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Study on Overhead Circular Water Tank using with and with Out Center Column by Staad Pro V8I

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- Elevated water tanks models are designed using STAAD Pro. The columns are taken circular for both tanks and diameter are 300 mm and height is 15 meter. The height of water tank is 4.3 meter and diameter is 8 meter for circular water tanks.
- Capacity of water stored is 200KL or 200000 liter. These models are analyzed for dead load, water load and seismic load. Dead load was designed according to IS: 875-1987(Part 1) and Seismic load was designed using response spectrum method for earthquake zone III of India using IS: 1903-2002.
- For analyzing a elevated water tank one has to consider all the possible loadings and see that the structure is safe against all possible loading conditions.
- Capacity of the water tank is considered 200000 L.
- There are several methods for analysis of different frames like finite element method. Two tanks are design for 200KL capacity in circular tank without center column and circular tank with center column. The height is kept same for both water tanks that is 21 m from ground level.

Introduction

- Water tanks are very important components of lifeline.
- They are critical elements in municipal water supply, fire fighting systems and in many industrial facilities for storage of water.
- A reinforcement concrete tank is a very useful structure which is meant for the storage of water, for swimming bath, sewage sedimentation and for such similar purposes.
- Reinforced concrete overhead water tanks are used to store and supply safe drinking water.
- With the rapid speed of urbanization, demand for drinking water has increased by many fields.
- Also, due to shortage of electricity, it is not possible to supply water through pumps at peak hours. In such situations overhead water tanks become an indispensable part of life.

- **CIRCULAR TANKS**

Circular tanks are usually good for very larger storage capacities the side walls are designed for circumferential hoop tension and bending moment, since the walls are fixed to the floor slab at the junction. The co-efficient recommended in IS 3370 part 4 is used to determine the design forces. The bottom slab is usually flat because it's quite economical.

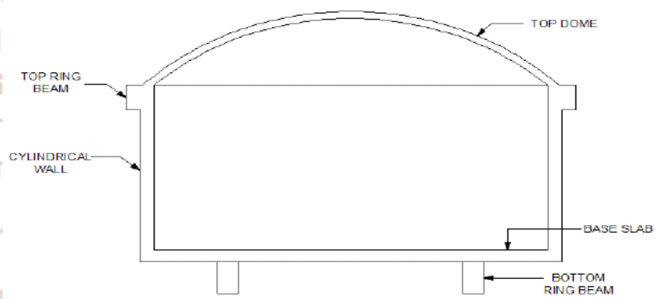

Fig1: Circular tank

OBJECTIVES

- **Modeling, analysis and Design of elevated water tank using STAAD PRO V8i Software using with and without center column.**

METHODOLOG

separate models are created on STAAD.pro to check the behaviour of centre column under the action of seismic forces, elevated water tank are modelled.
These are analysed for seismic and wind loadings.

RESULTS

COMAPRISION BETWEEN CIRCULAR OVERHEAD WATER TANK WITH & WITHOUT CENTERCOLUMNS

Study of capacity in circular tank without center column and circular tank with center column it is clear that the seismic hazard and water pressure are the measure component for the analysis of the tank. Due to addition of center column the moment of bottom slab is reduces. And hence it is more stable or got more stability.

- MAXIMUM BENDING MOMENT
- MAXIMUM SHARE FORCE
- AXIAL LOAD ON COLUMNS FOOTING

Table5.1 Maximum moment on Overhead Circular water tank without centre column

			Horizontal	Vertical	Horizontal	Moment		
	Node	L/C	FxkN	FykN	FzkN	Mx N-m	My N-m	Mz N-m
Max Fx	4	13	14.562	321.522	0.843	952.338	260.746	-25356.7
Min Fx	4	15	-14.482	174.021	-1.347	-1463.04	-260.744	25275.72
Max Fy	6	4	1.922	850.522	-6.565	-13377	2.38	-1920.49
Min Fy	1	1	-4.794	-49.243	-0.047	-554.279	-169.437	11433.02
Max Fz	8	18	-1.347	174.021	14.482	25275.72	-260.744	1463.038
Min Fz	8	7	1.153	625.125	-18.94	-33025.8	211.828	-1230.13
Max Mx	8	18	-1.347	174.021	14.482	25275.72	-260.744	1463.038
Min Mx	8	7	1.153	625.125	-18.94	-33025.8	211.828	-1230.13
Max My	8	12	0.843	321.522	-14.562	-25356.7	260.746	-952.338
Min My	4	15	-14.482	174.021	-1.347	-1463.04	-260.744	25275.72
Max Mz	4	15	-14.482	174.021	-1.347	-1463.04	-260.744	25275.72
Min Mz	4	13	14.562	321.522	0.843	952.338	260.746	-25356.7

Table5.2 Maximum moment on Overhead Circular water tank having column in centre

			Horizontal	Vertical	Horizontal	Moment		
	Node	L/C	Fx kN	Fy kN	Fz kN	Mx N-m	My N-m	Mz N-m
Max Fx	4	13	13.144	351.061	-0.164	14.880	229.625	-22615.340
Min Fx	4	15	-12.965	182.443	-0.970	-1133.611	-229.625	22438.152
Max Fy	349	4	-0.000	1202.48	-13.829	-24318.17	-0.001	0.000
Min Fy	1	1 EQ	-6.312	-74.170	-0.529	-1040.15	-184.721	11832.607
Max Fz	8	18	-0.970	182.443	12.965	22438.15	-229.625	1133.611
Min Fz	8	7	-0.014	747.923	-22.386	-38623.61	142.911	-174.613
Max Mx	8	18	-0.970	182.443	12.965	22438.15	-229.625	1133.611
Min Mx	8	7	-0.014	747.923	-22.386	-38623.61	142.911	-174.613
Max My	7	7	-4.787	604.073	-18.265	-34450.70	348.631	4911.783
Min My	6	11	-10.911	405.030	2.725	3049.278	-345.856	20280.887
Max Mz	4	15	-12.965	182.443	-0.970	-1133.611	-229.625	22438.152
Min Mz	4	13	13.144	351.061	-0.164	14.880	229.625	-22615.340

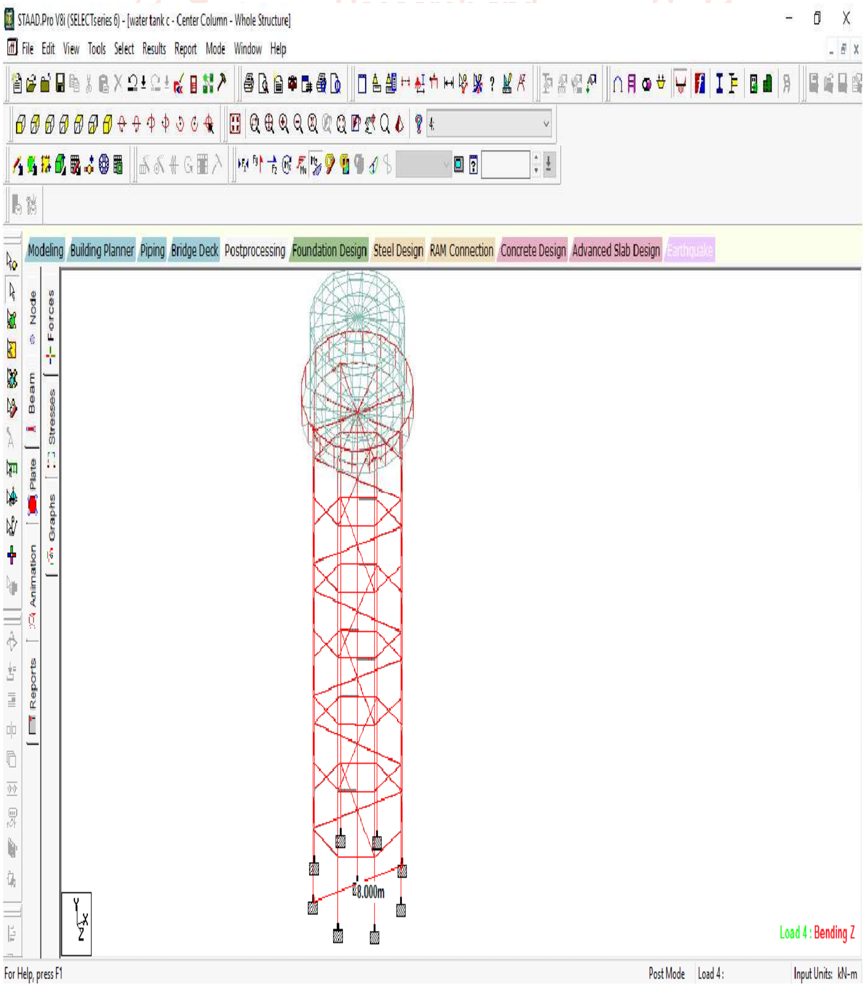

Fig.5.1 – STAAD Pro Model showingBending moment of the overhead Circular Water Tank

➢ **MAXIMUM SHARE FORCE**

Table5.3 Maximum share force on Overhead Circular water tank

			Horizontal	Vertical	Horizontal	Resultant	Rotational		
	Node	L/C	X mm	Y mm	Z mm	mm	rX rad	rY rad	rZ rad
Max X	173	11	38.454	-2.691	0.007	38.548	0	0.001	0
Min X	173	17	-38.405	-1.608	0	38.439	0	-0.001	0
Max Y	98	2 EQZ	1.872	0.377	23.588	23.665	0	0	0
Min Y	96	4	0.001	-19.251	24.522	31.176	0	0	0
Max Z	334	7	-0.01	-6.158	50.509	50.883	0	0	0
Min Z	193	14	0.007	-2.691	-38.454	38.548	0	0.001	0
Max rX	102	4	-0.059	-10.667	24.471	26.695	0.004	0	0
Min rX	92	4	0.061	-11.239	24.572	27.021	-0.004	0	0
Max rY	161	11	36.28	-2.475	2.255	36.434	0	0.001	0
Min rY	162	12	1.407	-2.641	33.637	33.77	0	-0.001	0
Max rZ	141	4	0.051	-10.952	24.463	26.803	0	0	0.004
Min rZ	53	4	-0.05	-10.954	24.583	26.913	0	0	-0.004
Max Rst	334	7	-0.01	-6.158	50.509	50.883	0	0	0

Table5.4 Maximum share force on Overhead Circular water tank having column in centre

	Beam	L/C	Node	Fx kN	Fy kN	Fz kN	Mx N-m		My N-m
Max Fx	538	4	349	1202.4	0.000	13.82	-0.001	24318.17	-0.000
Min Fx	1	1 QX	9	-74.170	6.312	0.529	-184.721	-546.066	7102.806
Max Fy	518	4	394	10.358	395.06	-9.159	-4018.32	2936.474	127.762
Min Fy	516	4	351	8.696	-395.36	10.86	1039.38	3486.569	124.078
Max Fz	340	7	32	703.14	-0.64	24.48	283.058	-37045.13	331.643
Min Fz	340	18	32	161.99	1.793	-13.98	-350.903	21106.21	2533.242
MaxMx	520	7	350	-6.015	272.10	4.084	8662.44	-1251.531	79488.179
Min Mx	519	7	93	-2.211	-280.33	-3.850	-8657.47	1120.188	-90456.541
Max My	8	7	8	747.92	0.014	22.38	142.911	38623.61	174.613
Min My	603	7	392	681.91	1.460	24.32	141.586	-44097.91	4432.472
Max Mz	518	4	394	10.358	395.06	-9.159	-4018.32	2936.474	127.76
Min Mz	516	4	73	8.696	-393.06	10.86	1039.38	-3329.846	-123.35

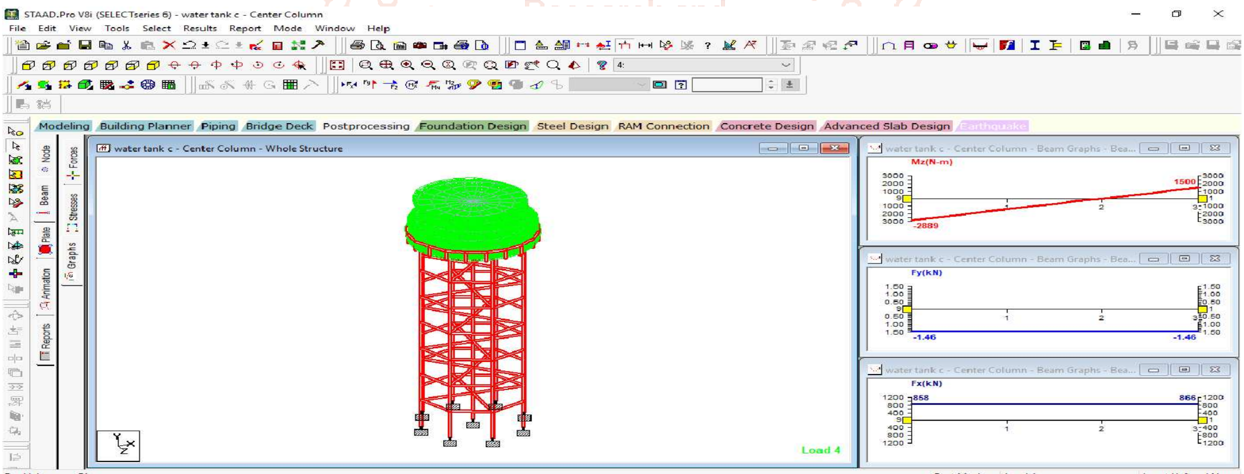

Fig.5.2 – STAAD Pro Model showing Maximum shear force of the Overhead Circular Water Tank

➢ **AXIAL LOAD ON COLUMNSUPPORT**

Table5.5 Maximum Axial load on Circular elevated water tank

Node	L/C	Force-X kN	Force-Y kN	Force-Z kN	Moment-X N-m	Moment-Y N-m	Moment-Z N-m
1	3	0.21	206.476	0.033	33.757	0.001	-212.792
	5	0.494	293.956	-6.06	-10599.9	-2.682	-497.916
2	3	0.143	216.472	-0.104	-100.886	-0.003	-138.763
	5	-1.388	341.638	-5.131	-9672.79	-2.163	1386.46
3	3	0.104	216.472	0.143	138.763	-0.003	-100.886
	5	1.367	284.983	-4.258	-8816.32	-1.607	-1354.36
4	3	0.033	206.476	-0.21	-212.792	0.001	-33.757
	5	-0.439	339.848	-3.366	-7930.36	-0.448	435.358
5	3	-0.033	206.476	0.21	212.792	0.001	33.757
	5	-0.454	260.698	-3.271	-7822.66	0.459	452.474
6	3	-0.104	216.472	-0.143	-138.763	-0.003	100.886
	5	1.385	350.543	-4.234	-8779.23	1.589	-1381.22

7	3	-0.143	216.472	0.104	100.886	-0.003	138.763
	5	-1.364	293.888	-5.149	-9699.65	2.144	1349.377
8	3	-0.21	206.476	-0.033	-33.757	0.001	212.792
	5	0.399	306.589	-6.075	-10617	2.693	-390.213

Table5.6 Maximum Axial load on Overhead Circular water tank having column in centre

Node	L/C	Force-X kN	Force-Y kN	Force-Z kN	Moment-X N-m	Moment-Y N-m	Moment-Z N-m
1	3	0.472	222.293	0.075	73.829	-0.000	-466.138
	5	0.503	354.971	-9.828	-17046.334	33.990	-534.128
2	3	0.154	226.307	-0.112	-114.909	-0.000	-158.154
	5	-1.928	449.055	-8.125	-15378.998	-59.957	1797.893
3	3	0.112	226.307	0.154	158.154	-0.000	-114.909
	5	1.873	296.664	-6.948	-14274.709	-43.561	-1751.367
4	3	0.075	222.293	-0.472	-466.138	-0.000	-73.829
	5	-0.268	480.249	-8.214	-15215.975	5.383	303.302
5	3	-0.075	222.293	0.472	466.138	-0.000	73.829
	5	-0.333	263.950	-7.808	-14817.439	-5.384	366.415
6	3	-0.112	226.307	-0.154	-158.154	-0.000	114.909
	5	1.919	473.192	-6.884	-14220.808	43.559	-1790.517
7	3	-0.154	226.307	0.112	114.909	-0.000	158.154
	5	-1.864	320.801	-8.171	-15418.148	59.955	1743.992
8	3	-0.472	222.293	-0.075	-73.829	-0.000	466.138
	5	0.098	389.229	-9.892	-17109.447	-33.991	-135.591
349	3	-0.000	254.814	-0.000	0.000	-0.000	0.000
	5	-0.000	546.845	-9.219	-16212.116	-0.001	0.000

CONCLUSION

- The deflection on circular tank without center column and circular tank with center column is reduces.
- In circular column the ring beam is not straight and hence there are much moment seen.
- The vertical load in overhead circular water tank the load is equal in all columns. Hence there more chances of settlement of heavy load columns or need to greater strength in footing.

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