SEISMIC ANALYSIS OF MULTI-STOREY BUILDING WITH DAMPING USING ETABS

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Abstract—Seismic energy dissipating devices (active and passive) are being used for various types of structures to mitigate the seismic response of structure. The main objective is to evaluate the effectiveness of passive dampers in the multi-storey building above basement. Among different types of dampers, fluid viscous dampers (FVD) are used for this study. For the better understanding of the effectiveness of passive dampers, stiff foundation system is considered thus soil-structure interaction is omitted. Proposed method is to study the seismic response of square high rise reinforced concrete building underground motions. Modelling and analysis of the structures and installation of the dampers are done by using finite element modelling software (ETABS). Time history analysis was performed to the structures without added damper and structures with added damper at different locations such as corner, centre and opposite centre positions and displacement evaluated. Optimum locations of the passive dampers were also revealed in this study.

Keywords—multi-storey building, ETABS, Time history analysis, FVD dampers.

I. INTRODUCTION

Thefundamentalgoalsofanystructuraldesignaresafety,serviceabilityandeconomy. To Achieve these aims of designing in seismic region is especially plays an important role.Earthquake were unpredictable to find when, and where it will strike a community increases the difficulty.

Earthquake causes a major collapse of structures especially tall building structures due to high displacement between stories. One of the solutions for the reduction of structural response by increasing the dissipationof input energy due to earthquake. Iif the amount of energy getting into the structure can be controlled by the damper and a major portion of the energy can be dissipated mechanically independently of primary structure, the seismic response of the structure and damage control potential can be considerably mitigate. These can be delivered by implements very popular techniques of base isolation and energy dissipation devices in the structural system. That's because damper devices are the very popular instruments for in creasing the input seismic energy dissipation of the structure .

II. ENERGY DISSIPATING DEVICES (Dampers)

Now a day's energy dissipation technology has modified usual seismic design. These are greatly improving the seismic performance of the structures and reducing structural seismic responses. These energy absorbing devices are available in two ways such as active or passive in nature.Activecontrolsdonotfoundmuchapplicationduetoitshighcostandlargeinstrumentationsetup.Thissystemrequiresapowersupplytooperatehenceundependable if the power supply disrupted during seismic events

On the other hand, passive control systems for example, base isolation, dampers,bracing systems etc,are found to be easy to install and cost effective as compared to first one. Among different types of passive dampers, metallic dampers, viscous dampers,visco-elastic dampers, and friction dampers are common in use. These devices were incorporated as special devices throughout a structure to mitigate the seismic induced energy. Use of passive dampers is now a day becoming cost effective solution for improve seismic performance of existing as well as new buildings. They reduce the seismic responses on the critical members of a structure.

2.1 Fluid Viscous Damper

In this study I am going to use fluid viscous damper FVD because of easier of installation of dampers, adaption and coordinating with other members also available in different sizes, viscous dampers have many applications in designing and retrofitting. Seismic energy dissipated using viscous fluid inside a cylinder.

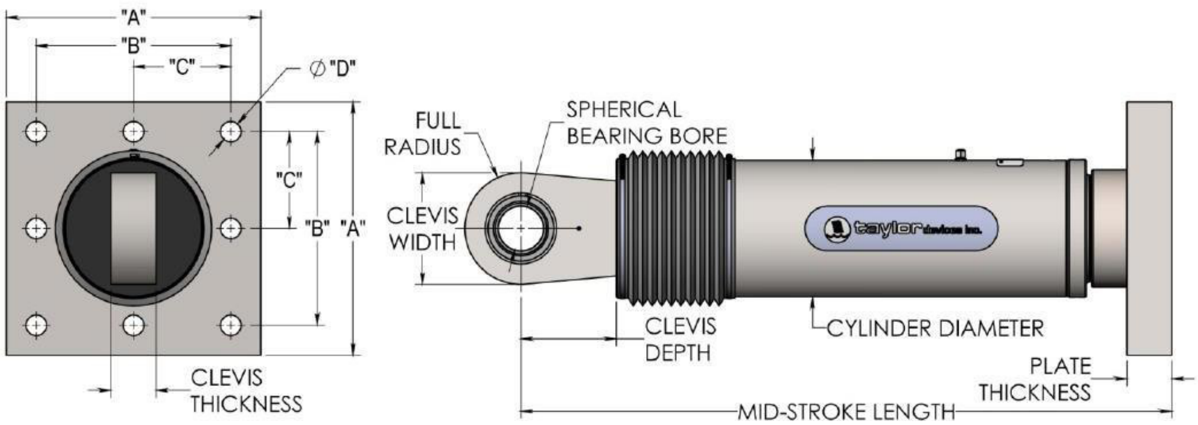

Figure1: Fluid viscous dampers & lock-up devices clevis – baseplateconfiguration.

III. DESCRIPTION OF MEMBER USED

The G+40 storey building with M25 concrete and Fe 415 steel are used for analysis purpose with following description

SquareColumns	600mm*600mm
Beams	300mm*600mm
Panel area	6m*6m=36m^2
Thickness of slab	125mm
Floor height	3m
Type of building	commercial
Seismic zone	IV
Zone factor z	0.24
Importance factor I	1
Response reduction factor R	5

IV. MODELLING OF BUILDING

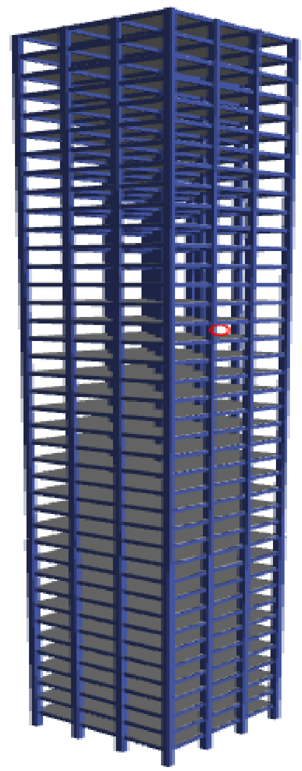

Figure 2: Elevation of building

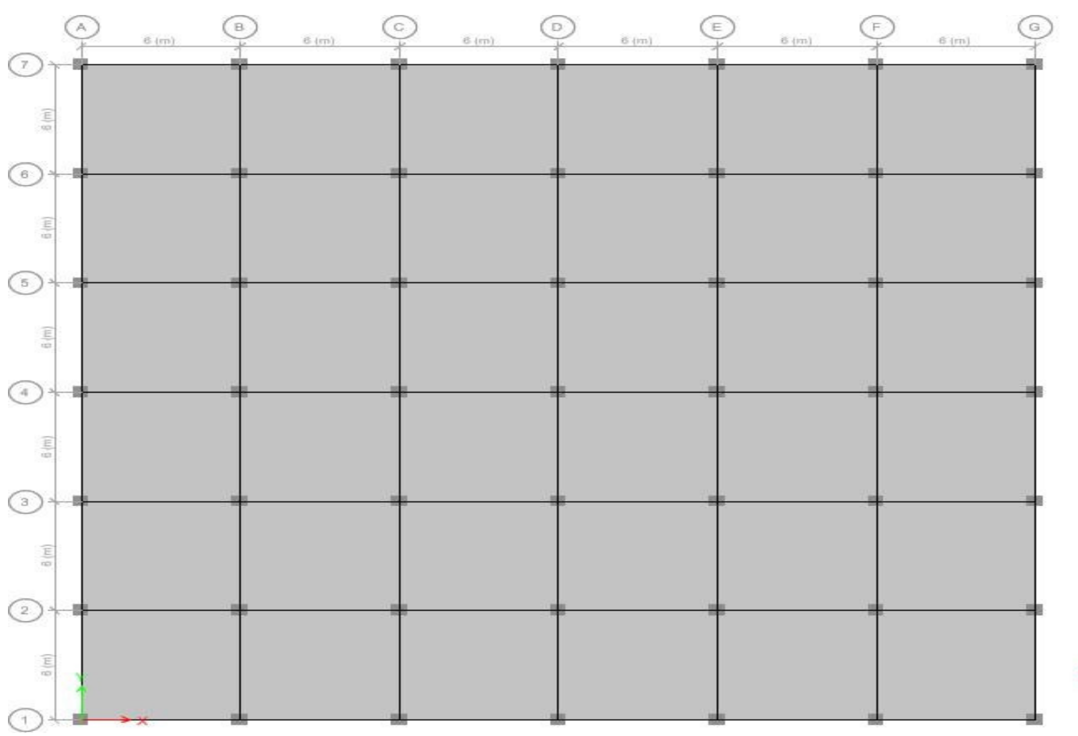

Figure3: Plan view of building

V. MODELLING OF DAMPER

FVDisaddedtostructureafterdefininginLinkpropertiesbyaddinganewDamper-ExponentialinLinkPropertyData.

ETABS MENU –To Define- Link Properties-have to Add new Link-enter Link PropertyData.

Damper were added in three ways

1) Adding dampers atMiddleofExterior Frame (4 sides)
2) Adding dampersat Exterior Corners.
3) Adding dampers at opposite Middle ofExteriorFrame(2 sides)

VI. INPUT OF TIME HISTORY FUNCTION (EARTHQUAKE DATA)

1940 Imperial Valley (El Centro) elcentro EW component with the PGA of 0.214 gwas considered for this study. This earthquake Function is available in earthquake record station HistoryofELCENTRO istakenwithstepsize of0.02seconds and8points per line.

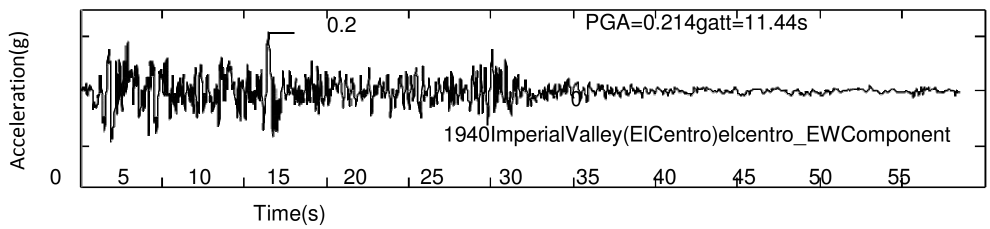

Figure4:GroundmotionaccelerationversustimewithPGA

VII. LOAD CASES

To appl the loads to the structure which is modeled we have to consider only the external loads which acting on the members neglecting its self-weight because ETABS will calculate the self weightautomaticallytakesthe membersself-weight.

Slab load of 3.125 kN/m^{2}is considered for the analysis and The Frame loadsapplieduniformlyonthebeamsasDead=5.25kN/m.IS875(Part1)[28].Liveloadof3.5kN/m^{2}is providedinaccordanceto IS 875 (Part2).

To apply the seismic weight, with the total dead load ,fifty percent of live load is considered as perTable 8 ofIS 1893 (Part1): 2002. For calculation of seismic weight, roof live load is not taken.

Name	Type
Dead	LinearStatic
Live	LinearStatic
EQ-x	LinearStatic
EQ-y	LinearStatic
wind-x	LinearStatic
wind-y	LinearStatic
Thx	NonlinearModalHistory (FNA)
Thy	NonlinearModalHistory (FNA)

Table1:Load cases

VIII. TIME HISTORY ANALYSIS

A time dependent function earthquake accelerogram is applied and the correspondingresponse–history of the structure at the time of earthquake is calculated. Due to the number of freedom of the structures it's very difficult to performing time history function manually.Computer programs have been generated for both linear and non-linear response of the structures by step-by-step integration procedures.

8.1 Fast Nonlinear Analysis (FNA)

Fast Nonlinear Analysis(FNA) is a modal analysis method usefulfor the staticordynamicevaluationoflinearornonlinearstructuralsystems.Becauseofitscomputationally efficient formulation, FNA is well-suited for time-history analysis andoftenrecommendedoverdirect-integrationapplications.

IX. RESULTS AND DISCUSSIONS

. The storey displacements were found by performing Time history analysis using Etabs from the results the comparison curve was plot for the building without damper (normal) to the building with damper at exterior corner (corner), building with damper at exterior center all sides (center) and the building with damper at exterior opposite sides (asymmetric).

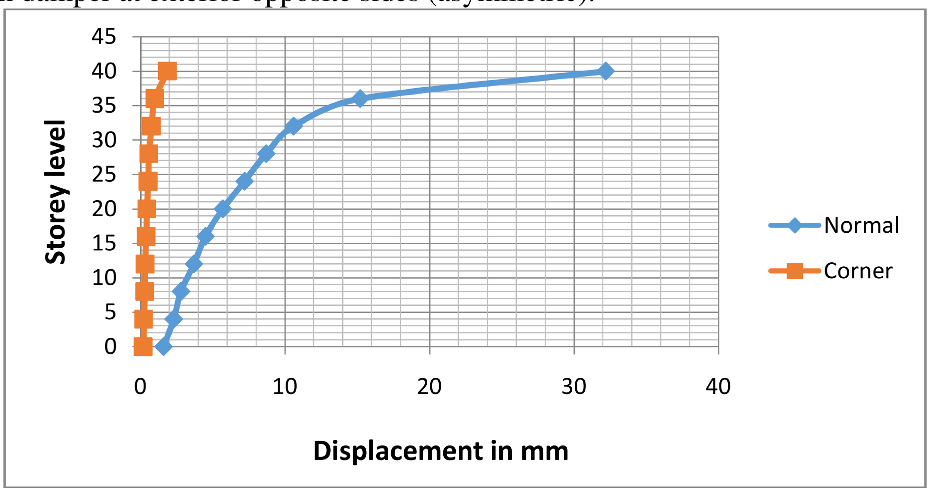

Figure5:Comparison of Storey displacement for normal building vs building with damper at corner

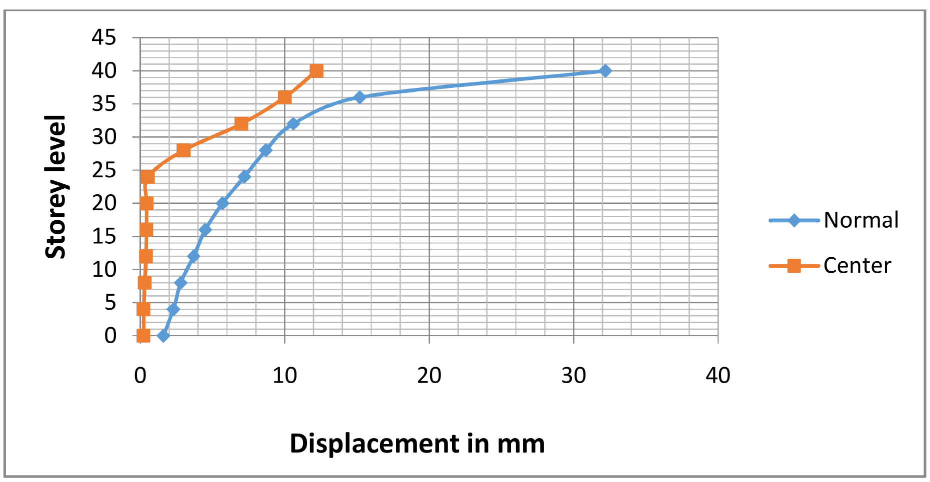

Figure6:Comparison of Storey displacement for normal building vs building with damper at center

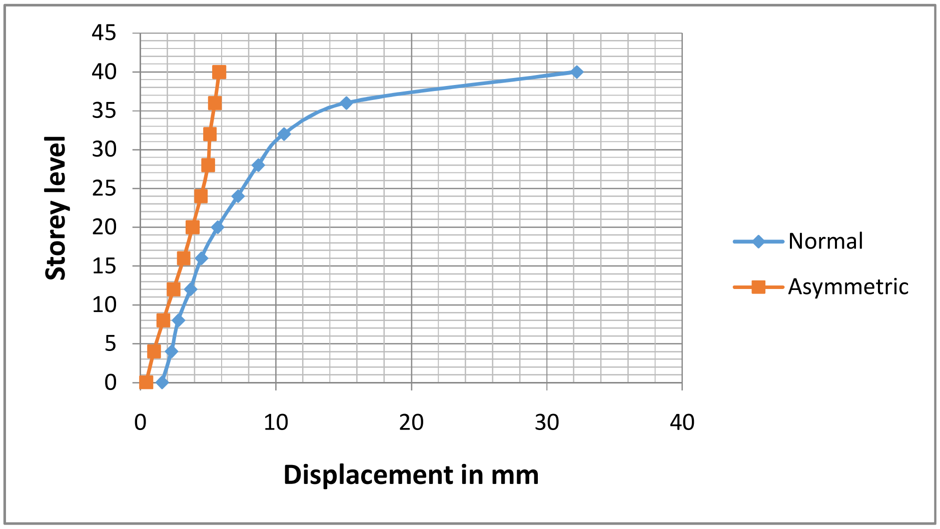

Figure7: Comparison of Storey displacement for normal building vs building with damper at opposite center

X. CONCLUSION

Basedontheresultsanddiscussionfollowingconclusionsare drawn.

- WhencomparedtothebuildingwithoutprovidingFVDThetopstorey Displacementsareminimizedby up to 90% when using ofdamper in buildings.
- From the results the building with damper provided at corner shows the minimum displacement while compare with other damper configuration.
- In evaluating the seismic performance of structures the prediction of damage in structures is efficient while performing nonlinear Time history analysis.

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