International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-1, November 2019

Dynamic Analysis of Structure using Fluid Viscous Damper for Various Seismic Intensities

Daniel C, Arunraj E, Vincent Sam Jebadurai S, Joel Shelton J, Hemalatha G

***Abstract*: The Dynamic analysis for 5 Storey RC Structure with various seismic intensities are carried out in the present work. SAP 2000 Software considered the structure for modeling. Six ground acceleration for various intensities on MMI Scale to relate seismic response and seismic intensities. In the result, similar variation in storey displacement and base shear with intensities V, VI, VII, VIII, IX and X was witnessed. Through this we can conclude that RC Building using Time History analysis is essential to know if the structure is safe against seismic force or not.**

***Keywords*: RC buildings, Scaling, Seismic responses, Time History Analysis**

I. INTRODUCTION

There is a huge demand in multistory building due to population rise in recent years; the safe factor of the structure is to be considered, as the number of stories goes high especially in terms of seismic activities [1-4]. Since the seismic forces are un predictable and causes heavy damage during its occurrences, it is necessary to know the structural behavior and reactions during an Earthquakes [5-9]. This can be accurately studied by using modern engineering tools such as software and satellite imaginary.

Different magnitude of earthquake occurring in various intensities causes various damages in different zones. Therefore, seismic analysis have to be carried out to determine the earthquake response of the structure [10-12]. Normally, damages that occur in a structure is caused by an Earthquake. Due to this, it is essential for a structure to be constructed to resist seismic forces at a particular level of intensity in a building without considering its magnitude [13]. Therefore, seismic analysis have to be carried out to determine the earthquake response of the structure.

Revised Manuscript Received on November 30, 2019.
***** Correspondence Author
Daniel C, Department of Civil Engineering, Karunya Institute of Technology and Sciences, Coimbatore, India, danielckarunya@gmail.com
Arunraj E, Department of Civil Engineering, Karunya Institute of Technology and Sciences, Coimbatore, India
Vincent Sam Jebadurai S, Department of Civil Engineering, Karunya Institute of Technology and Sciences, Coimbatore, India
Joel Shelton J*, Department of Civil Engineering, RGM College of Engineering and Technology, Kurnool, India
Hemalatha G, Department of Civil Engineering, Karunya Institute of Technology and Sciences, Coimbatore, India

II. FLUID VISCOUS DAMPER

In recent years fluid viscous damper is fused in more Earthquake resistant buildings. Fig 1 shows the schematic representation of viscous damper. When the damper is applied externally in the piston rod, it produce a damping effect through 'to and fro' medium. The friction force occurs in the piston, shaft and cylinder damping force is compost [14].

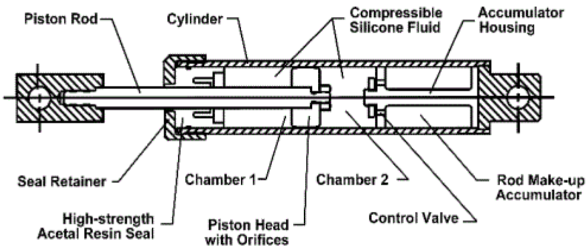

Fig. 1. Viscous Fluid Damper

The conventional damping force of VFD is imposed by,

$$F = CV^{\alpha} \quad (1)$$

Where F is the damping force, C is the damping coefficient, v is the velocity of the piston and α is the damping.

III. STRUCTURAL MODELING AND ANALYSIS

This For Fluid viscous dampers identifies the characteristics of control devices. In this study to determine damping coefficient [3],

$$C = 2m\xi\omega \quad (2)$$

To find the damping coefficient, equation (2) is being used. Where, m is the total mass in the floor, ω is the natural frequency and ξ is the damping coefficient.

The plan of the structure is shown in figure 2 and elevation in figure 3. The 3D view of the modeled build with and without viscous damper are shown in figure 4.

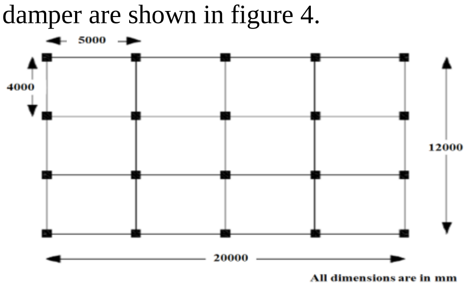

Fig. 2. Plan

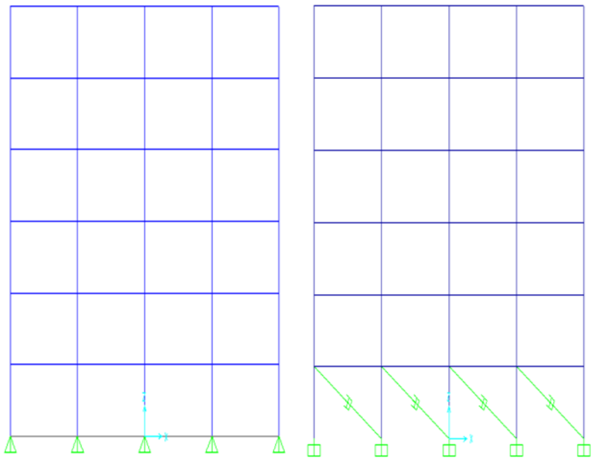

Fig. 3. Elevations of VFD

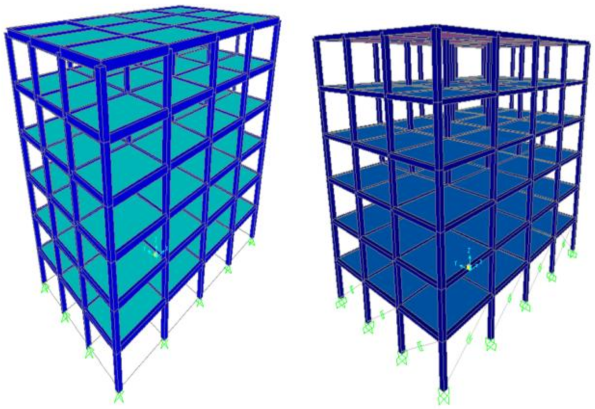

Fig. 4. 3d Views

A five storey structure with and without fluid viscous damper with various intensity of Earthquakes is considered at a floor height of 3m. The geometry and dimensions of the model is tabulated in Table 1. Various Time History data with various magnitudes with peak ground acceleration is tabulated in Table 2. The Intensity of earthquakes with respect to the seismic zone is tabulated in Table 3.

Table- I: Geometry and Dimensions of plan

Live Load (floors)	3.1 KN/m^2
Live Load (Terrace)	1.4 KN/m^2
Column	500mm X 500 mm
Beams	230 mm X 450 mm
Slab	150 mm
Brick wall	225 mm
Density of Concrete	24 KN/m^2
Density of Brick wall	21 N/m^2
Concrete, E	24 KN/m^2
Brick wall, E	14KN/m^2

Table- II: Earthquake data

S. No.	Earthquake	Date	Magnitude Richter Scale	P. G. A.g
1	Bhuj	Jan 26	6.8	0.108
2	Koyana	Dec 11	6.4	0.449
3	Anza	Feb 25	4.6	0.106
4	Nahanni	Dec 23	6.8	0.461
5	Northridge	Jan 17	6.6	0.431
6	El centro	May 18	6.7	0.289

Table- III: Various Seismic Intensities

S. No.	Intensity MMI	PGA g	Seismic Zones as per IS:1893-2002
1	V	0.009-0.030	-
2	VI	0.03-0.07	II
3	VII	0.12-0.16	III
4	VIII	0.24-0.29	IV
5	IX	0.49-0.49	V
6	X	>0.60	-

IV. RESULT AND DISCUSSION

The Maximum expected lateral force in the intensity X response through the building. In these results the various time histories has been done for Bhuj, Koyana, Anza, Nahanni, Northridge, El Centro. These data has been analyzed for Intensity V to X.

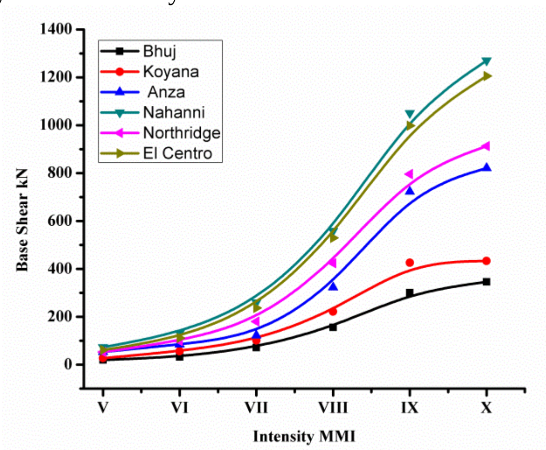

Fig. 5. Without VFD for base shear in X Direction

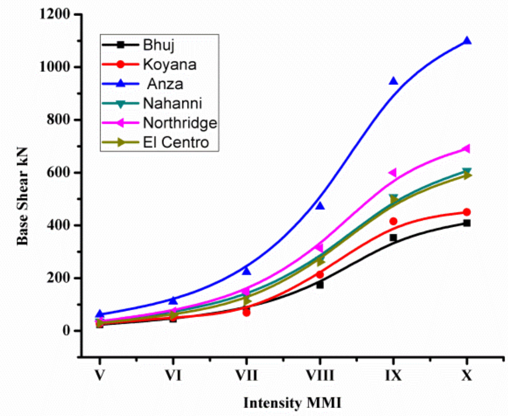

Fig. 6 Without VFD for base shear in Y Direction

The Maximum base shear in without viscous fluid Damper at both X and Y axis is 1314 kN and 1111 kN. The Maximum base shear in figure 5 and 6 at intensity X for X and Y axis is 649 kN and 419 kN without viscous fluid damper. The maximum roof displacement from the figure 7 and 8, without VFD is 0.456 in X- axis and 0.851 in Y- axis at the intensity X. From the figure 9 and 10, for with VFD the Maximum displacement is 0.225 in X – axis and 0.414 in Y – axis. Figure 11 and 12 shows the base shear with Viscous Fluid Damper.

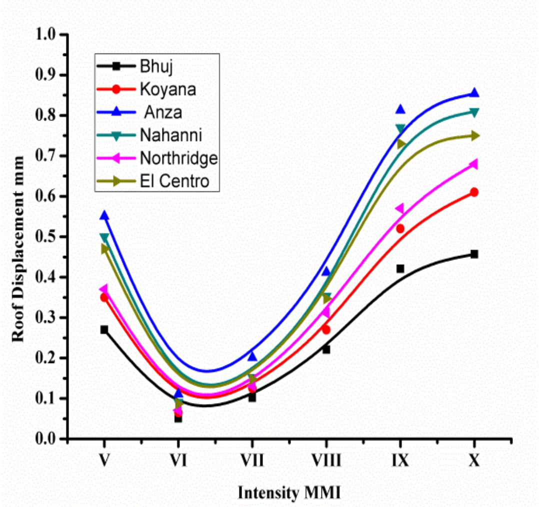

Fig. 7. Without VFD for Roof displacement in X Direction

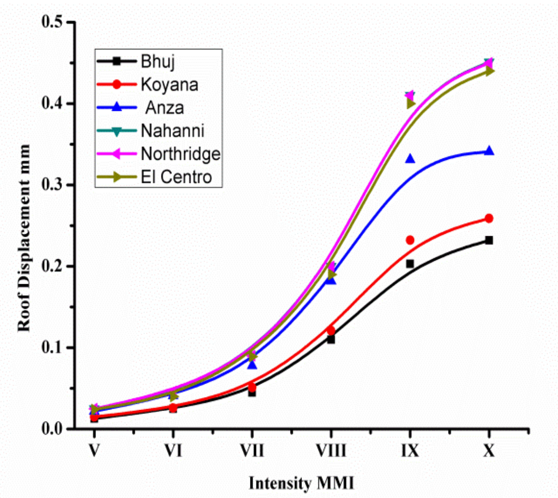

Fig. 8. Without VFD for Roof displacement in Y Direction

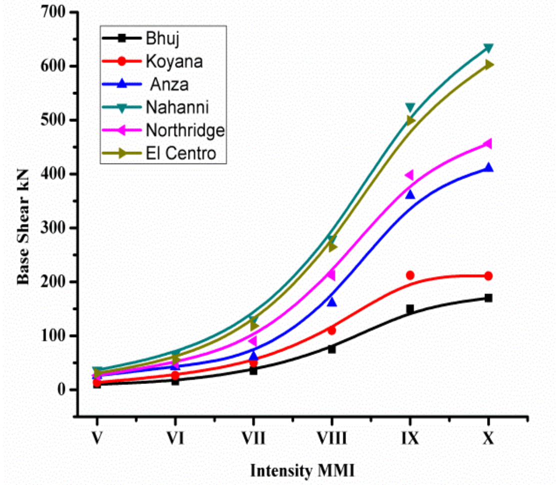

Fig. 9. With VFD for Base shear in X Direction

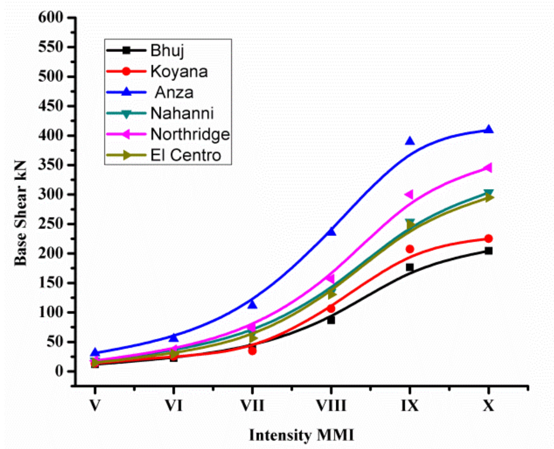

Fig. 10. With VFD for Base shear in Y Direction

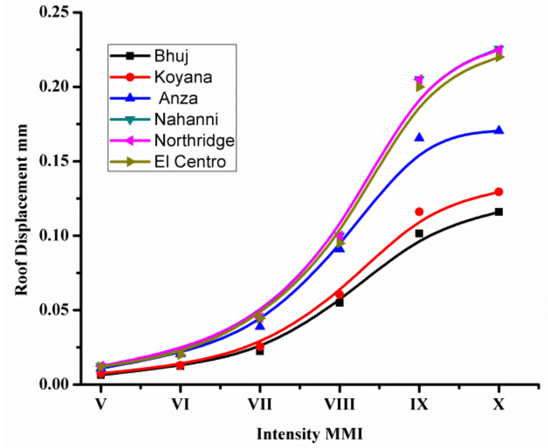

Fig. 11. With VFD for Roof Displacement in X Direction

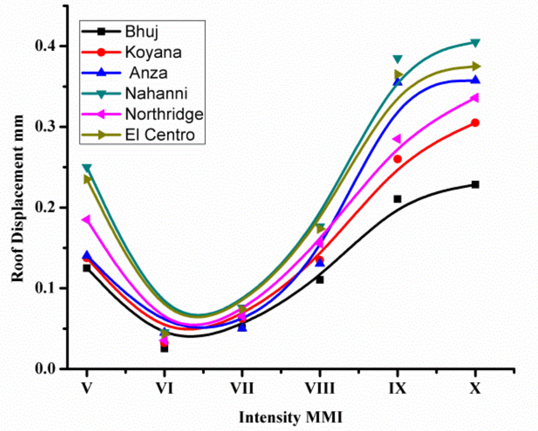

Figure 12 With VFD for Roof Displacement in Y Direction

V. CONCLUSION

A In this study, Viscous Fluid Damper controls the earthquake load. The 5-storey building is modelled and exposed to self-weight of structure in SAP 2000. As per IS 1893-2002 code, the building undergoes seismic forces. The time history method for static and dynamic values, the scale factor fixed from the various Time histories the base shear obtained has decreased to the percentage of 50 for X - axis and 61.3 for Y - axis. The Roof displacement for with VFD in X – axis is decreased to a percentage of 50.65 and in Y – axis 51.35.

When we observe it closely, there is only slight difference in the shear value when the damper is attached. When eventually introducing viscous dampers to the building, its behavior was different under earthquake force observed from the results.

REFERENCES

1. Pastia, Cristian, et al. "Seismic response of building structures with passive fluid dampers." the 5th international conference on Advanced Materials and Systems. 2014.
2. Patil, A. S., and P. D. Kumbhar. "Time history analysis of multistoried RCC buildings for different seismic intensities." International Journal of Structural and Civil Engineering Research 2.3 (2013): 194-201.
3. Khan, Salman I., and Ashoke R. Mundhada. "COMPARATIVE STUDY OF SEISMIC PERFORMANCE OF MULTISTORIED RCC BUILDINGS WITH FLAT SLAB AND GRID SLAB." International Journal of Structureal and Civil Engineering Research (IJSCER) 4 (2015).
4. Mohan, Romy, and C. Prabha. "Dynamic analysis of RCC buildings with shear wall." International Journal of Earth Sciences and Engineering 4.06 (2011): 659-662.
5. Wilkinson, S. M., and R. A. Hiley. "A non-linear response history model for the seismic analysis of high-rise framed buildings." Computers & structures 84.5-6 (2006): 318-329.
6. Umachagi, Vajreshwari, et al. "Applications of dampers for vibration control of structures: an overview." International Journal of Research in Engineering and Technology. EISSN (2013): 2319-1163.
7. Aye, Su Myat, and DR KYAW MOE AUNG. "Comparative Study on Seismic Response of RC Structure Using Viscous Dampers and Viscoelastic Dampers." International Journal of Scientific Engineering and Technology Research, ISSN (2014): 2319-8885.
8. Parmar, Abhijitsinh, et al. "Seismic Response Control of Asymmetric Building Using VISCOUS DAMPER." International Journal of Civil Engineering & Technology (IJCIET) 5.12 (2014): 267-276.
9. Miyamoto, H. Kit, et al. "Limit states and failure mechanisms of viscous dampers and the implications for large earthquakes." Earthquake engineering & structural dynamics 39.11 (2010): 1279-1297.
10. Marano, Giuseppe Carlo, Francesco Trentadue, and Rita Greco. "Stochastic optimum design criterion for linear damper devices for seismic protection of buildings." Structural and Multidisciplinary Optimization 33.6 (2007): 441-455.
11. Chang, Kuo-Chun, Yu-Yuan Lin, and Chang-Yu Chen. "Shaking table study on displacement-based design for seismic retrofit of existing buildings using nonlinear viscous dampers." Journal of structural engineering 134.4 (2008): 671-681.
12. Ou, J. P., X. Long, and Q. S. Li. "Seismic response analysis of structures with velocity-dependent dampers." Journal of Constructional Steel Research 63.5 (2007): 628-638.
13. Dicleli, Murat, and Anshu Mehta. "Seismic performance of chevron braced steel frames with and without viscous fluid dampers as a function of ground motion and damper characteristics." Journal of Constructional Steel Research 63.8 (2007): 1102-1115.
14. Tubaldi, Enrico, and Ioannis A. Kougioumtzoglou. "Nonstationary stochastic response of structural systems equipped with nonlinear viscous dampers under seismic excitation." Earthquake Engineering & Structural Dynamics 44.1 (2015): 121-138.