

Analysis of Circular Elevated Water Tank with Slant Columns Considering Hydrostatic Load - A Review

Prakash Chandra Sharma^{1*}, Vinay Singh Chandrakar²

P. G. Scholar¹, Assistant Professor²

Department of Civil Engineering, Madhyanchal Professional University, Madhya Pradesh, India

ABSTRACT

Article Info

Volume 5, Issue 3

Page Number: 62-69

Publication Issue :

May-June-2021

Article History

Accepted : 15 May 2021

Published : 22 May 2021

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.

In this paper we are presenting review of literatures and journals related to analysis of structures.

Keywords : Water Tank, Elevated, Sloping Columns, Staad.Pro, Hydraulic Pressure, Lateral Force, Review.

I. 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.

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.

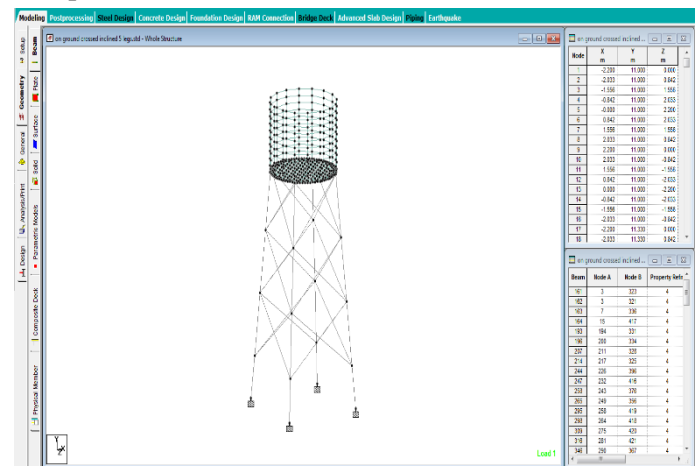


Fig 1 : Water Tank design

The majority of the writing has been introduced as specialized papers to date on the dynamic examination of Elevated Water Tanks. Various issues

and the focuses are canvassed in that investigation, for example, dynamic reaction to ground movement, sloshing impact on the tank, the dynamic reaction of outlined arranging and so on. A portion of those is examined underneath.

II. Literature Survey

Sagar T.Mane and Prashant M. Kulkarni (2019) ^[13] time history investigation of rectangular and round raised water stockpiling tank was examined utilizing SAP 2000 programming utilizing the solid bewilder divider to diminish the sloshing impact of the water tank. The tank reactions, for example, most extreme nodal removal, base shear and result were analyzed for unfilled and full tank water fill condition. From IS 11682:1985 provision when seismic stacking is viewed as just two cases might be taken one is tank void condition and other is tank full condition. The examination reveals the significance of reasonable supporting bewilder divider to stay to withstand against weighty harms of roundabout and rectangular raised water tanks during a tremor. According to IITK-GSDMA rules for a seismic plan of fluid stockpiling tanks, hydrodynamic weight for incautious and convective mode was determined. The baffle divider exhibited not so much dislodging but rather more base shear when contrasted with the without puzzle divider basic water tank in rectangular and round water tank for unfilled and full tank condition. The time-frame increments with astound divider when contrasted with the without bewildering divider in rectangular and round water tank because of the expansion in the mass of the tank. The convective time-frame stays consistent in both roundabout and rectangular water tank. This suggests that the convective mode doesn't rely upon arranging and in the end relies upon the size of the tank. The time-frame shifts in-tank void condition and tank full condition, this is because of the sloshing impact and hydrodynamic weight.

Tiruvedhula Chandana and S.V. Surendhar (2019) ^[15] the examination paper managed the exhibition of raised strengthened solid overhead water tanks to seismic and wind powers. Tanks of different shapes were considered in the current examination. Roundabout, Rectangular and Intze Elevated water tanks and demonstrated in STAAD.PRO programming. Gravity examination, Seismic investigation and wind investigation are performed on the displayed structure. The seismic boundaries, for example, removals, base shear and toppling minutes were inspected and thought about and cost examination was performed for all the three water tanks and analyzed.

The end got from the outcomes expressed that thinking about the shape and math, the over-turning second was discovered to be more prominent in a rectangular water tank when contrasted with the other two water tanks (Circular and Intze). Under seismic stacking, Circular water tank was suggested. Under wind stacking, Intze water tank was suggested. Round water tank encounters more noteworthy dislodging when contrasted with the other two water tanks because of its help conditions. Roundabout water tank encounters more noteworthy base shear when contrasted with Rectangular and Intze water tanks. Looking at seismic investigation and wind examination results, Intze water tank was suggested and according to cost investigation, Circular water tank was discovered to be practical when contrasted with the other two tanks augmentations.

Mareddy Arun Kumar et. al (2018) ^[8] the essential target of the examination paper was to plan, investigation and plan a Circular Overhead Tank of 15 lakh litres limit at N.B.K.R. Establishment of Science and Technology, Vidyanagar utilizing basic application STAAD.Pro. The overhead round water tank with 1500 KL limit was demonstrated. The end expressed that the proposed tank in NBKRIST College grounds planned in STAAD Pro programming. Plan of the tank is protected from the

product plan as for loads applied. For little limits, we go for rectangular water tanks while for greater limits we give roundabout water tanks. Since the proposed tank is of 12lakh limit the Planned examined and planned the round overhead tank in STAAD Pro programming. Plan of water tank is a tedious strategy.

R. Uma MaheshwaraRao et. al (2018) ^[11] the essential target of the examination was to assess the impacts of horizontal powers to be specific seismic and wind powers on raised water tanks. STAAD.pro was utilized for planning and examination of the characterized model. Structural angles, for example, hub powers, shear powers and bowing minutes are looked at for changed basic segments of the tank.

In the examination that the bearing limit increments for a similar breeze speed volume of cement and amount of steel both are diminished. For Columns, the greatest bowing second happened in Z-heading for the part 306 is 511.864 KNm with a shear power of 252.673. Ring radiates @ Bottom of the tank most extreme bowing second happened in Z-bearing for the part 4022 is 382.35 KNm with a shear power of 355.039 KN. For Ring radiates @ Top of the tank most extreme twisting second happened in Z-bearing for the part 4138 is 29.086 KNm with a shear power of 28.579 KN. For Tie radiates greatest bowing second happened in Z-bearing for the part 2008 is 471.68 KNm with a shear power of 350.95 KN.

Sagar Mhamunkar et. al (2018) ^[12] the goal of the examination paper was to plan and investigate a sheltered Elevated Storage Reservoir (ESR) according to IS code and study the different powers acting of the structure.

The end expressed that Elevated round water tank with enormous limit and level base necessities huge fortification at the ring pillar, to conquer this in intze tank, by giving a conelike base and another circular base decreases the anxieties in-ring radiates. intze tank is more affordable for high limit diminishing the steel prerequisite. Per capita request has been

determined which assisted us, with knowledge about the water utilization in the neighbourhood and further aided in plan the tank. Cutoff state strategy was discovered to be generally practical for the plan of the water tank as the amount of steel and cement required is less as the contrast with working pressure technique. After a manual plan and examination in staad.pro our structure is sheltered.

Salitha Elizabeth Ninan and Afia S Hameed (2018) ^[14] the examination paper led to a seismic investigation of rectangular and roundabout water tanks utilizing SAP 2000. The auxiliary components of the supporting edge framework were displayed as bar components and region components, for example, tank divider, rooftop piece and floor section were demonstrated utilizing shell components. To consolidate the dynamic conduct of the liquid mass in the FEM tank models, two masses were thought of. The essential mass is the imprudent mass segment of the liquid which is determined according to IS 1893 (section 2).

Results reasoned that the mode state of round water tank is torsion and that of rectangular is the interpretation along Y-pivot. Time-frame diminishes for water tank models with bracings. Shear and second qualities increment for supporting structures. This is because of the expansion in mass because of bracings. The torsional mode state of the round tank can be killed by reworking the places of the section. Component size needed for the rectangular tank is more when contrasted with a roundabout tank expressing round tank was more conservative.

Ayub Patel and Sourabh Dashore (2017) ^[2] the examination paper introduced the correlation of the seismic conduct of raised square and roundabout RCC water tanks having various limits of capacity. For this reason, square and round raised water tanks of limits 1 lakhs and 2 lakhs was considered to dissect under seismic powers. Statures of arranging considered were 12m, 18m and 24m for square and roundabout tanks for both the limits. All the models were analyzed for

zone III, zone IV and zone V utilizing Staad. Genius v8i programmings to consider the seismic conduct of both the tanks the reaction boundaries chose is parallel removal and base shear.

For all the zones considered in both square and roundabout water tank diversion esteems chase after comparable step by step expanding straight way along arranging statures. For all the models' redirection esteems and base, shear is less for lower zones and it goes on increments for higher zones. It is knowledgeable about all the models for all zones that estimations of avoidance and base shear are expanding to a great extent practically serve as the limit increments from 1 lakh litre to 2 lakhs litre. From an arranging perspective, it is seen that as the tallness increments from 12m to 18m and 24m, avoidance marginally diminishes at 3m, 6m and 9m yet over that it increments. By expanding organizing stature the estimation of base shear diminishes for both square and roundabout tanks for all the quake zones. In contrast with square and round water tanks estimation of avoidance and base shear are watched more in the roundabout tank and less in the square tank.

Mor Vyankatesh K. and More Varsha T. (2017) ^[9] the examination paper introduced a relative investigation of raised water tanks exposed to dynamic stacking upheld on RC outlined structure and solid shaft structure with various limits and put in various seismic zones. The dynamic examination of raised water tanks was led concerning the most recent IS code distributed for fluid holding structures by Bureau of Indian Standards, for example, IS 1893 (Part 2): 2014. Correlation of raised tanks with the diverse supporting framework, limits and seismic zones expresses that these boundaries may significantly change the seismic conduct of tanks. The hydrodynamic impact on the raised water tank, with a various supporting framework for example outlined arranging and solid shaft put in various seismic zones, was additionally assessed.

Results expressed that base shear for raised tanks, upheld on the solid shaft is more noteworthy than that of raised tanks upheld on outline organizing. The base second being a significant boundary while planning the structure is extensively more noteworthy for tanks with solid shaft upheld. Thus the territories with high seismic force, a danger to the tank with shaft supporting are more than that of organizing support. The time-frame in the hasty mode for shaft upheld tanks and edge upheld tanks very consequently. Yet, for the convective mode, the thing that matters is less nearly. The avoidance of organizing is discovered to be diminishing with the expansion of limit and change in arranging design, further causing an expansion in its solidness. Sloshing wave stature is roughly same for the tanks with the distinctive supporting framework, however, it varies for tanks as the limit increments.

Manish N. Gandhi and Ancy Rajan (2016) ^[7] the essential goal of the exploration paper was to comprehend the conduct of various organizing design in propping to reinforcing the regular sort of arranging, to give a superior exhibition during a seismic tremor. Identical static investigation for arranging with various kinds of the supporting framework applied to the organizing of a raised roundabout water tank in zone V was done utilizing STAAD Pro. Examination of base shear and most extreme uprooting in X, Y & Z heading of roundabout water tank is finished.

The distinctive model was utilized for computing base shear and most extreme uprooting for organizing with cross supporting, arranging with slanting propping, organizing with K-type supporting, organizing with V-type supporting organizing with chevron supporting and substitute cross propping in arranging, substitute K-type propping in organizing, substitute V-type propping in organizing substitute askew supporting in organizing and substitute chevron supporting in arranging. While doing a parametric report did by utilizing various examples of

bracings in the organizing of a raised water tank. base shear for the distinctive propping design plainly the base shear esteem decreases for another supporting example in organizing. This is clearly a result of the decrease of the general solidness of the structure.

The end expressed that Cross Bracing in arranging best in decreasing Displacement because of horizontal stacking diminishing relocation successfully by 81.09 % in the X course and 92.98 % in the Z bearing from that of the structure without bracings. From the correlation between removal for various propping framework and dislodging for various substitute supporting it was inferred that the cross-propping design gives the base estimation of relocation.

Patel Nikunj and Jugal Mistry (2016) ^[10] the exploration paper introduced a parametric report concerning conduct and plan of overhead Rectangular solid tank exposed to static loading conditions with unique accentuation on IS:3370, PCA, and STAAD-Pro. The plan includes load counts physically and examining the entire structure by STAAD.Pro V8i. The plan strategy utilized in STAAD. Star examination is Limit State Design and the water tank is exposed to dead load, self – weight and hydrostatic burden because of water. The impact of the diverse tank angle proportion, end condition for a similar limit was assessed and considered in the Analysis and Design.

The conclusion from the outcomes expressed that Deflection can be diminished by the propping framework. Solidness of water tank can be improved by giving a hefty segment at the base level. At the mid-range of the top bit get greatest burdens. Liquid thickness must be considered in plan and Slab thickness likewise impact on a diversion.

Dixitkumar. B. Patel (2016) ^[4] the primary point of the exploration paper was to consider the conduct of EVT at under various sort of soil-layered condition by Using FE-ANSYS Software to get the aftereffect of various Stress example and Deformation and Von-Mises Stress and were additionally analyzed.

Thinking about the Parameter of Staging System for EVT and diverse filling (Empty, Half, Full) condition and five Kinds of Soil. An RCC Overhead Intze water tank with Container limit of 1000m³ laying on supporting layered soil mass and exposed to Earth gravity and water mass stacking is broke down. The raised tank has a casing and shaft supporting on Rc Staging number of 8 segments are associated by the encasing bar at generally, at 4m, 8m, 12m and 16m tallness level and use Shaft supporting arranging is 16 m stature level is associated with underneath the establishment. The compartment is loaded up with water. The compartment and the supporting structure are being utilized in the greater part of India situated in a tremor inclined zone. To explore the Soil-Structure connection lead, the association.

Results expressed that the communication impact in Frame supporting tank causes an increment in the anxieties in the scope of - 13 to 59.52% in different segments of the tank. The greatest chief pressure happens in the round brace partition. The abatement of almost 13% is found in the greatest chief pressure in the tapered vault. The collaboration impact in shaft supporting tank causes increments in the anxieties in the scope of - 12 to 64.22% in different parts of the tank. The most extreme chief pressure happens in the round ring bar divide. The abatement of almost 12% is found in the greatest chief pressure in the ring pillar. Chief burdens were the equivalent in the two stagings of the different part of the tank for an alternate kind of homogeneous soil mass beneath the establishment or layered soil mass underneath the establishment of the tank. The common recurrence of the communication framework in shaft supporting 0 to 44.49 Hz and In void condition most extreme normal recurrence 32.116Hz and half condition 44.49Hz and Full filled condition 39.42Hz In Shaft supporting framework.

Urmila Ronad, Raghu K.S and Guruprasad T.N (2016) ^[16] in the examination, seismic conduct of round and hollow fluid stockpiling tanks was done by

performing dynamic reaction range investigation utilizing FEM based programming (ETABS) according to IS 1893: 2002. The examination was completed for raised round RC tank for void and full tank condition under various soil conditions and various zones. The reactions incorporate base shear and base moments in all dirt conditions have been thought about. The procedure incorporates fixing the elements of segments for the chosen water tank and performing nonlinear powerful investigation IS 1893-2002 (Part 2) draft code. This work proposes to consider Circular tanks of various zones with all sort of soil condition. The examination is done for a tank with a full tank and void condition. Finite Element Model (FEM) is utilized to display the raised water tank utilizing ETAB programming.

Results expressed that for tank full condition the base shear is more. The base moments are higher for full tank condition as a contrast with void tank condition. On the off chance that the water tank is situated in higher seismic zone comparing base shear and base moments would likewise increment. The base shear & Base moment changes with soil medium.

Dona Rose K J et. al (2015) [5] the examination paper zeroed in on the reaction of the raised roundabout sort water tanks to dynamic powers. Tanks of different limits with various organizing tallness were demonstrated utilizing ANSYS programming and the investigation was completed for two cases to be specific, a tank full and half level condition considering the sloshing impact alongside hydrostatic impact. The time history investigation of the water tank was done by utilizing tremor quickening records of El Centro. The tanks withstood the speeding up with the relocations inside as far as possible. The pinnacle removals and base shear got from the investigation were likewise analyzed.

The conclusion drawn from the examination expressed that the pinnacle removals from the time history investigation under El Centro quake records were beneath the greatest passable dislodging for

various water levels. The pinnacle relocation from the time history investigation increments with arranging statures. Yet, the dislodging first declines and afterwards increments with limits. The uprooting for half-filled tanks is lesser than the removal for tanks with a full limit. The base shear esteems from time history investigation were increments as arranging tallness increments. Likewise, the base shears diminishing and afterwards increments with a limit. Base shear for half limit tanks is lesser than that for full limit tanks under same organizing condition.

Dhotre Chandrakala and Jawalkar G.C.(2015) [3] the essential goal of the exploration was to contemplate the impacts of bearing limit of soil on the amount of cement and steel needed to develop around the tank. Variety of pivotal power, shear power and twisting second were analyzed for various parts of the tank-like segments, base pillar and supporting shaft because of slanting ground. Examination of various powers prompted in different individuals from the tank on the levelled surface and with an expanding incline for various statures was dissected and hub power, shear power and the bending moment was analyzed for various auxiliary segments of tank viz. base bars, sections and bracings.

Results expressed that both shear power and bending moment increments steeply in the section laying on the higher side of the slanting ground. Expansion in Shear Force and Bending Moment gets milder as one goes towards the descending side of the incline. It was additionally seen that as one move towards upper stories, the impact of an expansion in shear power and bowing second because of the slanting ground turns out to be as yet milder. There is no critical change in hub power concerning the variety of incline of the ground. For the expansion in tallness of organizing, the cross-part of the necessary zone of the section likewise increments. As the breeze speed increments for a similar bearing limit volume of cement and amount of steel both are expanded. As the bearing limit increments for a similar breeze

speed volume of cement and amount of steel both are diminished.

Hemishkumar Patel et. al (2014) [6] the exploration paper was the use of enhancement technique to the auxiliary investigation and plan of roundabout raised water tanks, considering the absolute economy of the tank as a target work with the properties of the tank that are tank limit, width and length of tank in rectangular, water profundity in a round, unit weight of water and tank floor piece thickness, as plan factors. A PC program was created to comprehend mathematical models.

The outcomes expressed that the tank limit is taken up the base economy of the rectangular tank and brought down for round tank. The tank floor piece thickness was taken up the base economy for tanks. The unit weight of water in the tank taken up the base economy of the round tank and brought down for a rectangular tank.

The end expressed that the whole water load in Rectangular tank is marginally higher than water load in a roundabout tank. A loop pressure power for Circular tank is lower contrast with Rectangular tank for a higher limit. A hub power in the segment because of complete water load in Circular tank is lower contrast with Rectangular tank for a higher limit. Programming results contrast with IS code count is higher.

Ayazhussain M. Jabar and H. S. Patel (2012) [1] the essential target of the examination was to comprehend the conduct of the supporting frame which is more compelling under various tremor time history records with SAP 2000 programming. Two diverse supporting frameworks, for example, spiral propping and cross propping are contrasted and the essential supporting framework for different liquid level conditions. For later conditions, water mass has been considered in two sections as rash and convective proposed by GSDMA rules. Notwithstanding that rash mass of water has been added to the compartment divider utilizing

Westergaard's additional mass methodology. Tank reactions including base shear, overturning moment and rooftop relocation have been watched, and afterwards, the outcomes have been thoroughly analyzed.

The outcome expressed that the structure reactions are extremely impacted by the presence of water and quake qualities. For essential organizing, the upsetting second is most noteworthy down the middle full condition for Loma Prieta having high PGA esteem. If there should be an occurrence of Full condition, most noteworthy base shear is acquired for spiral propping in Imperial Valley having low PGA esteem. Rooftop dislodging extensively diminishes with increment in PGA estimation of seismic tremor time history and noticed the higher incentive in Imperial Valley. Higher Roof dislodging values are gotten in full top off a condition for all examples.

III. CONCLUSION

In this study author's determine the stability of water reservoirs under static condition of loadings, here it be said that in past experimental analysis has been done but no one explain the effect of lateral forces and inclination of tanks over the structure stability.

IV. REFERENCES

- [1]. M. Bhandari and Karan Deep Singh, [Economic Design of Water Tank of Different Shapes With Reference To IS: 3370 2009], International Journal of Modern Engineering Research, ISSN: 2249-6645, Vol. 4 | Iss. 12 | Dec. 2014.
- [2]. Santosh Rathod and M. B. Ishwaragol, [Analysis of overhead water tank with different staging height and base width], International Research Journal of Engineering and Technology, Volume: 05 Issue: 06 | June-2018.

- [3]. Tiruveedhula Chandana and S.V. Surendhar, [Comparative Seismic and Cost Analysis of RCC Circular, Rectangular and Intze Elevated Water Tank], International Journal of Innovative Technology and Exploring Engineering (IJITEE), ISSN: 2278-3075, Volume-8 Issue-8, June, 2019.
- [4]. J.Karol Argazinski, José Alex P. Sant'Anna and Marcos R. Tristante, [Fluoropolymers for the Chemical Processing Industry Applications], INTERCORP ABRACO 2010.
- [5]. Dona Rose K J, Sreekumar M and Anumod A S, [A Study of Overhead Water Tanks Subjected to Dynamic Loads], International Journal of Engineering Trends and Technology (IJETT) – Volume 28 Number 7 - October 2015.
- [6]. Shivkumar Hallale, Tushar Deshmukh, Swapnil Manjramkar, Riyaj Sayyad and Digvijay Makode, [Seismic Behavior of Overhead Circular Water Tank with Shear Wall using STAAD PRO], International Journal for Research in Applied Science & Engineering Technology (IJRASET), ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887, Volume 6 Issue VI, June 2018.
- [7]. P.L.N. Saroja and Vanka. Srinivasa Rao, [Comparative Study of Seismic Analysis of Existing Elevated Reinforced Concrete Intze Water Tank Supported on Frame Staging], International Journal of Constructive Research in Civil Engineering, Volume 2, Issue 1, 2016, PP 10-21.
- [8]. Manoj Nallanathel, Mr. B. Ramesh and L. Jagadeesh, [DESIGN AND ANALYSIS OF WATER TANKS USING STAAD PRO], International Journal of Pure and Applied Mathematics Volume 119, No. 17 2018, 3021-3029.
- [9]. Prashant A Bansode and V. P. Datye, [Seismic Analysis of Elevated Water Tank with Different Staging Configuration], Journal of Geotechnical Studies, Volume 3 Issue 1, 2018.
- [10]. Krishna Rao M.V, Rathish Kumar. P and Divya Dhatri. K, [SEISMIC ANALYSIS OF OVERHEAD CIRCULAR WATER TANKS – A COMPARITIVE STUDY], International Journal of Research in Engineering and Technology, Volume: 04 Special Issue: 01 | NCRTCE-2014 | Feb-2015.
- [11]. RAMAKRISHNA HEGDE, YOGESH G and SANJAY CHAWHAN, [COMPARATIVE STUDY ON RECTANGULAR AND CIRCULAR WATER TANK USING STAAD PRO SOFTWARE], International Research Journal of Engineering and Technology, Volume: 05 Issue: 11 | Nov 2018.

Cite this article as :

Prakash Chandra Sharma, Vinay Singh Chandrakar, "Analysis of Circular Elevated Water Tank with Slant Columns Considering Hydrostatic Load - A Review", International Journal of Scientific Research in Civil Engineering (IJSRCE), ISSN : 2456-6667, Volume 5 Issue 3, pp. 62-69, May-June 2021. URL : <https://ijsrce.com/IJSRCE215310>