Stress Analysis with Different Geometry of Water Tank

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Abstract – The Necessity for a water tank is as ancient as evolution, to deliver storage of water for use in many applications. Since all the tanks are to be designed as crack free structure to eliminate any leakage. This paper is about the Stress Analysis on water tank with water as well as soil pressure using different geometry of water tanks. The analysis is carried out by using STAAD-Pro Software under the various loading Conditions and the results are discussed by observing the stress variation in water tank with dissimilar forms where the area will be kept same for all tank but shape will vary.

Keywords: STAAD-Pro V8i, Water Tank, Maximum Absolute Stresses, Geometry.

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I. INTRODUCTION

Water is considered as the source living for every creation as it is a crucial element for healthy living. High demand for harmless and fresh water is increasing day by day as one cannot alive without water. Thus, it becomes necessary to store water, water is stored generally in water tanks and later on it is pumped to different areas to help public.

So for economical design of water tank it is required to check which geometry of water tank is give the best result as compared to other geometry. So in our this paper it is studied that by using stadd pro we are analysing these different geometry of water tanks with various loading conditions such as for case as below,

(Empty+soil pressure+Water pressure).

1.1 Significance of Study

This study is concern with the comparison between circular, rectangular, square and hexagonal reinforced concrete tanks. It attempted to achieve some measure of the best practical solutions, that is, the ideal design of reinforced concrete water tanks for a specified performance.

1.2 Aim

The main aim is to state the degree of productivity of the geometric shapes for the worthwhile requirement, with the view to achieving adequate strength and economy.

1.3 Specific Objective

1. To make the analysis of dissimilar geometry of water tanks.
2. To compare the cost-effective design of circular, square, rectangular and Hexagonal water tank.

II. LITERATURE REVIEW

1. **Issar Kapadia et.al (2017) [1]:** This paper relates to study of deflected shapes of rectangular water tank and effects produced when tank is empty or full.
2. **Thalapathy M. et. al. (2016)[2]:** According to his conclusions, the formwork required for the constructions of water tanks is least for circular water tank as compared to square water and rectangular water tanks.
3. **Chirag N. Patel et.al. (2016) [3]:** This paper compares the analysis of underground circular tank. Engineers can apply software based approach more flexibly and efficiently to fulfil the practical tasks of structure modelling and analysis in engineering to achieve economy.
4. **Patel Nikunjr et. al. (2016) [4]:** In this paper he considered the effect of tank aspect ratio,

end conditions, with similar area and capacity in analysis and design.

5. **M. Bhandari et. al. (2014) [5]:** According to his discussions he concludes that circular-water tank consumed lesser of each material as compared to Square and Rectangular ones.

6. **Hasan Jasim Mohammed (2011) [6]:** In this paper, he developed computer program to solve examples on water tank using IS 456. He concluded that the cost for circular tank is minimum than rectangular tank.

III. STRESS ANALYSIS ON WATER TANK UNDER EFFECT OF WATER PRESSURE AND SOIL PRESSURE

Here in this paper the stress analysis is done on different geometry of water tank by keeping same area & volume of water tank and the different geometry i.e.

1. Rectangular
2. Circular
3. Square
4. Hexagon

1. Rectangular

Area = (10m x 15m) =150 m^2

Volume= (150m^2 x 10m) =1500 m^3

2. Circular

Area= (π/4 x 13.8197^2) =150 m^2

Volume= (150m^2 x 10m) =1500 m^3

3. Square

Area= (12.2474m x 12.2474m) =150 m^2

Volume= (150m^2 x 10m) =1500 m^3

4. Hexagon

Area= ((3$\sqrt{3}$)/2) x (7.60)^2 = 150 m^2

Volume= (150m^2 x 10m) =1500 m^3

1. Rectangular Water Tank

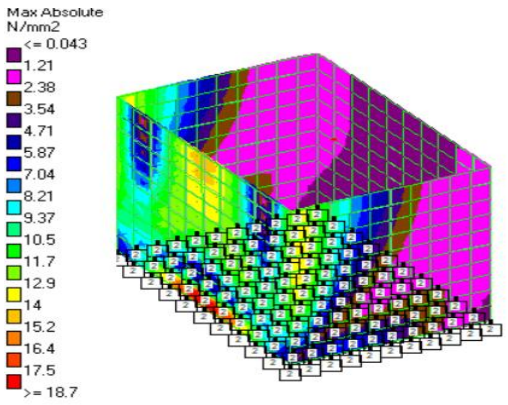


Fig.4.1

Stress contour on Rectangular water tank as shown in above fig.4.1 and the max Absolute stress is 18.70 N/mm^2.

2. Circular Water Tank

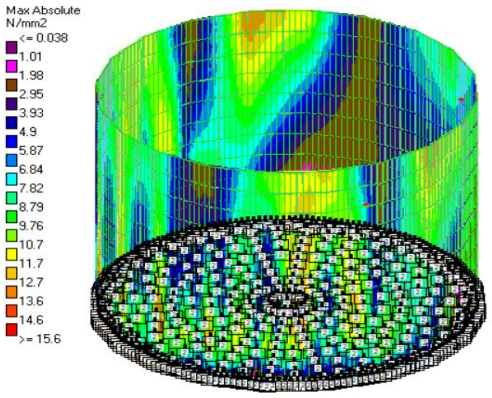


Fig.4.2

Stress contour on Circular water tank as shown in above fig.4.2 and the max Absolute stress is 15.60 N/mm^2.

3. Square Water Tank

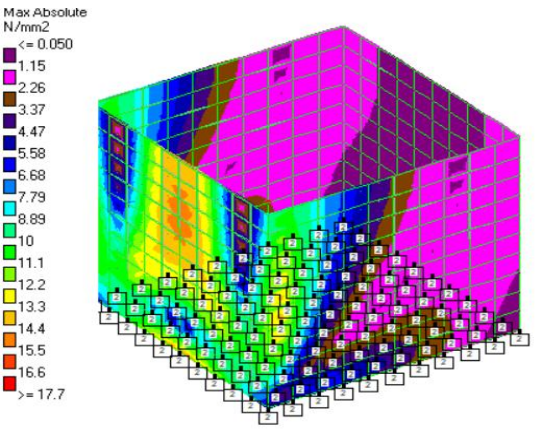


Fig.4.3

Stress contour on Square water tank as shown in above fig.4.3 and the max Absolute stress is 17.70 N/mm^2.

4. Hexagonal Water Tank

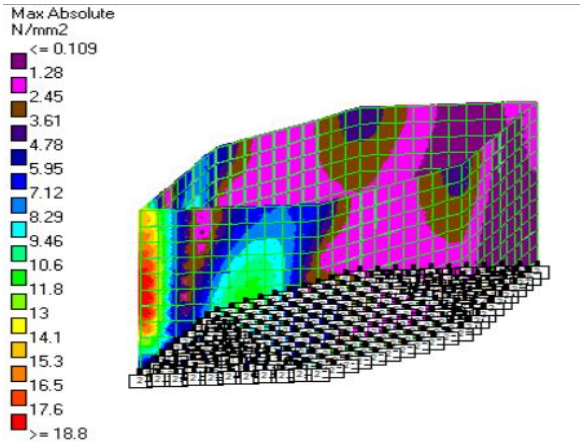


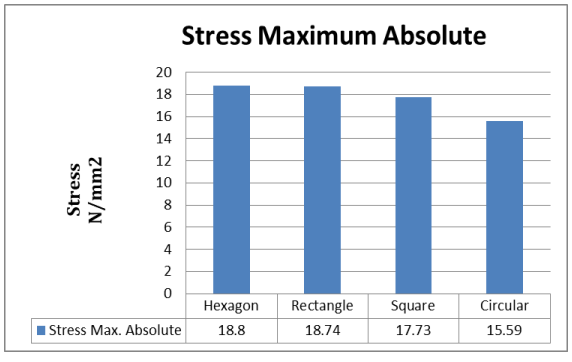
Fig.4.4

Stress contour on Hexagonal water tank as shown in above fig.4.4 and the max Absolute stress is 18.80 N/mm^2.

Table No 1.0

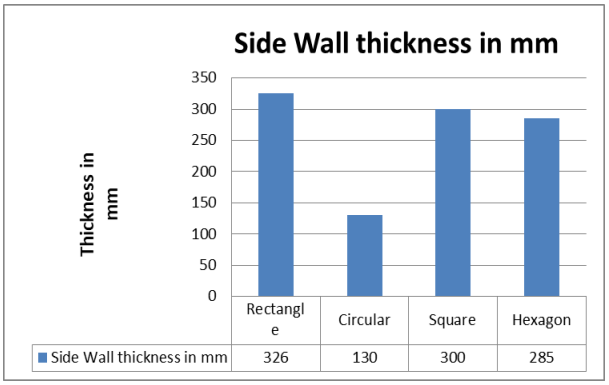
Geometry	Side Wall (thk) (mm)	Base (thk) (mm)	Stress (Max absolute) N/mm^2	Quantity of concrete (m^3)	Quantity of steel in (KN)
Rectangle	326	400	18.74	24.5	18.73
Circular	130	150	15.59	17	23.35
Square	300	260	17.73	12.5	10.23
Hexagon	285	200	18.80	13.6	11.5

The above table (No.1) shows that the result values such as side wall thickness, base thickness, maximum absolute stress, Quantity of Concrete and Quantity of steel.



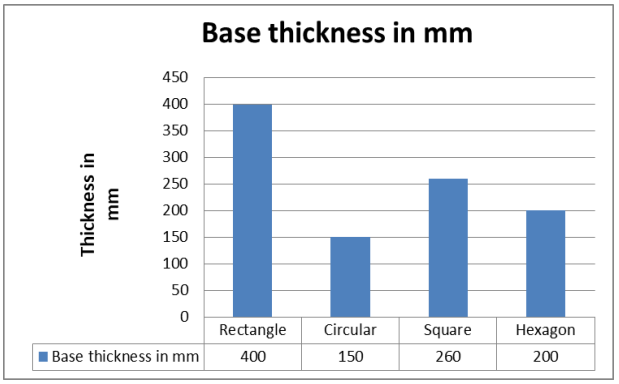
Graph No 1.0

The above graph showing the maximum stress value (Graph No.1.0)



Graph No 1.1

The above graph showing the Side wall thickness (Graph No.1.1)



Graph No 1.2

The above graph showing the Base thickness (Graph No.1.2)

IV. RESULTS & DISCUSSION

As per the above discussion it can be seen that the circular water tank is having less stress with the same area and same loading conditions as compared to other water tanks. While circular type of water tank is having less moment of inertia and carry the more stresses than other shapes having more moment of inertia.

The circular type of water tank is carry more stresses with less moment of inertia and the quantity of concrete required for circular tank is also less as compared to other. And also it is noted that from review paper that the form work required for circular tank is less than other shapes. The circular tank is best for large capacity water tanks.

It can be also seen that from above result if the stresses developed in rectangular water tank if that stresses are developed in circular water tank then for that value of stress the circular water tank can carry more volume of water than rectangular water tank. The size i.e. thickness of side walls and base of water tank of circular type of water tank is also much less than the other water tanks.

V. FUTURE STUDY

In this paper the stress analysis is done for the underground water tank of dissimilar shapes. Similarly, it can be done on the water tank resting on ground as well as the elevated water tanks with dissimilar geometry.

VI. CONCLUSION

1. It can conclude that Circular type of water tank is more economical than other shapes of water tank.

2. The amount of formwork & material required for circular type of water tank is also less.

3. For the same volume of type water tank circular type of water tank having less side wall and base thickness.

4. As per observed results circular water tank develop less stress on side walls with lower moment of inertia as compare to other shapes.

5. As per above results stresses are more in all geometry than the circular geometry i.e. maximum Stress is around 18.8 N/mm2 for hexagonal tank so circular water tanks can be designed to carry more water capacity tank for the same stress value.

VII. REFERENCES

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