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Behaviour of RC building Employed with Fluid Viscous Damper

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Abstract: ***In this thesis we are concentrating on finding the effect of fluid viscous dampers on Multi-storey Using Etabs. A G+12 building was analyzed and from the results it was concluded that Employment of Fluid viscous dampers reduces storey displacement by 50 to 70 % in horizontal X direction and 33.00 to 67.00 %. Employment of Fluid viscous dampers can reduce storey drift by 20 to 70 % in the middle and lower storey in both X and Y directions.***
Keywords: E-tabs., seismic zones, base shear, overturning moment, displacement.

I. INTRODUCTION

The findings will provide valuable insights into the performance enhancement of RC frame structurethrough VFD retrofitting, offering practical references for similar seismic retrofitting projects. Performance-Based Seismic Design (PBSD), which focuses on limiting the displacements, is evolving as a superior method over strength-based design. For important buildings expected to remain functional after the earthquake, PBSD can provide a guaranteed response when subjected to seismic hazards. The design philosophy is evolving toward performance-based design in which damage states are specifically defined. Also with the progress in research for controlling seismic vibrations, the addition of external control systems to mitigate the seismic vibration effect of the structure is coming out as a preeminent solution. Hence, designing a vibration control system for multi-storey frame systems is an important topic in structural engineering because it can help improve the safety and stability of buildings under extreme loads.

II. LITERATURE REVIEW

Magdalini Titirla *et al 01* The purpose of this study is to demonstrate the impacts of friction dampers (FD) or fluid viscous dampers (FVD) in irregular (in plan and elevation) reinforced concrete (RC) buildings. The buildings (a four-story, a nine-story, and a twenty-story skyscraper) were analyzed using nonlinear dynamic time-history analysis on earthquake-recorded accelerograms, three of which were real were analyzed using nonlinear dynamic time-history analysis on earthquake-recorded accelerograms, three of which were real while the other four were artificial. For this purpose, 70 nonlinear dynamic analyses were carried out. This paper describes optimal design of FDs and FVDs, with a focus on minimizing the following parameters: (i) maximum displacement (top of the structures), (ii) building torsion, and (iii) maximum horizontal inter-story drift. Two different placements of the dampers have been studied in each building. The consequences of each strengthening method are shown, and other relevant results were obtained from this creative comparison (optimal design, two passive energy systems, and three different story numbers). The comparable results show that in low-rise structures, FD was more successful than FVD in reducing torsional moment however in medium and high rise building VDF was more effective at improving the seismic performance of the structure.

Asma Belbachir *et al 02* This paper presents a comprehensive analysis of the seismic response and advanced simulation framework providing detailed results on key parameters. The findings highlight the potential of fluid viscous dampers to significantly improve the seismic performance of reinforced concrete structures, offering a promising solution for earthquake-prone areas. The base shear force decreases after the introduction of fluid viscous dampers by 40% in the X direction and 31% in the Y direction. This reduction occurs because the dampers absorb and dissipate kinetic energy from dynamic loads, converting it into heat and thereby reducing the amplitude of vibrations transmitted to the building's base. The inter-story displacements of the structure equipped with fluid viscous dampers decrease compared to the structure without damping in both the X and Y directions. This means that the relative movement between floors is reduced, enhancing the building's overall stability and reducing the risk of structural damage during dynamic events.

Amru Shamil *et al 03* In this study, response spectrum analysis technique is used for dynamic analysis. The analysis and design of the structure are carried out through the use of ETABS 2015 software program. Earthquakes are one of the major natural hazards in the world. In this study a fluid viscous damper is used to manipulate seismic response of the proposed building. The mechanic

properties of a fluid viscous damper used in this paper are mass 44Kg and weight 250kN. The maximum storey drifts, base shears, maximum story displacements and time periods are compared. Based on the analysis result It is founded that fluid viscous damper are effective in diminishing the seismic response of the building under earth quake. It's also founded that when fluid viscous damper are provided to RC building the maximum lateral displacement and story drift reduced. The base shear and fundamental time period of the building is decreased by providing fluid viscous dampers in the structure compared to building without dampers.

Badhon Singha *et al 04* This study investigates the effectiveness of two seismic protection systems: fluid viscous damper (FVD) and lead rubber bearing (LRB) isolation, in improving the seismic performance of a structure. The initial research did not include any base isolator or link damper for earthquake protection. The results were then compared to a similar investigation of the same structure using FVD and LRB isolation. Significant differences in structural behavior were observed, with both systems demonstrating improved performance in mitigating seismic forces. The findings highlight the importance of incorporating advanced damping mechanisms, such as FVD and LRB, in building design to enhance earthquake resilience in prone regions. This study underscores the critical need for integrating such seismic protection systems to reduce structural damage and improve safety during earthquakes.

Sarah Mariam Abraham *et al 05* This paper is about the seismic analysis of building. The aim of seismic design is to protect the buildings and reduce the damages occur through the seismic event. There were many studies are done to resist earthquakes. Providing base isolation and damper in building have greater impact to resist earthquake. The principle of base isolation is to alter the response of the building structure so that ground below can
move easily without transmitting these motion forces to the building structure above. Using damper it dissipates a significant portion of induced energy so that damage to the building reduces. In the present study, afive story RCC building is analyzed according to IS Code for seismic analysis by ETABS software. In this study a several conditions are taken first
considering a normal building, base isolated building, building with damper and building with base isolation and damper. From the results of the linear dynamic analysis it was found that Fluid viscous dampers can dissipate major portion of seismic energy and hence reduce the energy input on the primary structure. They are capable of reducing force and displacements. If we provide LRB only. Its displacement increases and it returns back to its original position with less damage and also it can remain without damage for a longer time period of earthquake compared to building with damper. The displacement of building with LRB&FVD is slightly higher than the displacement of building with FVD only. Building with LRB&FVD can't remain for longer time period of earthquake

Subasini Y *et al 06* This paper presents a comparative study of the performance of Fluid Viscous Damper (FVD) in mitigating the seismic response of both Reinforced Concrete (RC) and Steel structures. The aim of the study is to understand the behavior of the seismic resistant structures and to study the advantages of FVD over other dampers. The study is done to determine the optimum positioning of FVD in order to reduce the storey displacements and storey drifts. G+3, G+5, G+7 RC and steel structures were modeled in SAP2000 software and were subjected to non linear time history analysis under three different earthquake ground motions such as Imperial Valley – 02 (1940), Loma Prieta (1989) and Northridge-01 (1994). The dampers were placed in four different configurations such as alternate (AT), corner (CR), diagonal (DL) and middle (ML). The seismic response parameters such as the storey displacements and the storey drifts were determined for the structures. It is found that the presence of FVD reduces the storey displacement and storey drift values to about 40-70% from the uncontrolled structure. It is also understood that the optimum positioning of the dampers is greatly influenced by the aspect ratio of the building. he main aim of this study is to understand the 671taging671 of different staging, under different loading conditions and strengthening the conventional type of staging, to give better performance during earthquake. This paper presents the Importance of the supporting system of water tanks here this is considered different type of bracing and staging patterns. From the comparison between displacement for different bracing system and displacement for different alternate bracing it is conclude that new bracing pattern gives the minimum value of displacement.

Abba Mas'ud Alfanda This project therefore studies the efficiency of rectangular or circular tanks, 40,000 liters capacities were used in order to draw reasonable inferences on tanks shape design effectiveness, relative cost implications of tank types and structural capacities. The basic tanks construction materials include steel reinforcement, concrete and formwork obtained from the prepared structural drawings. Result of the materials take–off revealed that circular tank consumed lesser individual materials as compared to rectangular one. his will give circular shaped tanks more favored selection over the rectangular shaped tank, although some other factors must still be assessed.

Swati In this study a review of various literatures on calculative analysis of water tank was carried to understand the performance of elevated water tank under the action of various horizontal forces like wind load. From analysis it is seen that Horizontal Displacement in water tank due to wind is critical as they result in sloshing of water and additional displacement.

There is a need to investigate various methods to minimize this horizontal displacement. One method proposed in this direction is to adopt water tanks with different configuration of legs of staging.

Nandagopan.M. The main aim of this study is dynamic analysis of different types of RCC water tanks. Ground supported rectangular and circular water tanks, over head circular and rectangular water tanks are considered. Housner's two mass model for water tank is selected for dynamic analysis where the whole mass of water is divided in to two, impulsive liquid mass and convective liquid mass. Analysis is carried out to find the base shear and base moment. The manual dynamic analysis is done with varying height of water level in the tank using IS 1893 (Part 2) guide lines and study the effects due to change in height of water level. Based on the work in this study, it was summarized that Base shear and base moment are increases with increase in water level. Elevated water tank shows higher base reactions than ground supported tanks. So base reactions increase with increase in staging height. The base shear and base moment of ground supported rectangular tank exceeds ground supported circular tank by 6.89% and 6% respectively at full tank condition. So, geometry of water tank can influence base shear. The ground supported circular tank have fewer base reactions. i.e it is better than ground supported rectangular tank.

Prashant A Bansode The objective of this study was, to understand the behavior of different staging system, under different tank conditions. Response Spectrum Analysis is carried out on three different types of bracing systems of elevated water tank in all zones by using STAAD Pro V8i 2007. Comparison of base shear and nodal displacements of elevated water tank for empty and full condition is done. The spring mass model as per IS 1893:2002 Part 2 has been used for the analysis. From analysis work, it has been concluded that, Base shear increases as the level of bracing increases because, bracing system put on additional mass to the structure, which results into increase in base shear value. Similarly base moment is found to be increased as the level of bracing increases.

Ajagbe, W.O. This study therefore examines the efficiency of Rectangular and Circular tanks. Tanks of 30m3, 90m3, 140m3 and 170m3 capacities were used in order to draw reasonable inferences on tank‟s shape design effectiveness, relative cost implications of tank types and structural capacities. Limit state design criteria were used to generate Microsoft Excel Spreadsheet Design Program, named MESDePro for quick and reliable design. The basic tank‟s construction materials- steel reinforcement, concrete and formwork were taken-off from the prepared structural drawings. Results of the material take-offs showed that, for each of the shapes, the amount of each structural materials increase as the tank capacity increases. Also, Circular-shaped tank consumed lesser individual material as compared to rectangular ones. Hence, this will give Circular-shaped tanks a more favoured selection over the rectangular shaped tanks.

III.CASE CONSIDERATION AND MODELLING

Table 3.1 General structural parameters

Parameter	Value
Live load	2 KN/m2
Live load at Floor with mass irregularity	4 KN/m2
Density of concrete	25 KN/m3
Thickness of slab	150 mm
Depth of beam	450 mm
Width of beam	300 mm
Dimension of column	300 x 600 mm
Thickness of outside wall	230 mm
Thickness of Parapet wall (1m)	100 mm
Height of floor	3.50 m
Earthquake zone	III
Damping ratio	5%
Type of soil	Medium Stiff
Type of structure	Special moment resisting frame
Response reduction factor	5
Importance factor	1.0

Number of Storey's	13 (G+12)
Depth of Foundation	1.50 m
Wind Load	Vb = 50 m/s
Terrain category	1
Risk Factor K1	1
Topography factor K3	1

Table 3.2 Model details

Model Description	Label
RCC Building without Fluid Viscous Dampers	Model 1
RCC Building with Fluid Viscous Dampers	Model 2

A. Plan of Model

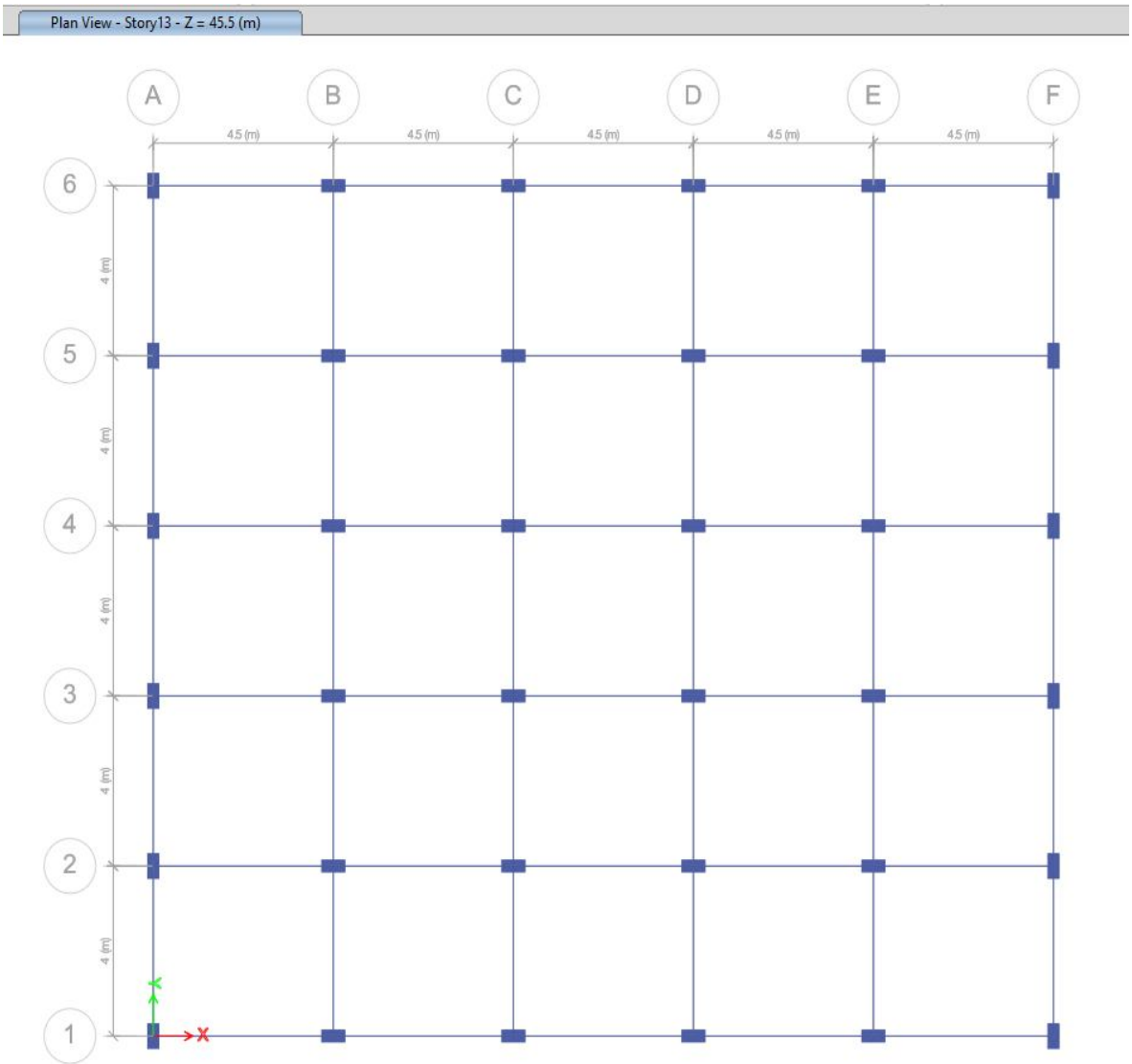

Fig 3.1 Plan of model

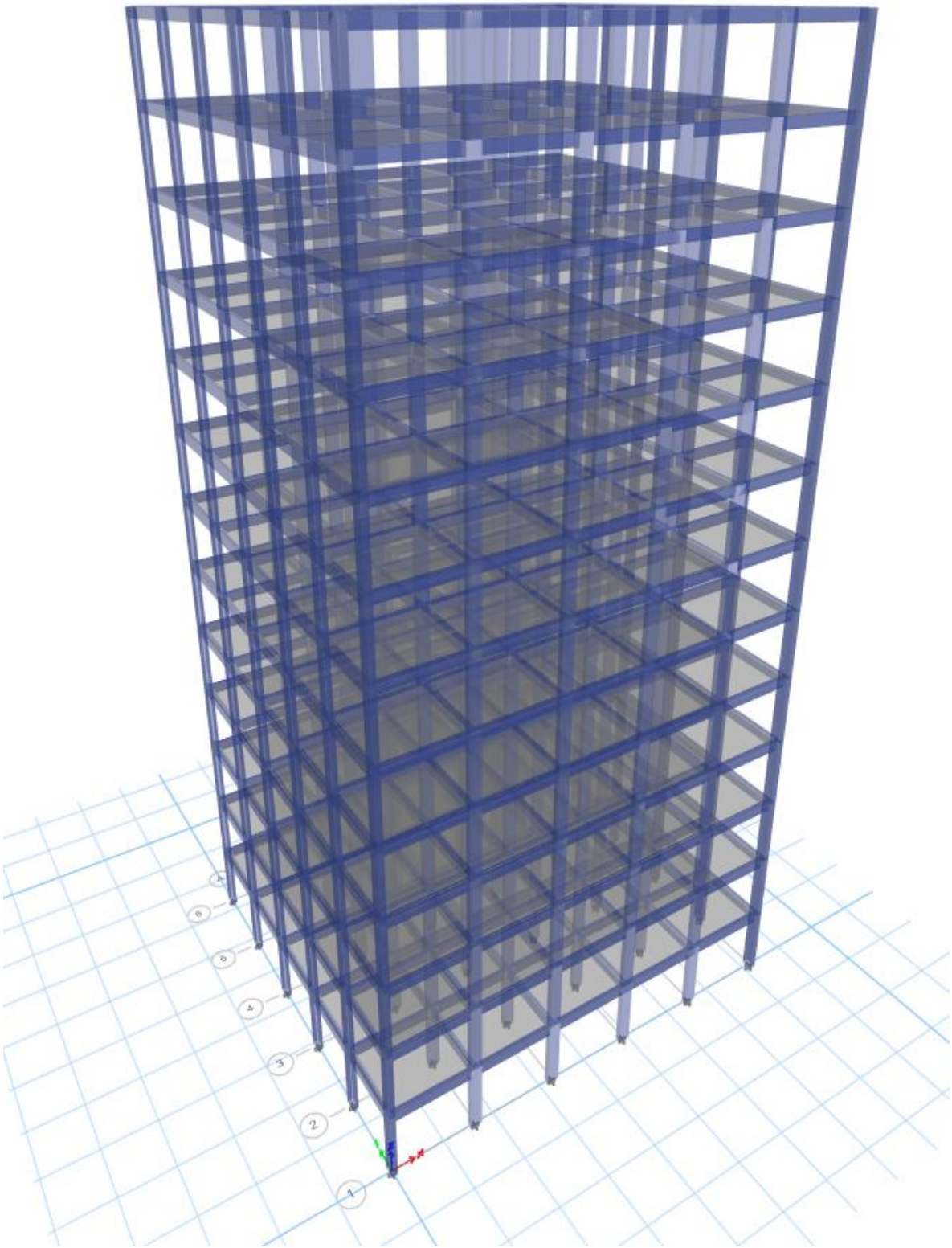

Fig 3.2 3D view of model 01 (without FVD)

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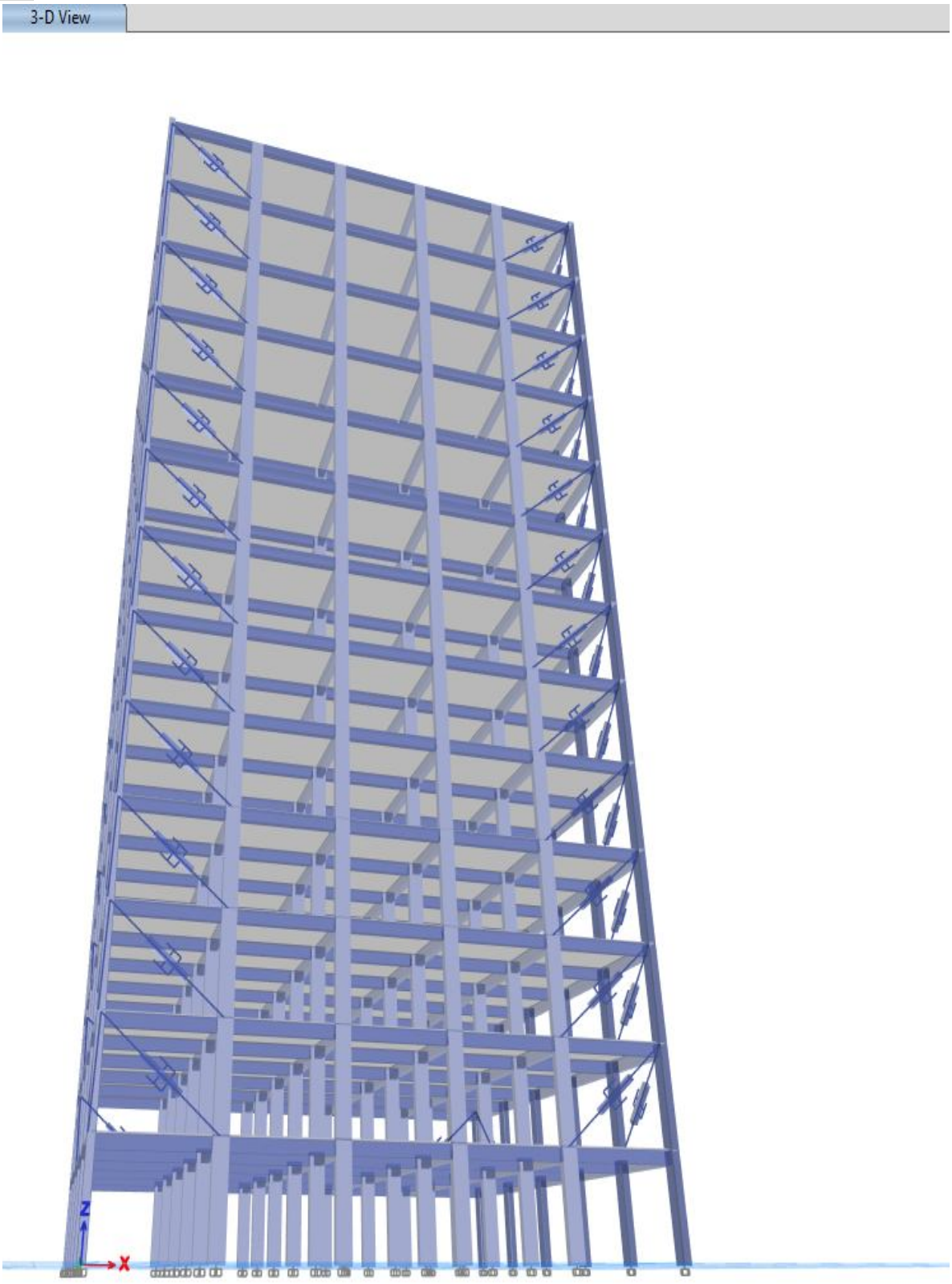


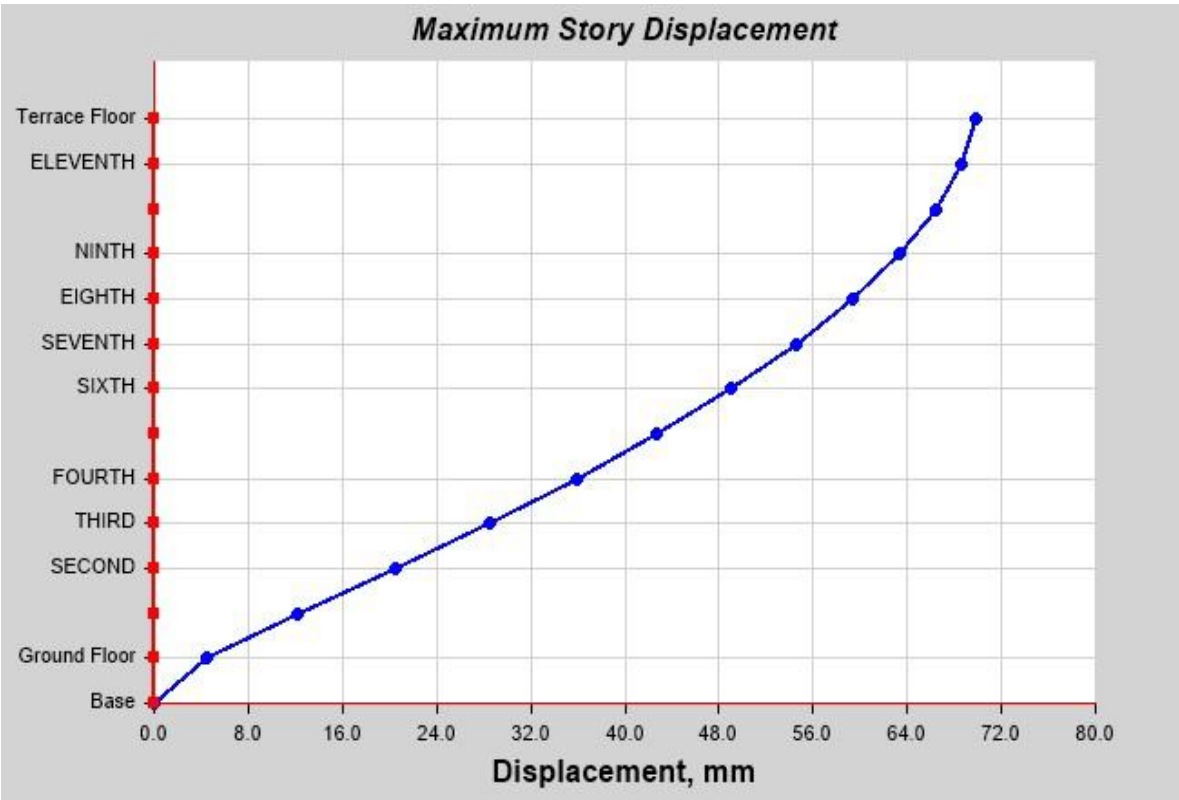
Fig 3.3 3D view of model 02 (with FVD)

IV. RESULTS AND DISCUSSIONS

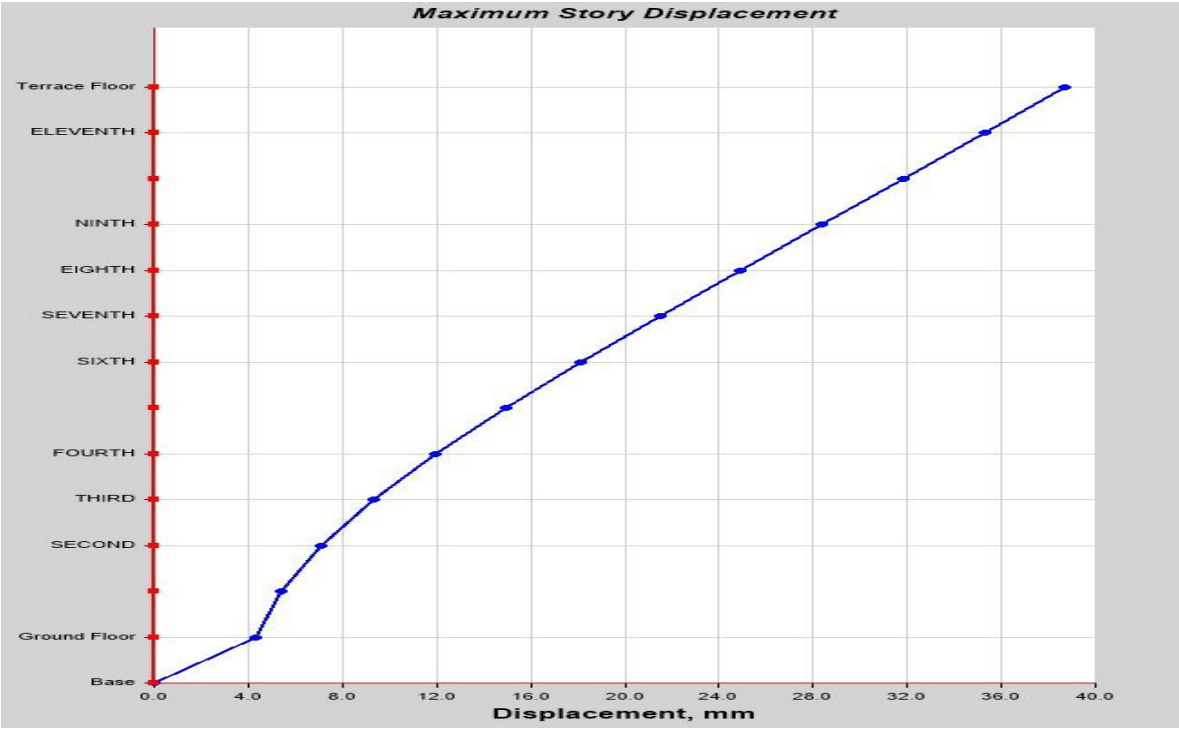
A. *Maximum Storey Displacement in X Direction*

Table 4.1 Comparison between storey displacement of model 01 and model 02 in X-direction

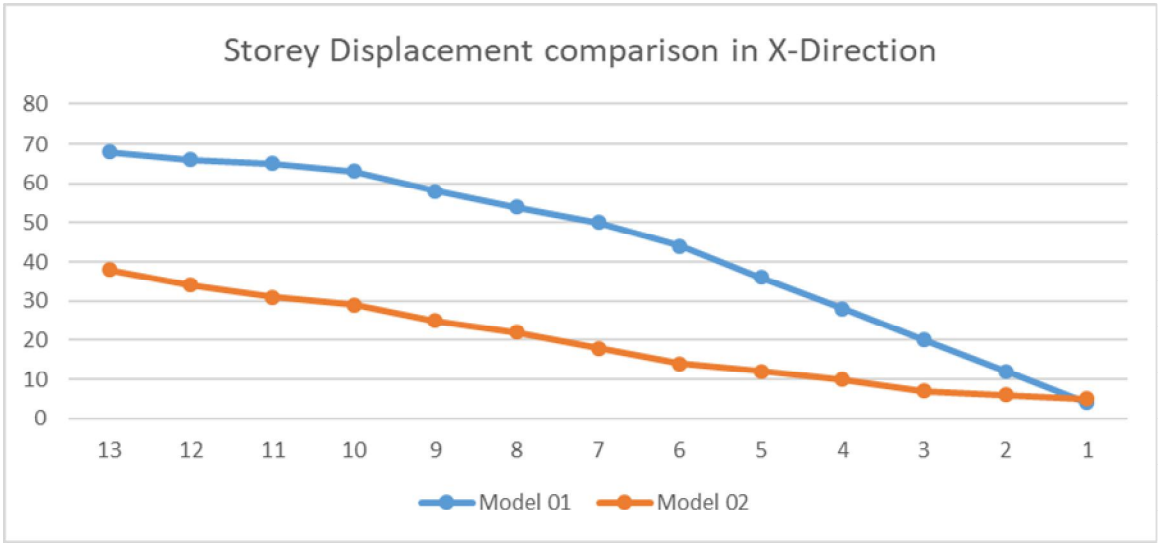
Sr No	Storey Number	Results without FVD (mm)	Results with FVD (mm)
01	13	68.00	38.00
02	12	66.00	34.00
03	11	65.00	31.00
04	10	63.00	29.00
05	09	58.00	25.00
06	08	54.00	22.00
07	07	50.00	18.00
08	06	44.00	14.00
09	05	36.00	12.00
10	04	28.00	10.00
11	03	20.00	07.00
12	02	12.00	06.00
13	01	04.00	05.00



Graph 4.1 Etabs displacement result graph for model 01 in X-direction



Graph 4.2 Etabs displacement result graph for model 02 in X-direction



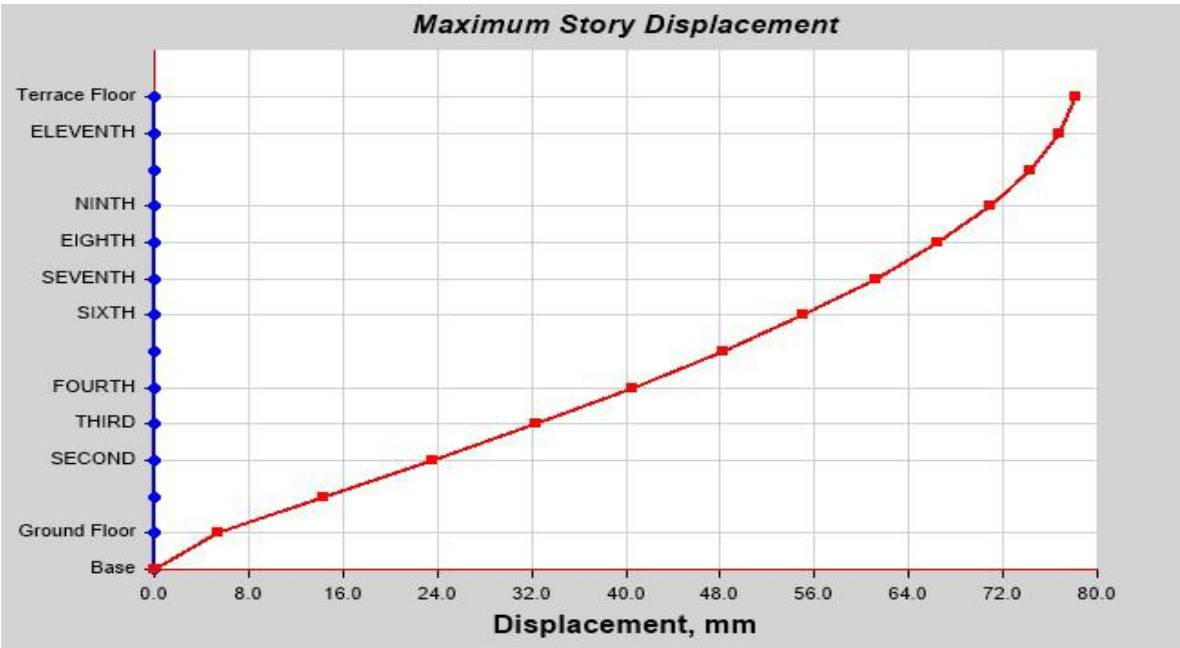
Graph 4.3 Comparison between storey displacement of model 01 and model 02 in X-direction

B. Maximum storey displacement in Y direction

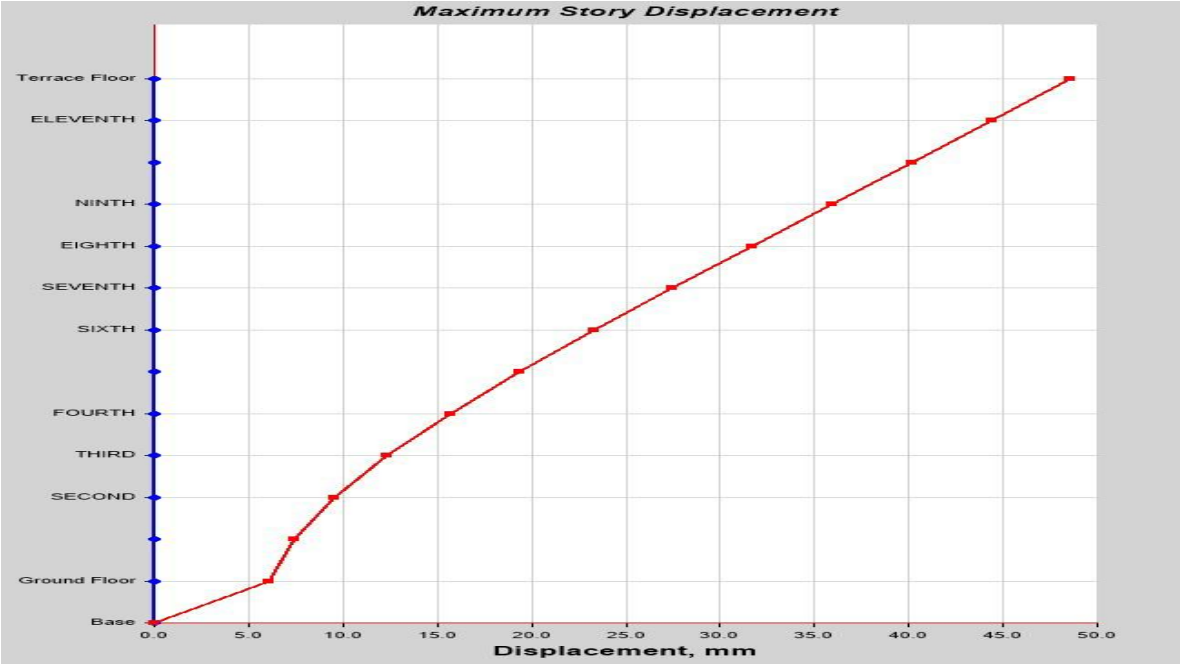
Table 5.2 Comparison between storey displacement of model 01 and model 02 in Y-direction

Sr No	Storey Number	Results without FVD (mm)	Results with FVD (mm)
01	13	78.00	48.00
02	12	76.00	44.00
03	11	74.00	42.00
04	10	68.00	37.00
05	09	66.00	32.00

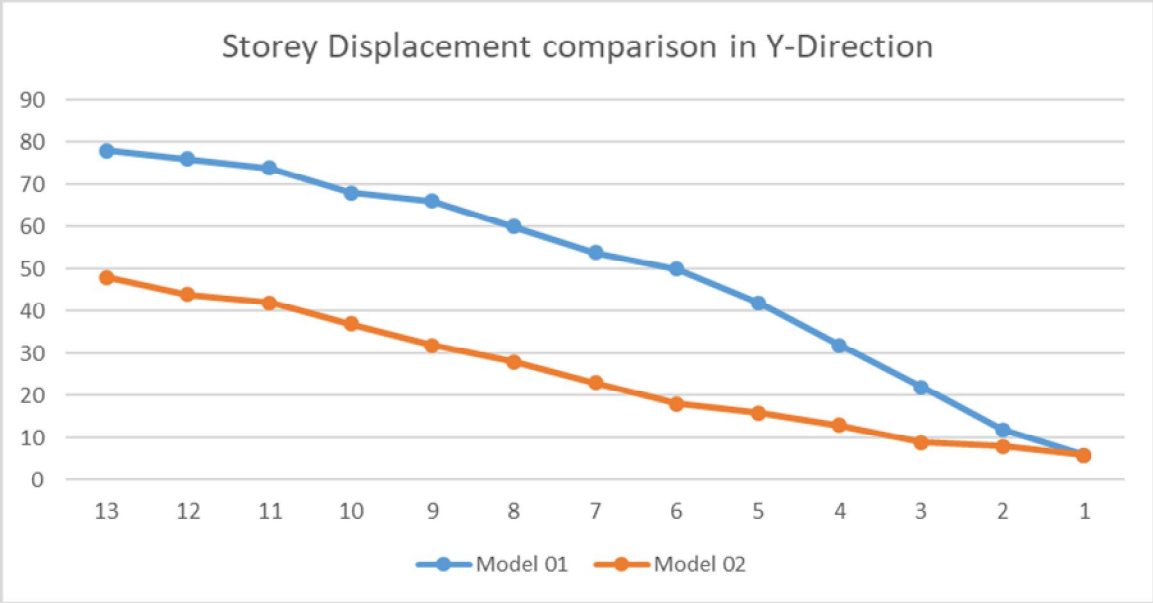
06	08	60.00	28.00
07	07	54.00	23.00
08	06	50.00	18.00
09	05	42.00	16.00
10	04	32.00	13.00
11	03	22.00	09.00
12	02	12.00	08.00
13	01	06.00	06.00



Graph 4.4 Etabs displacement result graph for model 01 in Y-direction



Graph 4.5 Etabs displacement result graph for model 02 in Y-direction

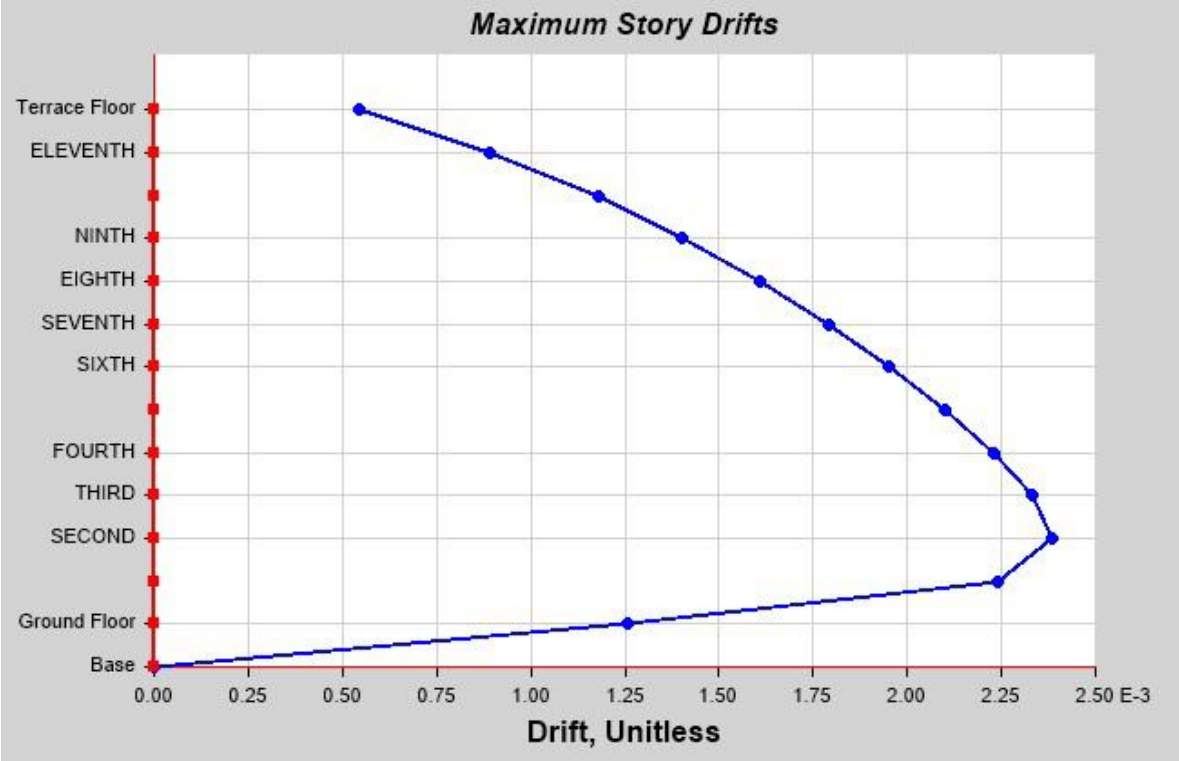


Graph 4.6 Comparison between storey displacement of model 01 and model 02 in Y-direction

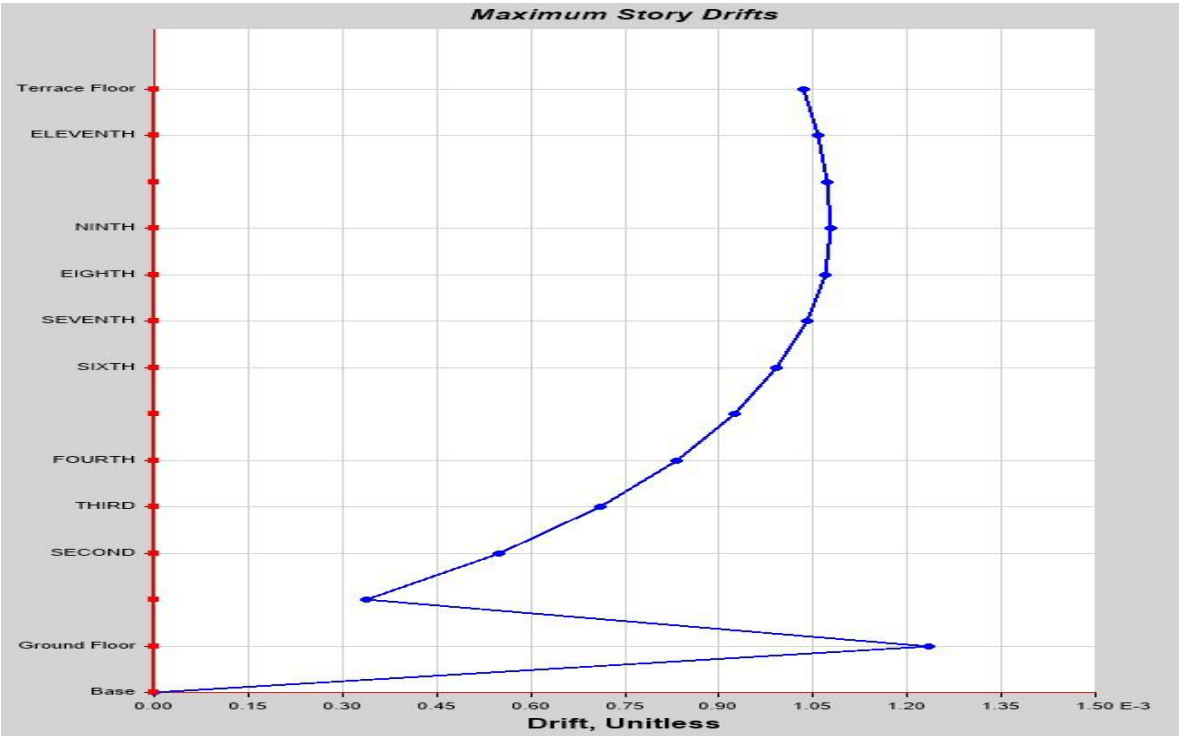
C. Maximum storey Drift in X direction

Table 4.3 Comparison between storey drift of model 01 and model 02 in X-direction

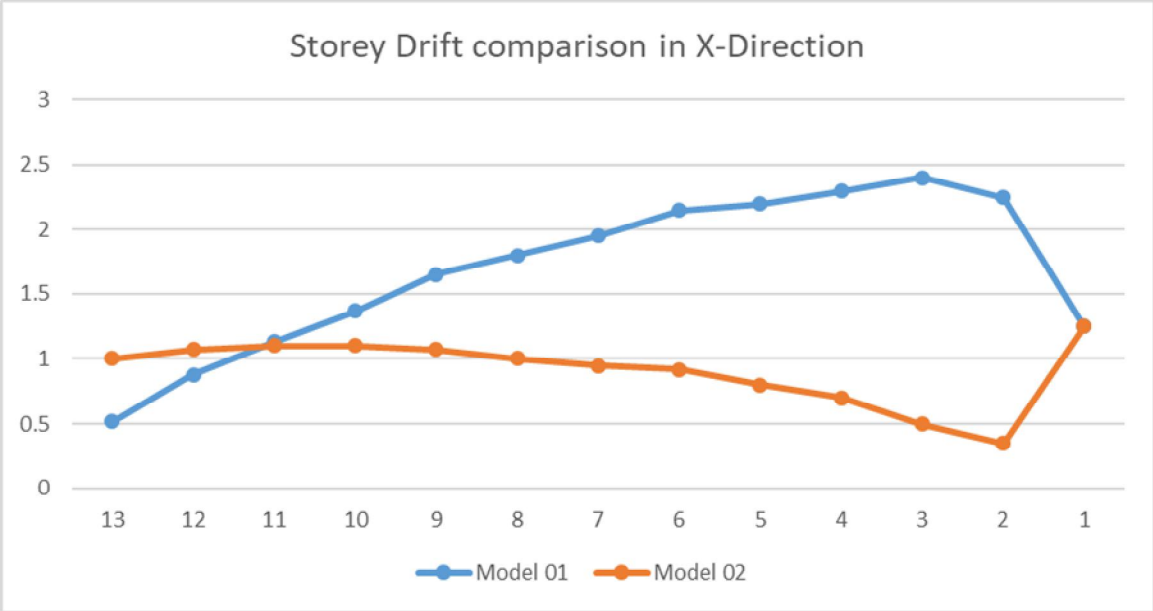
Sr No	Storey Number	Results without FVD	Results with FVD
01	13	0.52	1.00
02	12	0.88	1.07
03	11	1.13	1.10
04	10	1.37	1.10
05	09	1.65	1.07
06	08	1.80	1.00
07	07	1.95	0.95
08	06	2.15	0.92
09	05	2.20	0.80
10	04	2.30	0.70
11	03	2.40	0.50
12	02	2.25	0.35
13	01	1.25	1.25



Graph 4.7 Etabs Storey drift result graph for model 01 in X-direction



Graph 4.8 Etabs Storey drift result graph for model 02 in X-direction

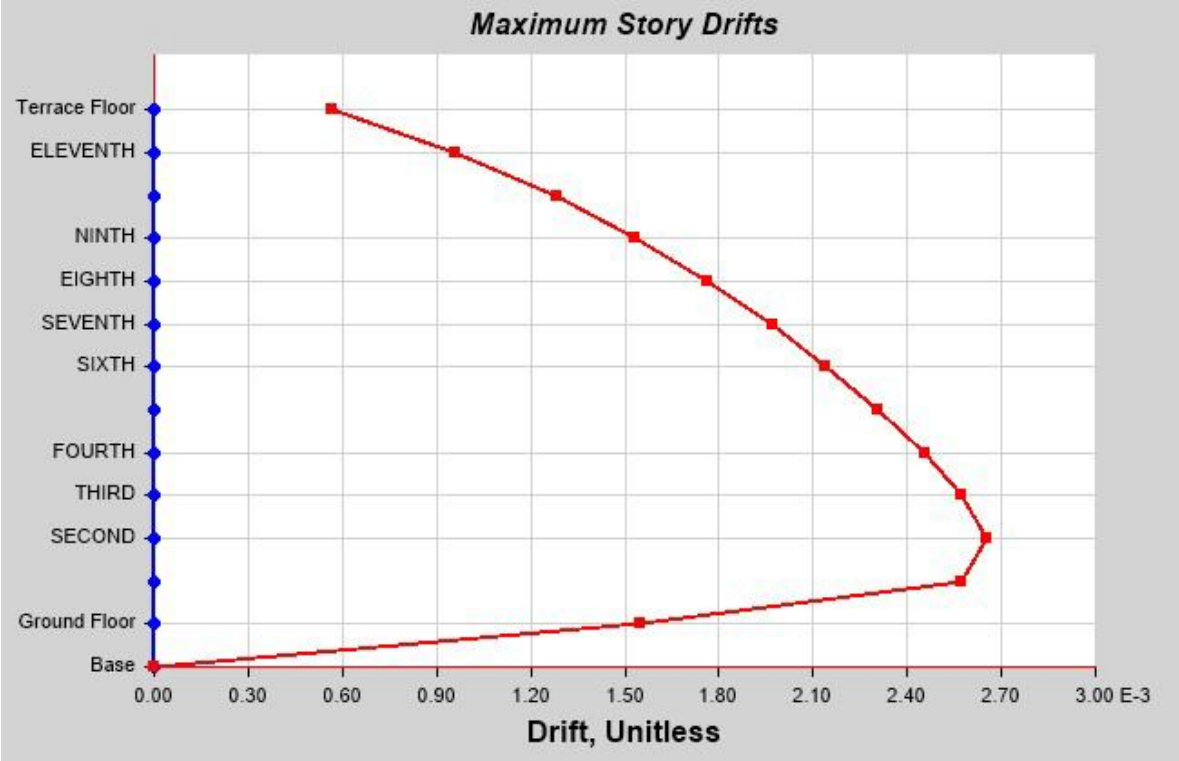


Graph 4.9 Comparison between storey drift of model 01 and model 02 in X-direction

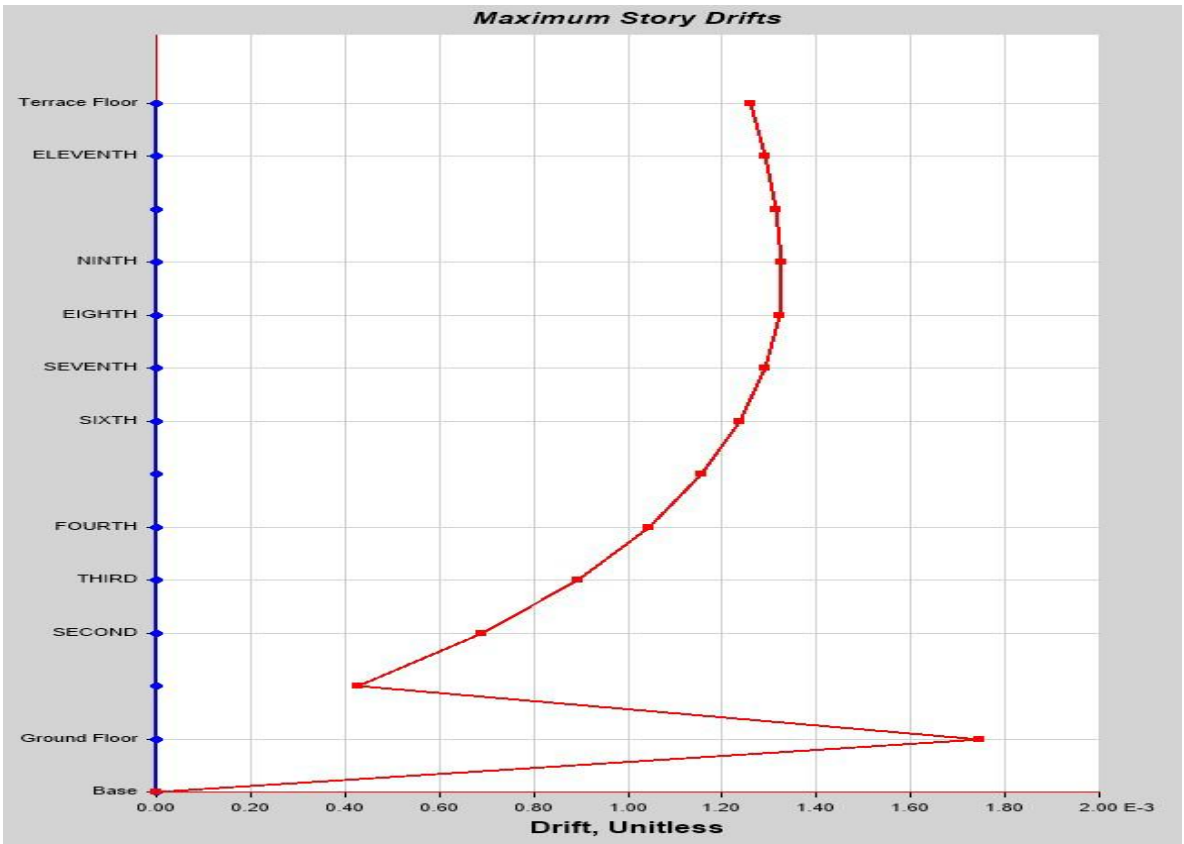
D. Maximum storey Drift in Y direction

Table 5.4 Comparison between storey drift of model 01 and model 02 in Y-direction

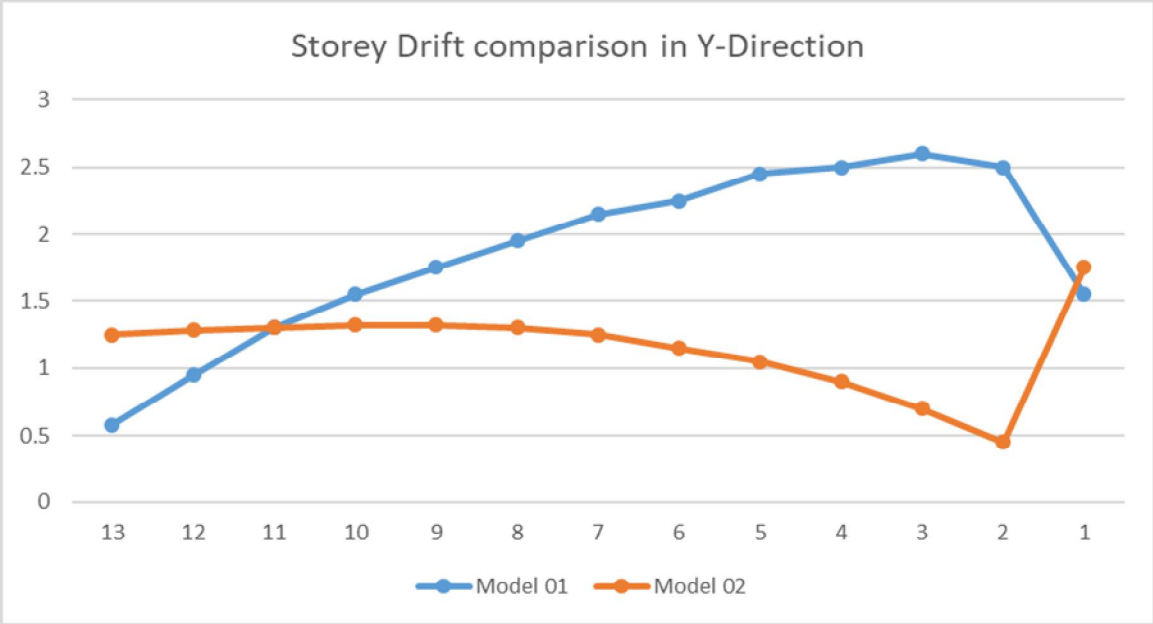
Sr No	Storey Number	Results without FVD	Results with FVD
01	13	0.58	1.25
02	12	0.95	1.28
03	11	1.30	1.30
04	10	1.55	1.32
05	09	1.75	1.32
06	08	1.95	1.30
07	07	2.15	1.25
08	06	2.25	1.15
09	05	2.45	1.05
10	04	2.50	0.90
11	03	2.60	0.70
12	02	2.50	0.45
13	01	1.55	1.75



Graph 5.10 Etabs Storey drift result graph for model 01 in Y-direction



Graph 4.11 Etabs Storey drift result graph for model 02 in Y-direction



Graph 4.12 Comparison between storey drift of model 01 and model 02 in Y-direction

V. CONCULSIONS

1) Employment of Fluid viscous dampers reduces storey displacement by 50 to 70 % in horizontal X direction and 33.00 to 67.00 %

2) Employment of Fluid viscous dampers can reduce storey drift by 20 to 70 % in the middle and lower storey in both X and Y directions

VI. ACKNOWLEDGMENT

It gives me great pleasure on bringing out the report entitled.

"Behaviour of RC building employed with fluid viscous damper**"**

No undertaking of the magnitude involved in the preparation of this project can be accomplished alone. Many have contributed till the successful acknowledge the assistance of the following individuals and would like to thank each one of them.

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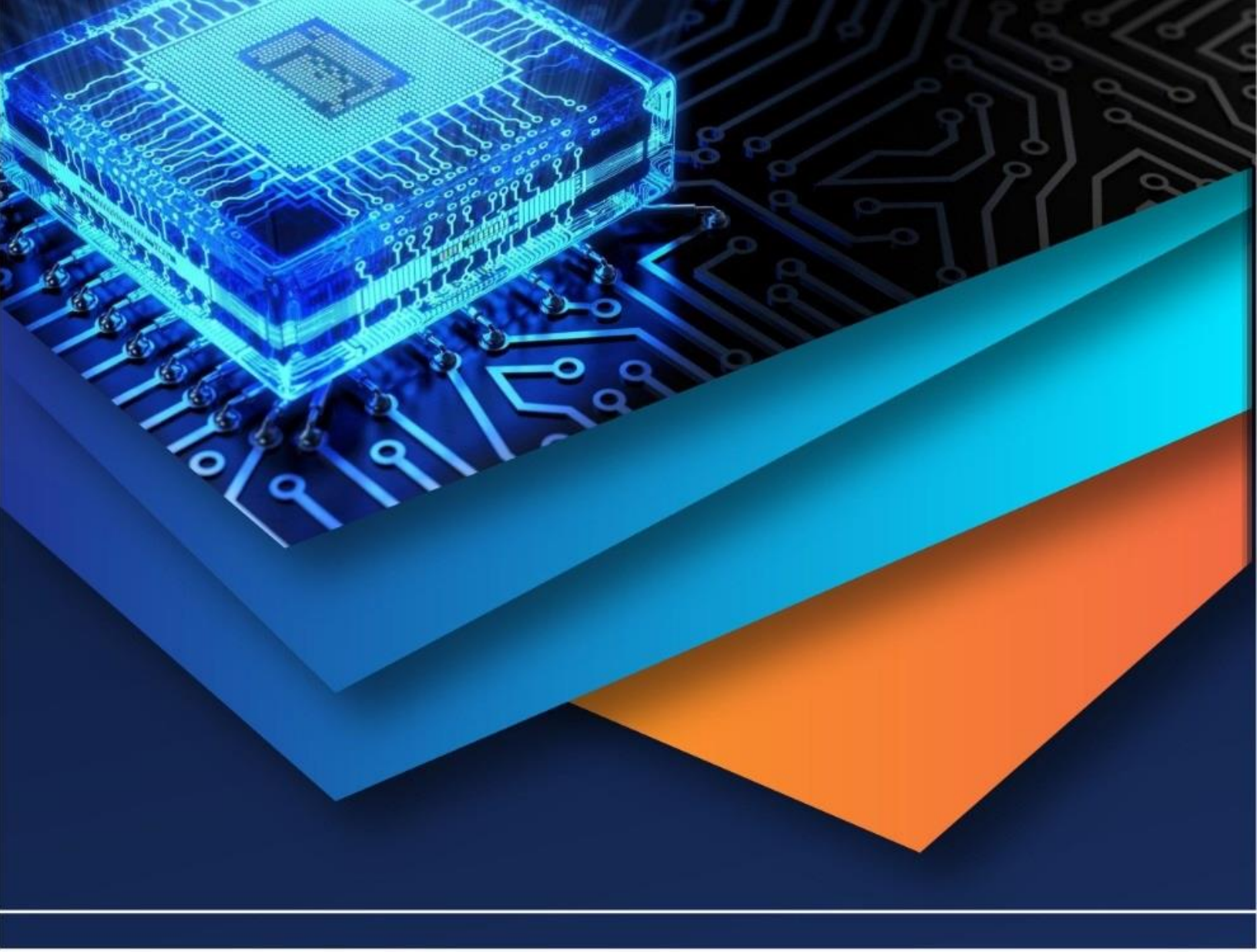

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