Study the effect on thickness of steel circular tank in response spectrum using ANSYS

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Abstract: In this paper water tanks lying on ground keep on being outlined in light of settled base thought expecting that it is moderate to overlook the commitment of basic soil. At long last, after the production of the geometry the model was transported in to investigation programming ANSYS Different Stresses will be found at various stacking conditions and the outcomes will be contrasted and organized along and diagrams. The power investigation of the supplies or tanks is about the same regardless of the synthetic way of the item. All tanks are outlined as break free structures to wipe out any spillage. In this paper we examine the limited component reenactment of steel water tank which is finished by utilizing ansys framework. The roundabout steel water tank having same H/D proportion with shifting thickness is proposed as per IS3370 part II furthermore with the reference of IS1893: Part II. In this paper the modular investigation is finished with the assistance of typical anxiety, all out distortion and shear stress. Reaction range investigation is additionally done.

Key words— Finite elements, impulsive and Hydrostatic pressure, Shell, Water tank.

I. INTRODUCTION

General:

Water is considered as the wellspring of each creation and is consequently an exceptionally essential component for human to carry on with a solid life. Popularity of Clean and safe drinking water is rising step by step as one can't live without water. It gets to be important to store water. Water is put away by and large in solid water tanks and later on it is pumped to various regions to serve the group. Fluid containing structures (LCS) are critical segments in the business and modern applications as they are utilized for capacity water and different items, for example, oil and gas. In this way, stockpiling tanks can likewise be considered as the life saver of the mechanical offices and are utilized broadly for capacity and/or handling of an assortment of fluids like water, oil, melted common gas, substance liquids. Expectedly RC tanks have been utilized widely for metropolitan and modern offices for a very long while These over the ground fluid containing tank have endured huge harm amid past quake More than 60% of India is inclined to be tremor.

It is said that "quake itself never slaughter individuals it is a severely built structure that murder." and this has spur extraordinary enthusiasm for comprehension and foreseeing the seismic conduct of tank. Tank containing the fluid of various consistency, temperature and properties alongside that fluid it is important that tank must be utilitarian even in post-tremor condition to compute the genuine seismic conduct of fluid containing tank it is important to speak to dominating methods of vibration, through these investigation we will confirm what modes are predominant in anticipating reaction Tank structure have design to open to activity of flat compel like quake. Harm to tank has been normal event with scope of harm is from general to a few relies on its ability to act amid quake.

➢ The tanks are named takes after

1. Roundabout   2. Rectangular

3. Cicular

➢ In light of situation of tank
1. lying on ground   2. Under-ground

3. Hoisted

In this segment, we are concentrate just the tanks laying on ground in which dividers are subjected to water weight and base of the tank is subjected to weight of water. Amid a tremor water is subjected to the movement

Fig1. Ground supported circular water tank

Execution of tank amid tremor: -
Past experience communicated that fluid containing tank fall or harm because of absence of information about legitimate conduct of supporting framework against element impact furthermore as a result of uncalled for geometrical choice which is specifically influenced by power of seismic tremor. The vital variables that influence the extent of tremor strengths are-

(a) Seismic zone component, Z
India has been separated into four seismic zones according to IS 1893 (Part 1): 2002 for the most extreme Considered Earthquake (MCE) and administration life of the structure in a zone. Diverse zone have distinctive zone variable India is separated into four seismic zones

(b) Importance variable, I

Significance component relies on the useful utilization of the structures, portrayed by .risky results of its disappointment, post-tremor useful requirements, verifiable quality, or financial significance. Raised water tanks are utilized for putting away consumable water and proposed for crisis administrations, for example, firefighting benefits and are of post-seismic tremor

significance. So significance component is 1.5for lifted water tank.

c) Response diminishment component, R

Reaction diminishment component relies on upon the apparent seismic harm execution of the structure, described by flexible or fragile distortions. R estimations of tanks are not as much as working since tanks are for the most part less malleable and have low excess when contrasted with building. For edge affirming to bendable specifying i.e. exceptional minute opposing casing (SMRF), R worth is 2.5.

(d) Structural reaction element, (Sa/g)

It is a variable indicating quickening reaction range of the structure subjected to seismic tremor ground vibrations, and relies on upon regular time of vibration and damping of the structure.

II. LITERATURE REVIEW

1) Krishna rao M.V, Rathish Kumar, Divya dhatri :-

They all are reason that base minute is 54-300% as the seismic zone get change from second Zone to5th zone, additionally hydro-dynamic weight on structure likewise in the same extent 50-260% with progressive increments in the zone of quake. The expansion in hasty hydrodynamic weight with expansion in zone variable and base section is higher for tank with expanding imprudent burden.

2) Halil Sezena,_, Ramazan Livaoglub, Adem Dogangunc:-

The fundamental goal of his study was to examinations the tanks utilizing a limited component model including melted gas–structure association and a disentangled model, and to contrast the ascertained reaction and the watched execution.. The requests ascertained from element investigations are contrasted and the anticipated limits of the bolster sections. The conclusions are the vertical crevice between the tank rooftop and the top level of fluid was adequately extensive such that the sloshing liquid did not influence the rooftop amid the quake. At the point when the impact of condensed gas sloshing is disregarded, i.e. on the off chance that the liquid is displayed as a solitary inflexible mass, the parallel disfigurements and segment inner strengths including shear and twisting minutes are overestimated. The quality and distortion limit or length of the segments ought to be expanded altogether or an option bolster structure ought to be utilized

3) Juan C. virella Luis A. Godoy, Luis E. Suarez;-

It was checked that the reaction of a tank-fluid framework subjected to a flat ground movement can be precisely anticipated by considering only the central mode. The major mode for the tank-fluid frameworks is a twisting mode (n = 1), paying little mind to the stature to-tank breadth proportions (H/D) considered in this study basic periods and mode shapes were found from the free vibration (eigen-esteem) investigations and from the symphonious reaction examinations, utilizing the additional mass plan and the model with fluid acoustic limited components. The distinctions were littler than 3% in all cases.

4) M.R. Kianoush , A.R. Ghaemmaghami ;-

In this study, the FE results are contrasted and those got by ghastly investigation taking into account plan seismic tremor reaction spectra. Despite the fact that the unearthly values are higher than the FE comes about, the same pattern because of seismic tremor recurrence substance is seen for both techniques. Considering the impact of SSI, the outcomes demonstrate that the most extreme incautious base shear and base minute acquired from the time history examination of the considered framework may increment or lessening as the dirt solidness changes which is a consequence of element weight variety amidst the divider because of the shaking movement of the establishment. This marvel is exceedingly reliant on quake recurrence substance and tank setup. A remarkable pattern is seen under low recurrence content quake for both shallow and tall tank designs. For this situation, the basic reactions increment as the dirt firmness increments. Also, the convective reaction is practically free of varieties of adaptability of the establishment and is by all accounts identified with geometric arrangements of tank, quake qualities and fluid properties.

5) M. Djermane D. Zaoui, B. Labbaci, F. Hammadi :-

He reasoned that intensive investigation of the universal benchmarks made it conceivable to recognize two unique systems in the assessment of the element clasping quality of liquid filled tanks under seismic excitations. The AWWA and EC8 were chosen to speak to the two procedures through this commitment. A correlation investigation of these two configuration norms among themselves and with a numerical model for the element clasping quality assessment of tanks under seismic excitations is then endeavored. The correlation for the expansive tank demonstrated a decent assention amongst numerical and EC8 results, with the exception of dejection clasping. For this situation, further and more point by point examinations are expected to enhance the standard procurements. For the tall tanks case, a few updates of gauges outline procurements appear to be important to an enhanced thought of the flaws, geometric nonlinearities. Furthermore, the basic anxiety restriction received by gauges of the primary family is by all accounts an exceptionally preservationist standard. The principles of these benchmarks require more corrections and redesigns in the light of the late looks into.

III OBJECTIVES

➢ To study the behaviour of circular water tank under seismic behaviour.

➢ To check effect of thickness of tank under static and dynamic loading.

➢ To study the behavior of water tank under seismic condition with the help of various H/D ratio with same thickness.

IV METHODOLOGY

Different manual techniques are accessible for the investigation of structure under seismic condition. Particularly water containing supply is seismically examinations as constrained single level of flexibility framework and for these we are utilized a reaction range strategy for the manual investigation. Different techniques are depict underneath

1. Linear Static Analysis
2. Linear Dynamic Analysis

1) Linear static technique:

The direct static strategy otherwise called Equivalent Static Method is utilized to appraise the interest for the structure whose reaction is especially commanded by the primary mode and anticipated that would carry on in flexible extent. The size of these pseudo parallel burdens has been chosen with the expectation that when connected to the directly flexible model of the structure, it will bring about outline relocation expected amid the configuration seismic tremor If the structure reacts flexibly to the configuration quake, the figured inner powers will be sensible guess of those normal amid the outline tremor. On the off chance that it in-flexibly to the configuration quake as is very normal in a large portion of the cases, the genuine inward powers that would create in the yielding building will be not exactly the inner powers figured utilizing the pseudo sidelong load

2) Linear Dynamic Method:

For the building whose reaction is overwhelmed by more than one mode, the Linear Dynamic Method is utilized to assess the interest of the structure. There are two approaches to do the Linear Dynamic Analysis.

I) Response Spectrum Method

II) Time History Method

1) Response Spectrum Method:

In this strategy the heap vectors are computed relating to predefined number of modes. These heap vectors are connected at the outline focus of mass to compute the individual modular reactions. These modular reactions are then joined by or CQC guideline to get the aggregate reaction. From the essentials of progression it is very clear that modular reaction of the structure subjected to specific ground movement, is assessed by the mix of the aftereffects of static investigation of the structures subjected to relating modular burden vector and element examination of the comparing single level of opportunity framework subjected to same ground movement. Static reaction of MDOF framework is then increased with the ghostly ordinate got from element examination of SDOF framework to get that modular reaction. Same methodology is completed for different modes and the outcomes are gotten through SRSS or CQC guideline. Accordingly range investigation the phantom qualities are perused from the outline range which are specifically duplicated with the modular burden vector and the static examination is performed to decide the comparing modular crest reactions. This technique is known as the CLASSICAL MODAL ANALYSIS.

I) Time History Analysis (Response History Analysis):

Dynamic examination utilizing the time history investigation figures the building reactions at discrete time steps utilizing ruined record of manufactured time history as base movement. On the off chance that three or additional time history examinations are performed, just the most extreme reactions of the parameter of interest are chosen.

2) Spring Mass Model for Seismic Analysis

At the point when a tank containing fluid vibrates, the fluid applies hasty and convective Hydro-dynamic weight on the tank divider and the tank base notwithstanding the hydrostatic weight. Keeping in mind the end goal to incorporate the impact of hydrodynamic weight in the examination, tank can be admired by a proportional spring mass model, which incorporates the impact of tank divider fluid communication. The parameters of this model rely on upon geometry of the tank.

In roundabout water tank because of hydrostatic weight, the tank has inclination to increment in width. This increment in distance across up and down the stature of the tank relies on upon the way of joint at the intersection of piece and divider as appeared in Fig
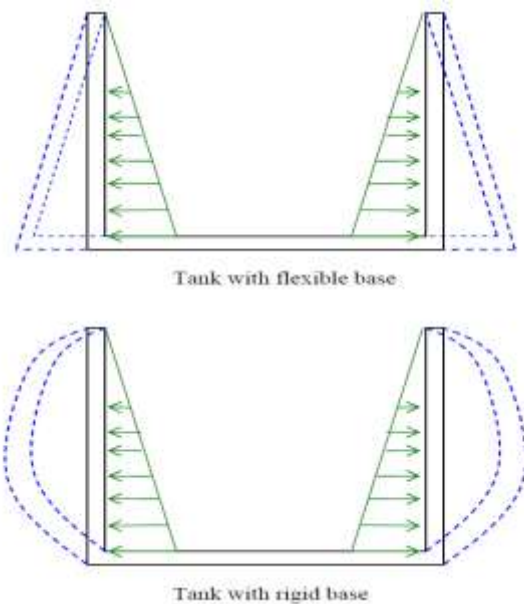

Fig.2 pressure distribution over tank

Contingent upon different above notice techniques some product's are configuration for the investigation of structure. For the most part the ANSYS programming is utilized for the examination of structure like water tank.

Limited Element Modeling of water tank in ANSYS.16

For displaying of hyperbolic cooling tower surface components are favored in that especially SHELL181, CONTA 174 and TARGE170 is utilized portrayal of components are as per the following

4.2.1 SHELL181 Element Description [1]

SHELL181 is reasonable for investigating dainty to respectably thick shell structures. It is a four-hub component with six degrees of opportunity at every hub: interpretations in the x, y, and z headings, and revolutions about the x, y, and z-tomahawks. (In the event that the layer alternative is utilized, the component has translational degrees of flexibility as it were). The savage triangular choice ought to just be utilized as filler components as a part of lattice era. SHELL181 is appropriate for direct, vast revolution, and/or expansive strain nonlinear applications. Change in shell thickness is represented in nonlinear examinations. In the component space, both full and lessened coordination plans are upheld. SHELL181 represents devotee (load firmness) impacts of disseminated weights. SHELL181 might be utilized for layered applications for displaying composite shells or sandwich development. The precision in displaying composite shells is represented by the principal request shear-disfigurement hypothesis (for the most part alluded to as Mindlin Reissner shell hypothesis). The component detailing depends on logarithmic strain and genuine anxiety measures. The component kinematics take into account limited film strains (extending). Be that as it may, the ebb and flow changes inside a period addition are thought to be
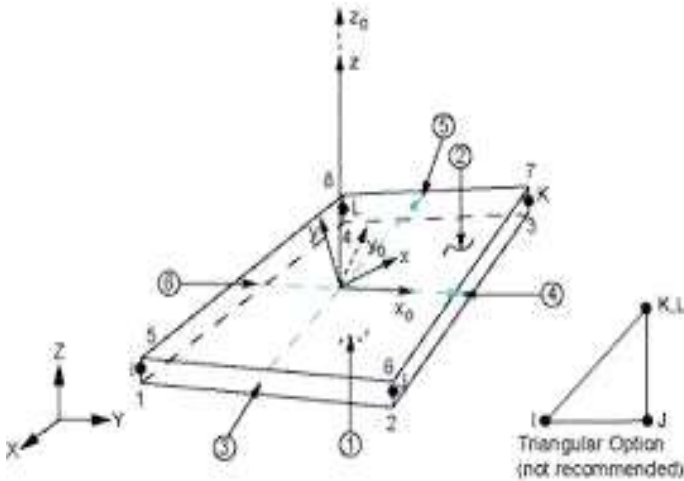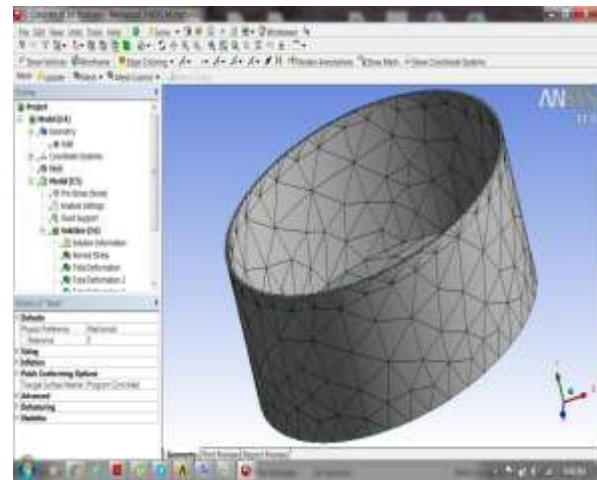
little.

Fig.3 SHELL 181

CONTA 174 and TARGE170 [1]

The 3-D contact surface components (CONTA173 and CONTA174) are connected with the 3-D target portion components (TARGE170) by means of a mutual genuine steady set. ANSYS searches for contact just between surfaces with the same genuine steady set. For either inflexible adaptable or adaptable get in touch with, one of the deformable surfaces must be spoken to by a contact surface.

On the off chance that more than one target surface will reach the same limit of strong components, you should characterize a few contact components that have the same geometry yet identify with isolated (targets which have distinctive genuine steady numbers), or you should consolidate two target surfaces into one (focuses on that have the same genuine consistent numbers).
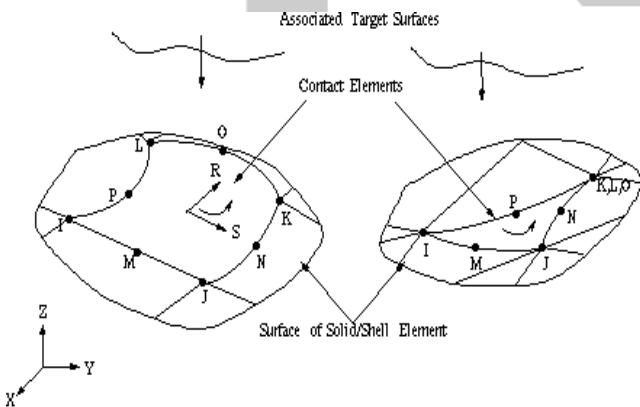

Fig.4 Conta 174

Fig. 5 Meshing to circular tank

V PROBLEM STATEMENT

To study the seismic performance of circular water tank resting on ground which is having capacity of 100000 liter for the various thickness having same H/D ratio. Height of the tank is 32.4m. Use M 20 and Fe 415 grade material.

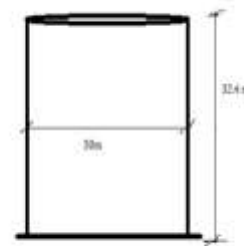The thickness is varies as 1m, 2m thickness. The above problem is solving by using ANSYS.

Fig.6 Water tank model

The diameter of tank is computed is computed as Volume= $(3.14/4*)D^2*h$

Assume thickness t= 30h+50.

Assume Free board =300mm

Hoop tension =$y_w*h*(D/2)$. Where y_w =9.81KN

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By solving the model with ANSYS following results are found out

Thickness	Normal stress (y)	Deformation(x)	Shear stress
1m	1.054mpa	0.90551mm	1.009mpa
2m	1.5506mpa	0.55321mm	0.656mpa

Table.1 Model analysis

By using response spectrum analysis for ground acceleration 0.5g and for frequency 1Hz.The total directional deformation is calculate as follows

In Y direction =0.28154mm …………...for 1m thickness

In Y direction =0.33mm ………...…...for 2m thickness
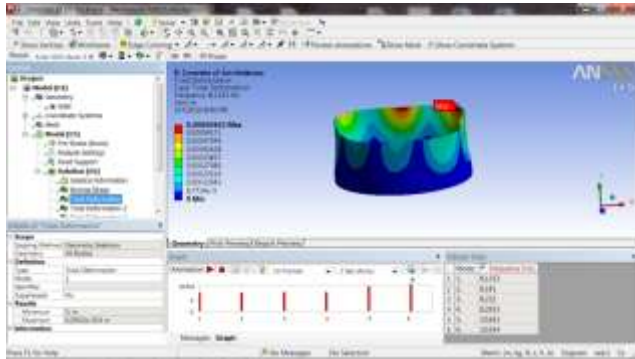
The deformation is as follows.
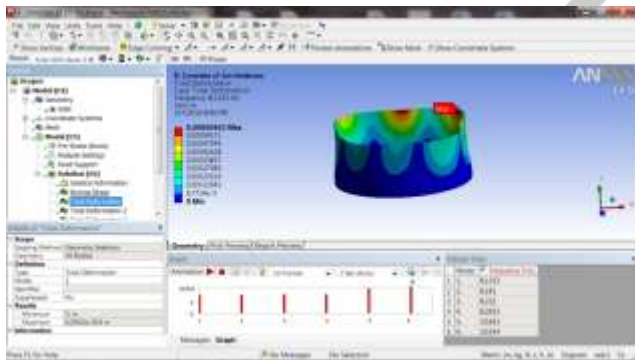

Fig. 7 Deformation for 1m thickness

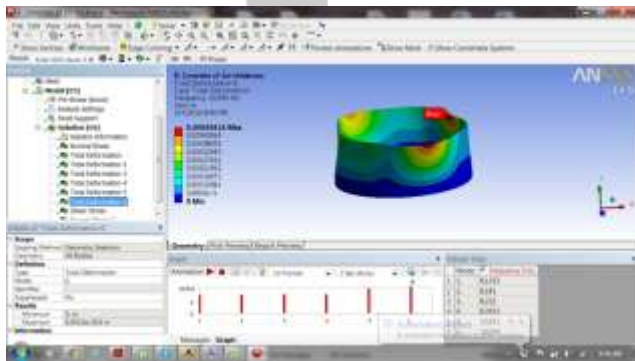Fig. 8 Deformation for 2m thickness
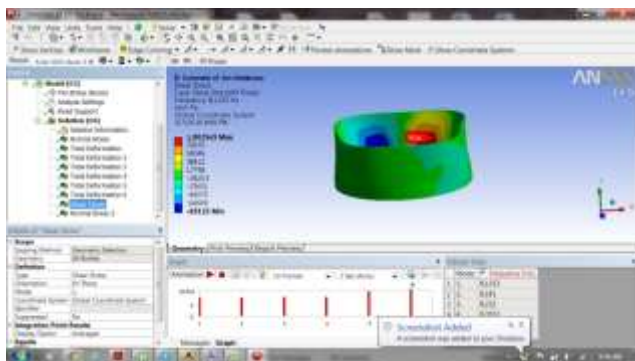

Fig. 9 Shear stress for 1m thickness

Fig. 10 Shear stress for 2m thickness

By the manually way the natural frequency is found out and also compare with ANSYS result for the validation of result.
In the manual way the natural frequency is found out by considering as undammed single degree freedom system. The calculation is done by following way.

Natural frequency $=\omega n =(K/m)^{1/2}$

$$K=\frac{\pi \rho h}{12}((3*(r^4_1-r^4_1))+(h^2(r^2_1-r^2_1)))$$

m=mass* density

Density of concrete=25
The tank gets divided into 6 parts. For each part ht. gets changes and also related stiffness and mass also changes. For same ht. and mass the natural frequency is found out with the help of ANSYS. Results are comparing with manual calculated frequency. They are as follows

Frequency	ANSYS VALUE	Numerical Value
For 1st mode	8.1152	8.659
For 2nd mode	8.181	8.688
For 3rd mode	8.232	8.805
For 4th mode	8.2653	8.678
For 5th mode	10.833	11.147
For 6th mode	10.954	11.22

Table.2 Comparison of results
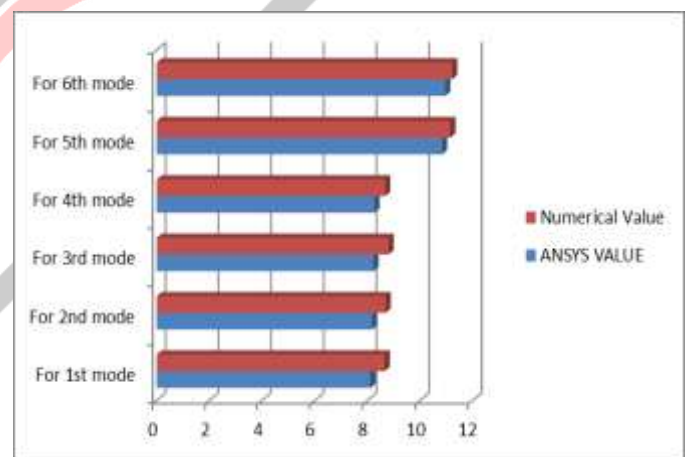

Fig. 10 Representation of result

VI Conclusion

In this paper reaction range investigation of roundabout water tank is finished by utilizing limited component examination device ANSYS16.

 In the main stage most extreme ordinary anxiety, disfigurement is figured and results are same in both condition

☐ Validation is done through manual count of mode state of round water tank by utilizing stodola technique

☐ and contrasted and the outcomes acquire by ANSYS. The mistake found is close to 4%. As the thickness continues expanding the aggregate distortion continues diminishing and in the meantime ordinary anxiety are additionally increments

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