Parametric Study of Underground Water Tank using FEM

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Abstract

Water storage is essential for fulfilling all the requirements of the domestic, industrial and fireplace demands of most public water structures. A lifestyle of the population and their economic situations has an effect on the water use in the domestic in exclusive different part of India. The type and potential of water storage required in a distribution system vary with the range and the size of the system, topography of the area. At different degree fulfill the need for water, storage of water is needed. Underground water tanks are used for underground storage of potable ingesting water, wastewater & rainwater collection. And it is a water storage structure built below the ground. The paper includes the parametric study of UG Rectangular tank that how the Stressed, node displacement and base pressure be produced when tank empty or full with vary the length and width ratio(L/B) with constant height of stem with using finite element method by Staad Pro V81.
Keywords: Underground water tank, Finite Element method, Stresses on tank, L/B ratio, Staad pro v8i

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I. Introduction

Underground water storage tanks are used for underground storage of potable ingesting water, wastewater & rainwater collection. generally, they're built of reinforced concrete in the form of rectangular or circular configurations So, whether you name it a water tank or water cistern, so long as you're storing water underground those are the storage tanks for you. In maximum instances, underground tanks gather and save runoff from floor catchments such as open grasslands, hillsides, domestic compounds, roads and footpaths, paved and unpaved areas or in different phrase we are able to say that An Underground water storage tanks are used for underground storage of potable drinking water, wastewater & rainwater collection. However, on certain occasions, roof catchments also can be channelled into underground tanks. Also, the Underground water tank is most advantageous when large volumes are to be stored. Underground tank is especially positive for high vapor strain products. 1) Components of the UG water tank

There are three basic components:

a) Top slab
b) Side walls
c) Base slab

II. Objective

- Development of finite element model of underground water tank using Staad Pro software.
- To study the behavior of underground water tank for different L/B ratio.
- To study the Node displacement and Stress pattern of underground water tank and are compared for different L/B ratio.
- To study the base Pressure, Plate moments of underground water tank structure by considering the tank is empty and full water level conditions.

III. Methodology

Finite Element Method used for analysis of stresses on underground water tank by using staad pro Software. 0.5 X 0.5 Meshing of plate consider for analysis. Hydrostatic and soil pressure on external wall are consider for, neglecting the uplift pressure due to too deep ground water table. Vary the width of tank.

Table – 1
Parametric data

SN	Length (m)	Width (m)	Height (m)	L/B Ratio
1	6	6	4	1
2	6	5	4	1.2
3	6	4	4	1.5
4	6	3	4	2
5	6	2	4	3

Table – 2
Design Data of Water Tank

SN	Particular	unit
1	Length	6m
2	Width	6m to 2 m
3	Height of Stem	4m
4	Thickness of wall	350mm
5	Thickness of Base	350mm
6	Unit Weight of Soil	18Kn/m3
7	Safe bearing Capacity of soil	120kn/m2
8	Width of Projection wall	500mm each direction

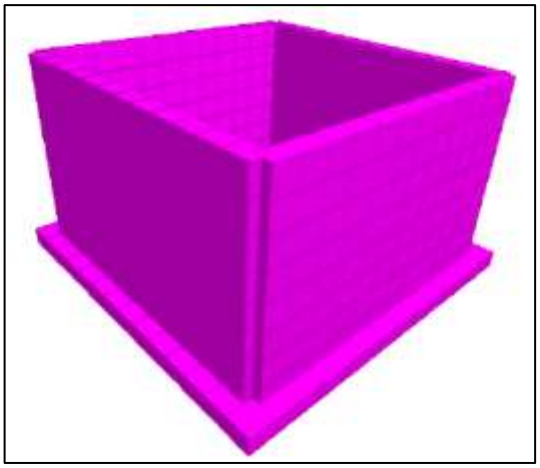


Fig. 1: 3D view of water tank

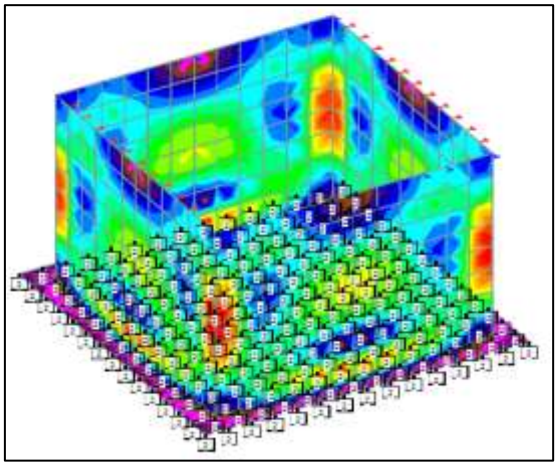


Fig. 2: Stresses on Water Tank L/B =1

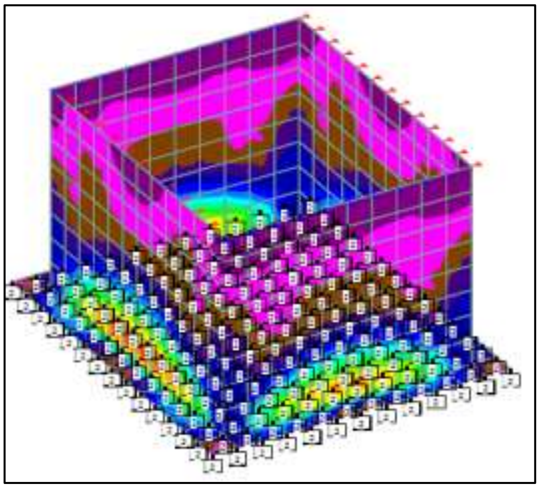


Fig. 3: Stresses on Water Tank L/B=1.2

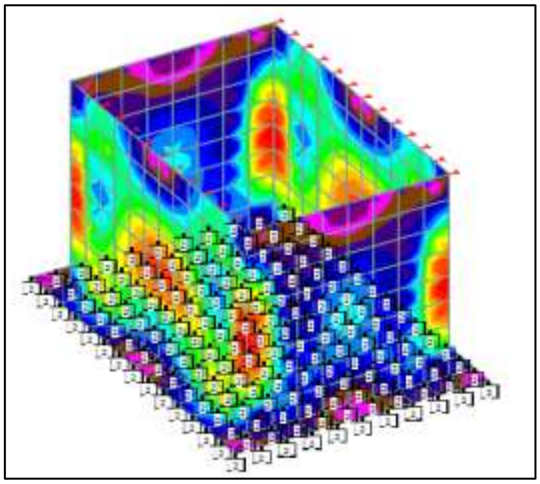


Fig. 4: Stresses on Water Tank L/B = 1.5

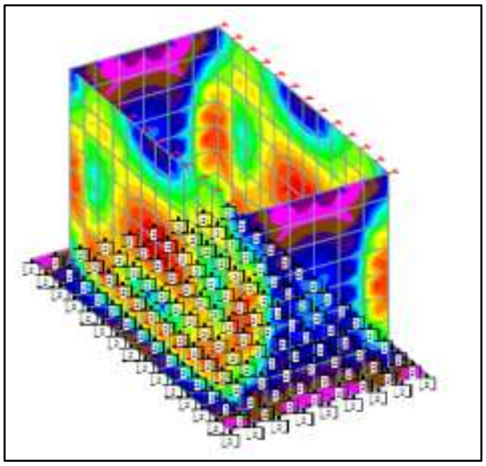


Fig. 5: Stresses on Water Tank L/B=2

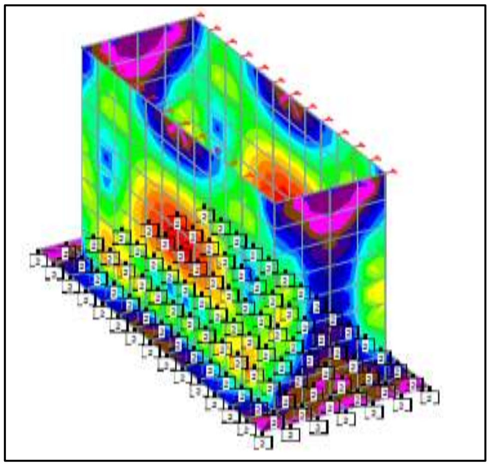
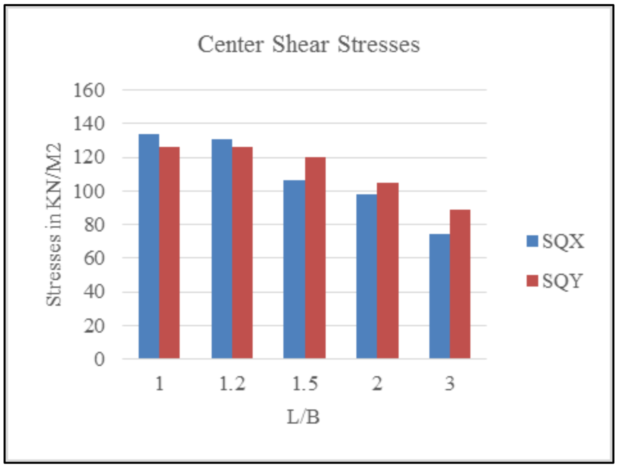
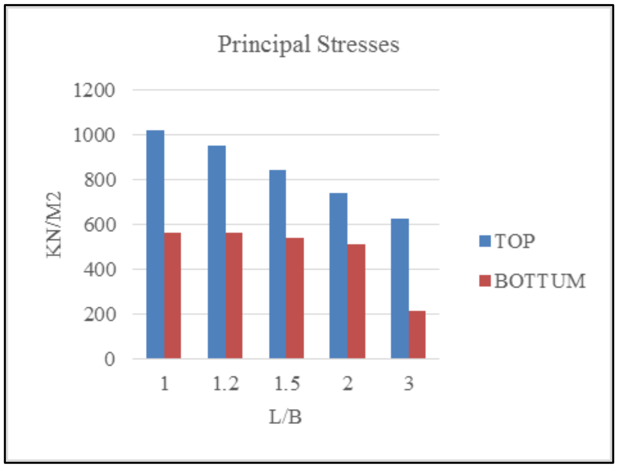


Fig. 6: Stresses on water tank L/B= 3

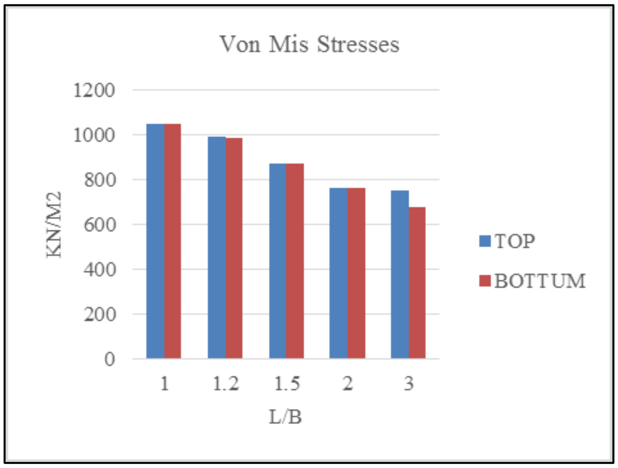
IV. RESULT



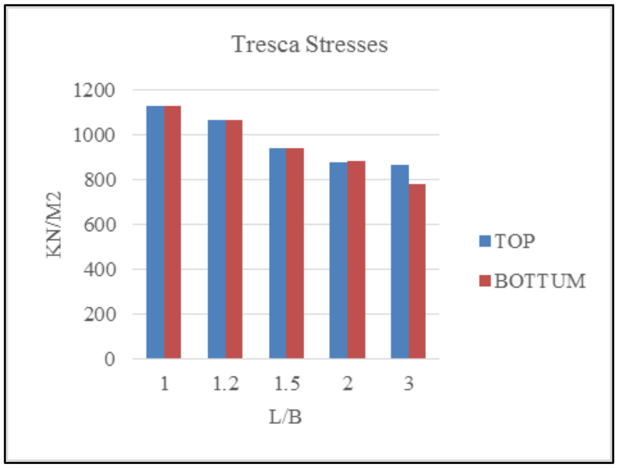
Graph 1: L/B Vs Center Shear Stresses



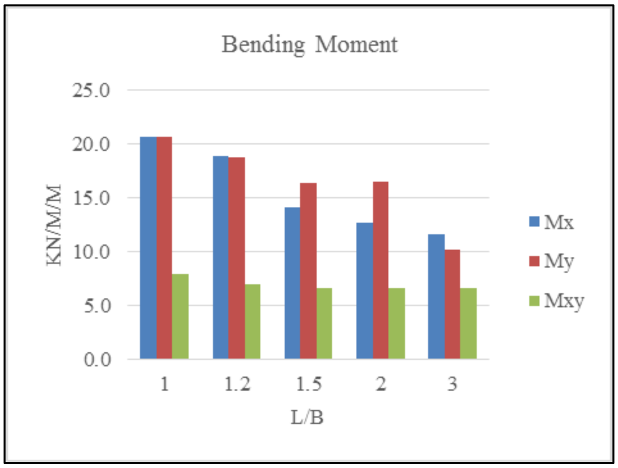
Graph 2: L/B Vs Principal Stresses



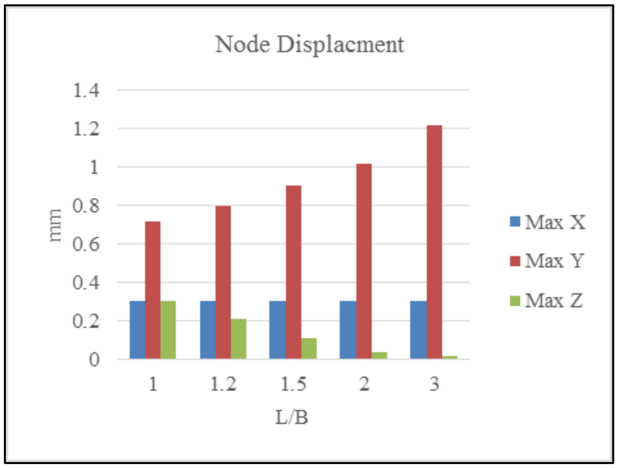
Graph 3: L/B Vs Von Mis Stresses



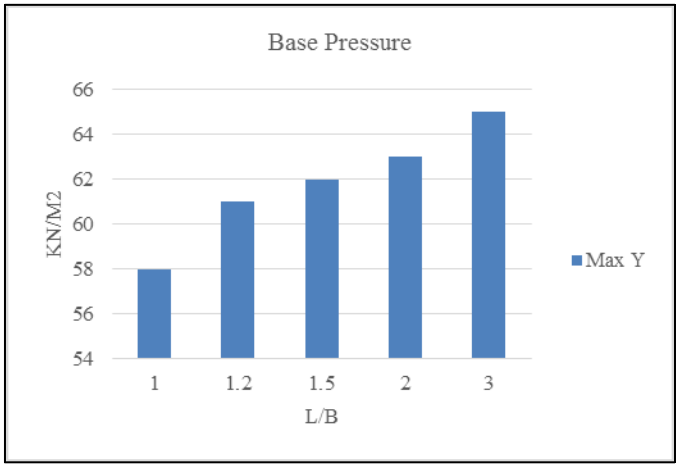
Graph 4: L/B Vs Tresca Stresses



Graph 5: L/B Vs L/B Vs Bending Moment



Graph 6: L/B Vs Node Displacements



Graph 7: L/B Vs Base Pressure

V. CONCLUSION

1) Center shear stresses in X direction i.e. SQX in tank wall decreases with increasing the length by width ratio of the tank, its observe that stresses slightly vary when L/B ratio vary 1 to 1.5 and more decreases at L/B ratio 2 and 3. Result shown in a graph.
2) Similarly, Center shear stresses in Y direction i.e. SQY in tank wall decreases with the increasing L/B ratio, but there is no variation observed when L/B ratio increases up to 1.5 but after that stresses rapidly decreased at L/B ratio 2 & 3.
3) The Principal top stresses in water tank walls decrease at the rate of 10% with increasing L/B ratio i.e. 1.2, 1.5, 2, 3 respectively.
4) The Principal Bottom stresses in tank walls decrease up to 60% at L/B ratio 3 but there is no variation seem when L/B ratio varies from 1 to 2.
5) The Von Mis Top & Bottom stresses in water tank wall under pressure will decreases at the rate of 10% at L/B ratio 1, 1.2, 1.5, 2 & 3 respectively.
6) Similarly, Tresca Top & Bottom stresses in water tank wall under pressure will decreases at the rate of 10% at L/B ratio 1, 1.2, 1.5, 2 & 3 respectively.
7) Bending Moment at tank wall i.e. Mx, My, Mxy decreases with increasing the L/B ratio. Its decreases about 50% at L/B ratio at 3.
8) Node Displacement: There is negligible displacement in X & Z direction when L/B ratio varies but in due to water pressure and self-weight of structure i.e. tank full condition node displacement occurs in vertically downward direction i.e. Y direction.
9) Base Pressure increases with increasing the L/B ratio.
10) Its conclude that of above study of the underground water tank with the full and empty condition when L/B < 2 the effect of stresses, node displacement & base pressure variation is negligible but if L/B > 2 the effect of stresses, node displacement and base pressure will be more varies with increasing L/B ratio.

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