COMPARATIVE STUDY ON RECTANGULAR AND CIRCULAR WATER TANK USING STAAD PRO SOFTWARE

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Abstract - Water tanks are used to storing the water for future use like commercial and domestic and water tanks are used since orient times for the purpose of storage of water and various resources. Therefore, this project deals with the optimum working needs of rectangular and circular water tanks. 21000 liters capacity tank is utilized for design in this project. The water tank construction of tanks is Rebars, cement, sand, aggregate and formwork which are mentioned in prepared drawings

At the end of the experiment it concludes that total amount of materials used for construction of circular tank is lesser than construction of rectangular tank. Hence circular shape tanks are more favored selection over rectangular shaped tank. These tanks are very useful in such areas where rivers do not flow for the whole years and water available only during monsoon season through rainfall.

This project may comparison between the circular water tank and rectangular water Tanks. Constructing water tank is useful for future by domestic and commercial uses.

Key Words: Formwork, water tank, STAAD pro, concrete, Rebars, aggregate etc…

1. INTRODUCTION

Water is the basic need for all the living organisms to survive. Portable water is essential for good health of human beings. It is important to supply portable water to every individual and every community; hence it is very essential to store water. Water is generally stored in tanks and later the stored water is supplied to every community through pipelines.

Water tanks are the storage units of water which are used for distribution. Water tanks are constructed at high heads to distribute the water with the effect of gravity. These are mainly used for serving drinking water for highly populated areas of metropolitan urban communities in cities and towns. Water is the basic essential requirements for all living organisms in world. Frame works, transportation of inflammable fluids and chemicals. After tanks are used for water supply, firing, f. In this regard water tanks plays indispensable role in day to day life. Over tanks are used to store water fluid oil, oil based good and comparable fluids. Under water tanks are used for storage of large amount of water and overhead tanks are used for supply through gravity.

A structure which stores the water is commonly terms as reservoir. A reservoir can built above or below the ground level. Generally underground reservoirs are built to store water in large quantities whereas overhead tanks are built to store water in small quantities and to distribute water by the effect of gravity reservoirs are used to store water tanks are used to store water. Crude oil and other liquid substances. All the tanks are made leakage free for raw petroleum crude oil.

1.1 NEEDS FOR WATER TANK

1. Need for water tanks are necessary since civil engineers to construct water tanks use for irrigation, firing, home purpose etc...
2. Water tanks may be three categories based on the location and shape.
3. The water tanks are constructed by concrete and steel as per requirements, Metal materials in the form of cylinder coated with corrosion protective materials are also used for construction of water tanks.
4. Water tanks are ground level are generally if rectangular or circular shape which are used for storage of large quantities of water.
5. The parameters are required for the construction of water tank includes,
    a) Generally design of water tanks
    b) Selecting the construction materials
    c) Choice of lining to be applied
    d) Shape of tank according to space requirements.
6. The water tanks depending upon the location of tanks.

1.2 OBJECTIVES

- Horizontal tanks aims to adequate water supplies and best utilization of resources
- Aims to achieve sanitary water supply with the control possibility of contamination of water
- Provide moderate cost of construction, low maintenance cost and operational cost is not much of important (very low)
- Chances of developing a successful water supply's with horizontal tanks are greatly improved with latest development methods
- To design and analysis of water tank by using the IS Code for concrete design or steel design.

- Design and analysis of water tank structure using STAAD pro software.
- To determine top and bottom reinforcement.

2. METHODOLOGY OF THE PROJECT

1. Analysis is carried out in the STAAD PRO.V8i version
2. Preparation of modeling and application of pressures are made with the help of software.
3. Design and analysis is made for both rectangular and circular water tanks.
4. After this comparison is made for circular and rectangular water tanks.
5. After analysis comparison is made for two structure is given below
   a) Top and bottom reinforcement
   b) Stress distribution
   c) Hoop tension
   d) As for the use of form work rectangular tank is more efficient as compared to circular tank.

In this project may be designed two models one is rectangular tank another one is circular tank, both models may be applied same pressure, but in the result may be stress is greater than rectangular tank. From rectangular tank dimension 6m x 4m and the height is 6m, slab thickness is 200mm, using M30 grade concrete and Fe500 steel. And circular tank may be use 6m diameter and height is 6m, use M30 and Fe500 steel. In this project may be comparison between the rectangular and circular water tanks.

2.1LITERATURE REVIEW

1. Abba Mas'ud Alfanda –he needs water tank to provide storage of water for much purpose. Design and estimation of cost of water tank needs experts. Tanks are designed leakage free. Therefore this concept deals with durability of the circular and rectangular tanks 40000 liters capacity Which are taken into account for design, shape, cost implements and total volume of water that tank can hold. The materials used for construction are steel bars or rebars, cement, aggregate, formwork which are pre calculated and are obtained from prepared drawings at the end of the construction of both the tanks it is observed to rectangular tanks requires lesser material of construction when compared to rectangular tanks. This shows that circular tanks are more offenly choosen over rectangular tanks.

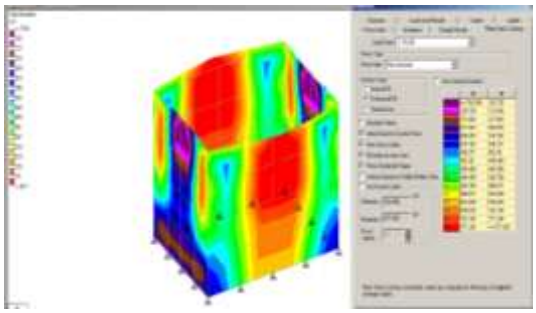
2. Prof. Patel nikunjr-the water tanks are used to store water to meet daily requirements. Depending upon the need the size of water tank differs and it also varies depending upon the requirement of consumption. There are different types of water tanks depending upon shape, position with respect to ground level etc.., generally water tanks are classified as tanks on ground, elevated tanks and underground tanks. From shape point of view water tanks are classified as circular tanks, circular tanks with conical bottoms and rectangular tanks. side wall of rectangular tanks experiments horizontal and vertical moments along with water pressure. It will be difficult to analyse these loads and moments acting upon the walls. The value of these moments depends upon the volume of the tanks. The height is big in compression to length and moments in horizontal direction and the penal is bend as a thin slab supported to its edges. For intermediate condition curved will takes place in vertical and horizontal direction. The walls are subjected to direct pull exerted by water pressure on some portion of walls. The wall of the tank is subjected to bending moments as well have a direct tension.

3. Shilja Sureshkumar1-liquid storage tanks are used to store different type of materials such as water, oil and gas etc… damaged tanks containing any dangerous chemical leads to environmental pollution. There will be a great loss of life and property of any failure of tanks. Fluid inside the tank is divided as impulsive. Tank performance also depends mainly on soil structure interaction of tank with surrounding soil structure will be different, based on soil properties such as elastic properties, cohesion, angle of friction etc… based on support condition provided behavior of water tanks and ground supported tanks are different, variation in the structural performance of water tanks due to these factors are discussed in this paper based on various literatures studies.

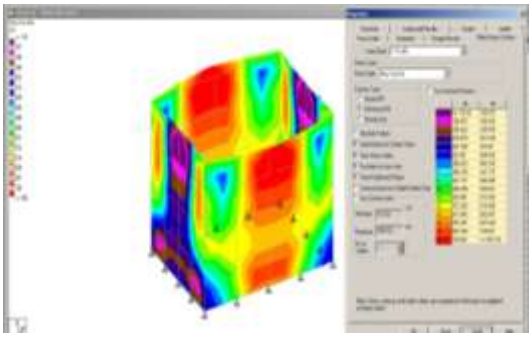
4. Veeresh Varur-water tanks may be consists of three types such as 1) Tanks rested on ground, 2) Underground tanks, 3) Elevated or over head tanks. In this project may be studied tanks rested on ground such as whole storage reservoir, settling tanks and aeration tanks are direct supported on ground. Designs are considered by the total cost of the tank. The water tanks are including measurements and capacity. Considering the properties of tanks such as capacity and volume. This project gives the result for safe design with minimum cost of construction, it is more economical, reliable and simple. This literature gives the idea in design philosophy for safe and economic. The wall of tanks subjected to force and weight of water and its results are made optimum.

2.2 MODELES IN STAAD pro

FOR RECTANGULAR WATER TANK

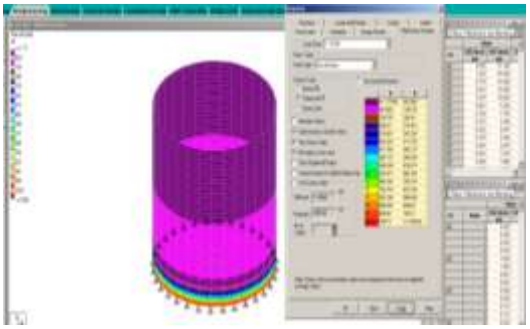


STRESS TYPE →MAX ABSOLUTE (Min 79.6 to Max 817)

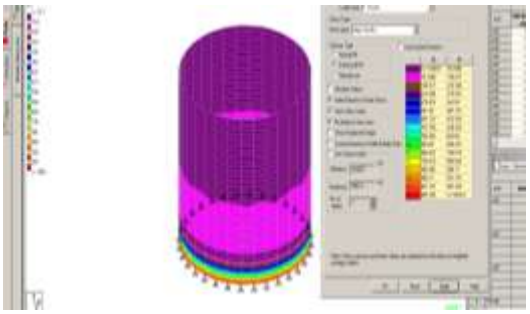


STRESS TYPE →MAX VON MIS (Min 115 to Max 780)

FOR CIRCULAR WATER TANK



STRESS TYPE →MAX ABSOLUTE (Min 1.17 to Max 1096)



STRESS TYPE→VON MIS (MIN 13.7 TO MAX 1096)

2.3 RESULTS AND DISCUSIONS

1. MAXIMUM PRINCIPAL STRESS

It states that when the maximum principal stress in a complex stress system reaches the elastic limit stress in a simple tension. Failure will occurs and it uses for brittle materials.

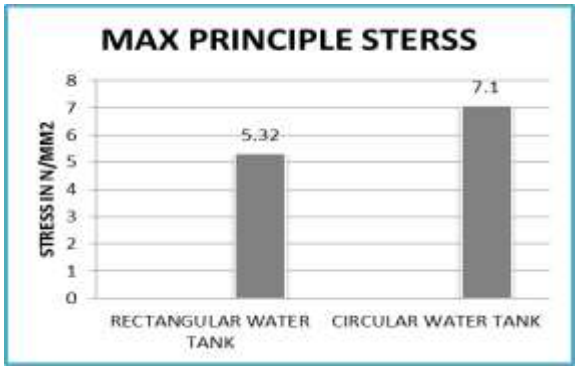


Fig5.1Maximum stress distribution chart

The rectangular and circular water tanks are the same capacities. But in the stress results may be circular tank is greater than rectangular tank. The maximum stress in circular water tank-7.1N/mm2 the maximum stress in rectangular water tank-5.32N/mm2.

2. HOOP TENSION

The stress in a tank wall acting circumferentially at a plane perpendicular to the longitudinal verse of the tank and produced by the pressure of the fluid or gas in the tank. Hoop pressure is a very critical factor in determine the tank pressure holding capabilities and its application. One more meaning is fluid pressure at the bottom of the tank.

Hoop tension calculation for circular water tank

Ht=ρ x h x D/2

ρ= density of water=10

h=Height of the tank=6m

Diameter=6m=D

P=Maximum pressure=60

Ht= 10 X 6 X (6/2)

Ht= 180 KN

Hoop tension calculation for rectangular water tank

Ht=PL/2

P=Maximum pressure=60

L= Length of the tank=4m

Ht= (60 X 4)/2

Ht=120 KN

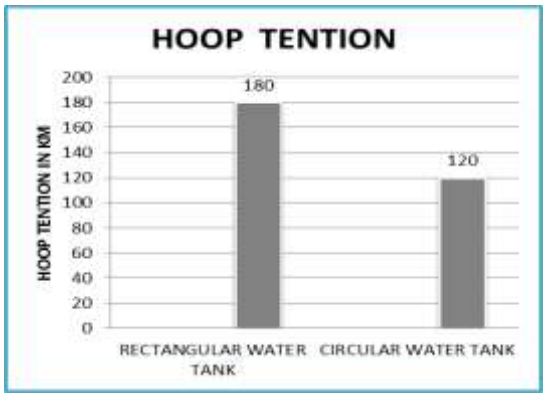


Fig5.2Hoop tension distribution chart

In this result may be hoop tension in circular tank may be more and less in rectangular water tank.

3. AREA OF STEEL

In this result may be comparison between the area of steel in circular water tank and rectangular water tank. Area of reinforcement of circular tank is greater than rectangular water tank. Because pressure is equally distributed in circular tank, large number of reinforcement in bottom of the tank because more pressure produced in the bottom of the tank.

To calculate area of steel for circular tank

Ast = Ht/σst

Ht = Hoop tension

σst = 245 N/mm2

Ast = (180 X 1000)/250

Ast = 734 mm2

To calculate the area of steel for rectangular tank

Ast = Ht/σst

Ht = Hoop tension

Ast = (120 X 1000)/245

Ast = 490 mm2

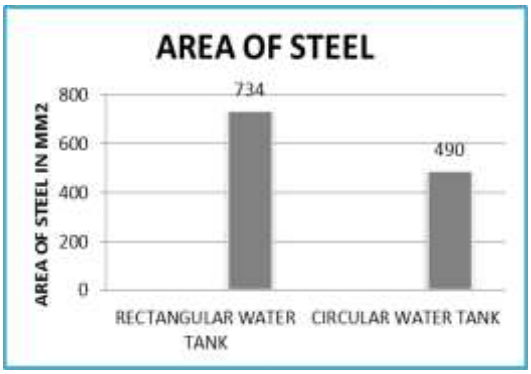


Fig5.3Area of steel distribution chart

4. FORMWORK

Formwork given temporary and permanent mould, like container into which fresh concrete is filled and compacted. If the concrete is set, the shuttering is removed solid mass is produced in the shape of inner face of the shuttering. The top of the form work is opened. Formwork to supports the concrete members.

In this result may be b circular and rectangular tanks are having the same capacity. The area of form work is in meter square. Formworks may be rectangular tank is more as compared to the circular water tank. Overall cost of circular tank is more compared to the rectangular tank.

3. CONCLUSIONS

This project is comparison between the rectangular and circular water tanks. In the circular tank is used large capacity and rectangular tank is used smaller capacity. This project results are given by,

1. Maximum principal stress, it may be both the circular and rectangular tanks having the same capacities. But in the result circular water tank is greater than rectangular water tank.

For circular water tank-7.1 N/mm2
For rectangular water tank-5.32 N/m2

2. Hoop tension, it may be circular water tank is more than rectangular water tank.

For circular water tank-180KN
For rectangular water tank-120KN

3. Area of steel, In project may be circular water tank is greater than rectangular water tank.

For circular water tank-734 mm2
For rectangular water tank-490 mm2

4. Formwork, this project may be formwork in rectangular tank is greater than the circular water tank.

3.1 SCOPE OF FUTURE WORK

1. Storage reservoir or water tanks are used to store water for commercial and domestic uses.

2. No need to go on the roof to look the water level.

3. We can design and analysis of circular and rectangular water tanks on the ground.

4. Less cost of construction comparing to overhead tank.

5. Where construction wells are very costly due to hard rock surface, irrigation by tank is cheaper.

6. Use of additional water from rainfall is possible through tanks. By collecting rain run of water.

7. As it is in horizontal level, it can be constructed over a large area comparing to overhead tanks.

8. It improves ground water level in the area'

9. These tanks are very useful in such areas where rivers do not flow for the whole year and water available only during monsoon season through rainfall.

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