International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 06 | June - 2022 Impact Factor: 7.185 ISSN: 2582-3930

Research Paper on To Determine Economical Cross Section of RCC Water Tank situated in seismic zone 3.

Namrata kamatwar[1], Prof. Deepak Irkullawar[2]

[1]*PG Student, Structural and Construction Engineering Department & Ballarpur Institute of Technology, Ballarpur, Chandrapur, Maharashtra, India*

[2]*Assistant Professor, Structural and Construction Engineering Department & Ballarpur Institute of Technology, Ballarpur, Chandrapur, Maharashtra, India*

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Abstract – Seismic excitation causes severe structural damage. Elevated water tanks are frequently used structures for various purposes like water sloppy, irrigation, etc. Thus, seismic behavior of these tanks needs to the structures. This aims to study the sloshing effects on elevated circular water tank for different water columns and heights of tank, Software package STAADPRO is used for analysis. Three different tanks models are analyzed and parameters study is carried out for base shear and plate stresses.

Water tanks are used to store water and are designed as crack free structures, to eliminate any leakage. In this design of two types of circular water tank resting on ground is presented, This reinforced concrete (RC) alternatives are considered in the design and are compared considering in the total cost of the tank. These water tank are subjected to the same type of capacity and dimensions. As an objective function with the properties of tank that are tank capacity, width & length etc.

1.INTRODUCTION

Water tanks are the structures used for storing liquids for various purposes like farming, drinking water. Irrigation, etc. Overhead water tanks are classified as

1. Rectangular overhead water tanks.
2. Circular overhead water tanks.
3. Intze type tank

For smaller capacities say 50,000 litres to 75,000 litres, rectangular tanks are used. They become uneconomical for larger capacities. Circular overhead water tanks can store water up to 7,50,000 litres. Their diameter varies from 5-15m and height 3-4.5m. Whereas Intze type of tank is used to store massive volume of water. These are now oftentimes used in cities with a potential of 1 million litres. All overhead water tank require roof on the pinnacle and staging at bottom to assist them (Bhavikatti 2008).

Natural disasters mostly earthquakes can cause severe harm to the water storing reservoirs. These reservoirs are often used in various seismic zones. Thus their seismic behavior becomes an vital factors the violent behavior of fluid inside a container/ tank with free surface is recognized as sloshing. The presence of a free surface in partially crammed liquid containers permits for a fluid motion relative to the containers, this is referred as liquid sloshing. If the liquid is allowed to slosh freely it can generate forces that cause extra hydrodynamics stress in case of storage tank and extra vehicle acceleration in case of moving tanks and space automobiles.

Storage reservoirs and over head tanks 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. In general there are three kinds of water tanks-tanks resting on ground Underground tanks and elevated tanks. Here we are studying only the tanks resting on ground like clear water reservoirs, setting tanks, aeration tanks etc. are supported on ground directly. The wall of these tanks are subjected to pressure and the base is subjected to weight of water.

In this, type of reinforced concrete water tanks will be resting on ground monolithic with the base Are design and their results compared. These tanks will be subjected to Same capacity and dimensions. Also a computer program will be developing for solving numerical examples using IS Code 456-2001S-1343-1984,IS 3370-Part I,II,III,IV 1965 & IS Code 1343-1980. From the analysis it will be conclude that for the tank having larger capacity (greater than 10 lakh liter) prestresses concrete water tank is economical.

Fig 1:- Overhead Water tank

1.1PROBLEM STATEMENT

“To analyse and design the water for 1 lakh litre capacity situated in seismic zone 3 and determine the economical cross section”.

1.2OBJECTIVES OF THE STUDY

1. To make the study about the analysis and design of RCC Circular water tank situated in seismic zone3.

2. To make a study about the guidelines for the design of liquid retaining structure according to IS Code.

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

4. To analyse and design water tank for H/D ratio = 1

5. To analyse and design water tank for H/D ratio=1.5

6. To analyse and design water tank for H/D ratio=2

7. Comparison of results.

1.3METHODOLOGY

1. Project topic finalization.
2. Literature survey.
3. Calculation of sizes of water tank for different H/D ratio.
4. Study of IS Code 1893-2016
5. Analysis and design of water tank for H/D ratio of 1.
6. Analysis and design of water tank for H/D ratio of 1.5.
7. Analysis and design of water tank for H/D ratio of 2.
8. Comparison of results.
9. Conclusion.

2. SPECIFICATION FOR THE OVERHEAD CIRCULAR WATER TANK

1. The Height / Diameter ratio for Designing the tank will be H/D = 1, H/D = 1.5, H/D = 2
2. Tank is Considered Circular.
3. Water Storage Capacity is 1Lakh Litre.
4. For H/D = 1, Considering the Height = 5m & Diameter = 5m
5. For H/D = 1.5, Considering the Height = 7.5m & Diameter = 5m
6. For H/D = 2, Considering the Height = 10m & Diameter = 5m
7. Height of Water Tank from Ground (X) Will be
For H/D = 1, X=16 m
For H/D = 1.5, X=20 m
For H/D = 2, X=24 m
8. Height of Column Per Segment = 4 m

3. MODELLING OF TANK

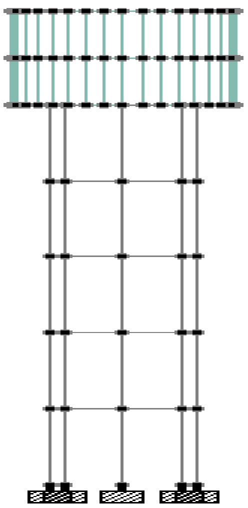

Fig 2:-STAAD MODEL OF TANK

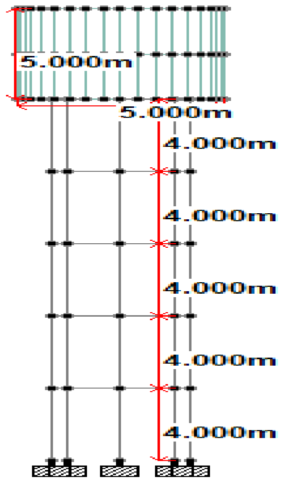

Fig 3:- H/D = 1

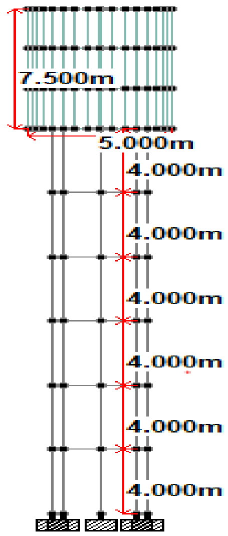

Fig 4:- H/D = 1.5

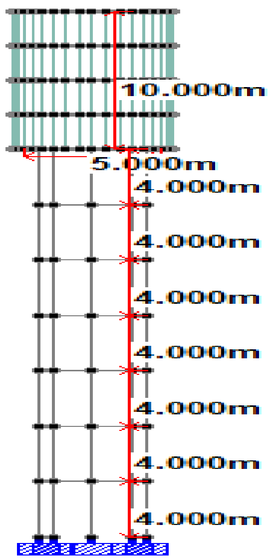

Fig 5:- H/D = 2

4. MATERIAL AND SECTION PROPERTIES.

1. Grade of Concrete :- M30
2. Grade of Steel:- Fe 500
3. Thickness of Wall of Tank = 200 mm (RCC)
4. Thickness of Slab = 300 mm
5. Size of Column :- Circular Dia 450 mm
6. Beam Size :- 230x380 mm

5. LOAD CONSIDERATION

- Dead Load:- Selfweight =1

(Wall is Considered as RCC wall so the weight of wall will be directly considered as Selfweight)

- Live Load :- 10kN/m2
- Seismic Parameter
- Zone:- III (0.16)
- Response reduction Factor =5
- Importance Factor = 1.5
- Soil Type= 2 (Medium Soil)
- Type of Structure= 1 (RCC)
- Damping :- 5%

6. RESULT OF ANALYSIS

1. BASE REACTION

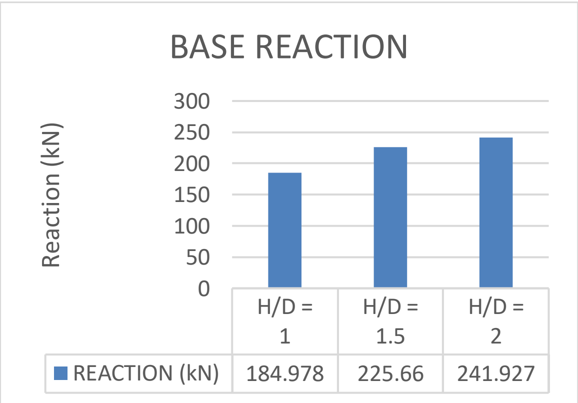

Fig 6:- Graph of Base Reaction

2. DISPLACEMENT

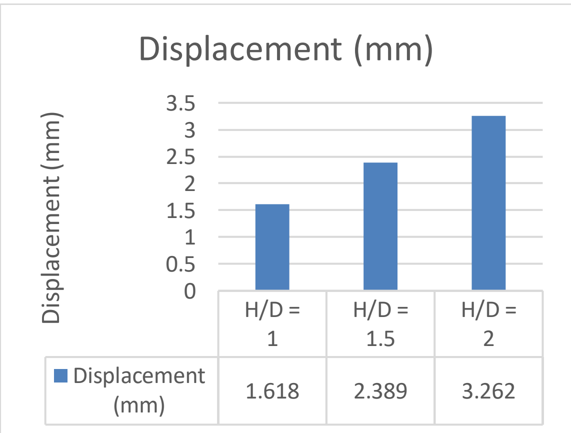

Fig 7:- Graph of Displacement

3. BENDING MOMENT

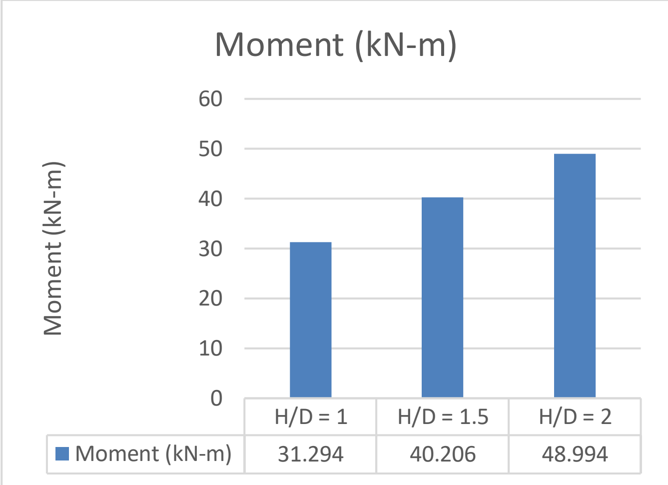

Fig 8:- Graph of Bending Moment

4. SHEAR FORCE

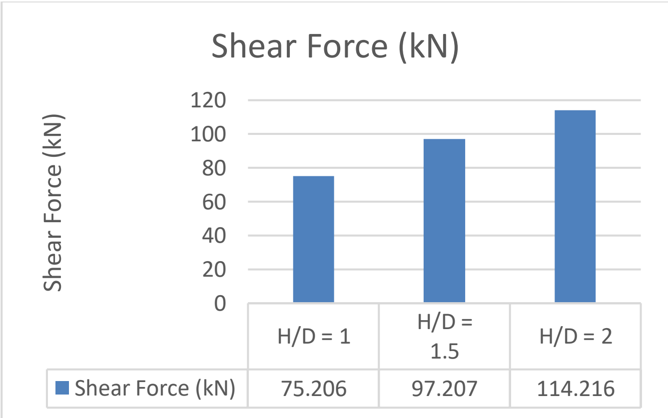

Fig 9:- Graph of Shear Force

5. QUANTITY OF CONCRETE

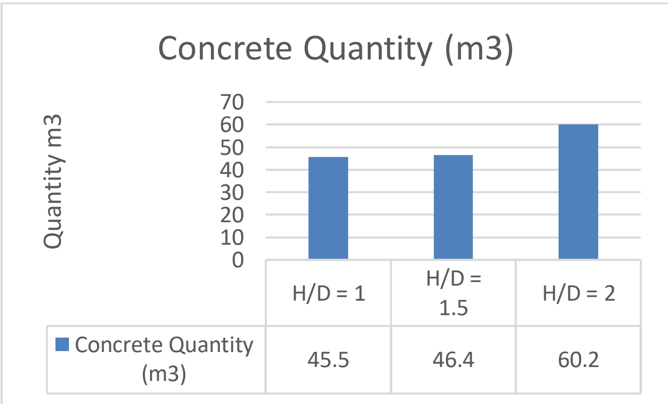

Fig 10:- Graph of Quantity Of Concrete

6. QUANTITY OF STEEL

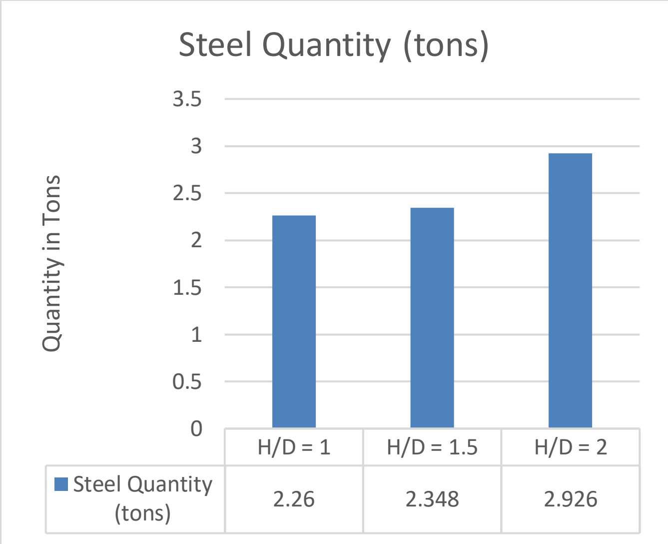

Fig 11:- Graph of Quantity Of Steel

7. CONCLUSION

From the Analysis result of the Water tank for different (h/d Ratio). It was found that.

1. As the ratio increases the base reaction also increased in which h/d=2 has more reaction as compared to other ratios.
2. The Bending Moment, Shear force and Displacement also compared to the other ratios were increasing significantly.
3. The Quantity of Concrete and steel for h/d 1 and 1.5 were almost nearby equal as compared to ratio h/d = 2
4. Overall the ratio h/d = 1 and 1.5 are safer and economical as compared to H/d = 2 where as the Ratio h/d =1.5 can take more quantity of water even without the excessive change in the results.

8. ACKNOWLEDGEMENTS

The Author(s) wishes to express their special thanks and gratitude to Prof. Deepak Irkullawar Sir, Assistant Professor, Structural and Construction Engineering, Ballarpur Institute of Technology. I would also give special credit to all the faculty member of Structural and Construction Engineering Department: -

1} Prof. Neeraj Bais (HOD)
2} Prof. Ganesh Mahalle (Assistant Professor)
3} Prof. Kirti Padmawar (Assitant Professor)
4) Prof. Nandkishor Sinha (Assistant Professor)
5} Prof. Shilpa Samrutwar (Assistant Professor)

Thanks to all for his constant support and guidance throughout the work.

9. REFERENCES

[1]. IS: 11682 - 1985 Criteria for Design of RCC staging for Overhead Water Tank.

[2]. IS: 1893 - 1984 Criteria for Earthquake Resistance Design of Structures.

a. Part 1 -1962 'Recommendations for earthquake resistant design of structures.

b. Part 2 – 2014 Design Base Shear of Elevated Water Tanks.

[5]. IS: 3370 -Design tables for Liquid retaining structure.

a. Part-1 General Requirements

b. Part-2 Reinforced Concrete Structures

c. Part-4 Design Tables

[6]. IITK- GSDMA Guidelines for Seismic design of liquid storage tank.

[7]. M I Adiyanto, A AADamit,SN Yaakup,S A H S Mustapha2,S C ChChin(2019)"Effect of column size on the seismic capacity of elevated reinforcedoncrete water tank".

[8]. Santosh Rathod, Prof. M. B. Ishwaragol (2018) "Analysis of Overhead Water Tank with Different Staging Height and Base Width"

[9]. Sayed HabiburahmanHaqbin, Chintan.D.Patel and Bansal. R. Patel (2016) "Seismic Analysis of RCC Elevated Rectangular Water Tank Using Is 1893 (Part2):2006 Draft Code".

[10]. Soheil Soroushnia1a, Sh. Tavousi Tafreshi2b, F. Omidinasab3, N. Beheshtian4, SajadSoroushnia5 (Sci paper on staging).

[11]. Sonali M. Pole, Amey R. Khedikar (2017) "Seismic Investigation of RC Elevated Water Tank for different Types of Staging Systems".

[12]. Kaviti Harsha and KSKK Reddy, International Journal of Science Technology and Engineering, Volume 2, Issue 03 September 2015.

[13]. Aqsa S. Faras and V.G. Khurd, International Journal of Science Technology and Engineering, Volume, 9,Issue 07 July 2014.

[14]. AjmalTokhi and SahilArora International Journal of Civil Engineering and Technology, Volume, 10 Issue, 03 March 2019, ppt 2519-2527.

[15]. JahnabiBasumatary and DhanjitBarman ,International Journal of Science Technology and Engineering, june 2016.

[16]. SM Methkar and Prof AR Mundhada, International Journal of Science Technology and Engineering, October 2015.

[17]. RS Meshram and S.N. Khanate International Journal of Science Technology and Engineering, Volume No.5,Issue: Special 3,ppr, 731-736.27 Feb 2016.

10. BIOGRAPHIES AUTHORS

Namrata kamatwar[1], (M-Tech 2nd Year Student), Structural and Construction Engineering Department, Ballarpur Institute of Technology, Ballarpur, Chandrapur, Maharashtra, India.

Prof. Deepak Irkullawar[2], (Assistant Professor), Structural and Construction Engineering Department, Ballarpur institute of Technology, Ballarpur, Chandrapur, Maharashtra, India.