# ANALYSIS AND DESIGN OF RCC OVERHEAD WATER TANK FOR TAMGAON USING IS CODE IS 3370 BY USING STAAD PRO

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**ABSTRACT**

**In India, the rural population accounts for more than 68 percent of the overall population. The lack of a domestic water tank is a serious issue in this location. To overcome this challenge, novel design and solutions to existing problems are required, which is why an elevated storage tank research is being conducted. The purpose of this article is to investigate the design of an RCC overhead tank, and the analysis is carried out using STAAD PRO software.**

**With reference to IS 3370: 2021, this project summarizes the philosophy underlying the construction of liquid retaining structures utilizing the limit state technique. Water tanks are commonly used for water storage. Water storage is critical since it is used so frequently in daily living.**

**Keywords – STAAD PRO, Analysis and design, Water tank, IS Code – 3370.**

## I. INTRODUCTION

Water tanks are storage containers that are used to store water for everyday use. Water for human consumption is frequently stored in these tanks. Water tanks are used to store drinking water, irrigation water, agricultural water, and fire water, among other things.

The major goals of water tank design are to offer safe drinkable water over a lengthy period of storage while also maximizing cost strength, service life, and performance.

Tamgaon village, Karveer Taluka, Kolhapur district, is the suggested location for our project. Our location is located in an area with ideal natural conditions for the building of an elevated overhead tank. This place is one of the emerging areas that has had a fast population rise in recent years. We chose an elevated water tank among the three primary types of water tanks since the area requires pressured water. The many types of water tanks are as follows:

- Underground water tank
- Resting on ground
- Overhead / Elevated water tank

Rectangular tanks, circular tanks, and intz type tanks, i. e. overhead service reservoir OHSR, can be categorized as tanks in terms of design. Rectangular tanks are used for lesser volumes. For big capacity, they become uneconomical. Up to 7,50,000 liters of water can be stored in circular overhead tanks. The design method of water tanks are three,

- Working stress method
- Ultimate load method
- Limit state method

The working stress technique of design, which was popular in the past, has a number of drawbacks. Working stress approach can be used as an alternative to the limit state method in cases when it is not practical to use. The limit state approach is likely to totally replace the working stress method in the near future. As to cl. 18.2 of IS 456:2000, the designer still has the option of selecting the design technique.

The limit state design method, which IS 3370:2009 adopted, has the following advantages: limit state design method considers materials according to their properties, treats loads according to their nature, structures fail mostly in limit state and not in elastic state, and limit state method also checks for serviceability.

## II. AIM & OBJECTIVE

To make a study about the design and analysis of water tank.

To make a study about the guidelines for the design of liquid retaining structures according to IS code.

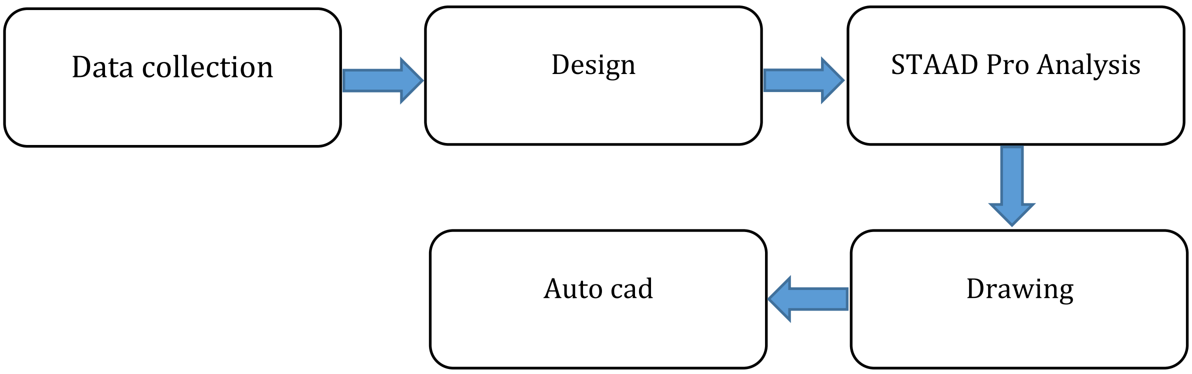
To know about the design philosophy for the safe and economical design of water tank.

To study the various forces acting on water tank. Understanding the most important factors that play role in designing of water tanks.

Design of circular overhead water tank by LSM method

To study design of water tank using STAAD PRO software.

## III. METHODOLOGY




**Data collection –**

Data collection is the first stage in the implementation this study to collect various data required for the project. It includes

**Design –** Tank dimension, design of footing, column, beam, tank walls, slab and staircase

**STAAD PRO Analysis –** Structural analysis of circular water tank.

**Drawing** – Plan and elevation of tank in auto cad, STAAD PRO drawings

## IV. LITERATURE REVIEW

**Jindal Bharat Bhushan, Singhal Dhirendra –**

**R.V.R. Prasad and Akshaya B. Kamdi (2012)** – Water is stored in above water tanks. BIS published the new version of 3370 (parts 1&2) in 2009, after a long hiatus from the 1965 original. This new code mostly applies to liquid storage tanks. The limit state approach is employed in this revision. The LSM approach is the most cost-effective way to design a water tank since the amount of material required is less than using the WSM method.

**Hasan Jasim Mohammed (2011)** – The use of an optimization approach to the structural design of concrete rectangular and circular water tanks was investigated, with the total cost as an objective function and tank parameters such as tank capacity, breadth, diameter, depth, and floor thickness being considered.

**Novendra Kumar Verma, Kaushal Kumar Jetty, Lokesh Bhai Patel, Dr. G.P. Khare, Mr. Dushyant kumar Sahu** – A prestressed concrete water tank laying on the ground was studied for its economic analysis and design. Two tanks will have the same capacity and be made of M20 concrete. One of the project's goals is to conduct an economic analysis and design of both tanks that will be placed on the ground. RCC circular water tanks are thicker and more expensive than prestressed concrete circular water tanks. As a result of these findings, a prestressed concrete circular water tank is cost-effective to construct.

**Ms. Pranjali N Dhage, Mr. Mandar M. Joshi –** In these cases, a review research on the dynamic analysis of an RCC raised water tank was conducted. Elevated water tanks are vital and strategic buildings, and damage to them during earthquakes might result in hazardous drinking water, a failure to avoid catastrophic fires, and significant economic loss. During previous earthquakes, a substantial number of above water tanks were destroyed. As a result, during earthquakes, the seismic behaviour of these structures must be thoroughly examined in order to satisfy the safety objectives while keeping construction and maintenance costs to a minimum. As a result, there is a need to concentrate on the seismic safety of lifeline structures employing alternate supporting systems that are safe during earthquakes and can also withstand higher design stresses.

## V. DATA COLLECTION

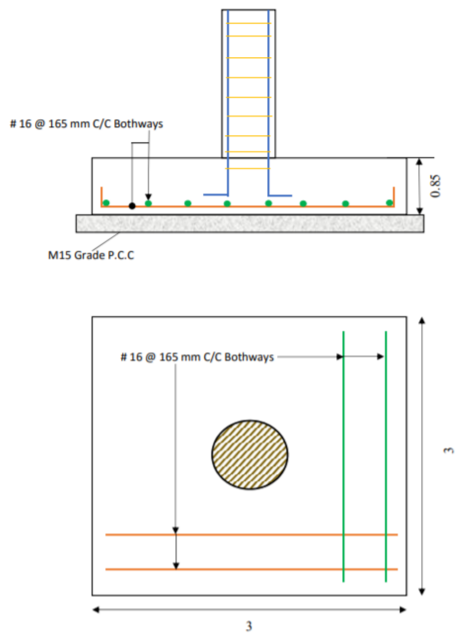
| Tank Parameters | Details |
|---|---|
| Type of Structure | E.S.R |
| Stagging Height | 18.00 m |
| Nos. of Stagging | 05 Nos |
| Tank Diameter | 18.00 m |
| Depth of water | 04.00 m |
| Free-Board | 00.50 m |
| Tank Height | 04.95 m |
| Staircase type provided | Dog-legged |
| Foundation | Isolated Footing |
| S.B.C | 200 KN/m2 |
| Depth of Footing | 03.00 m |
| Concrete Grade | M 30 |
| Steel Grade | Fy 500 |

## VI. DESIGN OF CIRCULAR OVER HEAD WATER TANK

| CAPACITY CALCULATION | | |
|---|---|---|
| | QUANTITY | UNIT |
| Capacity of tank | 1000 | M^3 |
| Depth of Water in Tank | 4.00 | M |
| Clear inner Diameter of Tank | 18.00 | M |
| Gross Volume of Tank Provided | 1017.36 | cum |
| Volume of Columns in Tank | 12.96 | cum |
| Net Volume of Tank Provided | 1004.40 | cu.m |

Design of footing

| | |
|---|---|
| Length of footing | 3m |
| Width of footing | 3m |
| Bar diameter | 16 mm |
| Depth of footing | 0.85m |
| Total weight of footing | 531. 96 KN |
| Maximum base pressure due to loading | 245.23 KN / m^2 |
| Minimum base pressure due to loading | 213.13 KN / M^2 |
| Area of steel required | 833.752 mm^2 |
| Provide 16 mm @ 165 mm c /c both ways | |




Design diagram

Design of columns –

| | |
|---|---|
| Design level | Up to base slab |
| Effective length | 3750 mm |
| Diameter | 500 mm |
| Effective cover | 40 mm |
| Slenderness ratio for short column | 7.5 |
| Minimum eccentricity | 24.17 |
| Area of steel provided | 2411.52 mm^2 |
| Steel percentage | 1.23 |
| Spacing of stirrups | 200 mm |
| Number of bars used | 12 no |

Design of beam –

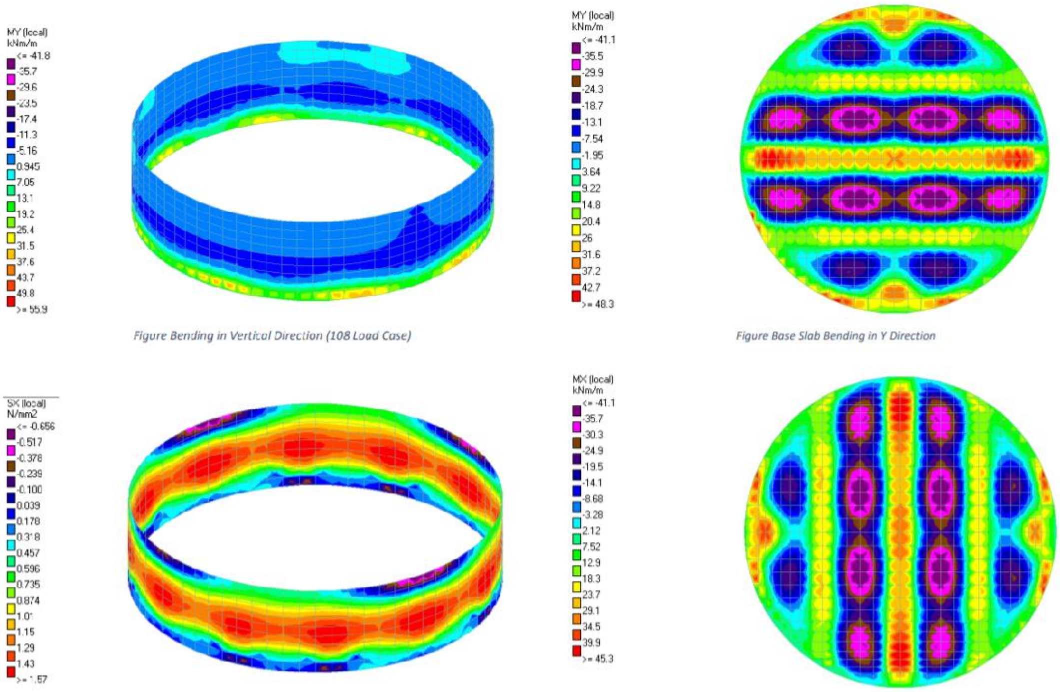
| | |
|---|---|
| Design level | Base slab beam |
| Length of beam | 3.3m |
| Width of beam | 250 mm |
| Depth of beam | 800 mm |
| Cover | 40 mm |
| Effective of section | 750 mm |
| Min . Tension steel | 310.25 $mm^2$ |
| Area of steel provided | 1884 $mm^2$ |
| Spacing of stirrups | 100 mm |

Design of tank walls –

| | |
|---|---|
| Wall location / Nature | Circular wall |
| Overall thickness | 200 mm |
| Width of wall assumed for design | 1 m |
| Diameter of bar | 10 mm |
| Height of wall for design | 5 m |
| Maximum crack width consideration | 0.2 mm |
| Total Area of steel required | 655.12 mm$^2$ |
| Spacing of steel | 70 mm |

For base slab

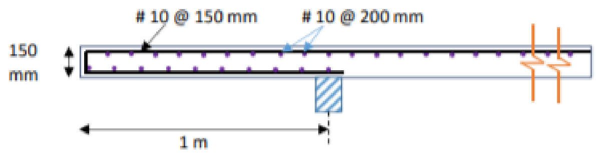
| | |
|---|---|
| Overall thickness of slab | 250 mm |
| Diameter of bars | 12 mm |
| Cover | 50 mm |
| Maximum factored moment | 48.337 KN.M |
| Spacing of steel | 120 mm |
| Total area of steel required | 660.49 mm$^2$ |




STAAD PRO analysis of tank wall and base slab

Design of slab

| | |
|---|---|
| Design level | Walkway |
| Span of slab | 1 m |
| Depth of slab | 150 mm |
| Diameter of bars | 10 mm |
| Cover | 30mm |
| Nature of slab | Cantilever |
| Self weight of slab | 3.75 KN / m^2 |
| Total working load | 7.75 KN / M^2 |
| Total factored load | 11.625 KN / M^2 |
| Factored bending moment | 5.81 KN .m |
| Spacing of steel | 200mm |




## VII. RESULT

Total volume – 1000 Cu m

Tank height – 4.95

Column diameter for footing – 0.5m

Diameter of tank – 18 m

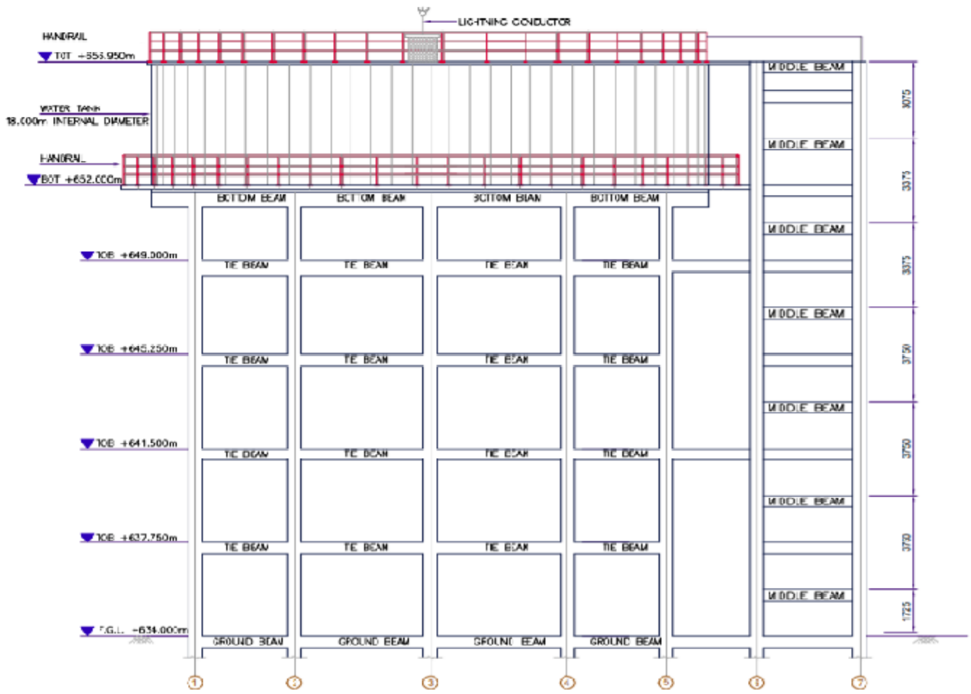
Number of columns – 8 f

Type of Foundation – Isolated Footing

Total height of structure – 23 m

Load on Footing – 328.95 KN

## VIII. DESIGNING AUTOCAD



## IX. CONCLUSION

The limit state approach was determined to be the most cost-effective for designing liquid retaining structures since it requires less steel and concrete than the limit state method.

Water tank design is a time-consuming process. It entails a lot of mathematical equations and calculations, and it takes a long time. As a result, STAAD PRO software provides a solution to the aforementioned issue.

Our construction is safe after STAAD Pro examination.

## X. REFERENCE

1) Bhandari, M (2014). Water Tank of different Shapes with reference to IS 3370 2009. International Journal of Modern Engineering Research.
2) Harsha, K (2015) Seismic Analysis and Design of INTZE Type water tank. International Journal of Science Technology and Engineering
3) Jindal, B. B. (2012), comparative study of Design of water tank with reference to IS 3370.Proceeding of Innovative Challenge in civil Engineering.
4) Kapadia I. (2017) Design Analysis and Comparison of underground rectangular water tank by using STAAD PRO Software. International Journal of scientific Development and scientific research
5) R.C.C. Design, Dr B.C Punmia, Er Ashok Kumar Jain, Dr. Arun K. Jain
6) Design of reinforced concrete structures. S Ramamrutham
7) Vanjari N. S. (2017), Design of circular overhead tank, International Journal of Engineering Research in Mechanical and Civil Engineering
8) Nallanathel M .M (2018) Design and analysis of water tank using STAAD Pro. International Journal of pure and Applied mathematics
9) IS 3370: (2009) Part I: General Requirement; code of practicing concrete structures for the storage of liquids.
10) Is 3370 Part II: Plain and Reinforced concrete structures.