Seismic Response Control of High Rise Building by using Viscous Damper

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ABSTRACT

Seismic response control by using dampers is most cost effective, satisfied the architectural requirement of opening and recent technique to control the vibrations of structures arising due to dynamic loading. The energy induced by earthquake will be absorbed by these devices and the load acted on the main structure of the building will reduce significantly. This study investigates the influence of mechanical control on structural systems through strategically applying reliable dampers that can modulate the response of building.

In present study, the 3 bay 14-Storied frame structure is compared with the seismic effect of fixed base structure with respect to viscous damper structure. The 14-Storied frame structure is designed with viscous damper by using ETAB software which gave efficient result for RCC frame structure over the fixed base structure. This present study demonstrates how a damper system can be efficient, evaluating its effectiveness for the building in terms of, Time period, storey drift and storey displacement reductions. The storey drift calculated is compared with the minimum requirement of storey drift as per IS 1893:2000. Result shows that viscous damper was effective on the overall seismic response of structure.

Keyword - *fixed base ,viscous damper, ETAB 9.7*

1. INTRODUCTION

For last few decades increasing high rise building day by day.the wind load and earthquake load will increase significantly as the height of building increasing, and the dynamic response will increase faster. Conventionally, the design approach taken to control the dynamic response is to increase the stiffness and strength of the lateral resisting structure, that is, more rigid structural system, larger member size and stronger material are used.The damages which have occurred during earthquake events clearly demonstrate that the shape of a building is crucial to how they respond. Building respond to earthquake ground shaking in different ways. When the forces on a building Or the displacement of the building exceeds certain limits, damage increased in different forms and to different extends. many structural engineers use the conventional approach to protect buildings from the destructive forces of earthquakes by increasing the strength of the building so that they do not collapse during earthquake. In order to achieve satisfactory earthquake response of a structure, as being practical and efficient. There are various seismic methods available such as fixed base, base isolation, energy absorption at plastic hinges and use of mechanical devices to provide structural control.

Viscous dampers are highly used in seismic retrofitting due to ease of installation, compatibility with other members, various sizes, high water absorption, and lack of deformation in structure. Viscous dampers can be used in seismic retrofitting of reinforced concrete frames which are vulnerable against earthquake as well as in enhancing their seismic performance. The concept of supplemental dampers added to a structure assumes that much of the energy input to the structure from a transient will be absorbed, not by the structure itself, but rather by supplemental damping elements. An idealized damper would be of a form such that the force being produced by the damper is of such a magnitude and function that the damper forces do not increase overall stress in the structure. Properly implemented, an ideal damper should be able to simultaneously reduce both stress and deflection in the structure.

The Present paper intend to investigate the seismic behavior of reinforced concrete frames with viscous dampers under earthquake effects. Damper was found to be effective technique to reduced displacement, story drift, forces and time period of structure during earthquake ground motion.

1. MODELING PROCEDURE IN SOFTWARE

The modeling procedure of provided dampers systemin walls and fixed building analyze in ETAB software and design steps of dampers and fixed base analysis using seismic design procedure has been done using IS 1893:2000(part 1)for the following data was used.

Common data consideration for FB & Viscous Damper

Number of story-G+14

Typical story height-3m

Bottom story height-3m

Parapet height -1.2m

Elements consider:

column size:500x500mm

beam size:230x700mm

slab :Two way slab with grade of concrete M25 and thickness 125mm.

concrete grade:M25 for columns and beams.

Steel grade: for bending-500 N/mm^2, For shear-415 N/mm^2

LOAD CONSIDERATION:

Live load-2.0 KN/m^2

Floor finish -1.5 KN/m^2

Wall load= 3.7KN/m

Earthquake static values:

Seismic zone factor- II

Consider ,Z=0.16 City Mumbai

Soil type-II (Medium soil)

Importance factor-1.0

Response Reduction -5.0

Total height of structure-42m.

Wind coefficient ;Vb = 44m/s

The RC building was analyzed by using fixed base systemand second damper system Total 42 dampers are placed just on the surrounding axis of the 3 bay 14 storey structure

The parameter selected to define isolators beam in the program are as follows :

size of isobeam	: 230x500 mm
Nonlinear type	:dampers,
U1 nonlinear stiffness	: 210000 kN/m,
U1 Nonlinear damping	:7000kN.sec/m,
U1 nonlinear damping exponent	:1.

This paper describes Damper technique and presents nonlinear dynamic analytical results of a residential building with this techniques adopted.

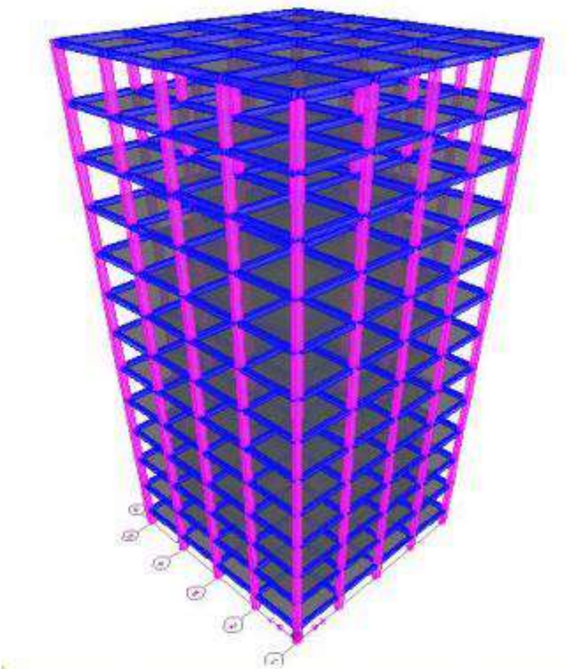

Fig.1.shows the perspective view of the building by using ETAB Software

2. RESULT AND DISSCUSSION

2.1 Point Displacement

The Graph shows the maximum lateral displacements of models of fixed base and viscous damper building at Top story for load case EQX, and EQY respectively. Considering Above all cases it was concluded that maximum displacement is found in case of fixed base and less in dampers.

At all external and internal column points displacement was found to be less. Point displacement only checked at top story.

Maximum point displacement in x-direction for a load case(EQX)

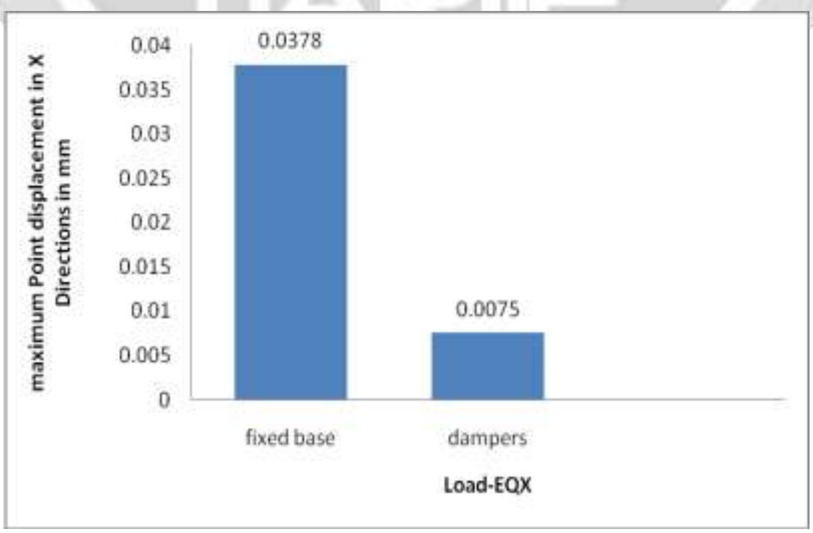

Fig.2 Maximum point displacement in x-direction

Maximum point displacement in y-direction for load case(EQY)

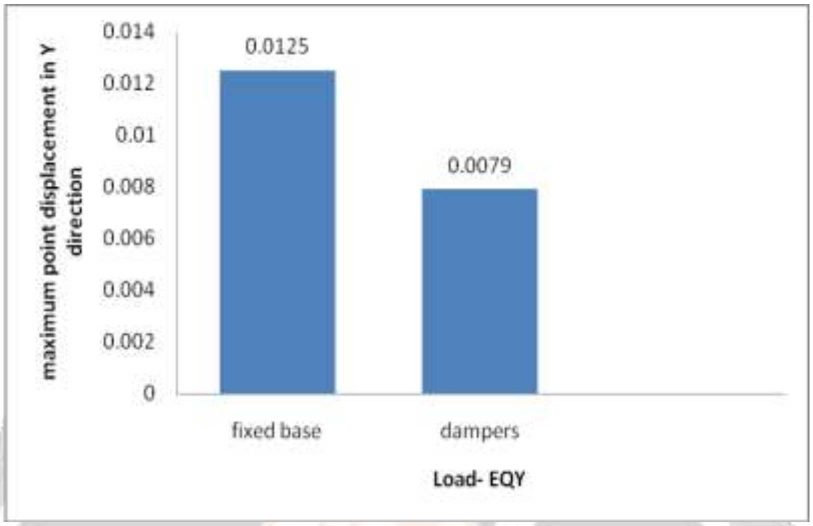

Fig no .3 Maximum point displacement in y-direction

2.2 SHEAR FORCE

The maximum shear force in fixed base and damper model are as shown in fig..Maximum Shear Force was found to be more at internal column no. 6 and external column no.14 and 12. it is observed that The maximum Shear force was found at fixed base model as compared to damper model.

Maximum shear force at internal column

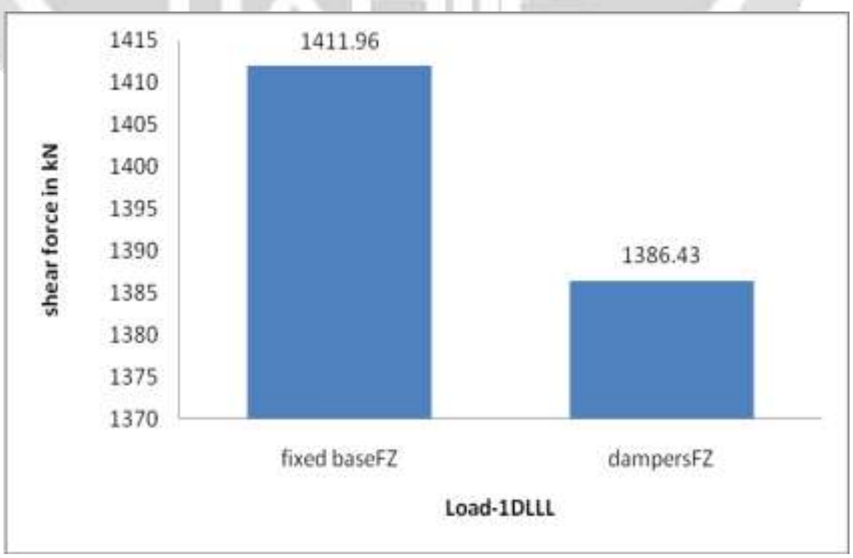

Fig no. 4.Maximum shear force at internal column.

Maximum shear force at external column

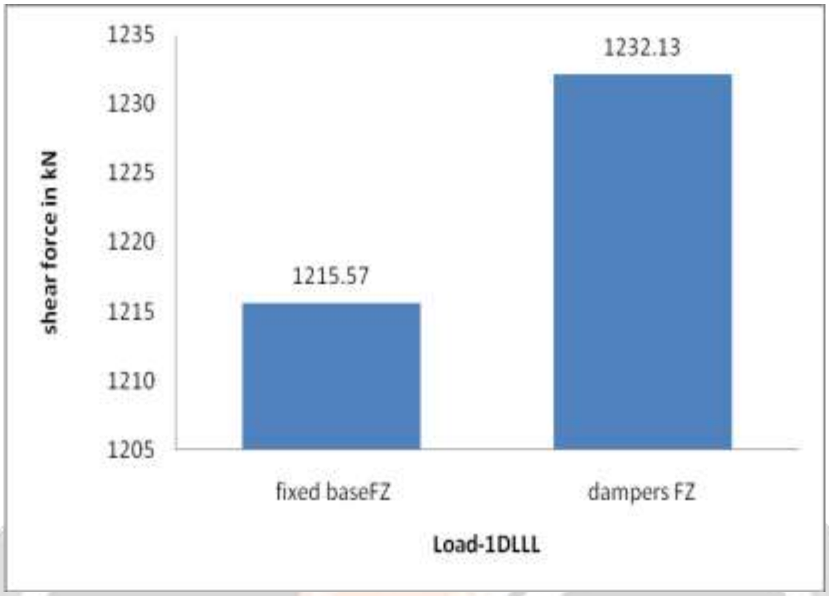

Fig No.5 Maximum shear force at external column

2.3 STORY DRIFTS

The floor level Vs storey drifts graph models of fixed base and viscous building are as shown in Figure, in X and Y Direction for load case EQX and EQY .from Graph it is observed that in viscous damper building storey drifts are significantly reduced in comparison with the corresponding fixed base models. Story drift has to be checked for every story since the drift at intermediate storey are more as compared to top storey.

Maximum Storey drift X for a load case EQX and Maximum Storey drift Y for load EQY In X, Y Directions respectively.

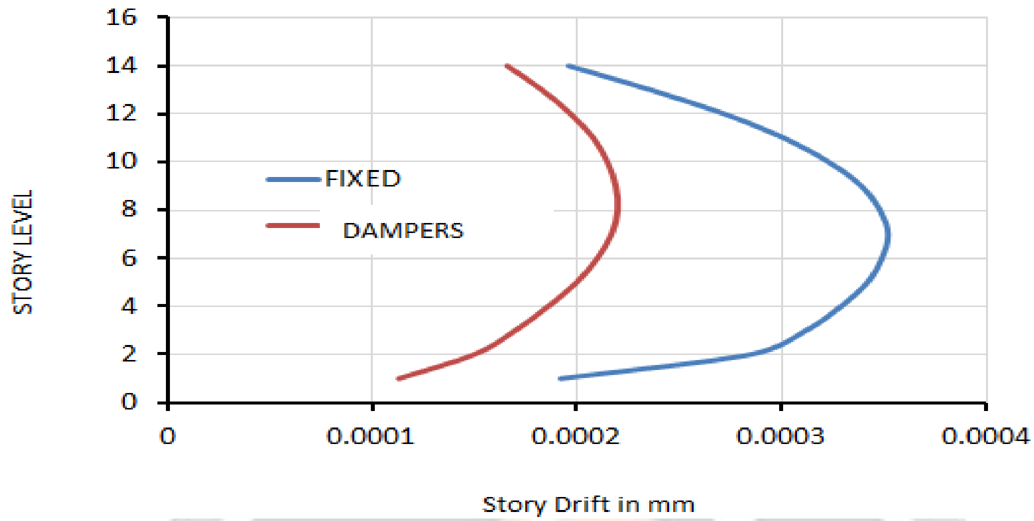

Fig no 6. Story Drift in FB and Damper Building

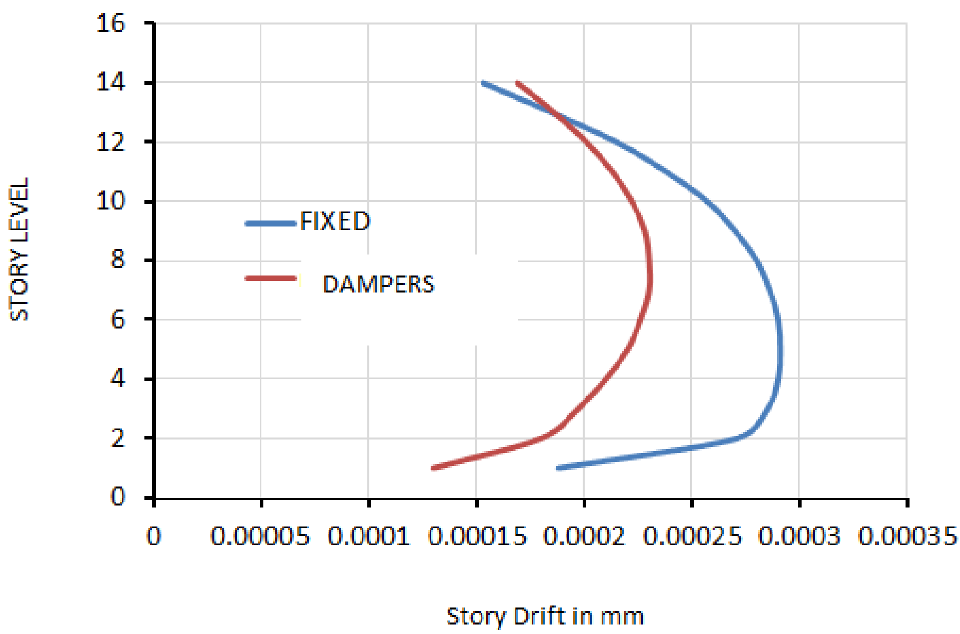

Fig no.7 Story Drift in FB and Damper Building

3 .CONCLUSIONS

1. The (G+14) stories frame structure is design with damper by using the ETABS software which having efficient result for frame structure over the fixed base structure than any other isolation system.
2. From analytical results, it is observed that viscous damper technique is very significant in order to reduce the seismic response of RC Structure as compared to fixed base building and control the damages in structure during strong ground shaking.

3. It is observed that in fixed base building the lateral point displacement are observed more as compared to damper building in both x and Y Directions.
4. In damper systembase reaction was found to be minimum for both external and internal column. Whereas in case of fixed base reaction was found more.
5. .At base more storey drift was observed for damper building as compared to model of fixed base building. As storey height increases, the storey drifts in Viscous damper building model drastically decreases as compared to model of fixed base building.

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