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Study and Analysis of Elevated Storage Reservior with Various Staging and Bracing System in Seismic Zone

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ABSTRACT: -

In this study, four support patterns viz. easy brace, cross brace, rectangular brace as well as radial brace connected with various staging heights (fifteen m, twenty m, along with twenty-five m) are analysed for seismic zone II, IV and III for tank wearing empty tank and condition loaded problem. Probably the most affordable as well as secure, Intze style tank of thousand kilolitre capacity continues to be considered. When it comes to the evaluation of Intze container, 72 designs are constructed with STAAD.ProV8i Software, by which 36 models are analysed for clean out state as well as an additional 36 models are analysed around tank loaded problem. Each and every seismic zone has 12 models as well as every brace has three distinct staging rises. Different types of lots as well as the combinations of theirs are utilized to each of the tanks as well as reaction spectrum evaluation has become performed. Different parameters are obtained for different brace method for the long time serviceability of theirs, safety and stability such as displacement, Axial Pressure, Shear force, base shear, bending moment

Keywords: Displacement, Axial Pressure, Shear force, base shear, Bending moment, Elevated Water Tank

1. INTRODUCTION

Elevated water tanks are among the most crucial public utility constructions because they form an important aspect of the water distribution process. Water is an essential commodity for just about all living as well as non-living beings. Apart from consuming along with other daily functions, drinking water also is needed for flame fighting; commercial and industrial make use of it. The governing administration of India has to pay the maximum interest to the water source pattern to help make the consuming water readily available for equally urban and rural public. The form of elevated water tank is frequently governed by the container of its as well as container governed by the capability. Capacity will be the volume of water which is able to keep between the complete level minimizing degree of supply as the design and style. The shape of the water tank additionally plays a crucial economic role within the overall structure

Probably the most typical form of containers that are put to use i.e. rectangular, circular, conical as well as Intze As per IS: 11682 - 1985, for water storage space capacity of up to 50 m 3 rectangular container are chosen. Within the assortment somewhere between 50 m3 to 200 m3 capability circular container as well as for capability above 200 m3 as well as much as 800 m3 the tank might be conical or circular, Intze type. For just about all above capability, we've make use of Intze type container. The Intze type container comprises of a conical dome introduce in between the cylindrical wall structure as well as bottom part dome to be able to decrease the hoop stress within the bottom part ring beam. The primary element of Intze type container is top dome, top ring beam, vertical cylindrical wall structure, center ring beam with balcony, a conical dome, bottom dome, along with bottom ring beam.

2. OBJECTIVE OF STUDY

The major objectives of the work are as follows. .

1. To analyze an Intze water tank with different horizontal braces in staging using response spectrum analysis with the help of “STAAD.ProV8i”.
2. To study the behavior of Intze tank on the different rise of staging in seismic zones II, III, and IV.
3. Comparative study of various parameters of tank with the different braced systems at empty and filled conditions in different seismic zones.
4. To obtain the most efficient, stable, and longtime serviceable horizontal brace system for Intze tank

3. MODELLING

3.1 General:

This particular chapter works with detail explanation of Intze tank. The specifics are describing the elevated water tank variables as diameter, length and width, capacity of tank as well as a two dimensional as well as three dimensional about perspective of modelling found STAAD.ProV8i expert system.

3.2 Detail of Frame Data

The table 3.1 shows all of the variables that is describing various zones, bracing, problems of tank and also all of the variables and that is going to be utilized around scrutinizing of Intze tank just for the present study..

Table 3.1 Intze tank version detail

S. No.	Name of parameter	Value of parameter
1.	Seismic zones	II, III, IV
2.	Seismic zone factor	1. II = 0.10 2. III =0.16 3. IV =0.24
3.	Types of bracing pattern	1. Simple bracing. 2. Cross bracing. 3. Radial bracing. 4. Rectangular bracing.
4.	Condition	1. Tank Full 2. Tank Empty
5.	Height of staging	15m, 20m, 25m
6.	Number of column	8
7.	Soil type	Medium soil
8.	Types of support	Fixed support
9.	Response reduction factor	2.5
10.	Importance factor (I)	1.5
11.	Damping ratio	5 %
12.	Capacity of tank (V) in KL	1000
13.	Diameter of cylindrical wall	15.57 m
14.	Rise of top dome	3.081 m
15.	Thickness of top dome	0.08 m
16.	Top ring beam	0.2 x 0.2 m2
17.	Thickness of cylindrical wall	0.17 m
18.	Height of cylindrical wall	4.622 m
19.	Middle ring beam length	1 m
20.	Middle ring beam height	0.25 m
21.	Height of conical wall	2.309 m
22.	Thickness of conical wall	0.38 m

S. No.	Name of parameter	Value of parameter
23.	Diameter of bottom dome	11.40 m
24.	Rise of bottom dome	2.156
25.	Thickness of bottom dome	0.38 m
26.	Bottom ring beam	1.25 x 0.62 m2
27.	Brace size	0.6 x 0.4 m2
28.	Number of braces on tank	4
29.	Number of column on tank	8
30.	Angle of inclination of conical dome	45 0
31.	Semi central angle of bottom dome	44 0

Heights of Staging in Frame

Elevation view of15m Elevation view of20m Elevation view of 25 m

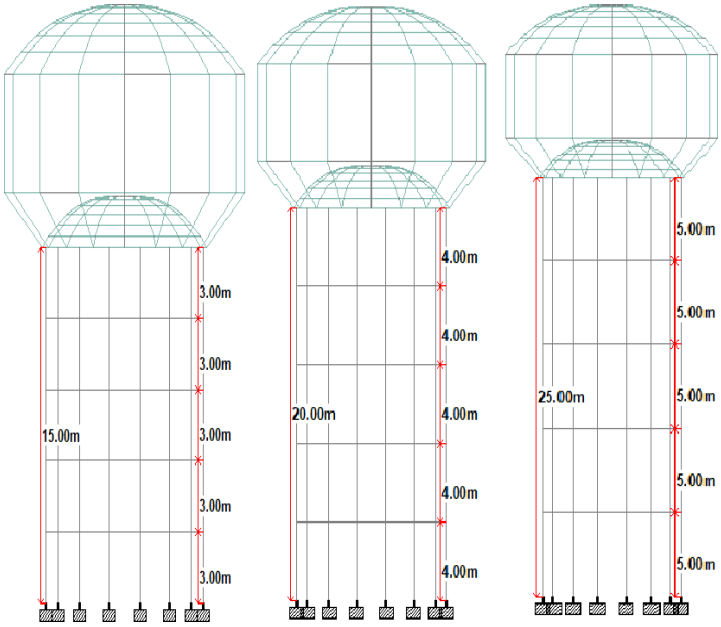


Fig.3.1 2D perspective of staging with various heights in STAAD.ProV8i

Intze Tank with Different Staging Model

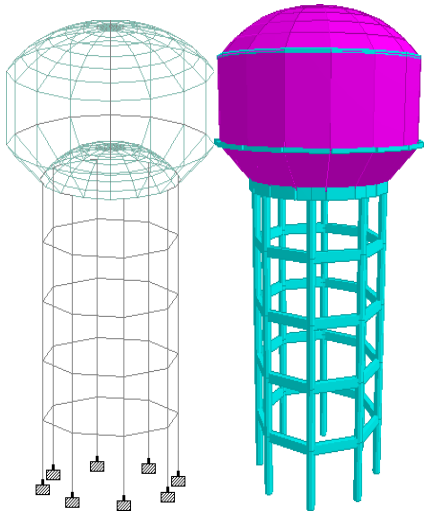


Fig. 3.2 2D and 3D simple type brace staging model

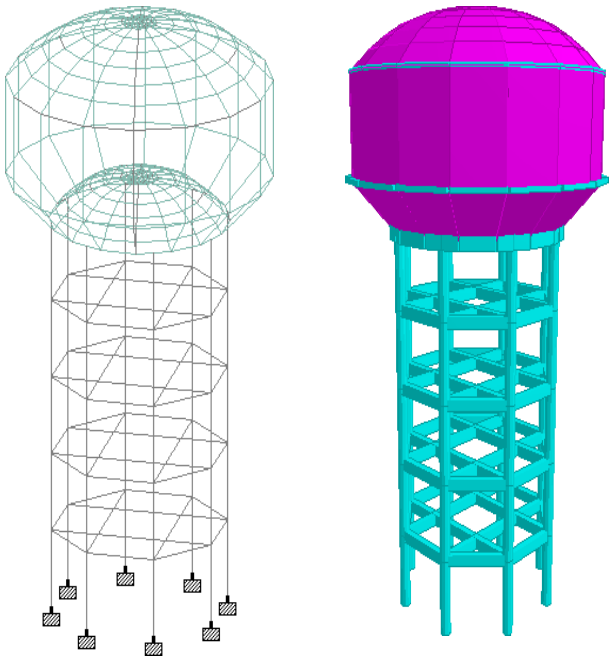


Fig 3.3 2D and 3D cross type brace staging model

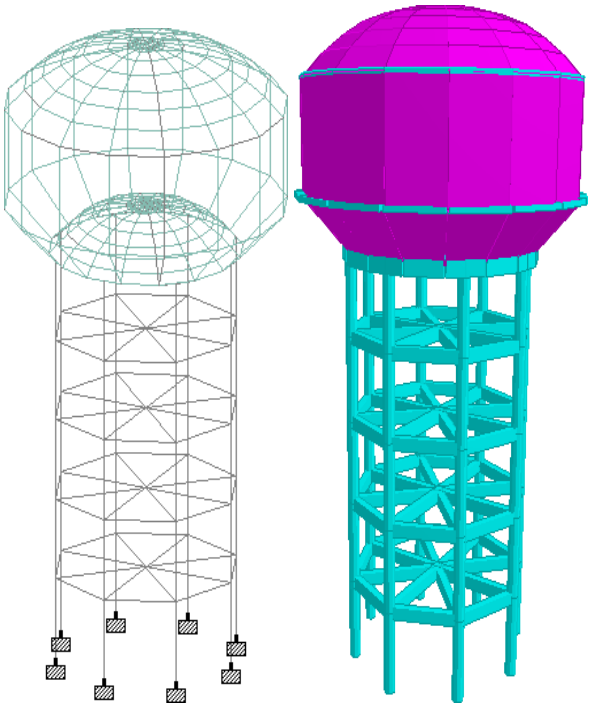


Fig 3.4 -2D and 3D radial type brace staging model

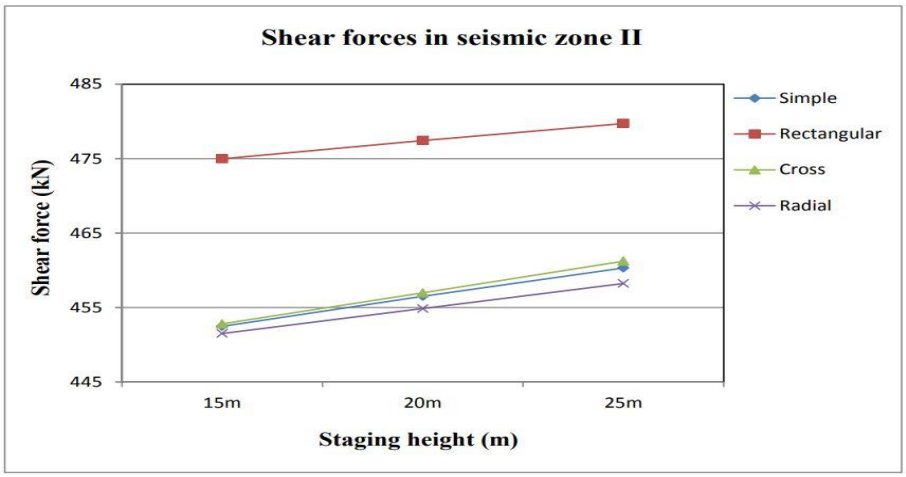
4. RESULT AND DISCUSSION

4.1 Shear Forces

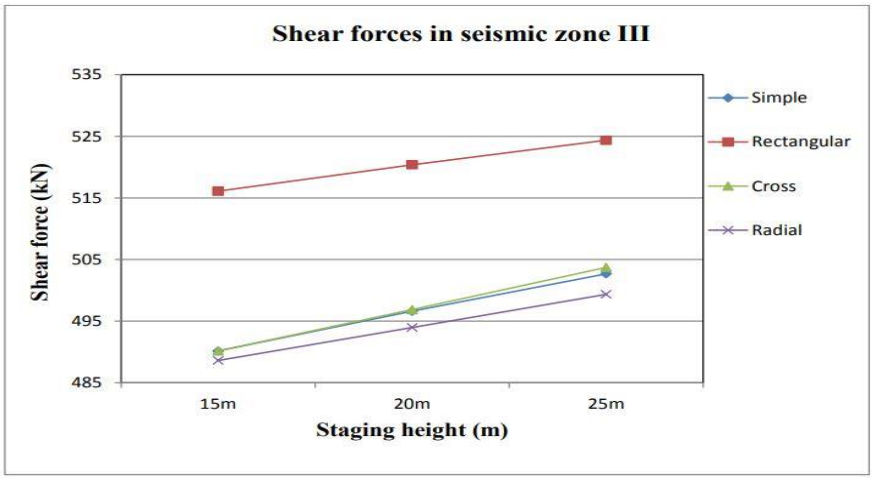
The examined importance of optimum shear pressure is displayed with the aid of graphs and table for various braces with staging wearing seismic zones II,III, and IV. The values are enhanced with increased seismic zone severeness and also the staging rise i.e. 15 m, 20 m as well as 25 m for most kinds of orthodontics when connected with staging heights.

Table 4.1 Shear force value at the empty condition of tank in seismic zones II, III, and IV

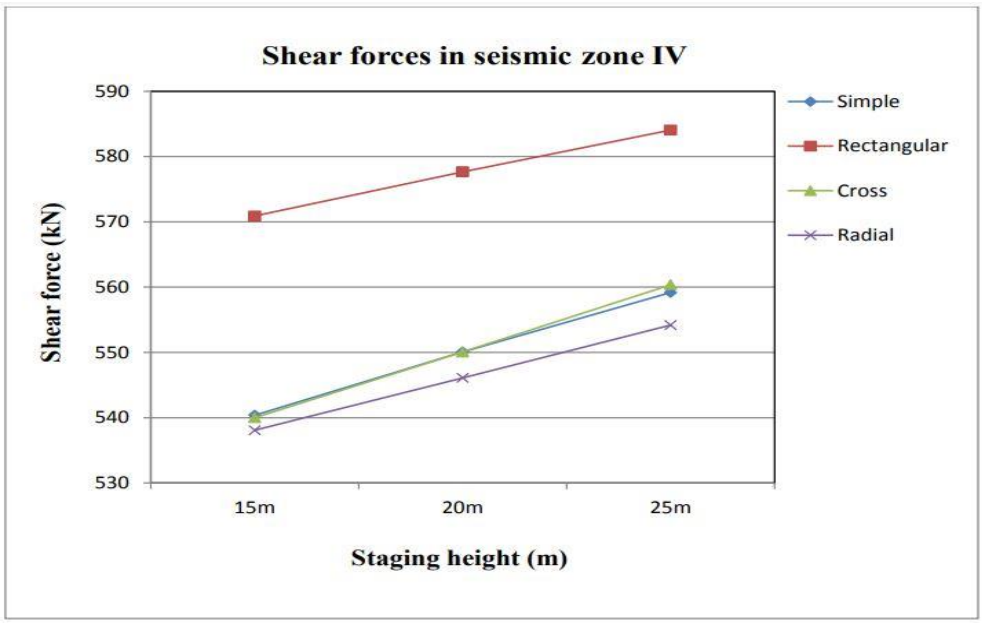
Braces on tank	Height of staging (m)	Shear force (KN)		
		Zone II	Zone III	Zone IV
Simple brace	15m	452.481	490.149	540.373
	20m	456.524	496.618	550.077
	25m	460.316	502.686	559.179
Rectangular brace	15m	474.989	516.088	570.887
	20m	477.434	520.389	577.622
	25m	479.715	524.357	584.061
Cross brace	15m	452.806	490.174	539.998
	20m	456.975	496.871	550.065
	25m	461.233	503.716	560.361
Radial brace	15m	451.519	488.611	538.066
	20m	454.863	493.961	546.093
	25m	458.235	499.358	554.188



Graph. 4.1 Shear force graph for different type of braces in staging at the empty condition of tank in seismic zone II



Graph. 4.2 Shear force graph for different type of braces in staging at the empty condition of tank in seismic zone III

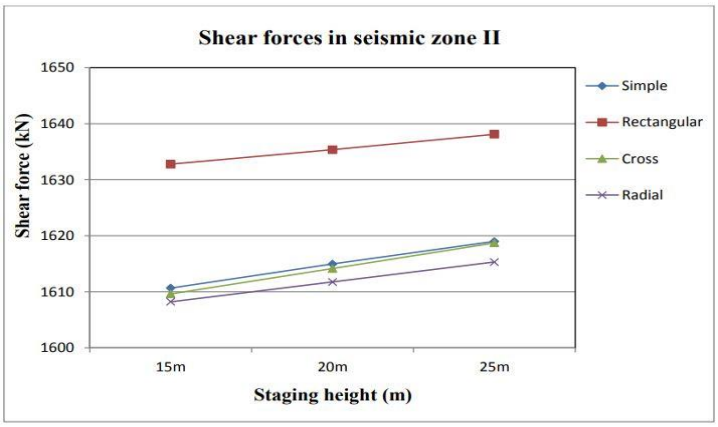


Graph. 4.3 Shear force graph for different type of braces in staging at the empty condition of tank in seismic zone IV

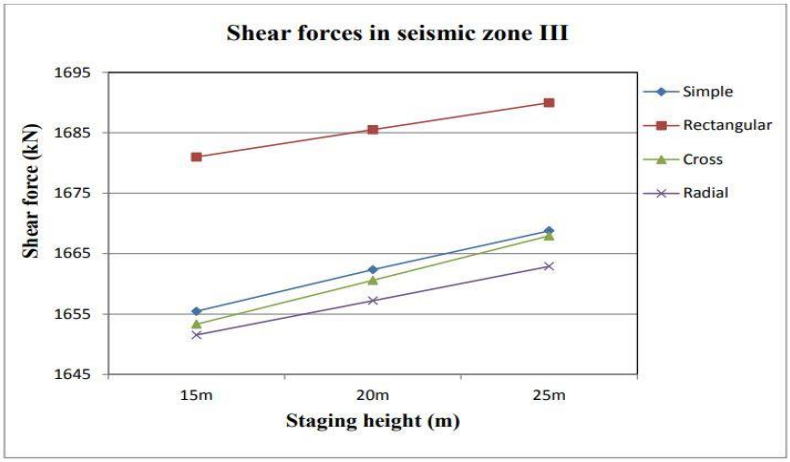
Table 4.1 shows the maximum shear force contained staging aspect in seismic zones II, III as well as IV for most braces when connected with staging rise 15 m, 20 m as well as 25 m for empty state of tank. Graph 4.1, 4.2 as well as 4.3 are plotted between shear force (kN) and also staging heights (m) within seismic zones II, IV and III respectively for most braces patterns. Within time of tank empty state, the values of maximum shear forces is displayed by rectangular category brace staging as well as bare minimum is shown by radial category brace staging within seismic zones II, III as well as IV for most staging go up i.e. 15 m, 20 m as well as 25 m.

Table 4.2 Shear force value at the filled condition of tank in seismic zones II, III and IV

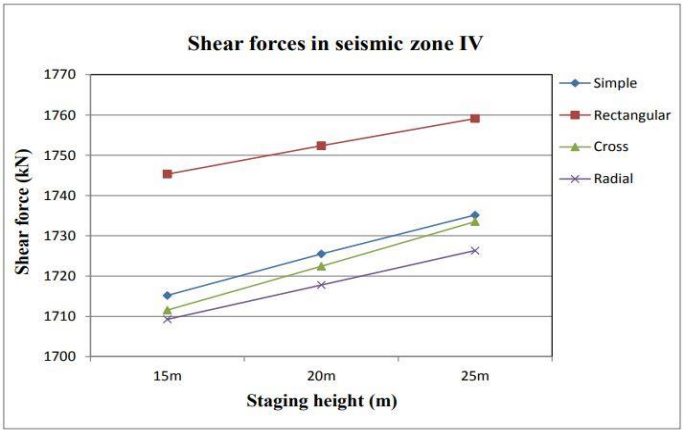
Braces on tank	**Height of staging (m)**	**Shear force (kN)**		
		Zone II	**Zone III**	**Zone IV**
Simple brace	15m	1610.666	1655.460	1715.215
	20m	1614.964	1662.337	1725.502
	25m	1618.991	1668.772	1735.154
Rectangular brace	15m	1632.776	1680.988	1745.334
	20m	1635.349	1685.500	1752.368
	25m	1638.110	1689.963	1759.102
Cross brace	15m	1609.628	1653.323	1711.582
	20m	1614.141	1660.566	1722.465
	25m	1618.727	1667.930	1733.537
Radial brace	15m	1608.210	1651.530	1709.290
	20m	1611.754	1657.202	1717.799
	25m	1615.311	1662.891	1726.334



Graph. 4.4 Shear force graph for different type of braces in staging at the filled condition of tank in seismic zone II



Graph. 4.5 Shear force graph for different type of braces in staging at the filled condition of tank in seismic zone III



Graph.4.6 Shear force graph for different type of braces in staging at the filled condition of tank in seismic zone IV

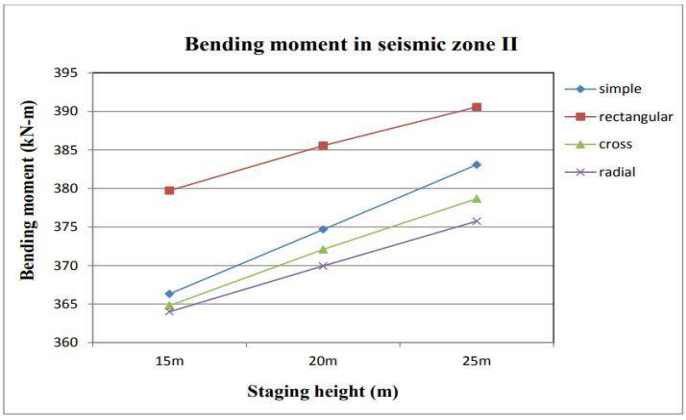
Table 4.2 shows the optimum shear force contained staging aspect in seismic zones II, III as well as IV for most braces when connected with staging rise 15 m, 20 m as well as 25 m with the loaded problem of tank. Graph 4.4, 4.5 as well as 4.6 are plotted between shear pressure (kN) and also staging heights (m) within seismic zones II, IV and III respectively for most braces patterns. Within time of loaded problem of tank the values of maximum shear forces are revealed by rectangular category brace staging and also decreasing for basic category brace staging, then simply for cross category brace staging as well as bare minimum is shown by radial category brace staging within seismic zones II, III as well as IV for most staging go up i.e. 15 m, 20 m as well as 25 m.

4.2 Bending Moment

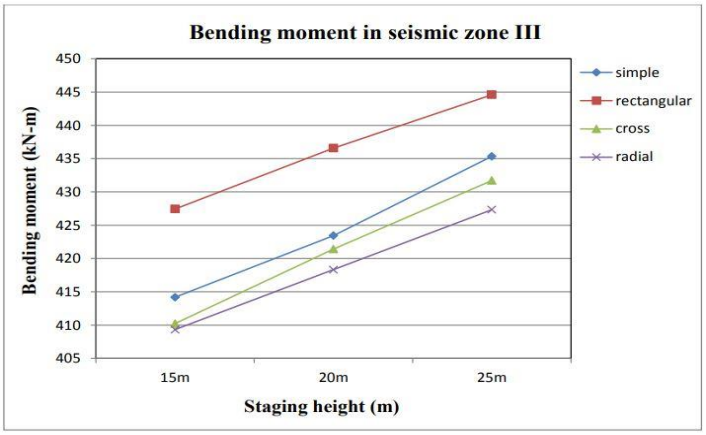
The end result presents the maximum importance of bending inside the staging element for tank at the time of empty as well as a loaded condition of tank in seismic zones II, III as well as IV for various braces. The analysed result is displayed with the aid of graphs and tables as uses.

Table 4.3 Bending moment value at the empty condition of tank in seismic zones II, III, and IV

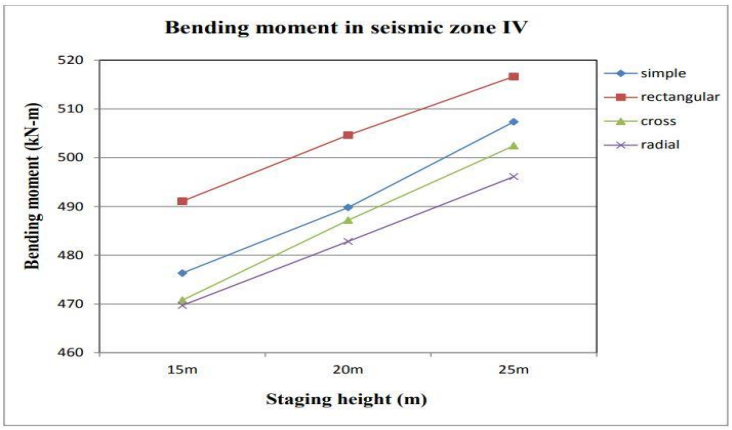
Braces on tank	Height of staging (m)	Bending moment (kN-m)		
		Zone II	Zone III	Zone IV
Simple brace	15m	366.324	414.179	476.320
	20m	374.682	423.438	489.779
	25m	383.075	435.342	507.364
Rectangular brace	15m	379.725	427.444	491.070
	20m	385.549	436.582	504.627
	25m	390.555	444.598	516.656
Cross brace	15m	364.813	410.224	470.772
	20m	372.085	421.413	487.184
	25m	378.677	431.723	502.452
Radial brace	15m	364.026	409.316	469.703
	20m	369.943	418.318	482.818
	25m	375.747	427.336	496.122



Graph. 4.7 Bending moment value graph at the empty condition of tank in seismic zone II



Graph. 4.8 Bending moment value graph at the empty condition of tank in seismic zone III

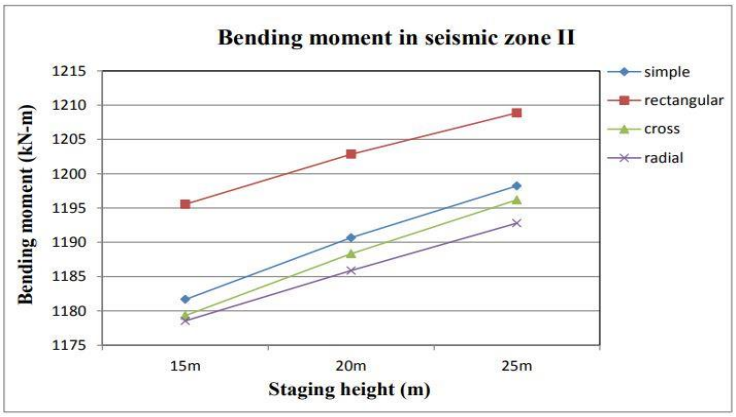


Graph.4.9. Bending moment benefit graph during the empty condition of tank in seismic zone IV

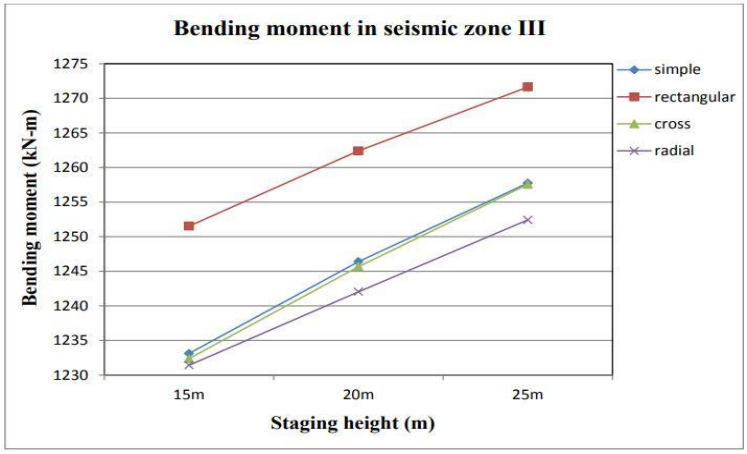
Table 4.3 shows the maximum bending values in staging at the time of tank empty condition for seismic zones II, III, and IV.The bending of staging component is enhanced when the seismic zone intensity boost and also the bending is maximum in higher rise staging. Graph 4.7, 4.8 as well as 4.9 are plotted for the maximum bending moment values between bending moment (kN m) and also staging height (m) for seismic zones II, III, and IV. At the moment of tank empty problems, the values of table in seismic zones II, III, and IV for 15 m, 20 m, along with 25 m rise are revealed the least importance of bending within radial category brace staging and also moves on increasing for cross category brace staging as well as subsequently for basic category brace staging as well as highest is displayed through the rectangular category brace staging.

Table 4.4 Bending moment value at the filled condition of tank in seismic zones II, III, and IV

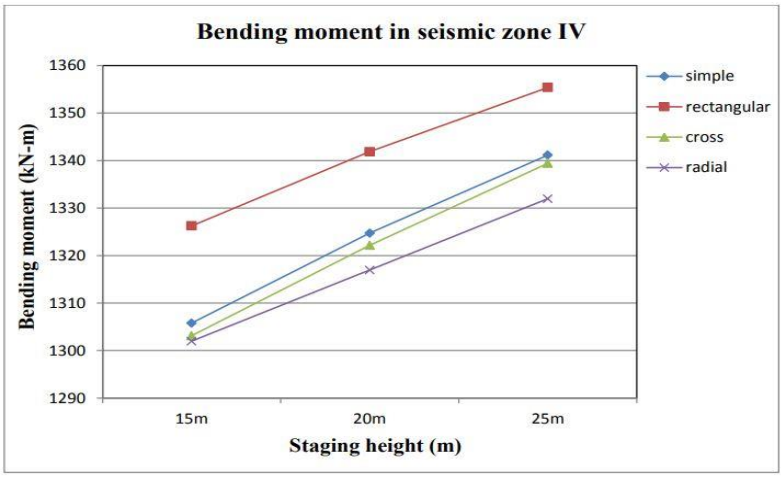
Braces on tank	**Height of staging (m)**	**Bending moment (kN-m)**		
		Zone II	**Zone III**	**Zone IV**
Simple brace	15m	1181.664	1233.135	1305.782
	20m	1190.666	1246.400	1324.713
	25m	1198.223	1257.756	1341.135
Rectangular brace	15m	1195.543	1251.537	1326.240
	20m	1202.841	1262.418	1341.855
	25m	1208.858	1271.646	1355.363
Cross brace	15m	1179.322	1232.376	1303.113
	20m	1188.343	1245.690	1322.152
	25m	1196.183	1257.569	1339.417
Radial brace	15m	1178.532	1231.435	1301.971
	20m	1185.867	1242.044	1316.948
	25m	1192.792	1252.431	1331.950



Graph.4.10 Bending moment value graph at the filled condition of tank in seismic zone II



Graph.4.11 Bending moment value graph at the filled condition of tank in seismic zone III



Graph. 4.12 Bending moment value graph at the filled condition of tank in seismic zone IV

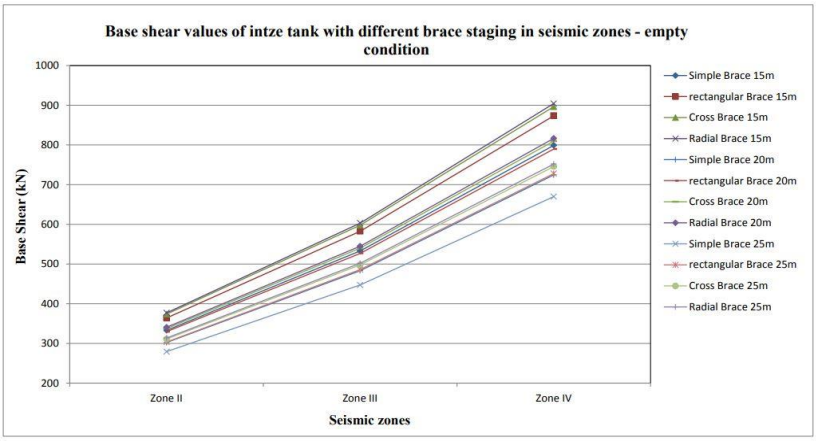
Table 4.4 displays the maximum bending values in staging in time of tank filled state for seismic zones II, III, and IV.The bending with staging component goes up as a result of a rise within seismic zone intensity and also the bending is maximum in higher rise staging. Graph 4.10, 4.11 as well as 4.12 are plotted for the optimum bending time values between bending moment (KN m) and also staging level (m) for seismic zones II, III, and IV. At the time of tank loaded circumstances, the bending moment values in seismic zones II, III, and IV for 15 m, 20 m as well as 25 m staging heights are least for radial category brace staging and also moves on boosting for cross category brace staging as well as subsequently for basic category brace staging as well as highest is displayed through the rectangular category brace staging.

4.3 Base Shear

The maximum expected lateral force,and that happens because of seismic activity on the foundation on the tank is base shear, that will be examined as well as outcomes are revealed in tables. The charts are plotted as the tank two instances, i.e. clean out state as well as the loaded situation that is done within seismic zones II, III as well as IV for various braces in deep staging with staging rise i.e. 15 m, 20 m, along with 25 m.

Table 4.5 Base shear value at the empty condition of tank in seismic zones II, III, and IV

Braces on tank	Height of staging (m)	Base Shear (kN)		
		Zone II	Zone III	Zone IV
Simple brace	15m	332.973	532.895	798.998
	20m	302.166	483.322	724.625
	25m	279.248	447.094	669.898
Rectangular brace	15m	364.003	582.604	873.529
	20m	329.303	526.729	789.704
	25m	303.427	485.807	727.903
Cross brace	15m	373.556	597.844	896.378
	20m	337.623	540.036	809.654
	25m	310.839	497.675	745.685
Radial brace	15m	376.898	603.194	904.401
	20m	340.544	544.709	816.661
	25m	313.443	501.842	751.929



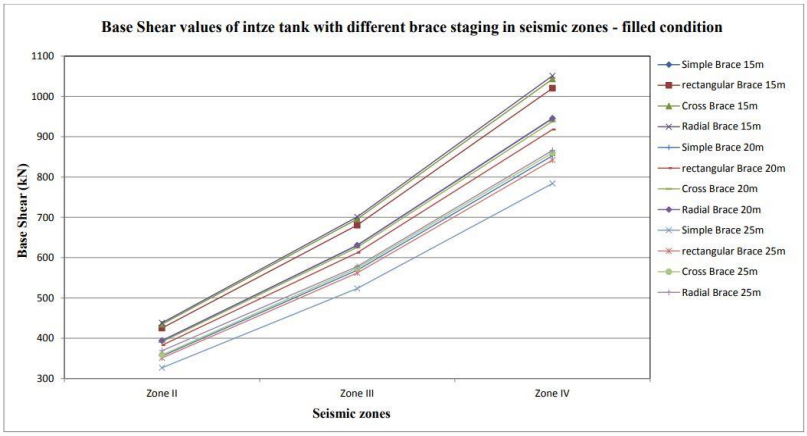
Graph. 4.13 Base shear force graph for different brace staging at the empty condition of tank in seismic zones II, III, and IV

Table 4.5 displays the base shear values of the tank for various brace staging as well as a number of heights to come down with seismic zones II, III, and IV at the time of empty state of the tank. The values of base shear are enhanced just for the greater seismic zones. Graph 4.13 displays the graph of base shear values as well as plotted between base shear (seismic zones and KN) II, III, and IV.The base shear worth for 15 m, 20 m as well as 25 m staging levels are least for basic category brace staging and also moves on expansion for rectangular category brace staging as well as subsequently for cross category brace maximum and staging for radial category brace staging within just about all seismic zones.

Table 4.6 Base shear value at the filled condition of tank in seismic zones II, III, and IV

Braces on tank	Height of staging (m)	Base Shear (KN)		
		Zone II	Zone III	Zone IV
	15m	394.098	630.719	945.671

Braces on tank	**Height of staging (m)**	**Base Shear (KN)**		
		Zone II	**Zone III**	**Zone IV**
Simple brace	20m	355.570	568.744	852.695
	25m	326.831	523.278	784.047
Rectangular brace	15m	425.158	680.428	1020.203
	20m	382.708	612.151	917.778
	25m	351.010	561.990	842.050
Cross brace	15m	434.679	695.667	1043.05
	20m	391.027	625.458	937.724
	25m	361.026	573.858	859.834
Radial brace	15m	438.024	701.019	1051.075
	20m	393.948	630.131	944.730
	25m	369.026	578.026	866.078



Graph. 4.14 Base shear force graph for different brace staging at the filled condition of tank in seismic zones II, III and IV

Table 4.6 displays the base shear values of tank for various brace staging as well as a number of heights to come down with seismic zones II, III, and IV with the moment of loaded condition of tank. The values of base shear are enhanced just for the greater seismic zones. Graph 4.14 displays the graph of base shear values as well as plotted between base shear (seismic zones and KN) II, III, and IV. The base shear worth for 15 m, 20 m as well as 25 m staging levels are the least for basic category brace staging and also moves on expansion for rectangular category brace staging as well as subsequently for cross category brace staging and also the maximum is displayed for radial category brace staging within seismic zones II, III, and IV.

5. Conclusion

Out of the outcomes as well as the conversation provided in previous chapter, we are able to conclude the next areas.

1. The maximum importance of shear pressure is displayed by rectangular category support staging and also the importance of least shear force for braces style is shown by radial category brace staging for most staging heights 15 m, 20 m as well as 25 m within just about all seismic zones for equally unoccupied as well as a loaded problem of the tank.
2. The bigger importance of bending time is displayed by rectangular category brace staging and also the reduced importance of bending moment is displayed in radial category brace staging for the tank equally loaded as well as clean out state within seismic zones II, III, and IV.
3. The tanks lessen base shear within clean out state as when compared with the loaded condition. The minimum base shear is within the type that is simple brace staging as well as maximum is within radial category brace staging simply because of how many beam components are expansion for various brace patterns as well as a result of beam components, the weight of the tank boosts therefore the base shear of tank likewise grow.

4. Seismic lots possess some impact in Radial category brace staging for tank and also the replies of staging with radial type brace provide good balance as examine to various other brace staging. Consequently, it is able to reduce the risks of collapse on the water container within seismic zones II, III, and IV.

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