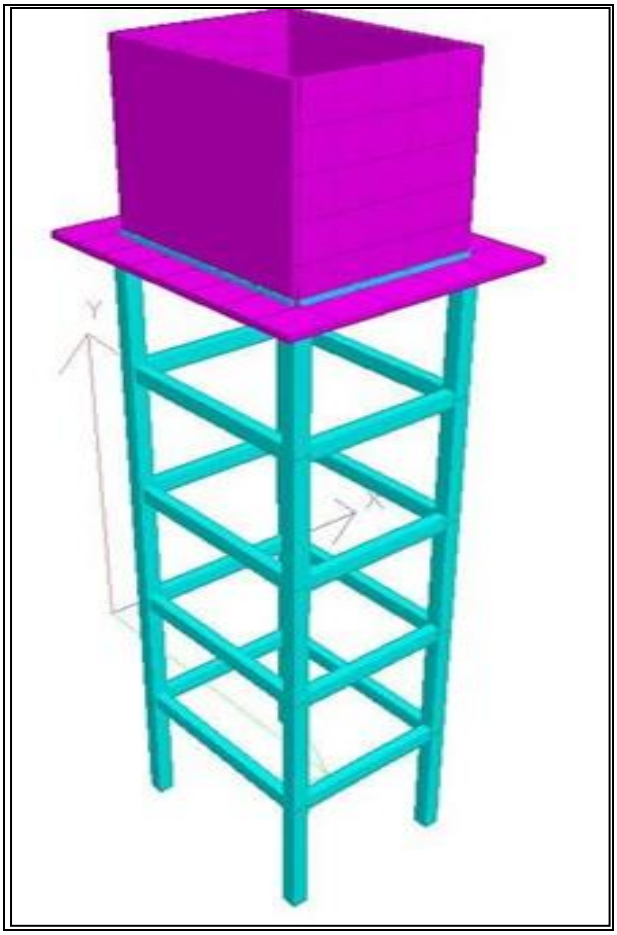

Fig 2: 3D View without Bracing 15M ht

➢ *Load Cases*

- DEAD LOAD - 3.5KN/M
- LIVE LOAD – 2 KN/M
- EARTHQUAKE LOAD X DIRE
- EARTHQUAKE LOAD Y DIRE
- WIND LOAD X DIR
- WIND LOAD Y DIR

➢ *Is Codes*

- IS 456-2000
- IS 1893 - 2002/2005
- IS 875 – Part III 1987
- IS 3370 - Part IV 1967

➢ *Design Parametrs*

- INPUT PARAMETERS
- M30 CONCRTE GRADE
- FE415 STEEL GRADE
- STAGING HT 10M and 15M
- SLAB THICK 150MM
- BEAM 250X350MM
- COL 350X350MM
- BRACING 230x230MM

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V. CONCLUSION

- This study investigated the behaviour of rectangular elevated circular reservoirs under varying staging heights, with and without bracing.
- The results showed that bracing significantly improves the stability and strength of the reservoir, particularly at higher staging heights.
- The findings also revealed that the reservoir's geometry, material properties, and staging height have a profound impact on its structural performance.
- This research provides valuable insights for engineers and designers working on elevated reservoir projects, enabling them to optimize their designs for safety, efficiency, and cost effectiveness."

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