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Design of Overhead Water Tank and Compare It with Conventional Approach

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ABSTRACT:In past, there is a great deal of studies done on the harms and disappointment of raised water tanks in seismic tremors. Various kinds of raised water tanks are developed for the stock of water, which incorporate substantial platforms, substantial framings, and mushroom-type raised water tanks. The pressure driven top of the water tank that is utilized in this study is 60. 2B seismic zone is considered for this review. Three unique sorts of soil genius le types are considered for the plan of raised water tanks for example SE, SD, and SC. There are various codes accessible on the lookout for the plan of raised water tanks, yet in this review, UBC 97 is utilized for the examination and plan. A complete six number of models are being broke down Furthermore, in this study a precise technique is utilized to examine the raised water tank on SAP 2000 and ARSAP programming.

A slight distinction is seen in the consequences of both programming that are utilized for the examination and plan of raised water tanks. The investigation on ARSAP takes less time when contrasted with the examination on sap2000. As the construction lays on better soil, results show that the diversion is less in it when contrasted with the design that is laying on delicate soil. The distinction in twisting second is no considerable as far as giving steel rebar's.

KEYWORDS:Elevated Water Tank, Sap2000, ARSAP, Seismic analysis.

I. INTRODUCTION

The past investigations shown that there are numerous virtual products are utilized for the plan of raised water tanks. Like E-tabs, SAP 2000, SAFE and Staad pro and so on numerous scientists chipped away at these virtual products and analyse the aftereffects of these particular plans. Eswaranet. al talked about the mathematical arrangement and contrasted it and different programming projects and presumed that these outcomes differ in reasonable cut-off points. Barakatet. al examined Finite component strategy related to enhancement technique is utilized in the investigation and plan of the RC water tanks and report affordable and safe plan of water tank. Ferrandizet. al announced the benefits of revit design over the auto creep. In that concentrate on it was reasoned that revit is simple and high level instrument when contrasted with auto lowlife and different virtual products.

There are numerous virtual products utilized in the plan business. Generally traditional SAP2000 and STAAD PRO is utilized for the plan of shell structures. By planning a shell structure by customary requires a ton of efforts, time as well as mastery. These are regular strategies which are being utilized for the plan of raised water tower. Many issues emerge while planning a design by utilizing these product's. Building drawings, first of all, are made the model by utilizing AutoCAD delicate product. The utilization of AutoCAD is tedious as well as it have numerous inconveniences with the plan. After that these drawings are demonstrated on SAP 2000 programming and construction is dissected and planned on this product. Furthermore, the plan cycle required numerous claims to fame of designers like general wellbeing, engineering and structure and so forth for working these programming projects. The reason for this review to plan all boundaries under the umbrella of BIM. In this manner, issue explanation is as follow.

In any development project there are a ton of issues that emerge from its arrangement stage to the fulfilment. Those issues are because of usage of ordinary techniques utilized for the preparation, plan and execution of any development project. During the plan of any shell structure for the most part SAP 2000 programming is utilized. The creators are utilizing this product from numerous years. By utilizing this product there are a ton of issues which are looked by the creators. For instance, architectural drawings are being made by the draftsman by utilizing AUTOCAD and afterward by considering these drawings underlying designer model the construction and dissect it. Numerous coordination issues emerge during this plan cycle. After the investigation of the design again underlying drawings are made by utilizing AUTOCAD programming. The issues of any development project in plan, execution and design are made by different

programming like auto miscreant SAP2000 and manual estimations. These issues can be diminished by utilizing BIM (Rivit,Robot) investigation and plan of the design will be looked at.

II. LITERATURE REVIEW

1) An IssarKapadia, purav Patel, NileshDholiya and Nikunj Patel

In this research, considered Combined Rectangular Water Tank in which combination of Rectangular Surface Water tank and Rectangular Overhead Water Tank are taken as together. For the given water tank Design and Analysis is to be prepared with help of STAAD Pro software. Also, the deflected shapes, Pressure exerted are to be described as result.

Considering the design of walls by Approximate Method is broadly classified into two categories: Tanks having ratio $L/B < 2$ and Tanks having ratio $L/B > 2$

It was stated in paper that, the combined rectangular overhead water tank and ground water tank can minimize the loss of failure of structure. Also, it can achieve that no more danger for water tank from overturning, wind load, earthquake load. As well as it can store more quantity of water as per population needed.

The main objective of this study is to know the deflected shape, hydrostatic pressure, stresses and B.M. For analysis dimensions are considered in STAAD Pro software and results are shown.

2) Ayazhussain M. Jabar, H. S. Patel.

In this research, the elevated water tank to be designed according to the purpose of heavily damaged or collapse during earthquake. In this study, the main aim is to understand the behaviour of supporting system which is more effective under different earthquake time history record with SAP2000 software. The tank to be designed with the proper behaviour of supporting system of the tank against dynamic responses, and selecting the proper staggered system in the column of the tank.

The main objective of this study is to analysed the critical responses of the tank with water filled and empty condition, also used of Lome Prieta Time history data and Kobe earthquake data for the analysis of the behaviour under seismic excitation.

3) AnshumanNimade, NirajSoni, Gautamverma.

In this studies, the underground water storage tank to be design for the purpose of collection of rainwater, storage of drinking water, and waste water collection. The main objective of this study is to find out the stress, node displacement, and the base pressure to be produced when the tank is empty or full with vary the length and width ratio with constant height. In this research, the variation of L/B ratio of the tank is considered and compare of this with shear stress, principle stress, Tresca stress, Von Mis stresses, bending moment, node displacement, and base pressure.

In this research, it is concluded that when $L/B < 2$ then all the stress goes on negligible and whenever the $L/B > 2$ then effect of all the stresses is increases with increasing L/B ratio.

4) N Farasat, A Farasat, AR Heysami, N Moridi

In this research, the designing of underground storage tank and non-underground storage tank were compared and it is found that the underground tanks gives better performance in terms of maximum displacement and stress against wall. In this research different parameters were studied like depth of underground tank, type of soil around the tank, the distribution of dynamic pressure by different fluids. The tension in the outer wall of the underground tank is very much low as compare to non-buried tank. Here for the seismic analysis El Centro earthquake record is applied in terms of time history. Here the dynamic pressure of the fluid is also calculated in the bottom of the tank.

From this research, the dynamic responses of the underground storage tank and above ground storage tank are used to be calculated, and underground storage tank gives better response than the above ground storage tank.

The main objective of this study is to examine the seismic response of the buried tank, half buried tank and visible tank, and also calculate the various dynamic responses of the tank.

5) KalyaniVanjari, Dr. Prof. R. S. Talikoti

In this study, the aspect ratio is more important for the proper dimension of the water tank. In this studies the various effect of the aspect ratio of tank wall on seismic force and behavior of ground supported water tank. In this studies, the various aspect ratios to be adopted and according to the aspect ratio the dimension of tank to be decided with the same volume of tank. The static analysis and response spectrum analysis to be carried out in ETABS software. The comparison of aspect ratio with the time history on Impulsive mode and convective mode.

In this research paper, it is noticed that, as the increasing aspect ratio, the base shear value decreases, and this is happen because of reduced height of tank walls. The vertical bending moment decreases with the increase in aspect ratio of the tank so that subsequently increase the horizontal moment of the tank.



III. METHODOLOGY

In ordinary methodology first demonstrating is finished by utilizing SAP 2000 programming and in new methodology displaying is finished by involving ARSAP for the underlying examination of the raised water tank.

Table 1: Number of models

Soil profile type	Zone 2	
	SAP/SAFE	ARSAP
SE	1	1
SD	1	1
SC	1	1

Absolute six numbers are displayed and dissected in this exploration as displayed in Table 3.2. Seismic zone for every one of the models are same which is 2B however soil professional le types are change as needs be. Two number of models are planned on the dirt ace le type SE. In which one model is examined in SAP/SAFE programming projects and the other is broke down and plan in ARSAP. The properties of the two models are steady so the outcome can be look at. The following two models are on soil ace le type SD. This one is displayed in ARSAP programming and other is in SAP 2000. The last two models are planned and investigated on soil genius le type SC as displayed in Table 3.2. In these two models one is examined on programming SAP 2000 and the examination of the other is done by utilizing ARSAP programming. Every one of the boundaries in these two programming projects are same so examination should be possible with in the consequences of the two models. In ARSAP, just raised water tank is demonstrated and broke down. No any simplified model is broke down in this review.

A few boundaries are steady in the review for the investigation and plan of raised water tank. As displayed in Table 3.3 the compressive strength of cement is utilized 3000 psi and 4000 psi. Yield strength that is utilized in this review, is 60,000 psi. Seismic zone is likewise steady 2B for every one of the models and permissible bearing limit of the dirt is considered as 1.9 TSF.

Table 2: Constant input parameters

Parameters	Values
f’c (raft and shaft)	3000 psi
f’c (bowl)	4000 psi
fy	60,000 psi
Seismic zone	2B
qe	1.90 TSF

Table 3: Input Parameters for Static Analysis

Member	Modifier
Shaft Wall	0.70
Base slab of bowl	0.35
Bowl inner wall	0.70
Bowl base slab	0.35
Bowl outer wall	0.70
Bowl top slab	0.35
Dome of canopy	0.5



Table 4: Load cases

Load Case	Load Case Type
Self	
Superimposed	
Live	
Live roof	Linear static
Ex	Linear static
Ey	Linear static
Ex'	Linear static
Ey'	Linear static
water	Linear static

IV. RESULT AND DISCUSSION

Time Period and Base Shear

Time-frame of the raised water tank on different soil profile type is concentrated in this review. This study is completed in both primary examination programming projects for example SAP2000 and ARSAP. As displayed in Table 4.1. Base shear is the first boundary that is concentrated in this exploration. Different base shear is seen in different programming as well as soil profile type, while seismic zone stays steady. For seismic zone is 2B and soil profile SE the noticed base shear is 1495 and 1489 kips in both primary investigation programming projects SAP2000 and ARSAP separately. Whenever soil profile type changes into SD the prominent upsides of base shear are 1506 and 1501 kips in SAP2000 and ARSAP, individually. In third gathering, the dirt profile type considered as SC and the upsides of base shear is 1513 and 1509 kips in SAP2000 and ARSAP, individually. At the point when soil profile type changes into SD the prominent upsides of weight are 1503 and 1501 kips in SAP2000 and ARSAP, separately.

Table 5: Seismic Analysis Parameters

Parameters	Zone 2B					
	SC		SD		SE	
	SAP	ARSAP	SAP	ARSAP	SAP	ARSAP
W (kips)	1503	1501	1503	1501	1503	1501
Tx (sec)	1.05	1.04	1.10	1.05	1.11	1.05
Ty (sec)	1.08	1.05	1.12	1.09	1.2	1.15
Vx (kips)	233	224	358	349	487	477
Vy (kips)	249	238	352	343	454	442
Ftx (kips)	19.25	18.75	28.5	27.90	38.00	37.50
Fty (kips)	19.25	18.75	28.5	27.90	38.00	37.50

External Stability Checks

Outer strength checks are applied to the construction of the raised water tank. After the clearance of these checks, the underlying steadiness is confirmed and afterward the part measures are examined too. Three kinds of the outer soundness checks are applied on each model of the raised water tank.

Table 6: External stability checks

Calculation Approach	Checks	Zone 2B		
		SC	SD	SE
Manual	Overturning	2.27>2	2.42>2	2.67>2
Manual	Stability	2.8> 1.5	2.8> 1.5	2.82> 1.5
Manual	Bearing pressure	1.79<qe	1.74<qe	1.89<qe
Safe	Bearing pressure	1.75<qe	1.70<qe	1.84<qe
ARSAP	Bearing pressure	1.77<qe	1.74<qe	1.87<qe

These are outside dependability makes sure that are applied to all models. These checks incorporate over turning, steadiness and bearing strain check. These all checks are applied to each of the three sort of models. Above all else, first check is applied on the raised water tank that is toppling check for the raised water tank model that exists on the dirt profile type SC, the toppling factor came 2.27 which is lesser than 2. 2 is the component of security that is defined by the code and the worth 2.27 is very protected as contrasted and 2. Soil profile type SD, the toppling check is applied on the raised water tank and the worth came is 2.42 which is sensible more than the element of security that is 2 as portrayed by the code. The raised water tank that exists on soil profile type SE, a similar check is applied on the design and the outcome came 2.67 which is substantially more than 2 and consequently it shows that the construction is very protected against this check.

Deflected Shapes

After the examination the deflected shapes can be seen in all investigation programming projects. The deflected shapes can be discretionary in any sort of stacking as well as load cases. The deflected shapes in both primary examination virtual products for example SAP2000 and AR-SAP are displayed in Figure 4.2 (a) and (b). The deflected state of the SAP 2000 programming displayed in Figure 4.2. The deflected shape against envelope is displayed in Figure 4.2(a) this shows the deflected shape after examination is finished. The deflection in x bearing is around 8 while structure is being dissected in SE soil expert profile type and seismic zone in 2B. At that comparable time deflection in y course is noticed 9 and 9.25 downwards in z bearing. The comparable pattern of deflected shapes is likewise seen in ARSAP programming.

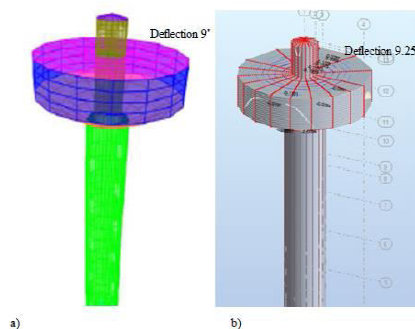


Figure 1:- Deflected Shapes in Different software's. a. In Sap 2000 b. In ARSAP when using soil profile type SE.

V. CONCLUSION

- Examination of the two programming projects shown that the difference in the result is exceptionally less and unimportant in term of steel gave in various components of the raised water tank.
 - In ARSAP less examination time is expected as contrasted and SAP 2000.
 - In ARSAP model can be altered utilizing Excel sheets and those changes can be addressed in Robot Model.
 - The creation of underlying drawing that are executable on location is absent from the two programming projects.



- A slight contrast is seen in the two virtual products results while dissecting the raised water tank.
 - Discovery is noted against envelope and tracked down slight contrast in greatest recognition.
 - Twisting second is seen from shapes and marginal distinction is found from the two programming projects results.
 - It is seen that greatest recognition is noticed that construction is laying on delicate soil and least is noticed the water tank that is lay on great soil SC.

Future Work

This work was the first step to investigate the top to bottom way of behaving of raised water tank by involving ARSAP programming for the plan of raised water tank. Following stages ought to be:

- Investigation on BIM instrument, with respect to underlying drawings and steel computations on a single tick from BIM.
- Non-straight examination and plan of hoists water tank by utilizing ARSAP.

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