Evaluation of Effect of Overhead Tank on the Performance of Multi-Story Building during Earthquake

Abhishek Arman[1], Vikram Chaudhary[2], Dr. Mohit[3]

[1]Abhishek Arman PG Student, M Tech Structural Engineering
[2]Professor Vikram Chaudhary Dept. of Civil Engineering, Cambridge Institute of Technology, Ranchi Jharkhand, India
[3]Dr. Mohit , Cambridge Institute of Technology, Ranchi Jharkhand, India

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Abstract - *Water Tank are the most essential part of any building during earthquake by which of every zone. In earthquake force applying on the building water tank also affected. In this we are collected the data from previous earthquake happen at a large magnitude. On the earth plate the most probable earthquake in zone V in Indian continent. every researchers are analysis of nature of water tank during earthquake. Water tank are very top to the ground thus if there are not to be proper design they must be effect of serious cause of damage. In this we are research a different height of multi-story building which is fifth, tenth and fifteen story building. In analysis of earthquake ETABS software will gives the data for Time History Analysis compression to the building. If we are consider when a water tank in height of the building then as a civil engineer we have to responsibly the structure must be in stable in nature. we have also consider that the structure is to be a parts of surrounding of nature. In this all the detailed must be follow, which is mention in the different of an IS Code detailed data provided by Govt. Of India.*

1.INTRODUCTION

Water tank are store a huge amount of water which is used in daily basic. Load of liquid water is applying on the all side of wall and also bottom parts. Internal water load and external earthquake load make a high critical condition to the shear wall and slab because there are a structural damage and hairline cracks. The formation of over-response structures under earthquakes is not economical, in particular in regions with a high risk of earthquakes. As a result, seismic details allow buildings to produce less than earthquake of the foundation. As long as sufficient details are provided, buildings can be constructed with compulsory standards much lower than was required for a flexible response. Typical earthquake-resistant structures rely on abstract behavior in selected components of properties.

In special temporary frames, where high requirements for ductility, inelastic character or damage are expected should be stored in beams away from the column surface and the rear column connection. Power dissipation (inelastic response) is the result of structural damage (permitting), sometimes very severe as well it costs repairs. In addition, if the location of power dissipation in the building can be predicted accurately, and if damage occurs to the gravitational load system, the structures may collapse Structures should be able to maintain several cycles of inelastic conversion without significant loss of power during an earthquake. The appropriate amount of solid loss can be applied during inelastic deformation, and the performance of the structure can be assessed by reviewing the distribution of energy in each area loading cycle.

1.1 EARTHQUAKE IN INDIA

India has suffer a high intensity of earthquake during history, In this the top most earthquake happen which magnitude is greater then 8. The moderate earthquake is in range between 6.0 to 7.0 . Moderate earthquake are also have a shaking intensity. At this last years higher intensity of earthquake have not seen yet. Higher intensity of earthquake (magnitude more then 8 or 9) cause effect of all the structural building. In this critical condition a structural building must have to be in stable condition because there are lots of population throng on that place. So the time history analysis of earthquake are also most important to our life safe and confidential. Let characterize the data of earthquake has to be done in India are

- In 26, December 2004 at 08:50 a earthquake of highest intensity of magnitude 9.1-9.3 and epicenter of earthquake was west coast of sumatra, Indonesia. Which is very far away from India, into this two countries an Indian ocean is located but due to the same tectonic plate the maximum level of disaster are into Indian coastal side of land area.
- In 26, January 2005 at 08:50 a earthquake of intensity of 7.6 of epic centre was Kashmir in this lots of construction damage.
- In 15, January 1934 at 14:13 a earthquake of high intensity of magnitude of 8.7 and the epic centre was South of Mount Everest. In this Bihar and Nepal are highly effected by which many of construction collapse in that place.
- In 26, January 2001 at 08:50 a earthquake of high intensity of magnitude of 7.7 at Kutch, Gujarat in this most of construction building has to collapse.

- In 4, April 1905 at 06:10 a earthquake of highest magnitude of intensity of 7.8 at Kanggra located in Himalayas.
- In 15 August 1950 at 19:39 a earthquake of highest magnitude of intensity of 8.6 at a place of Assam where epic centre was Rima, Tibat.

2. METHODOLOGY

Hydrodynamic pressure caused by liquid slide in the tank due to strong loading is considered in contrast to the compulsory pressure and sloshing pressure. Compulsory pressure is equal to the speed of the tank, but with opposite direction. Sloshing intensity is related to wave height and liquid sloshing volume.

2.1 EARTHQUAKE ANALYSIS

The choice of seismic analysis method depends on a number of factors such as the type of structure and configuration, the objectives of design and operation, the geographical stage, and the significance of the structure. In general, analytical methods for e-tabs software can be performed as the time history analysis for dynamic time history analysis. On the other hand, both consistent and dynamic analysis can be done as linear or offline. than the basic mode in each main direction. Analysis of the response rate of a method that can be used by all responsive and / or potential stakeholders with donations from the approaches vibration is higher than the default mode for each key indicator are Nonlinear Dynamic Analysis (Time History Analysis)

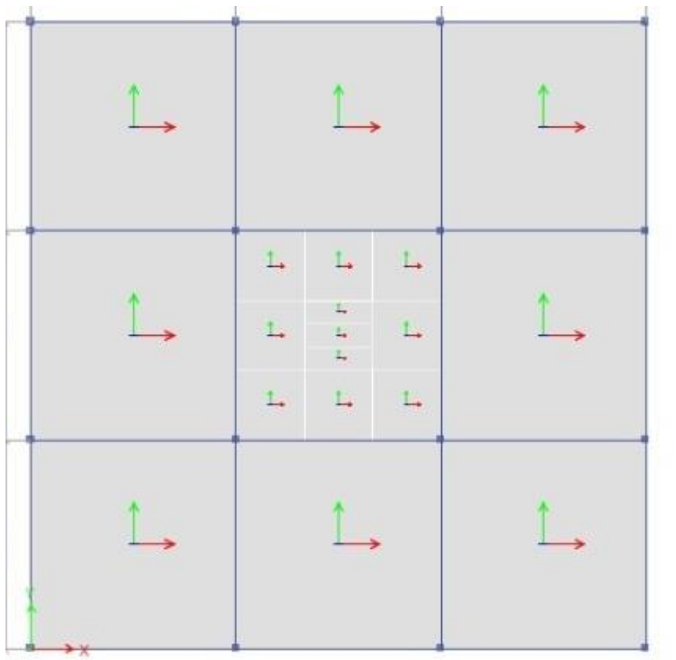
Table -1: Parameter for Model Design

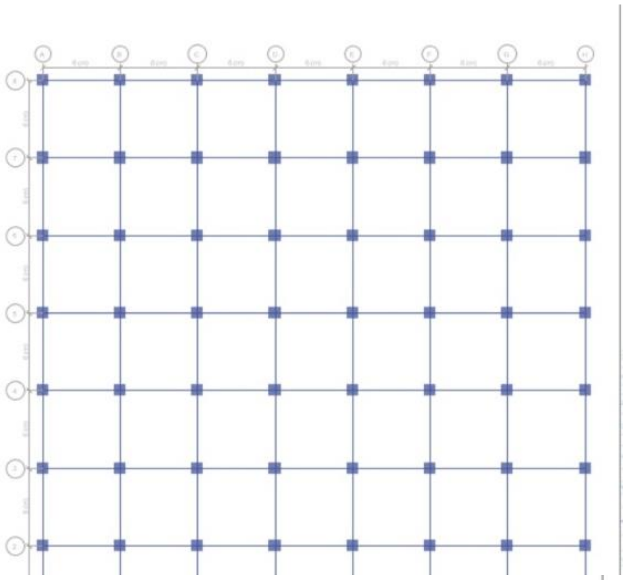
Types Of Structure	5 Story	10 Story	15 Story
Plan Dimension	(24 x 24)m	(56 x 40)m	(64 x 40)m
Number of Story	5	10	15
Storey height	3.0m	3.0m	3.0m
GRADE OF CONCRETE			
Beams	M30	M30	M30
Columns	M30	M30	M30
Slabs	M30	M30	M30
Grade of Steel	Fe415	Fe415	Fe415
Beam size	0.30 x0.40 m	0.60 x0.40 m	0.60 x0.40 m
Column Size	0.30 x 0.30 m	0.60 x0.60 m	0.90 x0.90 m
Slab Thickness	0.175 m	0.200m	0.200m
Tank Wall Thickness	0.25 m	0.25 m	0.25 m
LOAD APPLICATION			
Self Weight of Wall on each Floor	4.375KN/sq. m	5KN/sq. m	5KN/sq. m
Live Load	4 KN/sq.m	4 KN/sq.m	4 KN/sq.m
Floor Finish	1.5KN/sq.m	1.5KN/sq.m	1.5KN/sq.m
EARTHQUAKE ANALYSIS as per IS 1893:2002			
Seismic Zone	V	V	V
Zone Factor	0.36	0.36	0.36
Importance factor	1	1	1
Response Reduction factor	5	5	5

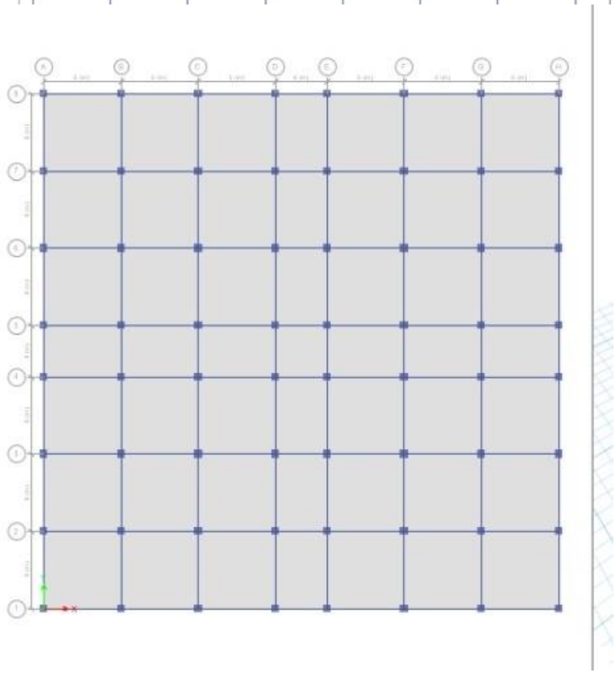
Table -2 Table for Rectangular Water Tank

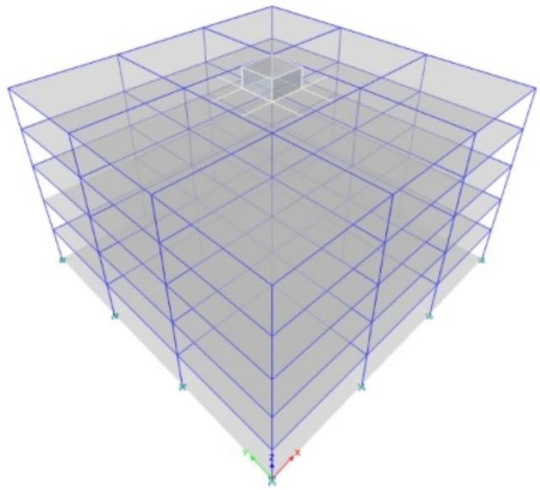
Structure	5 Story	10 Story	15 Story
Capacity of Tank	7,500 LITRE	27,000 LITRE	40,000LITRE
Base area	2.67 m x 2.67m	4 m x 4 m	6 m x 4 m
Concrete grade	M30	M30	M30
Steel	Fe415	Fe415	Fe415
Height of water tank	1.5 m	2.1 m	2.1 m
Top slab thickness	100mm	100mm	100mm
Bottom Slab thickness	150mm	200mm	200mm
Wall Thickness	250mm	250mm	250mm

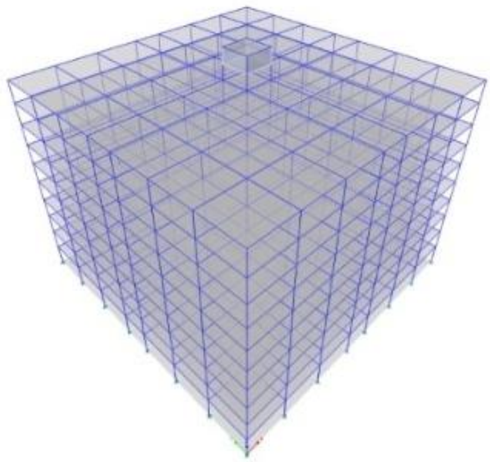
Building model in 3D and plan view for 5th , 10th and 15th store

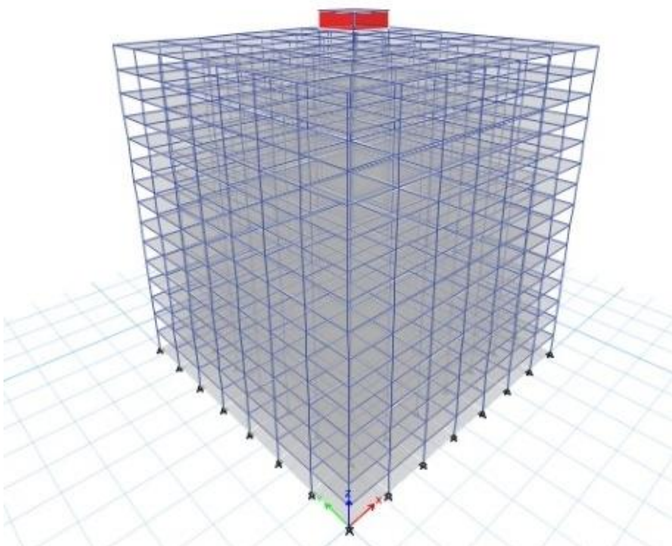












3. RESULTS

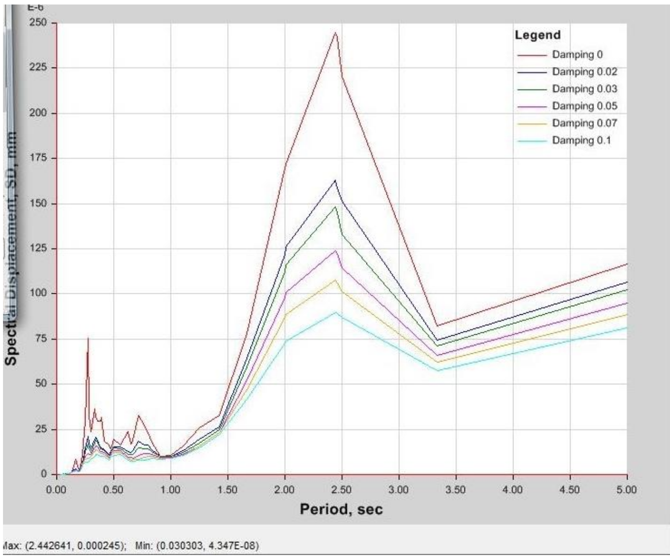
A Non linear dynamic time history has to be shown by a reaction base of structure.

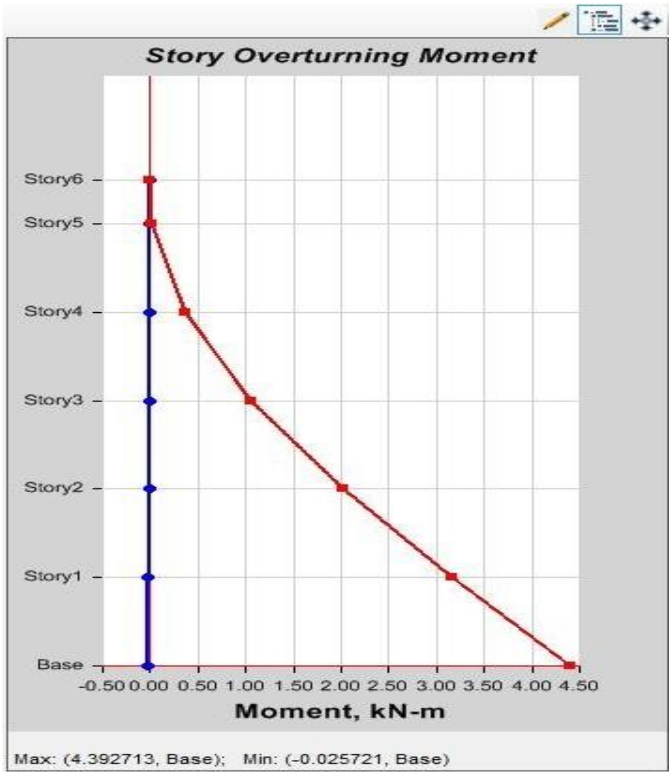
Table 2.1 - Base Reactions

Load Case/Combo	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m	MZ kN-m	X m	Y m
Dead	-712	-712	196685.8392	3943829.1837	-3945253	-641.9529	0	0
Live	0	0	141570.2392	2831404.7837	-2831405	0	0	0
EQ X	-5819.1926	0	141570.2392	2831404.7837	-2968797	116383.8519	0	0
EQ Y	0	-5819.1926	141570.2392	2968796.8954	-2831405	116383.8519	0	0
W X	-2470.4103	0	141570.2392	2831404.7837	-2873777	49408.2055	0	0
W Y	0	-2470.4103	141570.2392	2873777.3234	-2831405	-49408.2055	0	0
WATER	0	0	141570.2392	2831404.7837	-2831405	0	0	0
TH x Max	0.0029	0	4606.6756	103567.9068	0	442.6216	0	0
TH x Min	-796.7536	-742.3805	0	0	-104714.2227	-0.058	0	0
TH y Max	0	3.5751	0	86.1513	1.28E-06	71.5016	0	0
TH y Min	0	-3.717	0	-65.5789	-1.112E-06	-74.3395	0	0

Load Case/Combo	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m	MZ kN-m	X m	Y m
Dead	-108	-108	49094.5364	589361.3183	-590519.1819	-108	0	0
Live	0	0	13852.4444	166229.3334	-166229.3334	0	0	0
floor	0	0	0	0	0	0	0	0
EQ X	-7817.0755	0	0	0	-63001.3501	93800.8045	0	0
EQ Y 1	-890.8533	0	0	0	-10926.6834	10686.1378	0	0
EQ Y 2	0	-895.7653	0	10986.9311	0	-10751.9332	0	0
EQ Y 3	-890.8533	0	0	0	-10926.6834	10866.1759	0	0
EQ Y 4	0	-895.7653	0	10986.9311	0	-10933.476	0	0
EQ Y 5	-890.8533	0	0	0	-10926.6834	10506.0997	0	0
EQ Y 6	0	-895.7653	0	10986.9311	0	-10570.3904	0	0
W X	-406.016	0	0	0	-3394.56	4872.192	0	0
W Y 1	-406.016	0	0	0	-3394.56	4872.192	0	0
W Y 2	0	-409.344	0	3444.48	0	-4912.128	0	0
WATER	0	0	106.6667	1280.0001	-1280.0001	0	0	0
TH x Max	0.9885	0.0015	0	0.0044	10.4601	11.1899	0	0
TH x Min	-0.9172	-0.0016	0	-0.004	-9.3062	-11.9917	0	0
TH y Max	0.0015	0.9929	0	9.2836	0.004	11.9123	0	0
TH y Min	-0.0016	-0.9282	0	-10.433	-0.0044	-11.1449	0	0

Load Case/Combo	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m	MZ kN-m	X m	Y m
Dead	0	0	606475.6581	12726369	-12735989	0	0	0
Live	0	0	244459.6581	5124033.4106	-5133653	0	0	0
Eqx	-7208.42	0	244459.6581	5124033.4106	-5384640	158073.3117	0	0
Eqy	0	-7207.9248	244459.6581	5375003.8402	-5133653	-158351.1208	0	0
wind x	-4319.5391	0	244459.6581	5124033.4106	-5242927	90710.3219	0	0
wind y	0	-4319.5391	244459.6581	5233307.1542	-5133653	-90710.3219	0	0
water load	11160	-11160	244459.6581	5659793.4104	-4597893	-468719.9998	0	0
TH X Max	3.9976	0	0	0	113.7451	86.3457	0	0
TH X Min	-4.1038	0	0	0	-113.2937	-84.1557	0	0
TH Y Max	0	3.9973	0	113.2981	0	83.9436	0	0
TH Y Min	0	-4.1039	0	-113.7289	0	-86.1816	0	0





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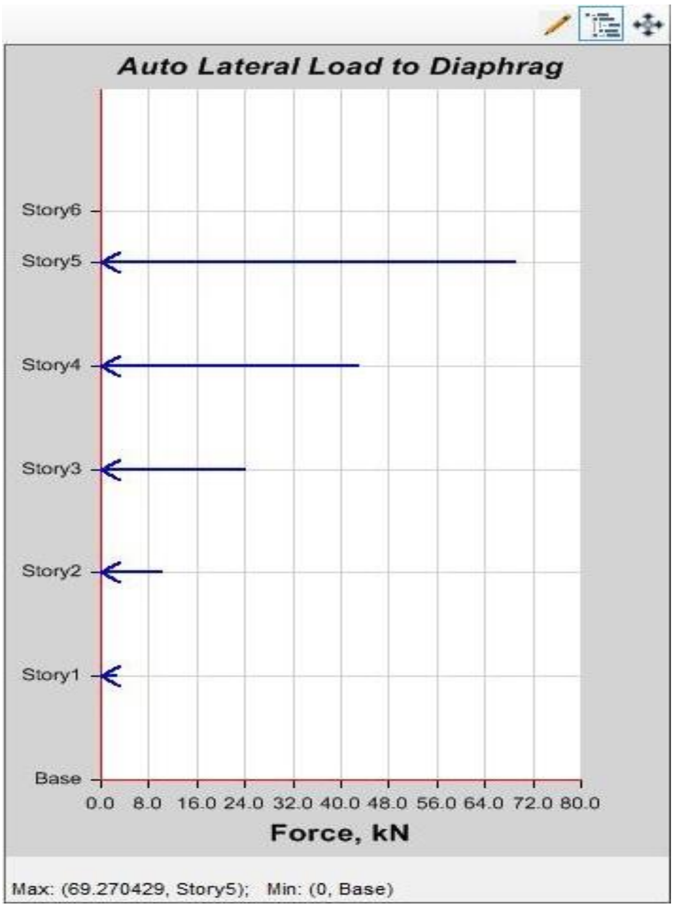
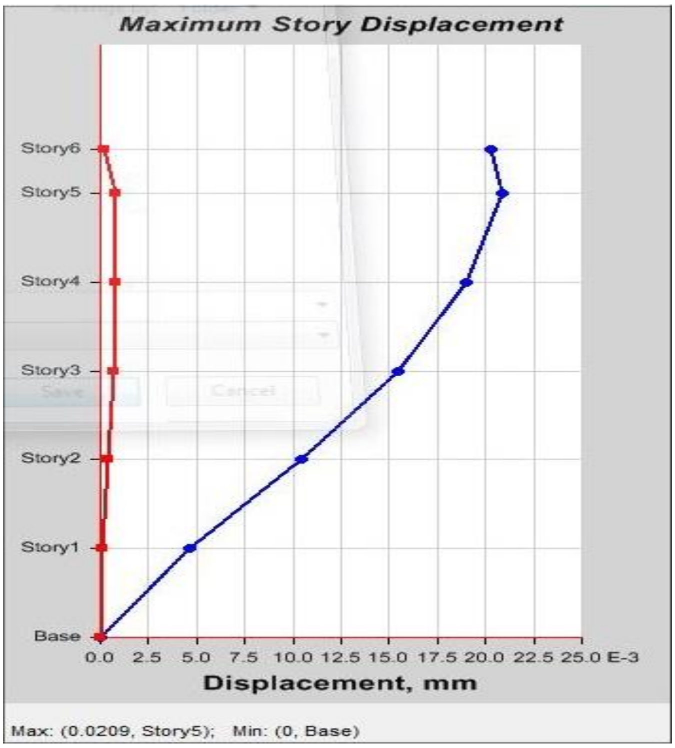
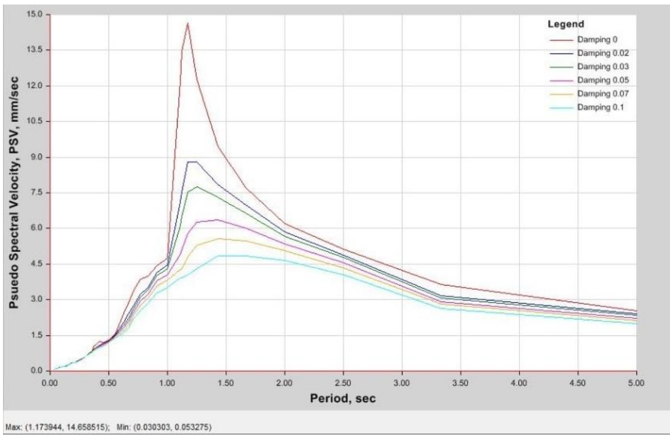
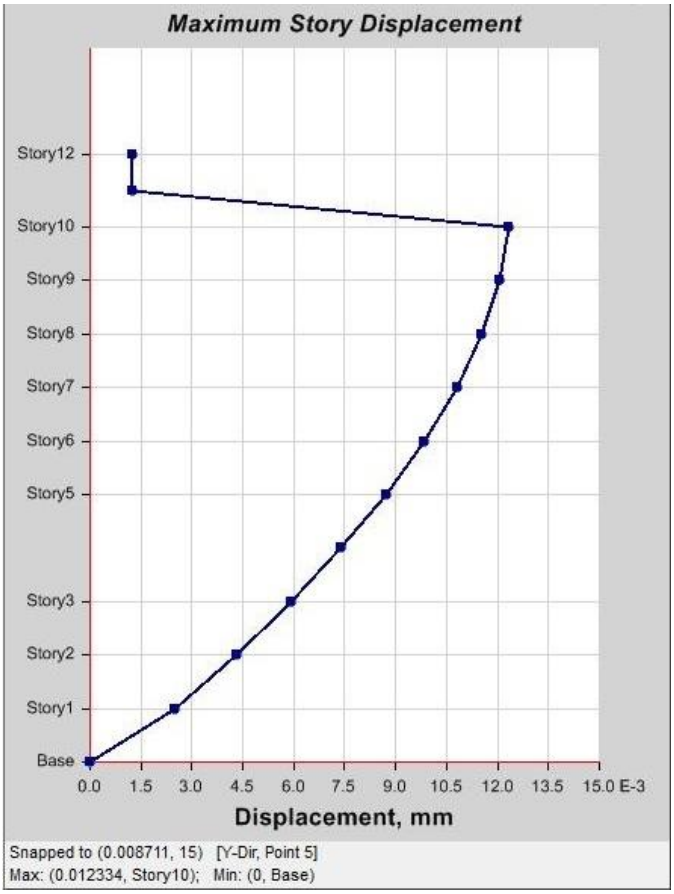
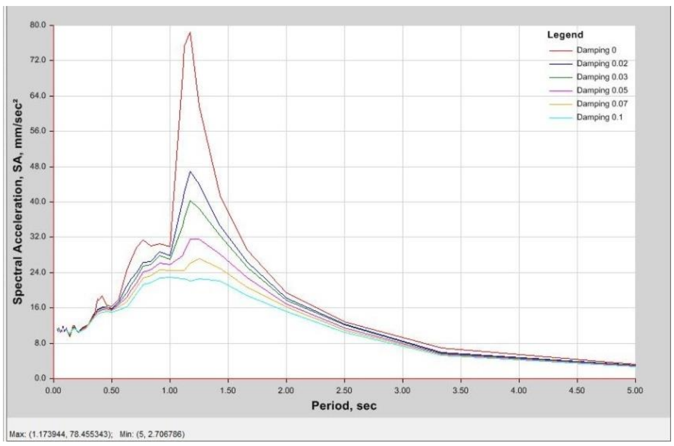
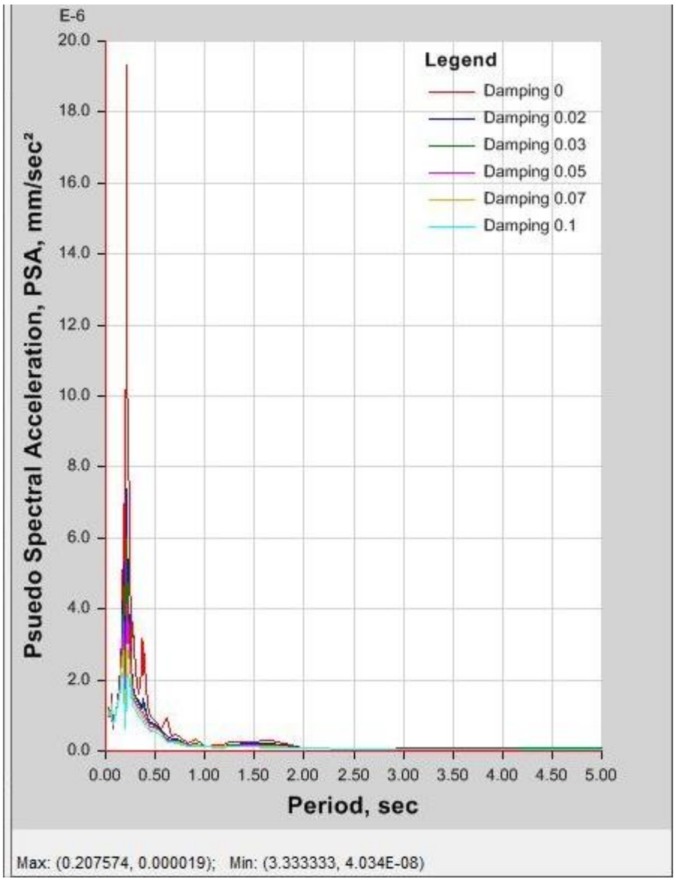


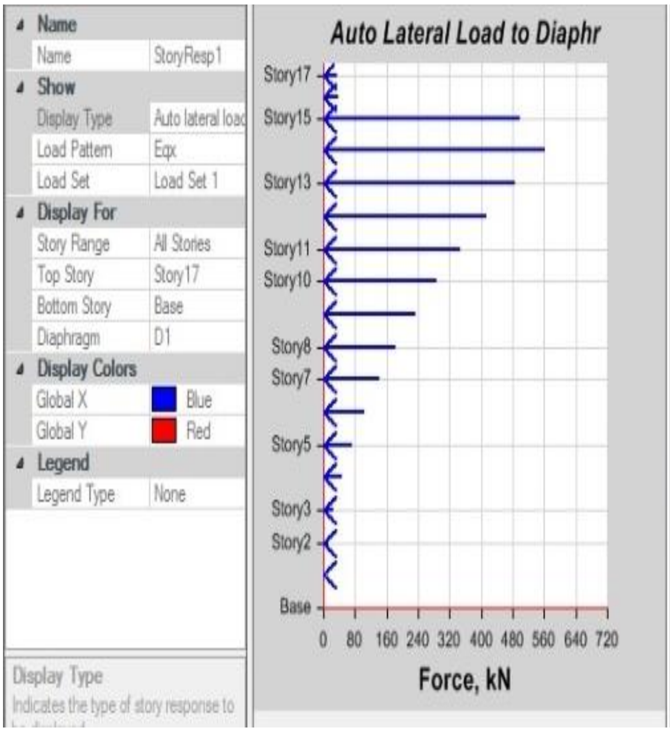


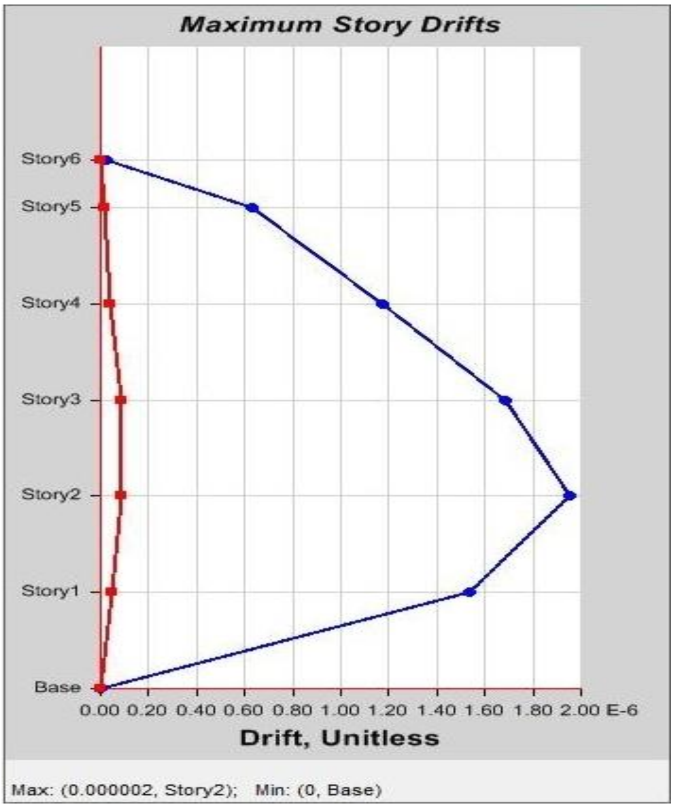


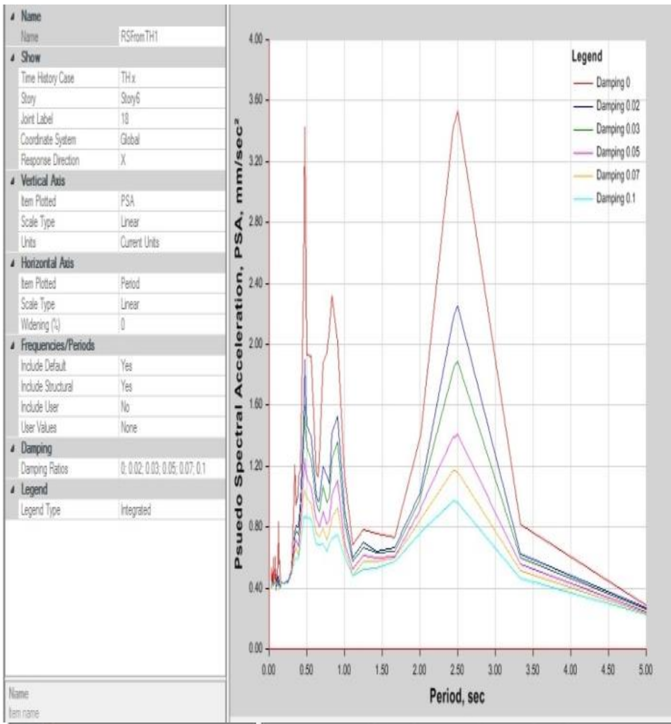


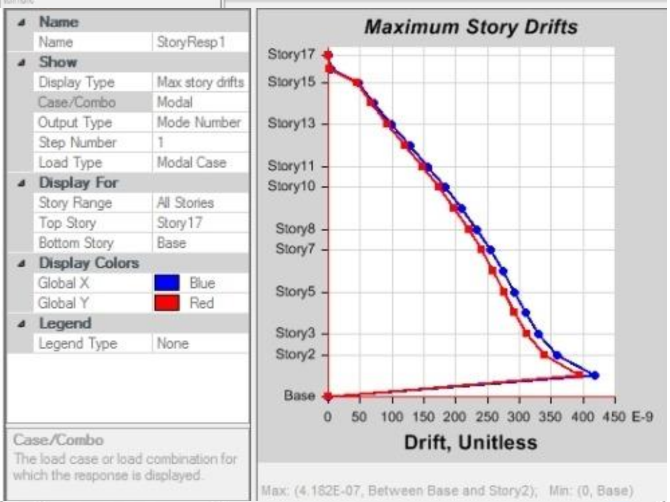


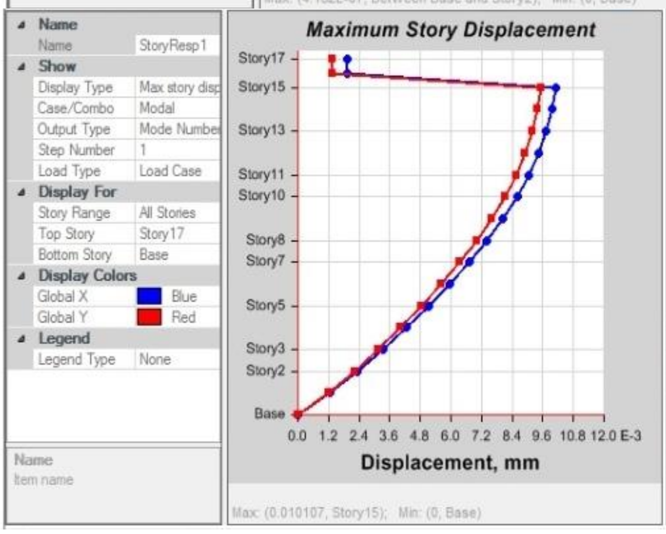

E-6
Psuedo Spectral Acceleration, PSA, mm/sec²
Legend
Damping 0
Damping 0.02
Damping 0.03
Damping 0.05
Damping 0.07
Damping 0.1
0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50 5.00
Period, sec
Max: (0.207574, 0.000019); Min: (3.333333, 4.034E-08)


Name
Name StoryResp1
Show
Display Type Auto lateral load
Load Pattern Eqx
Load Set Load Set 1
Display For
Story Range All Stories
Top Story Story17
Bottom Story Base
Diaphragm D1
Display Colors
Global X Blue
Global Y Red
Legend
Legend Type None
Display Type
Indicates the type of story response to
Auto Lateral Load to Diaphr
Story17
Story15
Story13
Story11
Story10
Story8
Story7
Story5
Story3
Story2
Base
0 80 160 240 320 400 480 560 640 720
Force, kN

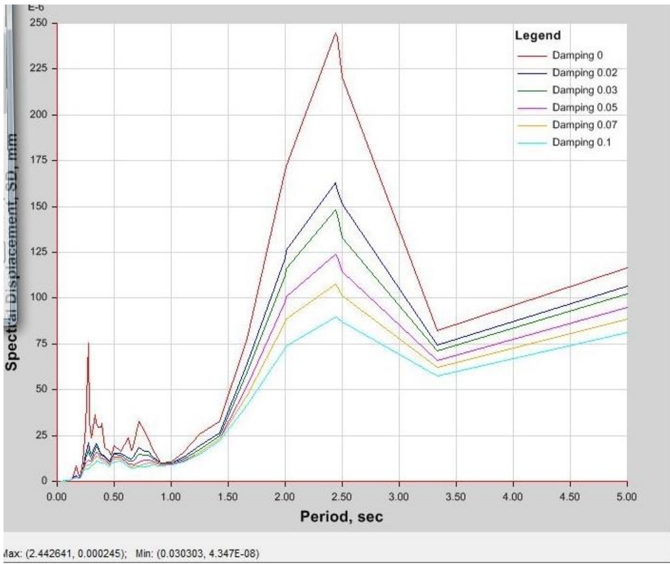

Maximum Story Drifts
Story6
Story5
Story4
Story3
Story2
Story1
Base
0.00 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 E-6
Drift, Unitless
Max: (0.000002, Story2); Min: (0, Base)

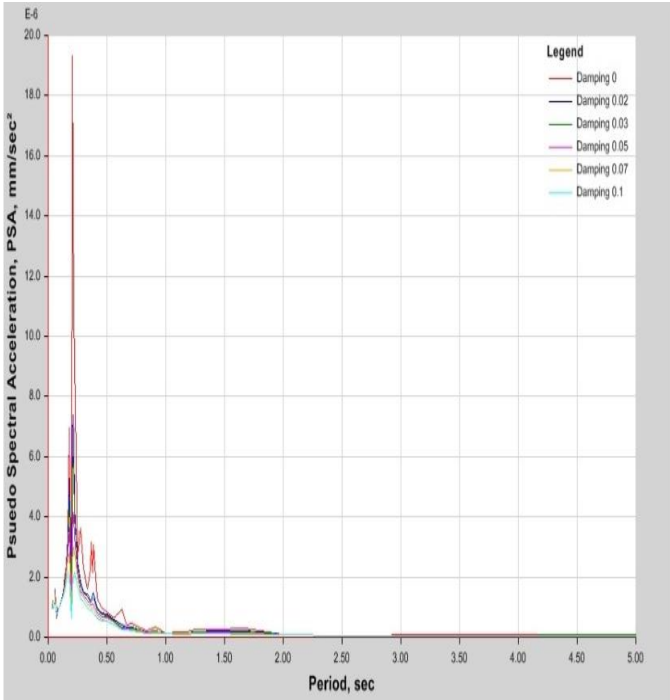


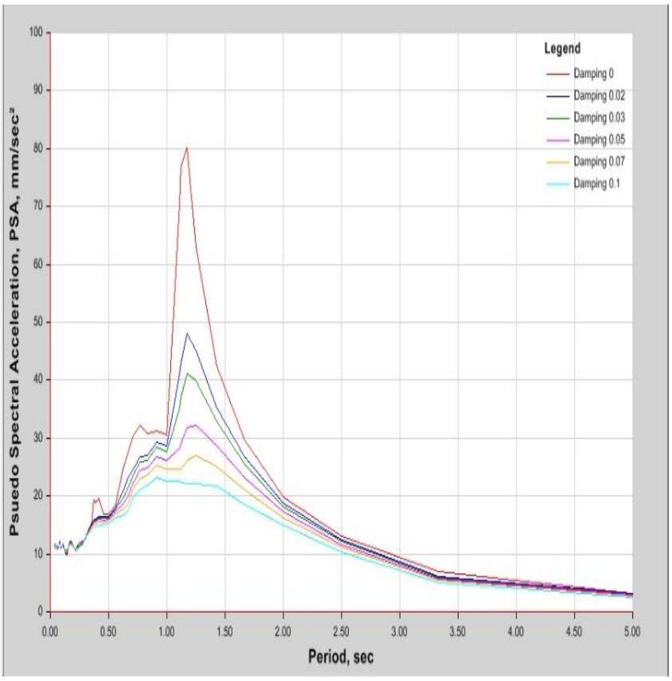


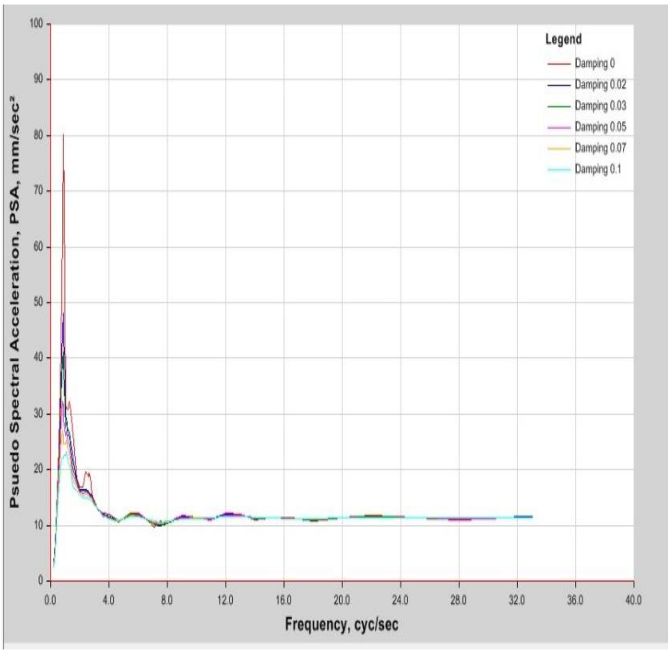


3.1Result of time History Analysis









4. CONCLUSIONS

The risk of an earthquake of high-pressure water tanks using a functional structure is a study. Reinforced concrete considered high water tanks with a capacity of containers. The need for a program is explored in conjunction earthquake records using direct and indirect analysis. On the other hand, the power of the system also checked. The level of demand on the volume of each item of the system is also estimated. A look at the powerful offline analysis will appear as appropriate proposed system approach for this project: using the concrete construction, reduces stress concentration Typical RC water tanks, Earthquake is the major load factor that are partially or even fully effect on the structure,thus we cannot counter it. If we are consider when a water tank in height of the building then as a civil engineer we have to responsibly the structure must be in stable in nature. We have also consider that the structure is to be a parts of surrounding of nature.

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