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Review Paper on Seismic Analysis of Multi-Storied Reinforced Concrete Building with Fluid Viscous Dampers

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***Abstract:** Frequent earthquakes around the world and the large number of buildings at risk have made it essential to focus on controlling how structures respond to these events. This demand has driven the increased use of structural response control methods globally. This study investigates the seismic performance of multi-storied Reinforced Concrete (RC) Buildings, distinguishing between Regular and Irregular Plan , with a focus on the role of Fluid Viscous Dampers (FVDs). The study aims to quantify the improvements in seismic resilience provided by these damping devices in mitigating the adverse effects of seismic events. Buildings having Regular and Irregular Plans are analyzed, with and without FVD using ETABS2018. The story responses in terms of Pseudo Spectral Accelerations, Maximum Displacement, Story Drift and Story Shear have been compared. The results of the Time History Analysis represent the effectiveness of dampers in improving the structural response and the damping demand on structural systems.*
***Keywords:** Fluid Viscous Dampers (FVDs), Regular and Irregular Plans, Pseudo Spectral Accelerations, Maximum Displacement, Story Drift, Story Shear, Time History Analysis.*

I. INTRODUCTION

Over the past few years, earthquakes have been happening more often and with greater intensity, highlighting the need for buildings capable to endure these forces. This challenge is made more difficult by the size and complexity of multi-story reinforced concrete (RC) buildings that are particularly at risk during earthquakes. Ever since, improvements to these buildings were made traditionally by improving materials and modifying their design for better resistance. But today, we have a variety of the most sophisticated dampings which can help absorb energy and prevent further damage.There are two main methods for analyzing how buildings might respond to earthquakes:

1) *Response Spectrum Analysis:* This method relies on a set of predefined data to estimate how a building might react during an earthquake. It uses general models and assumptions rather than specific earthquake data from a particular location.
2) *Time History Analysis:* This approach uses real data collected from actual earthquakes. By studying how buildings behave during real seismic events, engineers can design future structures to better withstand similar conditions.

In Structural Engineering, Damping is the process of dissipating the energy of vibrations in a structure It is an essential aspect how buildings and other structures respond to dynamic forces. There are different types of damping mechanisms uses in structures, and fluid viscous damping is one of them, which employs a Fluid Viscous Damper as an Energy dissipation device.

A Fluid Viscous Damper (FVD) is a mechanical device used in structural engineering to reduce vibrations by dissipating kinetic energy through the movement of a viscous fluid. These dampers consist of a piston that moves within a cylinder filled with a highly viscous fluid, such as silicone oil. As the structure experiences dynamic motion, the piston forces the fluid within the cylinder, converting mechanical energy into heat and, thereby reducing the amplitude of vibrations and enhancing the overall stability of the building.

The incorporation of FVDs into the structural design of multi-storied RC buildings offers a promising approach to improving their seismic resilience.

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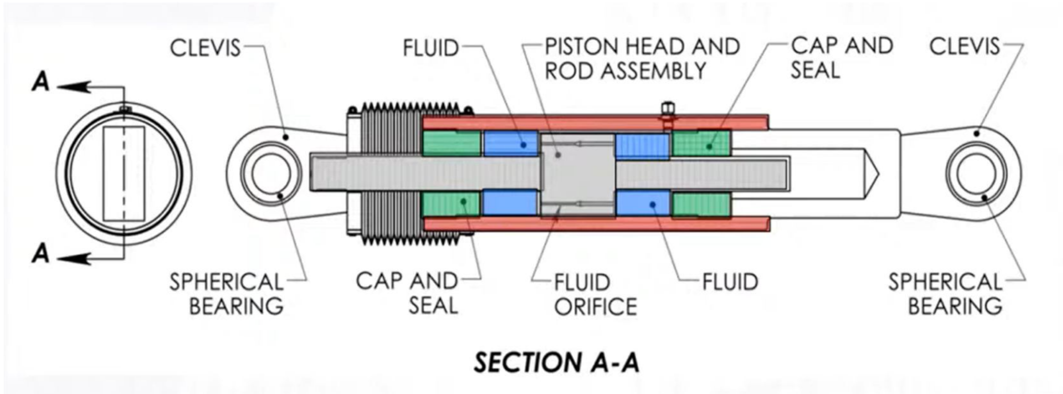

Fig. Fluid Viscous Dampers

The fluid viscous damper is mathematically modeled by the equation:

$$F = C \times u$$

Where,

- F denotes damping force,
- C denotes damping coefficient,
- u is the relative velocity across the damper.

This equation implies that the damping force is directly proportional to the velocity of movement. The proportionality constant is the damping coefficient C, which dictates how much resistance the damper provides.

The primary focus of this study is to analyze the seismic response of multi-storied reinforced concrete buildings integrated with fluid viscous dampers. By conducting a detailed investigation into the dynamic behavior of such structures, this research aims to evaluate the effectiveness of FVDs in enhancing the seismic performance of RC buildings. Key parameters such as displacement Pseudo Spectral Accelerations, Maximum Displacement, Story Drift and Story Shear will be examined to assess the impact of FVDs on structural stability and occupant safety during seismic events.

II. LITERATURE REVIEW

1) Vajreshwari Umachagi, Katta Venkataramana, G. R. Reddy, Rajeev Verma[1],In this paper, Authors attempt to provide an overview of different types of seismic response control devices and highlight some recent developments. They explain that fluid viscous dampers (FVDs) work based on fluid flow through orifices. In 2010, Stefano et al. manufactured a viscous damper and implemented it in a three-story building structure for seismic control of structure.
2) Md Mujeeb, J S R Prasad, and Venu Malagavelli[2],modeled and analyzed a G+10 storey building by placing FVD250 dampers at different locations. They concluded that placing FVDs at the external corners on all four sides is more effective compared to central damping and alternate damping
3) Liya Mathew and C. Prabha[3],conducted a nonlinear time history analysis on reinforced concrete buildings with and without fluid viscous dampers using SAP2000 software in 2014. From this study, they concluded that for maximum effectiveness in reducing dynamic responses, a structure with fluid viscous dampers should be designed with a damping ratio of 20% and a velocity exponent (α) of 0.5.
4) Himanshu Bansal, Gagandeep[4], considered a ductility-based design approach for vertical irregular buildings. The methods used for the analysis were Response Spectrum Analysis (RSA) and Time History Analysis (THA).They considered three types of irregularities namely mass irregularity, stiffness irregularity and vertical geometry irregularity. According to RSA results, the storey shear force was found to be maximum for the first storey and then it decreases. In case of mass irregular structure, Time History Analysis yielded slightly higher displacements for upper stories than that in regular building.
5) Angie Catalina Lamprea Pineda[5], Luis Fernando Garzón Amortegui2 , Claudio Chesi3;In this paper implementation citeria of Fluid Viscous Damper in Diagonal configuration is discussed. Two different values in the damping exponent (α), 0.25 and 0.50 are studied, in a 15th-story and heliport RC hospital building in Colombia. The study concluded that the use of the VFD effectively reduces structural displacements,Interstorey Drift and decreases Ductility level.

6) Wesam Al Agha[6], performed comparative study on Seismic Response of RC Building with and without Fluid Viscous Dampers. Using Etabs(18.0.2) Equivalent Static, Response Spectrum and Time history method is performed. The Results are shown that Damper reduceslateral deflection and enhance the performance of the structure.

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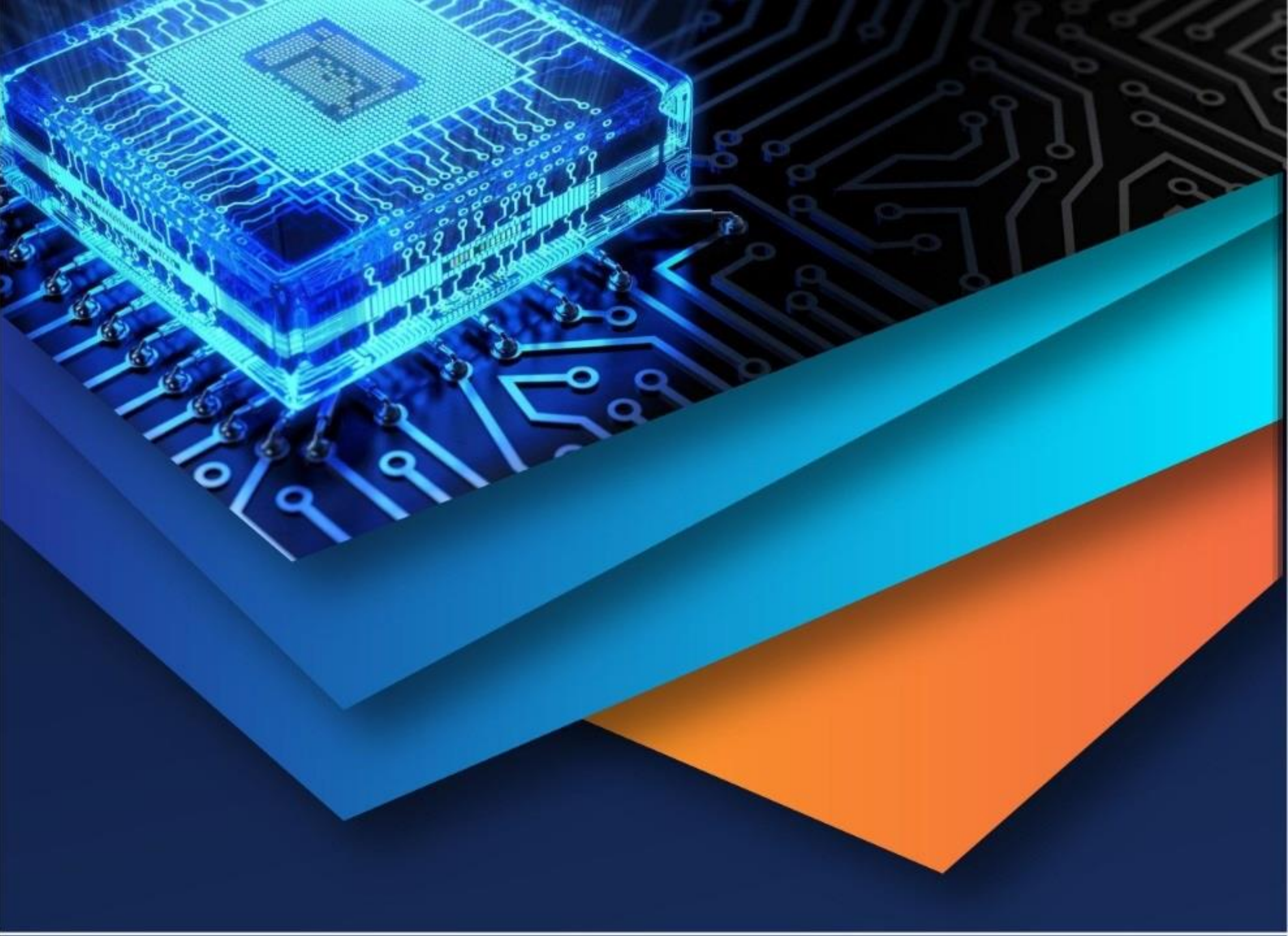

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