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ANALYSIS OF WATER TANK IN SEISMIC ZONE 2 AND 3

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Abstract **Water tank is a container which is used to store a large amount of water. These container are either placed on ground, underground or on a tower. In elevated water tank water is stored in certain height and water is distributed under the effect of gravity which is used to fulfilled domestic or industrial requirement. Due to the shortage of electricity elevated water tank become an important part in life. Steel tanks are also used now a day because it takes very less time in construction because all the parts of water tank is precast in the steel factory. The large weight of water at the top of water tank is highly affected by seismic waves. Due to the effects of earthquake some water tanks are collapse. The aim of this research is to analysis and design of an elevated steel rectangular tank under seismic zones 2 and 3 in India. In this research it is obtained that the base shear and displacement is more in zone 3 as compared to zone 2 in a same structure.**

Key Words: ***water tank, steel tank, seismic analysis, base shear, displacement***

INTRODUCTION

Elevated water tanks are very essential components for your water supply scheme in both rural and urban areas. The liquid retaining structures are always design as a crack free structure in order to prevent leakage. The human population is increasing day by day that is why requirement of water tank is also increases. Water tank can supply water from a long distance under the flow of gravity with sufficient static head. The underground water tank is built to store enormous amount of water but it takes any type of external pressure to distribute the water but due to shortage of electricity in rural areas generally elevated water tank are preferable. According to IS 1893-2002 (Part 1) India is highly prone to natural disasters like floods and earthquakes etc. Due to earthquake the seismic waves highly affects the large structures which causes destruction of property and loss of life. Steel tank are more effective to resist lateral load by earthquake because steel is more ductile than concrete. Elevated water tank is highly prone to seismic waves because it contain massive amount of water at the top of the structure. In order to decrease lateral loads due to seismic waves bracing is used in water tank.

EXPLAINATION OF MODEL

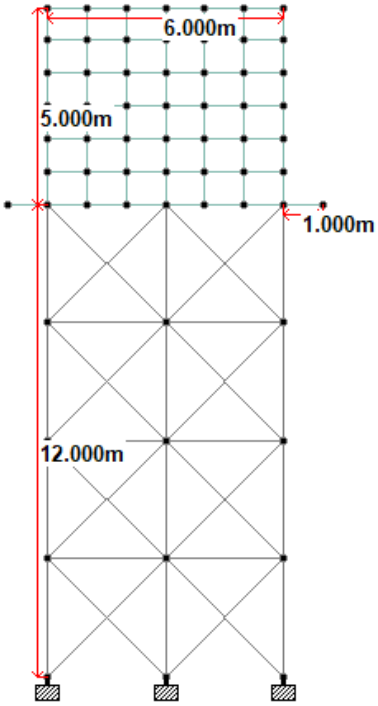
Elevated steel rectangular water tank model is used with the capacity of 172 kilo liter, which is mounted on a steel frame structure on the height of 12 meter supported by 9 columns in the vertical direction. The structure is made on a medium soil. The grade of steel is fe415. The static seismic analysis is done in seismic zone 2 and 3 in staad pro v8i sss6.

SCOPE OF THE PAPER

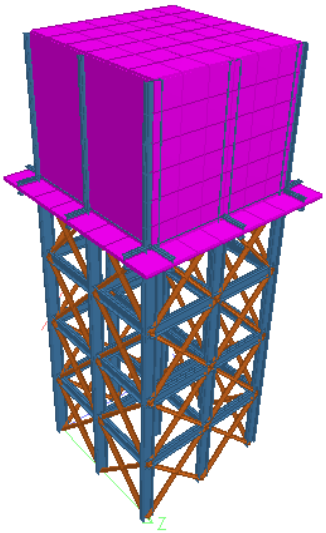
Aim of the paper was to study the effect of earthquake in elevated rectangular steel water tank in zone 2 and zone 3 by using IIT-K guidelines. In this model base shear and peak displacement are obtained by analysis and comparison is done.

ELEVATED RECTANGULAR STEEL WATER TANK

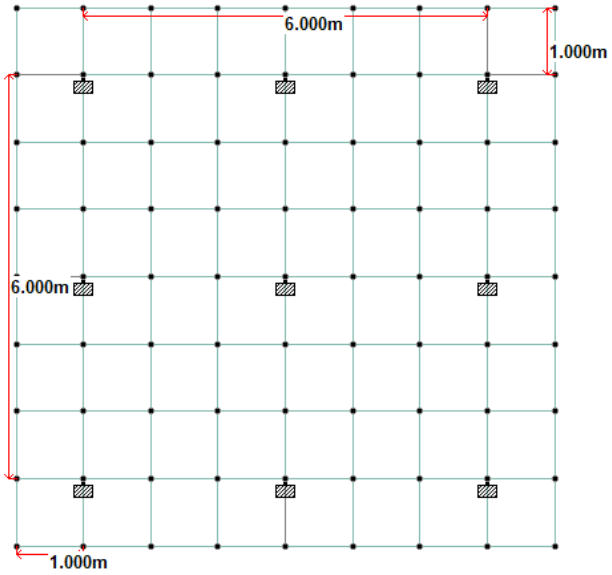
SIZE OF TANK	DIMENSION
Size of bracing	ISA 150*150*20
No. of bracing	24
No. of bracing level	4
No. of column	9
Size of column	IW450350*016
Size of beam	IW400300*016
No. of beam	8
Size of peak slab	0.12
Depth of wall	0.12



Elevation



3D view



Front view

Methodology

This method involves selecting the category of water tank and selection the dimensions of the section and done static seismic analysis by using IITK guidelines and IS 1893-2002 part 2.

Capacity of the tank

Volume of rectangular tank = length * breadth * height

= 6m * 6m *5m

= 180m^3

Then volume of tank is 180 kilo liter

According to IITK guidelines allow a free board of 150mm

Then the height of water in which water is filled = 5000-150

= 4850mm

Capacity of tank = 6m * 6m * 4.8m

= 172 kilo liter

Live load

Consider live load is 1.5KN/m² on the top of the rectangular for the maintenance work.

Seismic load

Importance factor, field factor and seismic load are the factor which can decrease reaction factor. In zone 2

physical factor Z is 0.1 and in zone 3 physical factor Z is 0.16.

Water tank is an important structure that is why importance factor I is 1.5.

Response reduction factor R is 2.5. According to IITK guidelines Damping is 2% in steelstructure that iswhy damping coefficient is 0.02. And structure made on medium type of soil.

RESULT

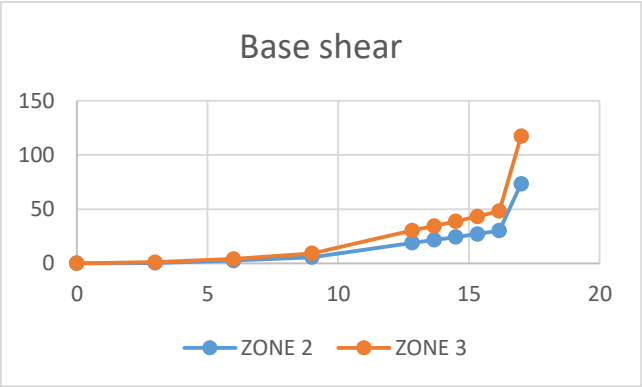
The various results are obtained by analysis of a model in different seismic zones. These results are written in graphical or tabular form in order to understand easily.

Base shear

At the base the base shear is always zero and it is directly proportional to the weight of the structure. Base shear is increases when the height of structure increases. And the maximum value of base shear is on the top of the tank.

The height of the tank is in meter and value in zone 2 and zone 3 are in KN.

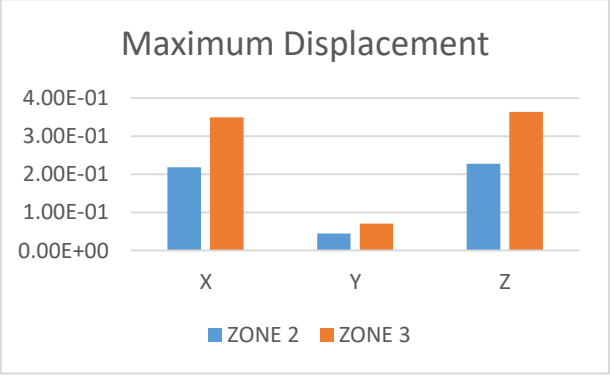
HEIGHT	ZONE 2	ZONE 3
0	0	0
3	0.303	1.017
6	2.542	4.053
9	5.719	9.15
12.83	18.994	30.391
13.67	21.542	34.466
14.5	24.247	38.795
15.33	27.116	43.385
16.16	30.143	48.229
17	73.412	117.458



MAXIMUM DISPLACEMENT

It is the maximum movement of the structure produced by vibration due to seismic waves. The results are discussed in the form of maximum displacements. All the values are in m in the direction of X, Y and Z.

ZONE	X	Y	Z
ZONE 2	2.18E-01	4.41E-02	2.27E-01
ZONE 3	3.50E-01	7.08E-02	3.64E-01



CONCLUSION

- Base shear is more in higher seismic zones
- At the base of the structure base shear is always zero in zone 2 and zone 3.
- The value of base shear is increases with the height in zone 2 and zone 3.
- Time period is same in both seismic zones.
- In zone 2 and zone 3 displacement is very less in Y direction as compared to X and Z direction.
- Displacement is less in seismic zone 2 as compared to zone 3.

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