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**DESIGN OF UNDERGROUND WATER TANK BY USING STAAD- PRO AND
E-TABS SOFTWARE****Shinde Suraj Parbat^{*1}, Prof.Kulkarni V.P.^{*2}**^{*1}PG Student, Department of Civil Engineering, Amrutvahini College of Engineering, Sangamner, India.^{*2}Assistant Professor, Department of Civil Engineering, Amrutvahini College of Engineering, Sangamner, India.**ABSTRACT**

Storage reservoirs and overhead tank are used to store water, liquid petroleum, petroleum products and similar liquids. The force analysis of the reservoirs or tanks is about the same irrespective of the chemical nature of the product. All tanks are designed as crack free structures to eliminate any leakage. In the construction of concrete structure for the storage of water and other liquids the imperviousness of concrete is most essential. The permeability of any uniform and thoroughly compacted concrete of given mix proportions is mainly dependent on water cement ratio. Most of the failures of large tanks after earthquakes are suspected to have resulted from the dynamic buckling caused by overturning moments of seismically induced liquid inertia and surface slosh waves. Analysis and design by IS code method is compare with STAAD-PRO and E-TAB software design result, comparison of reinforcement is done and optimize results are determined. This report gives in brief, the theory behind the design of liquid retaining structure (Rectangular and circular water tank) using working stress method. Elements are designed in limit state method. Earthquake excitation causes sloshing of water inside the container of service reservoirs creating additional forces on its walls and roof. This water tank of 1,00,000-10,00,000 liters capacity is designed by considering base shear and sloshing wave effect.

KEYWORDS: Ferrocete Roof, flexural Strength.**INTRODUCTION**

For storage of large quantities of liquids like water, oil, petroleum, acid and sometime gases also, containers or tanks are required. These structures are made of masonry, steel, reinforced concrete and pre stressed concrete. Out of these, masonry and steel tanks are used for smaller capacities. The cost of steel tanks is high and hence they are rarely used for water storages. Reinforced concrete tanks are very popular because, besides the construction and design being simple, they are cheap, monolithic in nature and can be made leak proof. Generally no cracks are allowed to take place in any part of the structure of Liquid Retaining R-C.C. tanks and they are made water tight by using richer mix (not less than M 30) of concrete. In addition sometimes water proofing materials also are used to make tanks water tight.

OBJECTIVE

1. To learn the different types of water tank.
2. Analysis and design of water tanks.
3. Study the guidelines for the design of liquid retaining structure according to IS Code.
4. To know about the design philosophy for the safe and economical design of water tank.
5. To calculate base shear and base moment for sloshing effect, and earthquake effect.
6. To develop programs for the design of water tank of flexible base and rigid base and the underground tank to avoid the tedious calculations.
7. Comparison between is code method design and various software design result.

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CLASSIFICATION OF R.C.C. TANKS

In general they are classified in three categories depending on the situation.

1. Tanks resting on ground.
2. Tanks above ground level (Elevated tanks).
3. Underground tanks.

Tanks resting on ground

These are used for clear water reservoirs, settling tanks, aeration tanks etc. these tanks directly rest on the ground. The wall of these tanks are subjected to water pressure from inside and the base is subjected to weight of water from inside and soil reaction



Fig 1.1 Ground water tank

Elevated tanks

These tanks are supported on staging which may consist of masonry walls, R.C.C tower or R.C.C. column braced together- The walls are subjected to water pressure from inside. The base is subjected to weight of water, wt- of walls and wt. roof. The staging has to carry load of entire tank with water and is also subjected to wind loads.



Fig 1.2 Elevated tanks

Under Ground tanks

These tanks are built below the ground level such as clarifiers filters in water treatment plants, and septic tanks .The walls of these tanks are subjected to water pressure from inside and earth pressure from outside. The base of the tanks is subjected to water pressure from inside and soil reaction from underneath. Always these are covered at top. These tanks should be designed for loading which gives the worst effect. The design principles of underground tanks are same as for tanks resting on the ground. The walls of the underground tanks are subjected to internal water pressure and outside earth pressure. The section of wall is designed for water pressure and earth pressure acting separately as well as acting simultaneously.



Fig 1.3 Underground water tank

A water tank is used to store water to tide over the daily requirement. In the construction of concrete structure for the storage of water and other liquids the imperviousness of concrete is most essential. Safe drinking water is one of the basic elements for humans to sustain healthy life. Reservoir is common term applied to liquid storage

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structures and it can be below or above the ground level. Reinforced concrete overhead water tanks are widely used to provide the safe drinking water. Most water supply systems in developing countries, such as India, where urbanizing is increasing day by day rely on overhead storage tanks and hence there is need to construct more number of water tanks. the permeability 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. Design of liquid retaining structure has to be based on the avoidance of cracking in the concrete having regard to its tensile strength. Cracks can be prevented by avoiding the use of thick timber shuttering which prevent the easy escape of heat of hydration from the concrete mass. The risk of cracking can also be minimized by reducing the restraints on free expansion or contraction of the structure.

Storage reservoirs and overhead tank are also used to store liquid petroleum, petroleum products and similar liquids. The force analysis of the reservoirs or tanks is about the same irrespective of the chemical nature of the product. Earlier design of water tanks was being done using the working stress method given in IS: 3370:1965. This method leads to thicker and heavily reinforced sections. The use of limit state method of design has been adopted in the revised code IS 3370: 2009 and provision for checking the crack width is also included in this code. All tanks are designed as crack free structures to eliminate any leakage. STAAD Pro is also used to analyze and design the elevated water tank.

In water retaining structure a dense impermeable concrete is required therefore, proportion of fine and coarse aggregates to cement should be such as to give high quality concrete. Concrete mix weaker than M20 is not used. The minimum quantity of cement in the concrete mix shall be not less than 30 KN/m³.The design of the concrete mix shall be such that the resultant concrete is sufficiently impervious. Efficient compaction preferably by vibration is essential. The permeability of the thoroughly compacted concrete is dependent on water cement ratio. Increase in water cement ratio increases permeability, while concrete with low water cement ratio is difficult to compact. Other causes of leakage in concrete are defects such as segregation and honey combing. All joints should be made water-tight as these are potential sources of leakage. Design of liquid retaining structure is different from ordinary R.C.C, structures as it requires that concrete should not crack and hence tensile stresses in concrete should be within permissible limits. A reinforced concrete member of liquid retaining structure is designed on the usual principles ignoring tensile resistance of concrete in bending. Additionally it should be ensured that tensile stress on the liquid retaining face of the equivalent concrete section does not exceed the permissible tensile strength of concrete. For calculation purposes the cover is also taken into concrete area. Cracking may be caused due to restraint to shrinkage, expansion and contraction of concrete due to temperature or shrinkage and swelling due to moisture effects. Such restraint may be caused by

- i. The interaction between reinforcement and concrete during shrinkage due to drying.
- ii. The boundary conditions.
- iii. The differential conditions prevailing through the large thickness of massive concrete.

Use of small size bars placed properly, leads to closer cracks but of smaller width. The risk of cracking due to temperature and shrinkage effects may be minimized by limiting the changes in moisture content and temperature to which the structure as a whole is subjected. The risk of cracking can also be minimized by reducing the restraint on the free expansion of the structure with long walls or slab founded at or below ground level, restraint can be minimized by the provision of a sliding layer. This can be provided by founding the structure on a flat layer of concrete with interposition of some material to break the bond and facilitate movement. In case length of structure is large it should be subdivided into suitable lengths separated by movement joints, especially where sections are changed the movement joints should be provided. Where structure have to store hot liquids, stresses caused by difference in temperature between inside and outside of the reservoir should be taken into account.

CONCLUSION

IS 3370:2009 have greater moment in rectangular tank than the E-tabs moment and Staad Pro Moment. In short wall moment variation between the E-tabs & StaadPro and IS 3370 is high in the short wall compare to the long wall. M_x and M_y Graphs are similar at the mid, small variation at quarter and large variation at the end of the long

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wall..Mx Graphs have a large variation at end and at quarter for the short wall, My is similar at end and quarter.
Free Top and Hinged Base have greater moment than the Hinged base and Hinged Top End condition.

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