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Seismic Vibration Control of Multistoried Building with Viscous Dampers and Shear Wall using ETABS Software

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ABSTRACT: The present work aimed at the study of seismic performance of a multistoried conventional building with shear wall, building with viscous damper and building with viscous damper and shear wall in it. Response Spectrum Analysis has been carried out on all three models. All the modeling and analysis has been done using ETABS 2017 Software package by following all the standard procedure. After analyzing all the models, the results of parameters like Storey Displacement, Storey drift and Storey shear are compared. From the outcome of the analysis, it can be said that, by using friction damper and shear wall the building performance is well under seismic activities.

KEYWORDS: Viscous damper, Response Spectrum Analysis, Lateral Displacement, Storey Drift, Storey Shear.

I. INTRODUCTION

Due to modernization, there is a simultaneous increase in construction of multistoried buildings day by day, the wind load and loads due to earthquake will be increased significantly as the total height of the building frame increases, and the dynamic response will also be increased at a faster rate. Viscous damper is a type of damper, which is highly used in controlling the damages due to seismic forces and seismic retrofitting process because of nominal cost and easy installation process and is compatible with other members of the structures such as RCC members, steel members and composite members and also available in various length and sizes and has high water absorption, controlled deformation and displacement in the building structure. The project tends to investigate the seismic behaviour of reinforced concrete frames, along with shear walls and viscous damper system under earthquake conditions. Damper is one of the components which were found to be most effective technique to reduce storey displacement, storey drift and shear forces of frame structure during ground motion due to earthquake.

II. RELATED WORK

Qureshi Taqweem.S., Dr. Hashmi.A.K (2021), this research paper states that the importance and capacity of the fluid viscous dampers in the multistoried building which is used for vibration control. The use of viscous damper reduces the storey drift, storey shear, axial force and overturning moment etc. in the structure.

Mr. Muralidhara G B, Mr. Naranagowda, Mrs. Swathi Rani K S (2015), to minimize the excess vibration of the structure due to seismic forces, the use of energy dissipation devices or vibration control systems seems to be very effective. This research paper represents the seismic vibration control of structure with multi degree of freedom using viscous dampers and semi active friction dampers.

H. Kit Miyamoto and Amir SJ Gilani (2012), the steel buildings were designed and constructed with the help of performance based engineering (PBE) and ASCE 7 codes for SMRFs were utilized to achieve strength. In order to control the storey drift dampers are installed. When compared to conventional method of designing, the PBE method is very effective.

Amir Fateh, Farzad Hejazi, Abdilahi Bashir Omer, Mohd Saleh Jaafar (2013), this paper explains that seismic response of the structure is affected by the location of the dampers in the shear wall, when three dimensional seismic forces act

on it. In this study two different models are considered, one with shear wall at the centre of span and other with shear wall at the corners. It is assumed that in different locations, the viscous dampers are installed.

Kapil P. Gunjal, Prof. Sanket S. Sanghai(2019), this study helps to understand the earthquake response of the structure having non-linear damper property installed at different places in between the shear walls. From this study it is obtained that, the seismic response of the structure decreases when it is placed inside the shear wall in the core of the building to about 30% to 40% compared to bare model.

Yukihiro Tokuda and KenzoTaga(2008), the study states that energy absorption equipment such as damper filled with oil are effective in improving the earthquake resistance of the structure and making the structure more elastic by introducing composite construction using steel and damper systems.

III. METHODOLOGY

- **ETABS**

ETABS is a structural design, modelling and analysis software which provides a user friendly interface to perform the task. It is highly used for static analysis and dynamic analysis of multistoried frames and shear wall buildings. The software contains pre-loaded codal provisions. Steel structures, concrete structures, shear walls, and also composite designs can be carried out in this software. This software mainly works on the basis of finite element method of analysis. The output obtained from the ETABS will be safer, efficient and we get detailed results of shear force, bending moment, deflection, and deformation of all the structural members.

- **Response spectrum method**

The analysis and design of structure is performed in ETABS software. Response spectrum method describes the maximum response of damped single degree of freedom system to a particular input motion at different natural periods. Response spectrum method is advantageous as it considers the frequency effects and provides a single suitable horizontal force for the design of structure. Response spectrum method allows determination of maximum modal response of a singly supported structural system or a multiple supported. Response spectrum is a linear dynamic method.

- **Building description**

In this study, the frame dimensions are 32.3088m x 21.336m which is G+9 storey and overall height having 30m. The modelling is done in ETABS 2017 software. The structure has 5 bays in both X and Y direction. Seismic zone factor V and type II soil is considered. The seismic analysis is executed in response spectrum method.

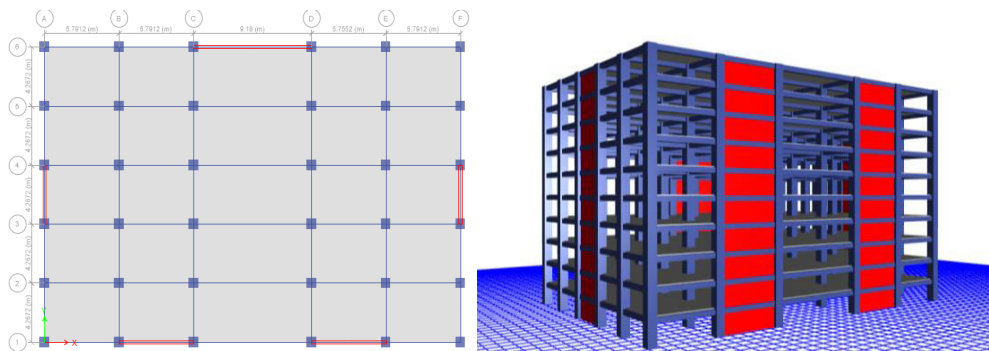


Fig. 1 plan and rendered view of building

The technical data for analysis is as follows:

Grade of Concrete	: M30
Grade of Steel	: Fe500
Beam size	: 400×600mm
Column dimension	: 750×750mm.

Depth of slab : 200mm
 Height of each storey: 3m
 Shear wall thickness : 230 mm
 Live load : 4 kN/m²
 Floor finish : 1.5 kN/m²
 Damper system : Fluid viscous damper
 Zone : V
 Zone factor : 0.36 (Refer Table 2).
 Type of structure : RCC Frame Structure.
 Type of soil : Type II (Medium soil).
 Response reduction factor : 3.0 (refer table 7).
 Importance factor : 1.0 (refer table 6).

IV. EXPERIMENTAL RESULTS

• STOREY DISPLACEMENT

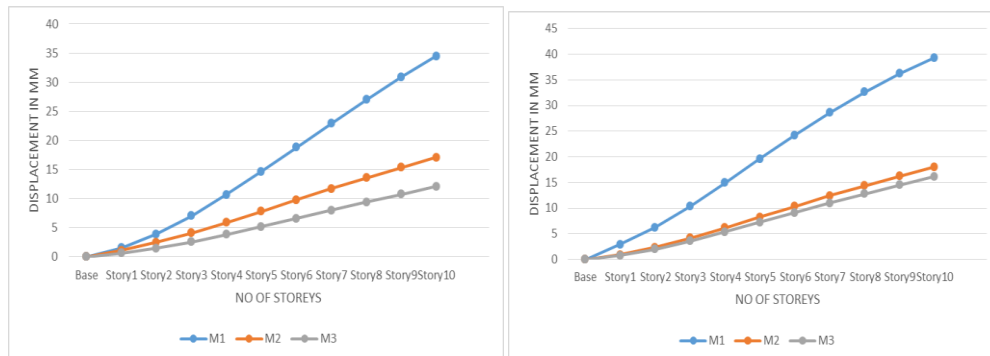


Fig.2. comparison of displacement in X-direction and Y-direction

The fig.2 shows storey displacement in X and Y direction. The storey displacement of conventional RCC structure with shear wall is 34.467mm in X-direction and 39.309 mm in Y-direction. And the model having only viscous damper is 17.034 mm and 18.028 mm in X and Y-direction respectively. And the model having both shear wall and viscous damper is 12.052 mm in X-direction and 16.157 mm in Y-direction.

• STOREY DRIFT

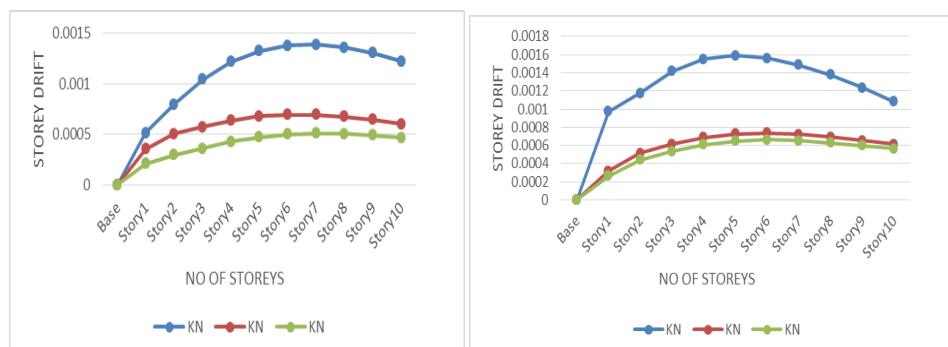


Fig.3. comparison of storey drift in X-direction and Y-direction

The fig.3 shows storey drift in X and Y direction. The maximum value of storey drift of conventional RCC structure with shear wall is 0.001389 mm in X-direction and 0.001588 mm in Y-direction. And the model having only viscous damper is 0.000695 mm and 0.000736 mm in X and Y-direction respectively. And the model having both shear wall and viscous damper is 0.000509 mm in X-direction and 0.000661 mm in Y-direction.

• STOREY SHEAR

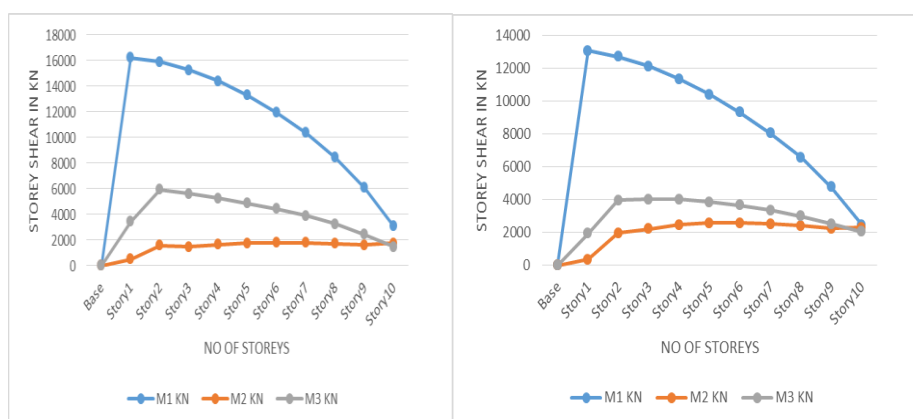


Fig.4. comparison of storey shear in X-direction and Y-direction

The fig.4 shows storey shear in X and Y direction. The maximum value of storey shear for conventional RCC structure with shear wall is 16233.546 kN in X-direction and 13090.252 kN in Y-direction. And the model having only viscous damper is 1793.8499 kN and 2598.3115 kN in X and Y-direction respectively. And the model having both shear wall and viscous damper is 5950.5 kN in X-direction and 4046.4845 kN in Y-direction.

V. CONCLUSION

We can finally justify that the use of shear wall and viscous dampers in the structure reduces the value of all the parameters considered in the design and analysis of the structure and have better performance when the viscous dampers are used in the structure.

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