PARAMETRIC COMPARATIVE STUDY OF RC BUILDING WITH EXTERNAL DISSIPATION SYSTEM

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Abstract — *The structure which are present in higher earthquake zone area are liable to get damaged or collapsed, hence to increase the safety of these structure few* external dissipation *techniques are done. This paper investigates the response of rc structures under simulated earthquake loads with fluid viscous dampers and consequently, evaluations are made as to how the damping systems affect the seismic response of these structures with respect to deflections and accelerations. This paper concentrates on the effects of damper's locations within the rc multistory building having geometric irregularity. The time history analysis is performed for dissipation system incorporated in building. The seismic event of BHUJ and ELCENTRO are taken in the analysis, which we can considered as extreme seismic event in INDIA. The main aim of the study is to compare the results of damper at different locations such as at corner, at middle in the reinforced concrete (RC) building*

***IndexTerms* – Geometric irregularity, fluid Viscous Damper, Time history analysis, ELCENTRO AND BHUJ earthquake ETABS 2016**

1) INTRODUCTION

In recent times considerable attention is to research and development of structural control devices of wind and seismic response of building. Many vibration-control measures like active, semi-active, passive and hybrid vibration control methods have been developed in earthquake. Passive dissipation systems utilize a wide range of materials and technologies as a means to enhance the stiffness,strength and damping characteristics of structures. External Dissipation may be achieved either by the conversion of kinetic energy to heat or by the transferring of energy among vibrations. The first mechanism incorporates both hysteretic devices that external dissipate energy with no significant rate dependence, and **fluid *Viscous Damper*** devices that exhibit considerable rate dependence. Hysteretic devices operate on principles such as yielding of metals and frictional sliding and **fluid *Viscous Damper*** devices operate on deformation of **fluid *Viscous Damper***. A third classification consists of re-centering devices that utilize either a preload generating by fluid pressure, or a phase transformation to produce a modify force-displacement response that includes a natural re-centering component. **fluid *Viscous Damper*** construction varies considerably from the **fluid *Viscous Damper*** counterpartsand mathematical models suitable for force-displacement response have a similar form. The devices are both frequency and temperature dependent, and in some cases amplitude dependence is also evident. The viscous dampers are passive energy dissipater device which is added to structure to increase the effective stiffness of new and existing buildings. They are very robust material and energy is transferred by piston and absorbed or vanishes by silicone-based fluid flowing between the piston-cylinder arrangement .the damping force of viscous damper is given by

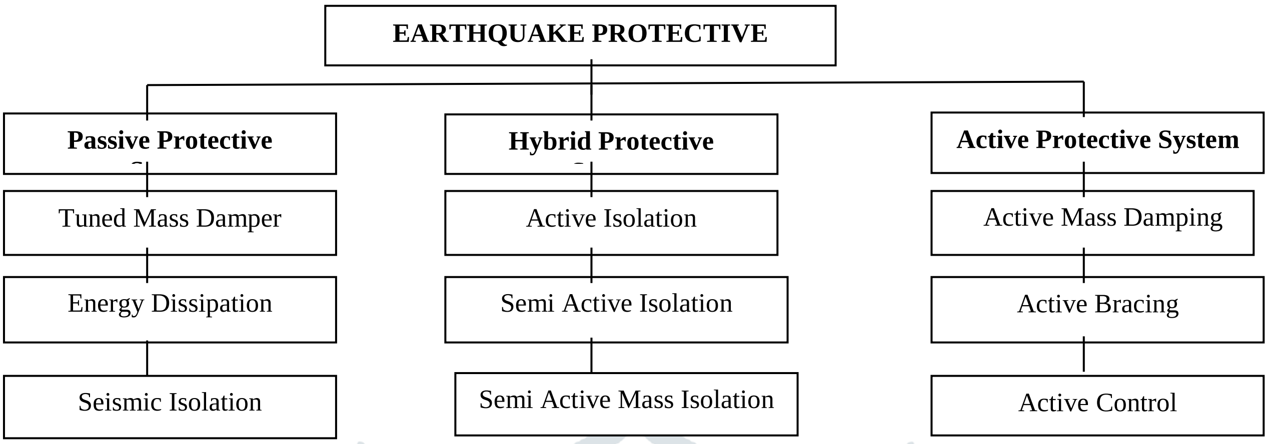
$$F = c \times v^{\alpha}$$

where, F– the damping force.
C - the damping coefficient.
V - velocity of piston.
A – velocity exponent.

1.1) SUPPLEMENTAL DAMPING SYSTEM

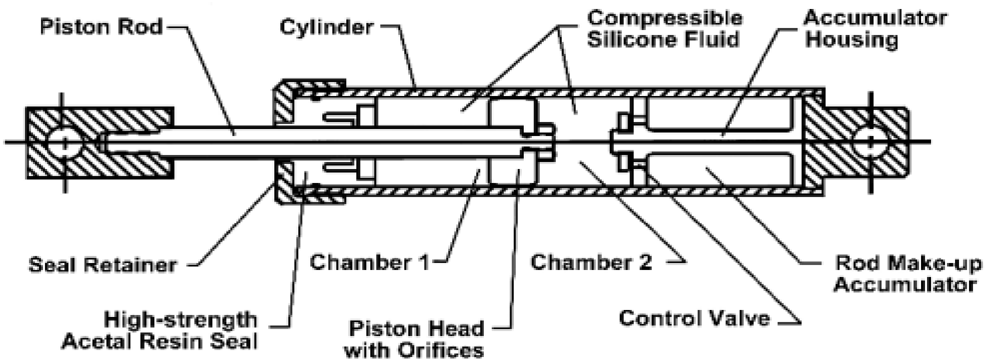
The Concept Of Improving Performance of Structure During Earthquake Was Introduced More Than Century Ago. But It Has Only 25 Years That Earthquake Protective System Are Designed And Implemented In Structure. In Recent Years, Considerable Attention Has Been Paid To Research And Development Of Structural Control Devices, With Particular Emphasis On Alleviation

Of Wind And Seismic Response Of Building And Bridges. These Devices Can Further Be Optimized In Mechanism, Cost, Durability, Effectiveness And Maintenance. Earthquake Protective Systems Are Generally Grouped As Per Buckle, 2000



1.2) **VISCOUS FLUID DAMPER**

Figures shows a longitudinal cross section of fluid viscous damper. It contains of stainless steel piston, with a bronze orifice head, and a self-contained piston displacement accumulator. The piston is driven by including velocity due to external loading. As piston moves, viscous fluid is passed through small orifice on piston head. Thus shear stress is developed among the inter particles of fluid which results in friction. energy is dissipated through friction which raises the temperature of fluid. So inert and moderate fluid is preferred which has high flashing point and is susceptible to drastic temperature change.



The main features of viscous dampers are presented:

(i) High damping coefficients;
(ii) The lifetime of the viscous dampers is on average higher than the lifetime of the building where they are installed (Taylor, Devices);
(iii) No need to high maintenance (Alga);
(iv) The dampers are extremely versatile for any application, without compromising the building's architecture.
(v) These devices allow a reduction of the stresses and deformation of a structure, reducing the damages in the structural and non-structural elements during seismic action (Taylor, et al.). Experience shows that this dissipation system can decrease about 50% of the accelerations and displacements between floors (Constantinou, 1992) (Hussain, et al.).

1.3) OBJECTIVE:

(i) To compare the seismic response of RC regular and irregular building with and without damper.
(ii) To compare the parameters such as storey displacement,storey drift, base shear and storey acceleration of both irregular and regular buildings.

(iii) To study the method of viscous damper regular and irregular RC building

1.4) SCOPE OF WORK:

Case 1 : Regular Building
Analysis Of Regular Building Without Damper In ETABS 2016
Case 2 : Irregular Building
Analysis Of Irregular Building Without Damper In ETABS 2016
Case 3 : Analysis Of Regular And Irregular Building With Damper In Different Position In ETABS 2016

2) REGULAR AND IRREGULAR STRUCTURES

According to the Indian standard, the structure is structurally specified in regular or irregular form. In a regular structure there is no significant imbalance in planning, vertical configurations, or lateral force resistance systems. In irregular structure, according to IS-1893 (Part 1) 2016 has such important constraints like plan irregularities and vertical irregularities. To perform well in the earthquake, there are few main features in a building, i.e simple and regular configuration, and sufficient lateral strength, stiffness and ductility.The failure of the structure mainly depends on the discontinuity in the mass of the structure, stiffness and geometry of the building. Mostly due to geometric irregularity structure possesses failure. To overcome this failure to use passive dissipation system in the building which decouples the superstructure from substructure by which the structure resist the lateral force and gain adequate stability.

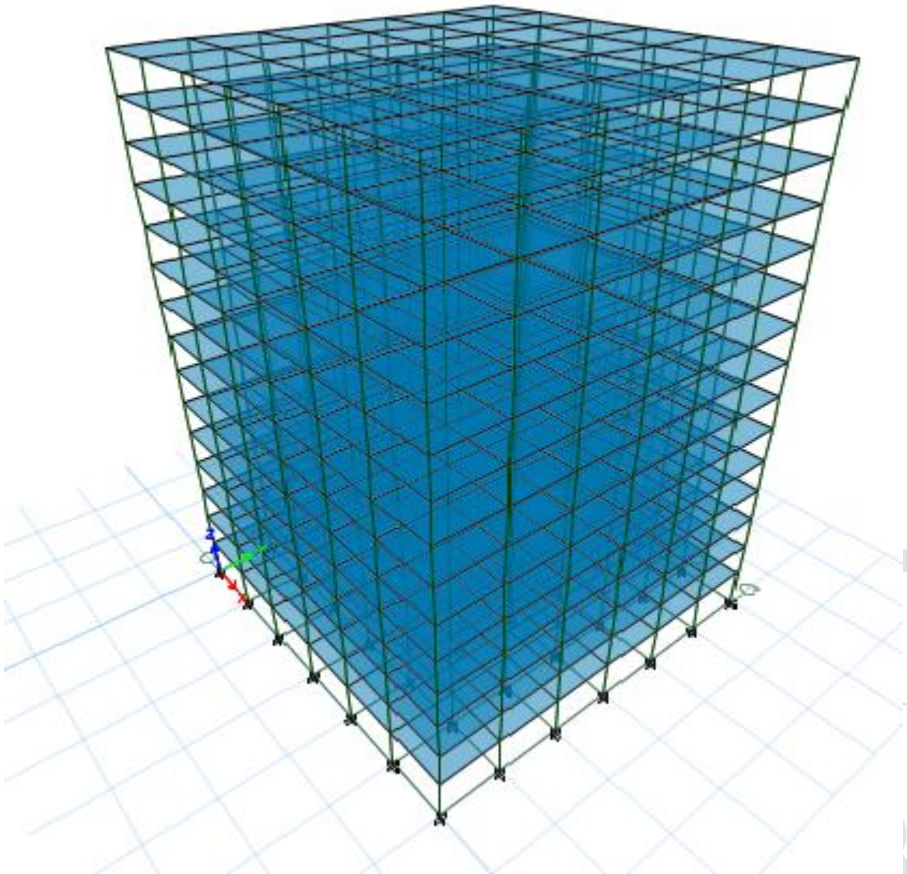
2.1) STRUCTURAL PROPERTIES AND MODELING

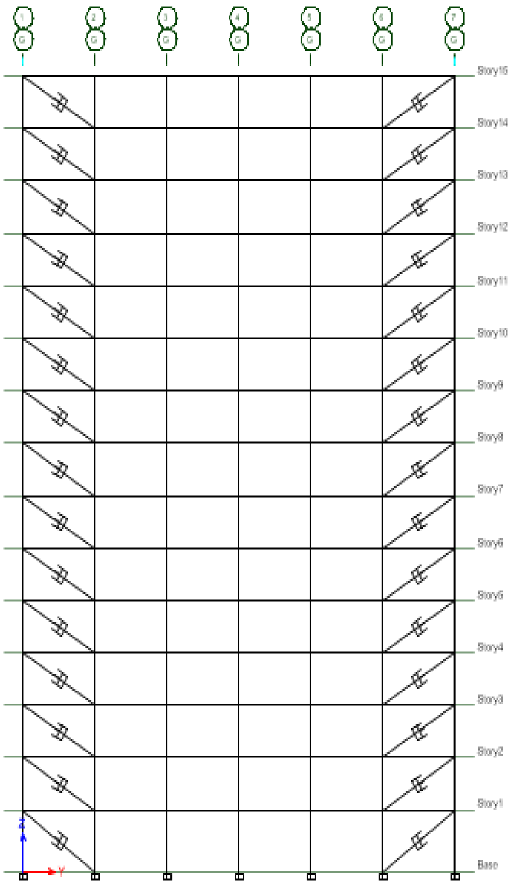
A G+14 multi storey building with the plan dimensions of 30m x 30m have been adapted in the present work with 6 bays in both longitudinal and transverse directions respectively. The storey height of building up to 1st storey is 3m and above all storey is 3.5m. Table 1 Detail of the Building

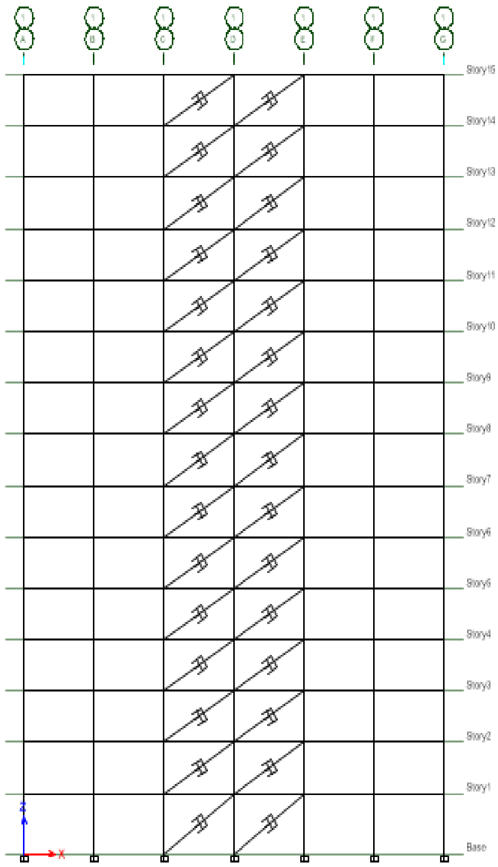
Building Parameters	**Details**
Beam	600mm x 600mm
Column	550mm x 550mm
Slab	200mm
Grade of Steel(fy)	Fe 415
Grade of concrete (fck)	M-30
Live load	4 kN/m2
Floor finish	2 kN/m2
Soil type	II
Zone	V

There are 4 models is taken in the analysis :

1) Building with Fixed base
2) Building with fluid Viscous Damper at middle
3) Building with fluid Viscous Damper at corner




Story15
Story14
Story13
Story12
Story11
Story10
Story9
Story8
Story7
Story6
Story5
Story4
Story3
Story2
Story1
Base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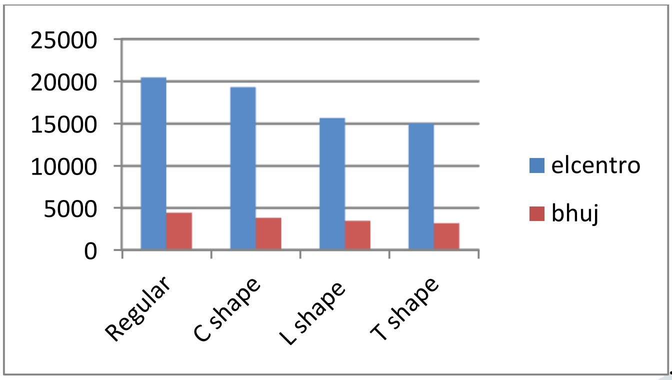
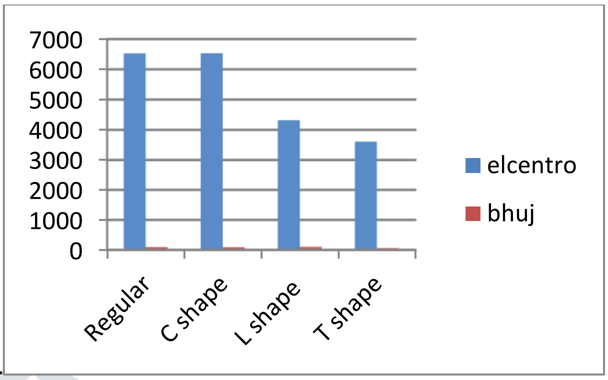
Story3
Story2
Story1
Base

3) RESULTS AND CONCLUSION:

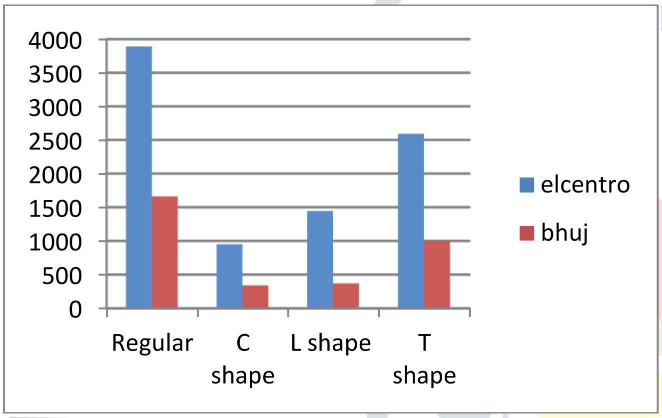
All figures show the response of the building such as (Time period, Base shear, Story drift, Story displacement) incorporated with the damper at different locations such as at corner, at middle and in whole building, under the seismic excitation of BHUJ



Base shear without damper in KN



Base shear with damper at middle in KN



Base shear with damper at corners in KN

STOREY DRIFT WITHOUT DAMPER(m)				
	ELCENTRO		BHUJ	
	EQ X	EQ Y	EQ X	EQ Y
REGULAR	0.0115	0.0115	0.0051	0.0051
C SHAPE	0.0122	0.0118	0.0051	0.0049
L SHAPE	0.014	0.0143	0.005	0.005
T SHAPE	0.0098	0.0099	0.0045	0.0045

STOREY DRIFT WITHDAMPER AT MIDDLE (m)				
	ELCENTRO		BHUJ	
	EQ X	EQ Y	EQ X	EQ Y
REGULAR	0.0014	0.0014	0.0001	0.00012
C SHAPE	0.0015	0.002	0.0001	0.0001
L SHAPE	0.0013	0.0013	0.0001	0.0001
T SHAPE	0.0011	0.001	0.0001	0.0001

STOREY DRIFT WITHDAMPER AT CORNER (m)				
	ELCENTRO		BHUJ	
	EQ X	EQ Y	EQ X	EQ Y
REGULAR	0.0016	0.0015	0.001	0.0014
C SHAPE	0.0015	0.0013	0.0017	0.0014
L SHAPE	0.0021	0.002	0.0022	0.0021
T SHAPE	0.0014	0.0013	0.001	0.0011

STOREY ACCELERATION WITHOUT DAMPER(m/s^2)				
	ELCENTRO		BHUJ	
	EQ X	EQ Y	EQ X	EQ Y
REGULAR	3.697	3.697	1.897	1.897
C SHAPE	4.019	4.252	2.073	2.096
LSHAPE	4.197	4.2	2.198	2.071
T SHAPE	5.61	5.55	3.192	3.17

STOREY ACCELERATION WITH DAMPER AT CORNER(m/s^2)				
	ELCENTRO		BHUJ	
	EQ X	EQ Y	EQ X	EQ Y
REGULAR	6.368	5.851	0.721	0.6139
C SHAPE	6.57	5.96	0.6758	0.66
LSHAPE	4.82	4.815	0.61	0.589
T SHAPE	7.38	5.87	0.7321	0.715

STOREY ACCELERATION WITH DAMPER AT MIDDLE(m/s^2)				
	ELCENTRO		BHUJ	
	EQ X	EQ Y	EQ X	EQ Y
REGULAR	7.422	7.475	0.94	0.94
C SHAPE	9.752	10.278	0.173	0.228
LSHAPE	8.105	8.224	0.224	0.228
T SHAPE	10.704	9.998	0.224	0.123

Conclusions :

- In asymmetric building C shape building give good performance related to ,storey drift and accelerationand base shear than L and T shape building.
- Under all earthquake excitations, for all the structures considered in this study, damper located at ground or within the structure gives good reduction in response quantities.
- The damper at corner gave satisfactory result. It can provide good rigidity to the structure in case of story acceleration and drift
- FVD250 reducing the *Base Shear* of the structures by 70% in Time history analysis.

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