NON LINEAR TIME HISTORY ANALYSIS OF TALL BUILDING USING DAMPERS SUBJECTED TO SEISMIC LOADS

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effects of which are devastating causing severe damage to human life, property, wealth and animals .Many measures can be taken to build infrastructure which are Earthquake resistant. Now-a-days theories have been proposed which are being practiced to design structures/buildings that are Earthquake resistant. One such theory is "Non-Linear Time History Analysis". Through Non-Linear Time History Analysis, we will be able to anticipate Earthquake forces that a building may be subjected to. But knowing the forces will not make the building safe, the buildings have to be designed and built such that they can resist those forces. In addition to the design methodology, Mechanical equipment's are invented which when installed in a building can reduce the effects of the Earthquake of a building. One such equipment is "Damping System" generally called "Dampers". In this thesis, it is studied that Non direct seismic appraisal is a decent apparatus in helping us to anticipate the seismic limit. Numerous gadgets are utilized to enhance the seismic limit of the structures. So as to decrease the negative effects of quakes, various types of defensive framework have been received in the structures around the world. Position of liquid gooey damper is one of the methods in which it assimilates the stun vibrations of the building which causes harm. The effect of damper on the seismic response of the RC structures is analyzed in this. Little thought has been paid to surveying the effect of the number and game plan of dampers on the dynamic response . unequal model are differentiated and without dampers are broke down in high seismic zone(V) in business programming with ETABS 9.7.4 Time History examination is finished to inspect the effect of damper on the day and age, base shear and accelerating in RC structures.

keywords: asymmetric models, dampers , ETABS, time period, base shear, acceleration spectrum etc,.

INTRODUCTION

Earthquakes are natural phenomena, which cause the ground to shake. The earth's interior is hot and in a molten state. As the lava comes to the surface, it cools and new land is formed. The lands so formed have to continuously keep drifting to allow new material to surface. According to the theory of plate tectonics, the entire surface of the earth can be considered to be like several plates, constantly on the move. These plates brush against each other or collide at their boundaries giving rise to earthquakes. Therefore regions close to the plate boundary are highly seismic and regions further from the boundaries exhibit less seismicity. Earthquakes may also be caused by other actions such as underground explosions. The study of why and where earthquakes occur comes under geology. An important characteristic of earthquake loading is the uncertainty associated with its amplitude, duration, and frequency content. Structures are normally designed to withstand gravity loads acting vertically with adequate factor of safety. Therefore the lateral loads arising due to horizontal earthquake ground motion can cause severe damage unless special provisions are made to resist them the third characteristic of earthquake ground motion is that it is cyclic and induces reversal of stresses. Therefore axially loaded members may have to resist both tension and compression while beam cross-sections will have to resist both positive and negative bending moments.

The main aim of all kinds of structural system in a building is to transfer the gravity load effectively and thus assure safety of the structure. Apart from these vertical loads, structure is also subjected to lateral loads which can develop high stress which will cause, sway of the structure.

DAMPERS

In seismic structures upgrading, one of the lateral force reduction caused by the earthquake is use of dampers. During an earthquake, high energy is applied to the structure. This energy is applied in two types of kinetic and potential (strain) to structure and it is absorbed or amortized. If structure is free of damping, its vibration will be continuously, but due to the material damping, vibration is reduced. Input energy caused by earthquake to structure is presented in the following equation:

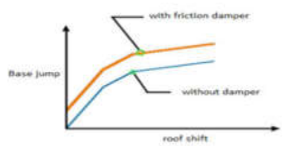
$$E = E_k + E_s + E_n + E_d \qquad (1)$$

In this equation, E is earthquake input energy, E_k is kinetic energy, E_s is reversible strain energy in the elastic range and E_h is the amount of wasted energy due to inelastic deformation and E_d is the amount of amortized energy by additional damper.

TYPES OF DAMPERS

Friction Dampers

In this type of damper, seismic energy is spent in overcoming friction in the contact surfaces. Among other features of these dampers can be classified as avoiding fatigue in served load and their performance independent to loading velocity and ambient temperature. These dampers are installed in parallel to bracing.



The effect of using friction dampers on structure capacity curve

Rotational friction dampers are shown. Because of very simple behavior and easy to install and make, this type of damper is converted to one the most common types of friction dampers.

Using rotational friction dampers in retrofitting

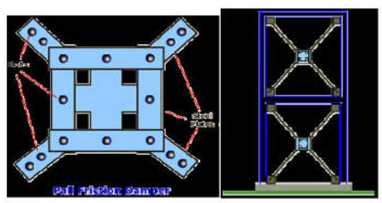
PVD Damper

It is another type of friction damper and due to ease to installation is one of the most widely used dampers in structures.PVD damper can be used to create necessary damping for flexible structures, such as bending steel frame or to provide effective damping to relative stiffness of structures.PVD damper is designed to installation where displacement can generate necessary damping such as installation of metal skeleton brace or concrete moment frame.

The place of PVD damping installation

Pall Friction Damper

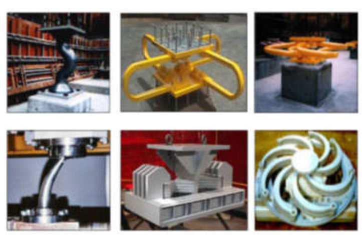
Another type of friction damper is Pall friction damper. This damper includes a bracing and some steel plate with friction screws. And they should be installed in the middle of bracing. Steel sheets are connected to each other by high strength bolts and they have a slip by a certain force, to each other.



Using Pall friction dampers

Metallic Dampers

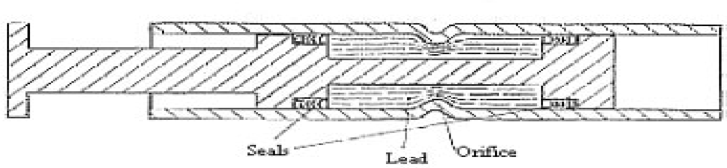
In this damper, transferred energy to the structure is spent to submission and non-linear behavior in used element in damper. In these dampers, metal inelastic deformation is used such as for formability metals such as steel and lead for energy dissipation. In all conventional structures, energy dissipation is based on deformation of steel members after the submission.



Samples of metallic dampers

Lead Injection Damper

This damper is made of a two-chamber cylinder, piston and lead inside piston. And by piston moving during earthquake, lead moves from larger chamber to smaller chamber.



LITERATURE REVIEW

Shaik Kamal Mohammed Azam, Vinod Hosur The dual structural system consisting of special moment resisting frame (SMRF) and concrete shear wall has better seismic performance due to improved lateral stiffness and lateral strength. A well designed system of shear walls in a building frame improves its seismic performance significantly. The configurations of RC moment resisting framed building structure with different arrangements of shear walls are considered for evaluation of seismic performance, so as to arrive at the suitable arrangement of shear wall in the structural framing system for better seismic resistance. A comparison of structural behaviour in terms of strength, stiffness and damping characteristics is done by arranging shear walls at different locations/configurations in the structural framing system. The elastic (response spectrum analysis) as well as in-elastic (nonlinear static pushover analysis) analyses are carried out for the evaluation of seismic performance. The results of the study indicate that the provision of shear walls symmetrically in the outermost moment resisting frames of the building and preferably interconnected in mutually perpendicular directions forming a core will lead to better seismic performance.

METHODLOGY

MODELING DETAILS

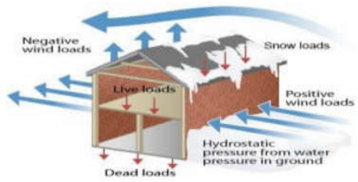
Basic parameters considered for the analysis are

1. Utility of building : Apartment building
2. Number of stories : G+25
3. Shape of building : asymmetric building
4. Geometric details
   a. Ground floor : 3.3m
   b. floor to floor height : 3m
5. Material details
   a. Concrete Grade : M40 (COLUMNS AND BEAMS)
   b. All Steel Grades : HYSD reinforcement of Grade Fe415
   c. Bearing Capacity of Soil : 200 KN/m^2
6. Type Of Construction : R.C.C FRAMED structure
7. Column : 0.45m X 0.45 m,
8. Beams : 0.45m X 0.30m,
9. Slab : 0.150m

TYPES OF ANALYSIS ON STRUCTURE

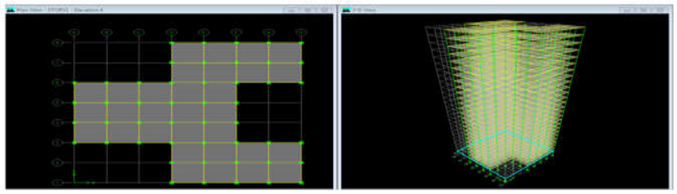
Types of loads acting on the structure are:

- Dead loads
- Imposed loads
- Wind loads
- Snow loads
- Earthquake loads
- Special loads

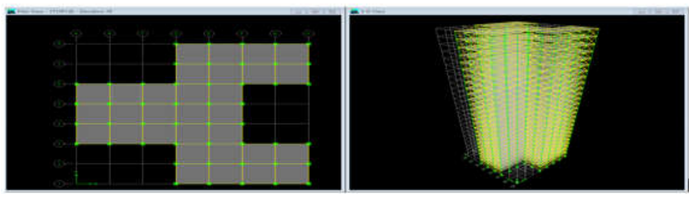


MODELING DETAILS

MODEL 1: BUILDING WITHOUT DAMPERS



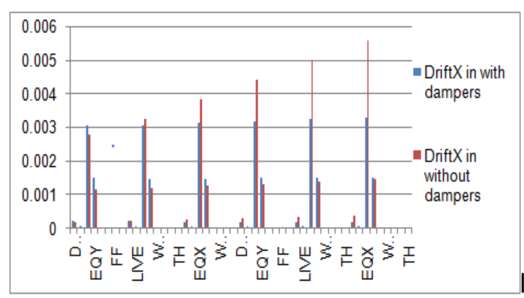
MODEL 2 : BUILDING WITH DAMPERS



RESULTS AND ANALYSIS

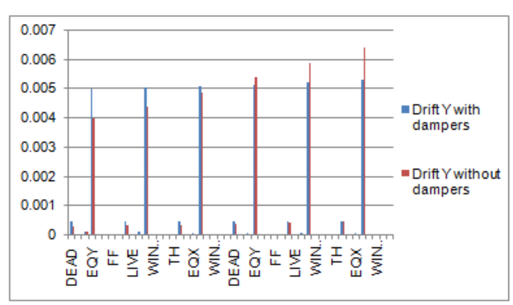
Drift in X direction

Story	Load	Drift X in with dampers	Drift X in without dampers
STORY26	DEAD	0.00024	0.00019
STORY26	LIVE	9.2E-05	0.00002
STORY26	EQX	0.00305	0.00278
STORY26	EQY	0.0015	0.00117
STORY26	WINDX	0	0
STORY26	WINDY	0	0
STORY26	FF	4.6E-05	0.00001
STORY26	TH	5E-06	3E-06
STORY25	DEAD	0.00022	0.00024
STORY25	LIVE	8.9E-05	1.2E-05
STORY25	EQX	0.00306	0.00327
STORY25	EQY	0.00148	0.00119
STORY25	WINDX	0	0
STORY25	WINDY	0	0
STORY25	FF	4.5E-05	6E-06
STORY25	TH	5E-06	3E-06
STORY24	DEAD	0.00022	0.00027
STORY24	LIVE	8.9E-05	1.1E-05
STORY24	EQX	0.00312	0.00384
STORY24	EQY	0.00149	0.00127
STORY24	WINDX	0	0
STORY24	WINDY	0	0
STORY24	FF	4.5E-05	5E-06
STORY24	TH	5E-06	4E-06
STORY23	DEAD	0.00021	0.00031
STORY23	LIVE	8.9E-05	0.00001
STORY23	EQX	0.00318	0.00442
STORY23	EQY	0.0015	0.00134
STORY23	WINDX	0	0
STORY23	WINDY	0	0
STORY23	FF	4.4E-05	5E-06
STORY23	TH	5E-06	4E-06



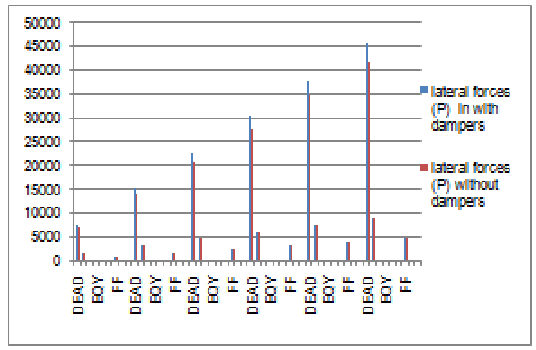
DRIFT IN Y DIRECTION

Story	Load	Drift Y with dampers	Drift Y without dampers
STORY26	DEAD	0.00043	0.00027
STORY26	LIVE	2.3E-05	0.00001
STORY26	EQX	0.00011	0.0001
STORY26	EQY	0.00496	0.00396
STORY26	WINDX	0	0
STORY26	WINDY		
STORY26	FF	1.1E-05	5E-06
STORY26	TH	8E-06	4E-06
STORY25	DEAD	0.00043	0.00029
STORY25	LIVE	1.3E-05	2E-06
STORY25	EQX	0.00009	0.00002
STORY25	EQY	0.005	0.00434
STORY25	WINDX	0	0
STORY25	WINDY	0	0
STORY25	FF	6E-06	1E-06
STORY25	TH	8E-06	4E-06
STORY24	DEAD	0.00043	0.00033
STORY24	LIVE	1.1E-05	0
STORY24	EQX	6.9E-05	0
STORY24	EQY	0.00505	0.00484
STORY24	WINDX	0	0
STORY24	WINDY	0	0
STORY24	FF	6E-06	0
STORY24	TH	8E-06	4E-06
STORY23	DEAD	0.00043	0.00036
STORY23	LIVE	0.00001	0
STORY23	EQX	5.3E-05	1E-06
STORY23	EQY	0.00511	0.00535
STORY23	WINDX	0	0
STORY23	WINDY	0	0
STORY23	FF	5E-06	0
STORY23	TH	8E-06	5E-06
STORY22	DEAD	0.00043	0.0004
STORY22	LIVE	8E-06	0
STORY22	EQX	4.2E-05	0
STORY22	EQY	0.00519	0.00587
STORY22	WINDX	0	0
STORY22	WINDY	0	0



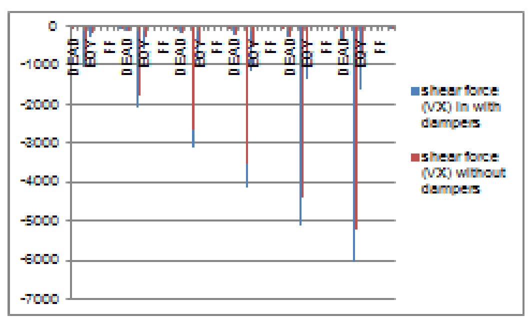
Lateral forces (P)

story	Load	Loc	lateral forces (P) in with dampers	lateral forces (P) without dampers
STORY26	DEAD	Bottom	7545.62	6909.45
STORY26	LIVE	Bottom	1488	1488
STORY26	EQX	Bottom	0	0
STORY26	EQY	Bottom	0	0
STORY26	WINDX	Bottom	0	0
STORY26	WINDY	Bottom	0	0
STORY26	FF	Bottom	744	744
STORY26	TH MAX	Bottom	0	0
STORY26	TH MIN	Bottom	0	0
STORY25	DEAD	Bottom	15091.2	13818.9
STORY25	LIVE	Bottom	2976	2976
STORY25	EQX	Bottom	0	0
STORY25	EQY	Bottom	0	0
STORY25	WINDX	Bottom	0	0
STORY25	WINDY	Bottom	0	0
STORY25	FF	Bottom	1488	1488
STORY25	TH MAX	Bottom	0	0
STORY25	TH MIN	Bottom	0	0
STORY24	DEAD	Bottom	22636.9	20728.4
STORY24	LIVE	Bottom	4464	4464
STORY24	EQX	Bottom	0	0
STORY24	EQY	Bottom	0	0
STORY24	WINDX	Bottom	0	0
STORY24	WINDY	Bottom	0	0
STORY24	FF	Bottom	2232	2232
STORY24	TH MAX	Bottom	0	0
STORY24	TH MIN	Bottom	0	0
STORY23	DEAD	Bottom	30182.5	27637.8
STORY23	LIVE	Bottom	5952	5952
STORY23	EQX	Bottom	0	0
STORY23	EQY	Bottom	0	0
STORY23	WINDX	Bottom	0	0
STORY23	WINDY	Bottom	0	0
STORY23	FF	Bottom	2976	2976
STORY23	TH MAX	Bottom	0	0
STORY23	TH MIN	Bottom	0	0
STORY22	DEAD	Bottom	37728.1	34547.3
STORY22	LIVE	Bottom	7440	7440
STORY22	EQX	Bottom	0	0
STORY22	EQY	Bottom	0	0
STORY22	WINDX	Bottom	0	0
STORY22	WINDY	Bottom	0	0
STORY22	FF	Bottom	3720	3720
STORY22	TH MAX	Bottom	0	0
STORY22	TH MIN	Bottom	0	0
STORY21	DEAD	Bottom	45273.7	41456.7
STORY21	LIVE	Bottom	8928	8928
STORY21	EQX	Bottom	0	0
STORY21	EQY	Bottom	0	0
STORY21	WINDX	Bottom	0	0
STORY21	WINDY	Bottom	0	0
STORY21	FF	Bottom	4464	4464
STORY21	TH MAX	Bottom	0	0
STORY21	TH MIN	Bottom	0	0



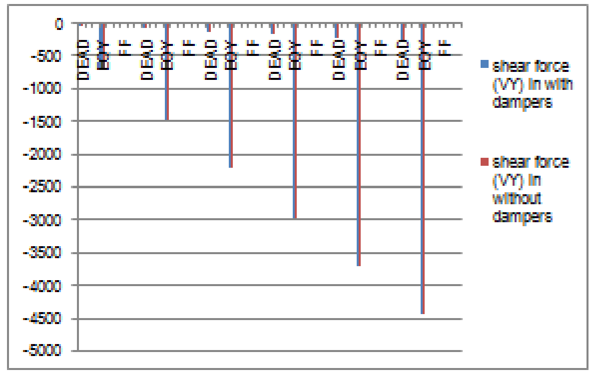
Shear force in x direction

story	Load	Loc	shear force (VX) in with dampers	shear force (VX) without dampers
STORY26	DEAD	Bottom	-48	-48
STORY26	LIVE	Bottom	0	0
STORY26	EQX	Bottom	-1019.6	-881.68
STORY26	EQY	Bottom	-275.57	-137.68
STORY26	WINDX	Bottom	0	0
STORY26	WINDY	Bottom	0	0
STORY26	FF	Bottom	0	0
STORY26	TH MAX	Bottom	0	0
STORY26	TH MIN	Bottom	-1.2	-0.64
STORY25	DEAD	Bottom	-96	-96
STORY25	LIVE	Bottom	0	0
STORY25	EQX	Bottom	-2069.8	-1767.8
STORY25	EQY	Bottom	-581.82	-279.8
STORY25	WINDX	Bottom	0	0
STORY25	WINDY	Bottom	0	0
STORY25	FF	Bottom	0	0
STORY25	TH MAX	Bottom	0	0
STORY25	TH MIN	Bottom	-2.58	-1.35
STORY24	DEAD	Bottom	-144	-144
STORY24	LIVE	Bottom	0	0
STORY24	EQX	Bottom	-3096.4	-2642.9
STORY24	EQY	Bottom	-864.36	-410.92
STORY24	WINDX	Bottom	0	0
STORY24	WINDY	Bottom	0	0
STORY24	FF	Bottom	0	0
STORY24	TH MAX	Bottom	0	0
STORY24	TH MIN	Bottom	-3.9	-2.07
STORY23	DEAD	Bottom	-192	-192
STORY23	LIVE	Bottom	0	0
STORY23	EQX	Bottom	-4100.2	-3507.5
STORY23	EQY	Bottom	-1124.2	-531.48
STORY23	WINDX	Bottom	0	0
STORY23	WINDY	Bottom	0	0
STORY23	FF	Bottom	0	0
STORY23	TH MAX	Bottom	0	0
STORY23	TH MIN	Bottom	-5.16	-2.79
STORY22	DEAD	Bottom	-240	-240
STORY22	LIVE	Bottom	0	0
STORY22	EQX	Bottom	-5082.2	-4361.9
STORY22	EQY	Bottom	-1362.2	-641.94
STORY22	WINDX	Bottom	0	0
STORY22	WINDY	Bottom	0	0
STORY22	FF	Bottom	0	0
STORY22	TH MAX	Bottom	0	0
STORY22	TH MIN	Bottom	-6.37	-3.52
STORY21	DEAD	Bottom	-288	-288
STORY21	LIVE	Bottom	0	0
STORY21	EQX	Bottom	-6043.3	-5206.7
STORY21	EQY	Bottom	-1579.3	-742.72
STORY21	WINDX	Bottom	0	0
STORY21	WINDY	Bottom	0	0
STORY21	FF	Bottom	0	0
STORY21	TH MAX	Bottom	0	0
STORY21	TH MIN	Bottom	-7.51	-4.26



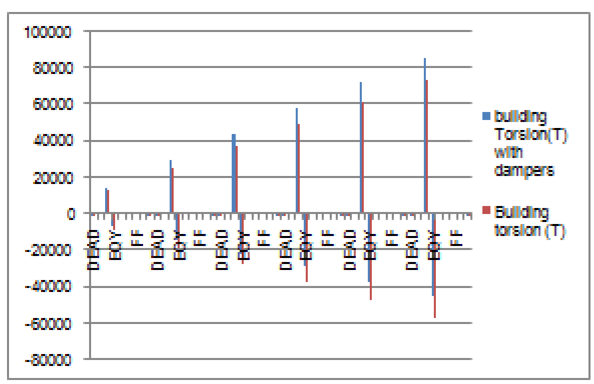
Shear Force In Y Direction

story	Load	Loc	shear force (VY) in with dampers	shear force (VY) in without dampers
STORY26	DEAD	Bottom	-48	-48
STORY26	LIVE	Bottom	0	0
STORY26	EQX	Bottom	0	0
STORY26	EQY	Bottom	-744	-744
STORY26	WINDX	Bottom	0	0
STORY26	WINDY	Bottom	0	0
STORY26	FF	Bottom	0	0
STORY26	TH MAX	Bottom	0	0
STORY26	TH MIN	Bottom	-1.09	-0.63
STORY25	DEAD	Bottom	-96	-96
STORY25	LIVE	Bottom	0	0
STORY25	EQX	Bottom	0	0
STORY25	EQY	Bottom	-1488	-1488
STORY25	WINDX	Bottom	0	0
STORY25	WINDY	Bottom	0	0
STORY25	FF	Bottom	0	0
STORY25	TH MAX	Bottom	0	0
STORY25	TH MIN	Bottom	-2.37	-1.33
STORY24	DEAD	Bottom	-144	-144
STORY24	LIVE	Bottom	0	0
STORY24	EQX	Bottom	0	0
STORY24	EQY	Bottom	-2232	-2232
STORY24	WINDX	Bottom	0	0
STORY24	WINDY	Bottom	0	0
STORY24	FF	Bottom	0	0
STORY24	TH MAX	Bottom	0	0
STORY24	TH MIN	Bottom	-3.63	-2.04
STORY23	DEAD	Bottom	-192	-192
STORY23	LIVE	Bottom	0	0
STORY23	EQX	Bottom	0	0
STORY23	EQY	Bottom	-2976	-2976
STORY23	WINDX	Bottom	0	0
STORY23	WINDY	Bottom	0	0
STORY23	FF	Bottom	0	0
STORY23	TH MAX	Bottom	0	0
STORY23	TH MIN	Bottom	-4.87	-2.75
STORY22	DEAD	Bottom	-240	-240
STORY22	LIVE	Bottom	0	0
STORY22	EQX	Bottom	0	0
STORY22	EQY	Bottom	-3720	-3720
STORY22	WINDX	Bottom	0	0
STORY22	WINDY	Bottom	0	0
STORY22	FF	Bottom	0	0
STORY22	TH MAX	Bottom	0	0
STORY22	TH MIN	Bottom	-6.08	-3.46
STORY21	DEAD	Bottom	-288	-288
STORY21	LIVE	Bottom	0	0
STORY21	EQX	Bottom	0	0
STORY21	EQY	Bottom	-4464	-4464
STORY21	WINDX	Bottom	0	0
STORY21	WINDY	Bottom	0	0
STORY21	FF	Bottom	0	0
STORY21	TH MAX	Bottom	0	0
STORY21	TH MIN	Bottom	-7.26	-4.17



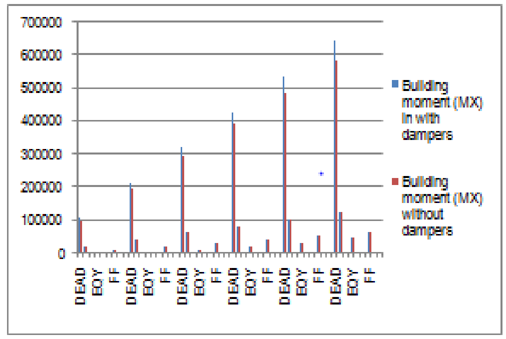
Building Torsion

story	Load	Loc	building Torsion(T) with dampers	Building torsion (T)
STORY26	DEAD	Bottom	-120	-120
STORY26	LIVE	Bottom	0	0
STORY26	EQX	Bottom	14292.6	12343.5
STORY26	EQY	Bottom	-7403.4	-9352.5
STORY26	WINDX	Bottom	0	0
STORY26	WINDY	Bottom	0	0
STORY26	FF	Bottom	0	0
STORY26	TH MAX	Bottom	0	0
STORY26	TH MIN	Bottom	-1.296	-0.668
STORY25	DEAD	Bottom	-240	-240
STORY25	LIVE	Bottom	0	0
STORY25	EQX	Bottom	29030.5	24749.2
STORY25	EQY	Bottom	-14362	-18643
STORY25	WINDX	Bottom	0	0
STORY25	WINDY	Bottom	0	0
STORY25	FF	Bottom	0	0
STORY25	TH MAX	Bottom	0	0
STORY25	TH MIN	Bottom	-3.371	-1.382
STORY24	DEAD	Bottom	-360	-360
STORY24	LIVE	Bottom	0	0
STORY24	EQX	Bottom	43433.9	37000.9
STORY24	EQY	Bottom	-21654	-28087
STORY24	WINDX	Bottom	0	0
STORY24	WINDY	Bottom	0	0
STORY24	FF	Bottom	0	0
STORY24	TH MAX	Bottom	0	0
STORY24	TH MIN	Bottom	-5.813	-2.037
STORY23	DEAD	Bottom	-480	-480
STORY23	LIVE	Bottom	0	0
STORY23	EQX	Bottom	57516.3	49104.8
STORY23	EQY	Bottom	-29268	-37679
STORY23	WINDX	Bottom	0	0
STORY23	WINDY	Bottom	0	0
STORY23	FF	Bottom	0	0
STORY23	TH MAX	Bottom	0	0
STORY23	TH MIN	Bottom	-8.648	-2.622
STORY22	DEAD	Bottom	-600	-600
STORY22	LIVE	Bottom	0	0
STORY22	EQX	Bottom	71291.2	61067.1
STORY22	EQY	Bottom	-37189	-47413
STORY22	WINDX	Bottom	0	0
STORY22	WINDY	Bottom	0	0
STORY22	FF	Bottom	0	0
STORY22	TH MAX	Bottom	0	0
STORY22	TH MIN	Bottom	-11.884	-3.128
STORY21	DEAD	Bottom	-720	-720
STORY21	LIVE	Bottom	0	0
STORY21	EQX	Bottom	84772	72894.1
STORY21	EQY	Bottom	-45404	-57282
STORY21	WINDX	Bottom	0	0
STORY21	WINDY	Bottom	0	0
STORY21	FF	Bottom	0	0
STORY21	TH MAX	Bottom	0	0
STORY21	TH MIN	Bottom	-15.522	-3.546



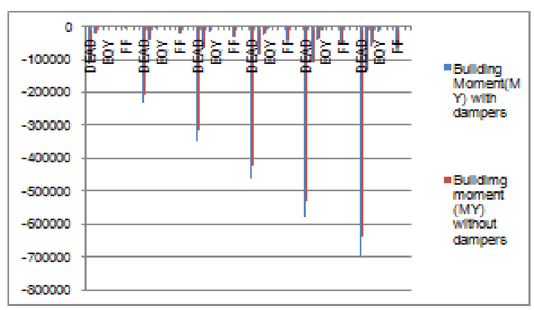
Building moment in X direction

story	Load	Loc	Building moment (MX) in with dampers	Building moment (MX) without dampers
STORY26	DEAD	Bottom	106180	96828.4
STORY26	LIVE	Bottom	20832	20832
STORY26	EQX	Bottom	0	0
STORY26	EQY	Bottom	2232	2232
STORY26	WINDX	Bottom	0	0
STORY26	WINDY	Bottom	0	0
STORY26	FF	Bottom	10416	10416
STORY26	TH MAX	Bottom	3.27	1.894
STORY26	TH MIN	Bottom	0	0
STORY25	DEAD	Bottom	212504	193801
STORY25	LIVE	Bottom	41664	41664
STORY25	EQX	Bottom	0	0
STORY25	EQY	Bottom	6696	6696
STORY25	WINDX	Bottom	0	0
STORY25	WINDY	Bottom	0	0
STORY25	FF	Bottom	20832	20832
STORY25	TH MAX	Bottom	10.391	5.898
STORY25	TH MIN	Bottom	0	0
STORY24	DEAD	Bottom	318972	290917
STORY24	LIVE	Bottom	62496	62496
STORY24	EQX	Bottom	0	0
STORY24	EQY	Bottom	13392	13392
STORY24	WINDX	Bottom	0	0
STORY24	WINDY	Bottom	0	0
STORY24	FF	Bottom	31248	31248
STORY24	TH MAX	Bottom	21.292	12.013
STORY24	TH MIN	Bottom	0	0
STORY23	DEAD	Bottom	425584	388177
STORY23	LIVE	Bottom	83328	83328
STORY23	EQX	Bottom	0	0
STORY23	EQY	Bottom	22320	22320
STORY23	WINDX	Bottom	0	0
STORY23	WINDY	Bottom	0	0
STORY23	FF	Bottom	41664	41664
STORY23	TH MAX	Bottom	35.897	20.248
STORY23	TH MIN	Bottom	0	0
STORY22	DEAD	Bottom	532340	485582
STORY22	LIVE	Bottom	104160	104160
STORY22	EQX	Bottom	0	0
STORY22	EQY	Bottom	33480	33480
STORY22	WINDX	Bottom	0	0
STORY22	WINDY	Bottom	0	0
STORY22	FF	Bottom	52080	52080
STORY22	TH MAX	Bottom	54.134	30.615
STORY22	TH MIN	Bottom	0	0
STORY21	DEAD	Bottom	639240	583130
STORY21	LIVE	Bottom	124992	124992
STORY21	EQX	Bottom	0	0
STORY21	EQY	Bottom	46872	46872
STORY21	WINDX	Bottom	0	0
STORY21	WINDY	Bottom	0	0
STORY21	FF	Bottom	62496	62496
STORY21	TH MAX	Bottom	75.922	43.127
STORY21	TH MIN	Bottom	0	0



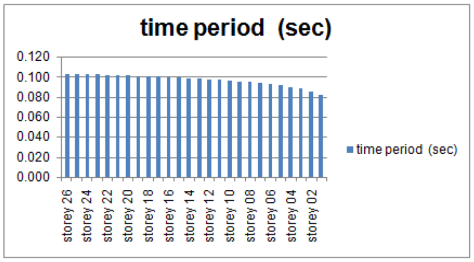
Building moment in Y direction

Story	Load	Loc	Building moment (MY) in with dampers	Building moment (MY) without dampers
STORY26	DEAD	Bottom	106180	96828.4
STORY26	LIVE	Bottom	20832	20832
STORY26	EQX	Bottom	0	0
STORY26	EQY	Bottom	2232	2232
STORY26	WINDX	Bottom	0	0
STORY26	WINDY	Bottom	0	0
STORY26	FF	Bottom	10416	10416
STORY26	TH MAX	Bottom	3.27	1.894
STORY26	TH MIN	Bottom	0	0
STORY25	DEAD	Bottom	212504	193801
STORY25	LIVE	Bottom	41664	41664
STORY25	EQX	Bottom	0	0
STORY25	EQY	Bottom	6696	6696
STORY25	WINDX	Bottom	0	0
STORY25	WINDY	Bottom	0	0
STORY25	FF	Bottom	20832	20832
STORY25	TH MAX	Bottom	10.391	5.898
STORY25	TH MIN	Bottom	0	0
STORY24	DEAD	Bottom	318972	290917
STORY24	LIVE	Bottom	62496	62496
STORY24	EQX	Bottom	0	0
STORY24	EQY	Bottom	13392	13392
STORY24	WINDX	Bottom	0	0
STORY24	WINDY	Bottom	0	0
STORY24	FF	Bottom	31248	31248
STORY24	TH MAX	Bottom	21.292	12.013
STORY24	TH MIN	Bottom	0	0
STORY23	DEAD	Bottom	425584	388177
STORY23	LIVE	Bottom	83328	83328
STORY23	EQX	Bottom	0	0
STORY23	EQY	Bottom	22320	22320
STORY23	WINDX	Bottom	0	0
STORY23	WINDY	Bottom	0	0
STORY23	FF	Bottom	41664	41664
STORY23	TH MAX	Bottom	35.897	20.248
STORY23	TH MIN	Bottom	0	0
STORY22	DEAD	Bottom	532340	485582
STORY22	LIVE	Bottom	104160	104160
STORY22	EQX	Bottom	0	0
STORY22	EQY	Bottom	33480	33480
STORY22	WINDX	Bottom	0	0
STORY22	WINDY	Bottom	0	0
STORY22	FF	Bottom	52080	52080
STORY22	TH MAX	Bottom	54.134	30.615
STORY22	TH MIN	Bottom	0	0
STORY21	DEAD	Bottom	639240	583130
STORY21	LIVE	Bottom	124992	124992
STORY21	EQX	Bottom	0	0
STORY21	EQY	Bottom	46872	46872
STORY21	WINDX	Bottom	0	0
STORY21	WINDY	Bottom	0	0
STORY21	FF	Bottom	62496	62496
STORY21	TH MAX	Bottom	75.922	43.127
STORY21	TH MIN	Bottom	0	0



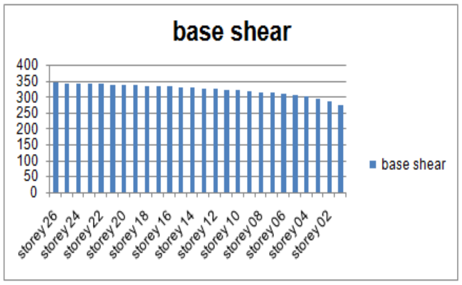
TIME PERIOD

time period		
storey	height of building	time period (sec)
storey 26	78.5	0.104
storey 25	75.5	0.104
storey 24	72.5	0.103
storey 23	69.5	0.103
storey 22	66.5	0.103
storey 21	63.5	0.102
storey 20	60.5	0.102
storey 19	57.5	0.102
storey 18	54.5	0.101
storey 17	51.5	0.101
storey 16	48.5	0.100
storey 15	45.5	0.100
storey 14	42.5	0.099
storey 13	39.5	0.099
storey 12	36.5	0.098
storey 11	33.5	0.098
storey 10	30.5	0.097
storey 09	27.5	0.096
storey 08	24.5	0.095
storey 07	21.5	0.094
storey 06	18.5	0.093
storey 05	15.5	0.092
storey 04	12.5	0.091
storey 03	9.5	0.089
storey 02	6.5	0.086
storey 01	3.5	0.082



BASE SHEAR

storey	ACCELERATION SPECTRUM	BASE SHEAR
storey 26	0.003	346.8806
storey 25	0.003	345.8683
storey 24	0.003	344.8181
storey 23	0.003	343.727
storey 22	0.003	342.5913
storey 21	0.003	341.4073
storey 20	0.003	340.1703
storey 19	0.003	338.8753
storey 18	0.003	337.5161
storey 17	0.003	336.0859
storey 16	0.003	334.5765
storey 15	0.002	332.9781
storey 14	0.002	331.279
storey 13	0.002	329.4652
storey 12	0.002	327.5192
storey 11	0.002	325.4192
storey 10	0.002	323.1374
storey 09	0.002	320.6378
storey 08	0.002	317.872
storey 07	0.002	314.7731
storey 06	0.002	311.2452
storey 05	0.002	307.1423
storey 04	0.002	302.2268
storey 03	0.002	296.0697
storey 02	0.002	287.7619
storey 01	0.002	274.7071



CONCLUSIONS

Upon the results of investigations the following conclusions were made:

- The drift values in the X and Y direction shows higher values of the structure without dampers, the displacement of story with dampers was reduced, it shows that the structure with dampers can be used for high rise buildings in the high seismic zone.
- Lateral displacements due to earthquake forces reduce by providing friction dampers.
- Storey drift also reduces thus shear resistance of the building increases.
- Base shear of the building increases by providing friction dampers.
- The effectiveness of friction dampers in controlling lateral displacements storey drifts due to earthquake force is observed in response spectrum analysis.

- From above results it is clear that by adding friction dampers in a building response of a structure get reduced by significant amount.
- The results of this investigation show that, the response of structure can be dramatically reduced by using friction damper without increasing the stiffness of the structure.
- Friction dampers are unique in combating the wind forces, for its friction material, whereas other dampers are suitable mostly for earthquake forces only.
- The performance of friction damper devices is much better for the tall buildings with slender design.
- From the above tables it is evident that when the story height goes on increasing the Base Shear increases and also when we provide Friction Dampers, the Base Shear increases.

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