https://dx.doi.org/10.22161/ijaers.71.19 ISSN: 2349-6495(P) | 2456-1908(O)

A Review on Economical Design of Intz Water Tank as per IS-875-III, for Wind Speed in India

Sapan Chawla[1], Sagar Jamle[2], Kundan Meshram[3]

[1]M. Tech. Scholar, Department of Civil Engineering, Oriental University, Indore (M. P.), India
Email: sapancivil@gmail.com
[2]Assistant Professor, Department of Civil Engineering, Oriental University, Indore (M. P.), India
Email: sj.sagarjamle@gmail.com
[3]Associate Professor, Department of Civil Engineering, Oriental University, Indore (M. P.), India
Email: kundan.transpo@gmail.com

Abstract *— Overhead Water Tank had been the primary and the most fundamental piece of pretty much every task. Because of increment of population consistently, it is important to offer water request to the different purposes, for example, mechanical use, cultivating, residential use, for drinking reason and so on. The capacity of water is principal done by introduction of Overhead Water Tank. The piece of land has been seen expanding step by step over some stretch of time and it is important to productive utilization of a large portion of its part inside the limit that is a significant issue. Various works dependent on various stockpiling tank criteria alongside the perspectives on different specialists are referenced in literature survey. The paper contributes by breaking down the past work finished with the similar investigation of cost adequacy with linkage to the gap of the study and proposed work.*

Keywords *— **Footing, Overhead Water Tank, Wind component, Wind Pressure.***

I. INTRODUCTION

The water supply demand has now increased when compared to previous year data. Due to increase of population and shifting of people day by day leads to increase the water demand for drinking, domestic use, industrial along with commercial use. The water tank has now become the essential component of every structure just because to fulfill the water needs.

Water tanks Classification as per size are as follows:-

1. Rectangular water tanks
2. Circular water tanks
3. Spherical water tanks
4. Intz water tanks

Water tanks Classification as per material are as follows:-

1. Steel water tanks
2. Composite alloy based water tanks
3. R.C.C. water tanks
4. P.S.C. water tanks
5. Traditional brick wall type water tanks
6. Plastic water tanks

Water tanks Classification as per location are as follows:-

1. Overhead water tanks
2. Tanks resting on ground
3. Overhead water tank

Since Overhead water tank has many advantages are as follows:-

1. To store different types of liquids.
2. To store liquid products that contains high vapor pressure.
3. To store a huge amount of water.
4. To collect, save and store runoff water from channels connected from large catchment areas.
5. To transfer inside water pressure directly to the soil.
6. It can easily be cleaned and maintained.
7. The space above the water tank can be utilized hassle free.

II. LITERATURE SURVEY

A concise review of previous studies conducted on the tuned mass damper on different structural configuration. This literature review also comprises past studies on diverse application of sensations of tuned mass damper. This literature review on new contribution associated to sensations investigation of building structure with tuned mass damper.

Following are the closures reliant on the arrangement and examination finished in this endeavor: as the breeze speed and seismic zone increases for a comparative bearing breaking point volume of cement and nature of steel both are extended. We have seen that, as the breeze speed grows the breeze control on sorting out keeps

https://dx.doi.org/10.22161/ijaers.71.19 ISSN: 2349-6495(P) | 2456-1908(O)

extending for different cases. We separated that the breeze load has been extended by directly around 15-18% for every circumstance. We come to understand that the seismic weight in case-4 has been extended practically on numerous occasions when appeared differently in relation to case-1 in tank full condition. Additionally, the seismic weight in cas-4 has been extended on numerous occasions in tank void condition. From chart-3, we inspected that for different cases the minutes at face of props, from most negligible backings to top outer props has been extended right around various occasions for each circumstance. Furthermore, we see that the torsional minute has been extended practically on different occasions as the breeze speed increases. we dismembered that the supreme weight on segments in first story keeps growing for every circumstance, anyway the hard and fast weight on second and third story remains for all intents and purposes predictable for every circumstance, we separated that the hard and fast minutes on area on first story keeps growing in each cases.as the breeze speed keeps extending the stack on boat foundation keeps extending for every circumstance by pretty much 2-5 %. We examined that the full scale minutes on barge foundation has been extended by 15 % as the breeze speed increases for every circumstance. As the store and minutes on foundation keeps extending for every circumstance the size of barge foundation keeps growing. For every circumstance, as the breeze speed keeps changing or growing the breeze minute decided [Nitesh J Singh, Mohammad Ishtiyaque].

From as of late referenced down to business appraisal and assessment a piece of the terminations can be made as looks for after for same most distant point, same geometry, same stature, with same organizing framework, in a similar zone, with same significance factor and reaction decrease factor; reaction by comparing static strategy to dynamic technique separate incredibly. It also express that paying little mind to whether we consider two cases for same point of confinement of tank, change in geometric features of a holder can show the noteworthy change in the response of raised water tank. All the while static response shows high scale regards that of the dynamic response. it happens on account of the different picks of time allotments. for static examination water-structure joint effort shows that both water and structure achieve a pick at the same time in light of the doubt that water is clung to the holder and goes about as a structure itself and both structure and water has same immovability, while in ground-breaking assessment we considered two mass model which shows two various robustness for both water and structure in this way pick of time for both the parts are particular in this way fundamental timespans are different for both static and dynamic assessment.be that as it may, auxiliary timespan in powerful investigation is more prominent than both basic timeframe on the grounds that water in the upper district (convective area) stays in un damped condition (sloshing condition) for some additional time. As the limit expands distinction between reaction increments. Increment in the limit shows that contrast between static reaction and dynamic reaction is in expanding request. Itself it shows that for enormous limits of tank static reaction not exact but rather it is to some degree on the higher side, and whenever examined by static technique and planned by the equivalent can give over balanced out or state over fortified area however it will be uneconomical. Subsequently is code arrangement of static investigation are confined for little limits of tanks as it were. During the wind rash weight is constantly more prominent than convective weight for little limit tanks, yet it is the other way around for tanks with enormous limits. Consequently static examination for huge limits tanks can be uneconomical as all the water mass acts itself as a convective. This announcement indicates that if enormous limits tanks are structured by static technique twisting in the compartment can be seen simultaneously of breakdown of arranging. Enormous limits are subject of creating high weights on the divider and the sections of the holder, if the hydrodynamic components are overlooked during the examination they will influence enthusiastically and breakdown of the structure can happens. From charts 18, we can likewise say that the indiscreet weight for various limits fluctuates with enormous contrast; and yet convective weight for various limits meets at a similar point [Gaikwad Madhukar V, Prof. Mangulkar Madhuri N].

All around, the improvement material-yields for all water vessel limits would be built up on the decision of the course of action contemplations, with the extents of their associate fragments. Thusly, there exists the believability of having a proportionate cutoff and close to geometrically encircled water tanks yet with some quantifiable separation in material necessities. for example, a tank divider orchestrated as a cantilever would devise a decently separate material-aggregate when separated and its material fundamentals, at whatever point composed as a two-way spreading over divider, (with respect to rectangular tank) or ring (or band) divider, (stressed round tank). Additionally, it may be plainly observed that material required for the improvement of rectangular water tank is similarly more than those required for aberrant ones yet ease of headway is progressively badly designed in backhanded water tank when showed up diversely in

https://dx.doi.org/10.22161/ijaers.71.19 *ISSN: 2349-6495(P) | 2456-1908(O)*

connection to that of rectangular water tanks [Ajagbe W. O., Adedokun S. I. and Oyesile W. B.].

It very well may be seen from the prior code is 1893: 1984 can utilized just single level of opportunity and from the later existing tank contrasted and water code is 1893 (section 2): 2007 draft code it can pursue the two mass modular. The conveyance of incautious and convective hydrodynamic weight is spoken to graphically for comfort in investigation, the indiscreet hydrodynamic weight on divider and base of existing water tank is bring down the qualities when contrasted with zone-4 is 33% and with zone-5 is 55% . the convective hydrodynamic weight on divider and base of existing water tank is bring down the qualities when contrasted with zone-4 is 34%and with zone-5 is 56%. The most extreme hydrodynamic weight of existing water tank is bringing down the qualities when contrasted with zone-4 is 44% and with zone-5 is 63%. The sloshing wave tallness of the current tank is inside the free board and in the zone-4 and zone-5 the sloshing wave stature isn't with in the free board [D. Kumara Swamy, V. Srinivasa Rao].

The procedure suggested in is: 1893-1984 considers the tank as single degree of freedom system (lumped mass model) which is applicable to closed tanks completely full of water. Hence for tanks with free water surface, two mass idealization of tank are used which is incorporated in is: 1893-2002 draft code (part 2).is: 1893-2002 (part 2) has considered the sloshing motion of water surface. Due to effect of sloshing, convective pressure acts on the tank which were not given due consideration in the analysis of tank using lumped mass model concept of is: 1893-1984. With the thought of convective hydrodynamic weights, bases shear and base minute's qualities increments extensively which were very little for lumped mass admiration of tank. Subsequently the bases shear and base minute. A value acquired from two mass romanticizing for example according to seems to be: 1893-2002 (section 2) are progressively reasonable. Henceforth convective weights assume a significant job in seismic examination of the raised water tank. Base shear and base minute qualities got from two mass glorifications are far more prominent than that in lumped mass model. Thus forward profound respect of water tank as single degree of chance system isn't fitting for seismic examination of water tanks. Therefore two mass profound respects should be used for dynamic examination of water tanks. The hydrodynamic pressures calculated using is: 1893-1984 code provisions are by considering the rigidity of the tank wall whereas those calculated using is: 1893-2002(part 2) code provisions are by considering the flexibility of the tank wall. The impulsive pressures obtained considering flexibility of wall are very large as compared to those obtained by lumped mass model. the impulsive hydrodynamic pressures obtained by two mass model concept are almost sixteen times more than that obtained using two mass model concept. Hence lumped mass model underestimates the impulsive pressure values. from the graphs, it is clear that shaft type arranging ought to be maintained a strategic distance from beyond what many would consider possible sooner rather than later to keep away from harm to the water tanks and consequently anticipate loss of lives [Pradnya V. Sambary, D. M. Joshi].

Based on above study, following are few conclusions.in all the three types of soil conditions, up to 30 m3 capacity static wind load is governing, in all other cases dynamic wind load is governing dynamic wind load as per is 875-1987 (part iii) is giving higher forces compared to the is 875 draft (part iii).for soft soil the effect of wind force for 50 m/s wind speed is quite significant as compared with the wind forces in zone ii, iii, and iv.in medium soil for wind speeds 47, 50 m/s is more effective as compared with the wind forces in zone ii, iii, and iv. for hard soil with wind speeds of 47, 50 m/s is more significant as compared with the wind forces in zone ii, iii, iv, and v. the results presented in this paper can be utilized in deciding the governing load case for design of staging. However results are based on data (structural) considered and may vary with different sizes and configuration [Chintha Ravichandra, R. K. Ingle].

In light of the work exhibited in this examination, geometry of water tank can influence base shear. The ground supported circular tank has less base reactions. Since, it is better than ground supported rectangular tank.in case of elevated tanks the base shear and base moment of circular tank exceeds rectangular tank by 1.37% and 3.69% respectively. The elevated rectangular tank is better than elevated circular tank. in the case of elevated rectangular tanks the base shear obtained from manual dynamic analysis at full tank condition exceeds 6.5% and base moment exceeds 0.1% from software dynamic analysis but in the case of ground supported circular tanks the base shear obtained from manual dynamic analysis exceed software dynamic analysis by 4% and base moment lags 6 %.the manual dynamic analysis and software dynamic analysis performed are found to be comparable [Nandagopan .M., Shinu Shajee].

In unique examination we consider two mass model which shows two distinctive solidness for both water and structure thus pick of time for the two segments are extraordinary. The rash weight is constantly more noteworthy than convective weight. The imprudent too the convective hydrodynamic weight on divider continues

https://dx.doi.org/10.22161/ijaers.71.19 ISSN: 2349-6495(P) | 2456-1908(O)

expanding with y/d proportion. The estimation of weight on base piece continues expanding with increment in level measurement in barrel shaped segment [Kulkarni Reshma, Prof. Mangulkar].

Wind powers diminishes with increment in arranging tallness in light of the fact that as organizing stature builds the structure become increasingly adaptable. Subsequently timespan increments because of which auxiliary reaction factor diminishes from lower to higher organizing tallness. Maximum column forces will reduces as staging height increases up to a width to height ratio of 2 to 2.5 after that the forces are stable [Nishigandha R. Patil, Dr. R. S. Talikoti].

By and large, when wind happen significant disappointments of raised water tank occur because of disappointment of supporting frameworks, as they are to take care for seismic powers. In this manner supporting structures of raised water tanks are very powerless under sidelong powers because of a wind. Seismic examination and execution of raised RC Intz water tanks have been displayed in this investigation for outline kind of arranging design Displaying is performed utilizing Staad professional programming. Further, the conduct of raised water tank with arranging design is dissected utilizing lumped mass model and two mass model techniques. it very well may be seen from the investigations that raised water tank with outline kind of arranging perform better by following draft code is: 1893 (section 2) rules than prior rules because of the accompanying attributes.

From the correlation of indiscreet and convective method of vibration it was seen that timespan, base shear, base minute got by convective method of vibration is more noteworthy than rash method of vibration. Horizontal power is more in tank full condition when contrasted with tank void condition and thus tank full case is considered for seismic investigation. Base shear got by two mass models is seen as expanded by 36% when contrasted with lumped mass model strategy. Toppling minute got by two mass model strategies is seen as more prominent than the minute got in lumped mass model technique by 41%. Results from the examination propose to think about convective and incautious segments in seismic investigation of tanks. The convective weights during winds are significantly more in extent when contrasted with incautious weights and its impact is a sloshing of the water. The hydrodynamic weight got by two mass models is more than that got by lumped mass model. For raised tanks, the two level of opportunity romanticizing of tank ought to be utilized for examination as opposed to utilizing single level of opportunity of admiration of tank as the impact of convective hydrodynamic weight has been remembered for the investigation of the tanks. The most extreme estimation of powers and minutes acquired from Staad ace advises the greatest burden to which the tank is oppressed and subsequently basic. the check for basic individuals from Staad expert likewise uncovers that the tank is steady for most extreme powers and minutes [Kaviti Harsha, K S K Karthik Reddy, K S Kala].

The organizing obstruction under parallel stacking can be fundamentally improved by giving shear dividers situated close to the focal center bit of arranging. Parallel dislodging for model m1 is 5 to multiple times the other three models; however the base shear for model m1 is least because of its decreased seismic weight. For fringe and inside section the most extreme powers for example bowing minute and shear power is seen as least for model m2. The sections gave along the outskirts of building have been focused on increasingly because of arrangement of bracings [Nishigandha R. Patil, Rajashekhar S. Talikoti].

III. GAP OF THE STUDY

Following are the points to be notes while doing literature survey work:-

1. Study of mix design in water tank.
2. Study of different height of water tank.
3. Study of different ground angles of water tank.
4. Study of different earthquake zones of water tank.
5. Study of different capacity of water tank.
6. Study of different Bottle size of water tank.
7. Study of different country of water tank.
8. Study of different IS CODES of water tank.
9. Study of footing size as per different wind zone and speed.
10. Study of footing size as per different speed.
11. Study of column frame spacing and supports.
12. Study of thickness of raft foundation.
13. Study of wind pressure.

IV. CONCLUSIONS

Subsequent to looking into the beforehand work done on water tank, it has been reasoned that the different works having a place with various research moves toward that pertinent physically, by programming and together by physically and programming. The accompanying ends developed during the already work done are as per the following:-

1. The FEM technique is the best strategy to know the precise pressure hypothesis and gives the accurate area of different sorts of stresses.
2. Programming examination and plan technique approach has been demonstrated to be a best and practical

https://dx.doi.org/10.22161/ijaers.71.19 *ISSN: 2349-6495(P) | 2456-1908(O)*

methodology by contrasting the manual customary methodology with structure a water tank.

3. The tank ought to be practical; for that the ideal element of the various parts of the equivalent ought to be given.
4. Weight inside and outside the tank prompts fluctuating elements of the tank.
5. The contextual investigation mirrors the definite circumstance of the area where the tank made, the power of careful soil pressure at that area and measures prompts cost decrease can be resolved not hypothetically yet for all intents and purposes also.

ACKNOWLEDGEMENT

I would like to thank and convey my deepest gratitude to Mr. Sagar Jamle, Assistant Professor and my guide, that he had been supporting me from the beginning of my Masters till current work. Also, his assistance and guidance bring me to write this paper.

REFERENCES

[1] Ajagbe W. O., Adedokun S. I., Oyesile W. B. (2012), "Comparative study on the design of elevated rectangular and circular concrete water tanks", International Journal of Engineering Research and Development, Vol. 1, pp. 22-30.

[2] Chintha Ravichandra, R. K. Ingle (2015), "Analysis of cylindrical water tanks- wind", International Journal of Mechanical and Production Engineering, Vol. 3, pp. 96-100.

[3] D. Kumara Swamy, V. Srinivasa Rao (2016), "Seismic analysis and design of existing elevated RC Intz water tank at Pedana as per latest is provisions and staad pro", International Journal for Technological Research in Engineering, Vol. 4, pp. 600-605.

[4] Gaikwad Madhukar V., Prof. Mangulkar Madhuri N. (2013), "Comparison between static and dynamic analysis of elevated water tank", International Journal of Civil Engineering & Technology, Vol. 4, pp. 12-29.

[5] Kaviti Harsha, K S K Karthik Reddy, K. S. Kala (2015), "Seismic analysis and design of Intz type water tank", International Journal of Science Technology & Engineering, Vol. 2, pp. 11-24.

[6] Kulkarni Reshma, Prof. Mangulkar (2015), "Dynamic analysis of elevated Intz water tank", International Journal of Research in Advent Technology Special issue 1st International Conference on Advent Tends in Engineering Science and Technology, pp. 211-214.

[7] Mariyam, Sagar Jamle, (2019), "A Technical Approach to Flat Slab Multistorey Building under Wind Speed of 39 m/s", International Research Journal of Engineering and Technology, (ISSN: 2395-0072(P), 2395-0056(O)), vol. 6, no. 5, pp. 7629-7636.

[8] Markanday Giri, Sagar Jamle and Kundan Meshram (2019), "Response Spectrum Analysis", LAP LAMBERT Academic Publishing, Mauritius.

[9] Nandagopan. M., Shinu Shajee (2017), "Dynamic analysis of R. C. C. water tanks with varying height of water level", International Journal of Innovative Science, Engineering & Technology, Vol. 6, pp. 6819-6824.

[10] Nishigandha R. Patil, Rajashekhar S. Talikoti (2015), "Seismic behavior of elevated water tank", International Journal of Research in Engineering and Technology, Vol. 4, pp. 131-135.

[11] Nishigandha R. Patil, Dr. R. S. Talikoti (2015), "Seismic Analysis of Elevated Water Tank", International Journal of Civil and Structural Engineering Research, Vol. 3, pp. 90-94.

[12] Nitesh J. Singh, Mohammad Ishtiyaque (2015), "Design analysis and comparison of Intz type water tank for different wind speed and seismic zones as per IS code", International Journal of Research in Engineering and Technology, Vol. 4, pp. 291-300.

[13] Pradnya V. Sambary, D. M. Joshi(2015), "Seismic analysis of RC elevated water tanks", International Journal of Scientific & Engineering Research, Vol. 6, pp. 247-252.