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Comparision of Seismic Behaviour of Regular and Vertical Irregular Structure by using Pushover Analysis

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Abstract*—There are different analysis methods to study the seismic behavior of RC building frame. In present study the seismic analysis of building frame is carried out by using pushover analysis. Pushover analysis is non-linear static analysis method in which the structure is subjected to monolithically increasing lateral loads. Now a day's most of the structures are involved with architectural importance, so it is necessary to study the seismic behavior of irregular structure. The present study is concerned with the comparison of seismic responses of regular and vertical irregular structure. The purpose of doing this study is to carry out the pushover analysis of two (regular and vertical irregular) G+7 RC building by using design and analysis software ETABSv9.5.0.and designed as per the Indian standard 456:2000 and 1893:2000.The objective of concerned work is study effect of vertical irregularity on building frame in terms of parameter storey drift,storeydisplacement,andstoreyshear.
***Keywords* – Pushover analysis, Seismic response, storey drift, storey displacement, storey shear**

I. INTRODUCTION

The behavior of building frame during an earthquake depends upon discontinuity in mass stiffness and the strength. To ensure safety against seismic forces of multistoried building frames, there is necessity to study the seismic analysis to design structure as earthquake resistant.

Now a day's requirement of the latest generation and growing population has made the architects inevitable towards development of irregular building configuration. There are different types of irregularity-plan irregularity and vertical irregularity. Vertical irregularities are again divided into subtypes such as, mass irregularity, stiffness irregularity, vertical geometric irregularity, and discontinuity in capacity, In-plane discontinuity in vertical elements resisting lateral force. Among these the vertical geometric irregularity is considered for present study. When the horizontal dimension of lateral force resisting system in any storey is more than 150% of that adjacent storey, then it is called as vertical irregular structure.

Two G+7RC building frames with and without vertical irregularity are considered for present study. Vertical irregularity is achieved by reducing number of bays in vertical downward direction. The pushover analysis is carried out by using design and analysis software ETABSv9.5.0.and designed as per Indian standard 456:2000 and IS1893:2002.

II. PROBLEM STATEMENT

Type of frame	: RC moment resisting Frame
Seismic zone	: III
Number of storey	: G+7
Live load	: 4.0 kN/m^2
Floor finish	: 1 kN/m^2.
Earthquake load	:As per IS-1893(Part-1)2002.
Type of Soil	: Type II, Medium soil As per IS: 1893:2002
Storey height	: 3 m.
Floors	: G.F + 7 upper floors.

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Size of columns : C_1=520X480mm for ground floor, 1^{st},2^{nd} and 3^{rd} floor
C_2=340x300mm for 4^{th} ,5^{th},6^{th} 7^{th} floor

Size of Beams : B_1=420X380mm for 1^{st} , 2,$3^{rd}$and 4^{th} floor

B_2=340X320mm for 5^{th},6^{th},7^{th} and 8^{th} floor

Walls : 230mm thick brick Masonry walls.
Slab thickness : 150mm thick
No. of Bays : 6 along both direction.
Spacing along X-axis : 4.5 m
Spacing along Y-axis : 3 m
Materials : Concrete M30, Steel Fe 415
Density of concrete : 25kN/m^3
Type of Soil : Medium
Damping of structure : 5%
M-I -regular building frame
M-II -irregular building frame (building frame Having 200% vertical irregularity).

III. MODELING AND PUSHOVER ANALYSIS OF REGULAR BUILDING FRAME (M-I)

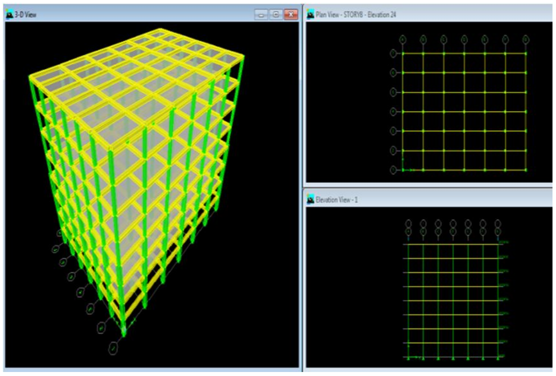

Fig. 1 plan elevation and 3D view of model (M-I)

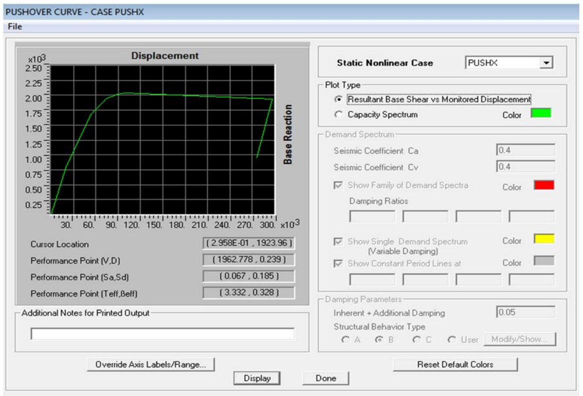

Fig. 2 Pushover curve for model M-I case PUSH-X

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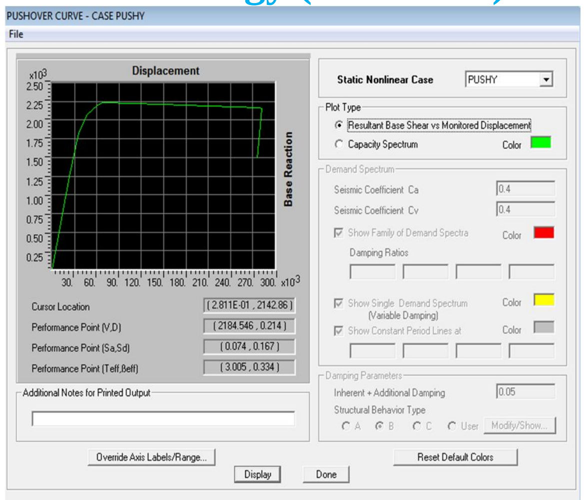

Fig.3 Pushover curve for model M-I case PUSH-Y

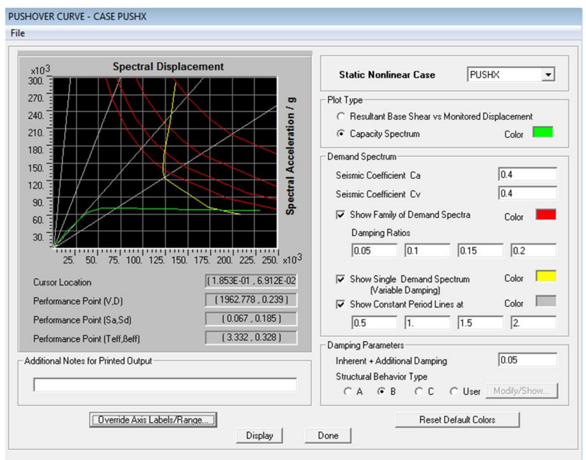

Fig.4 Capacity and demand curves of model M-I PUSH X load case

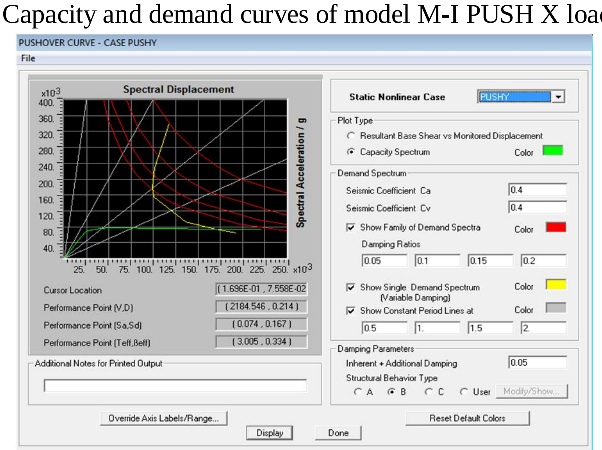

Fig.5 Capacity and demand curves of model M-I PUSH Y load case

The base shear at performance point of model M-I for PUSH X and for PUSH Y case is 1962.778 kN and 2184.546 kN respectively.

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IV. MODELING AND PUSHOVER ANALYSIS OF VERTICAL IRREGULAR BUILDING FRAME (M-II)

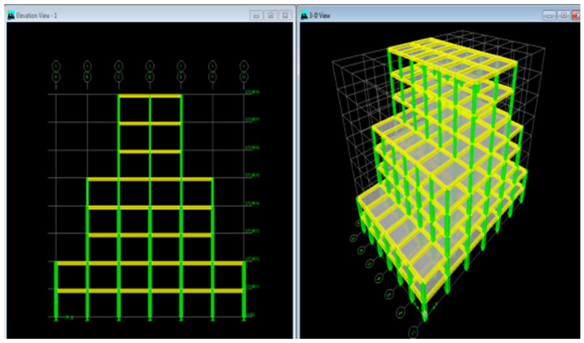

Fig..6 Elevation and 3D view of model (M-II)

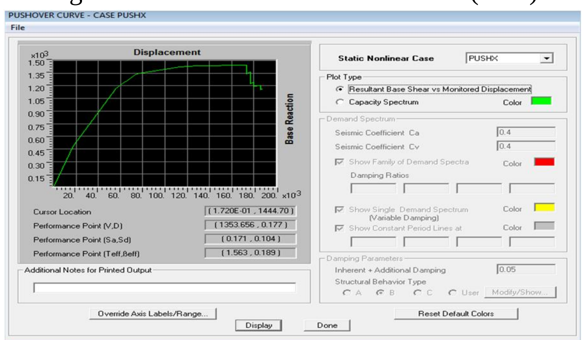

Fig.7 Pushover curve for model M-II case PUSH-X

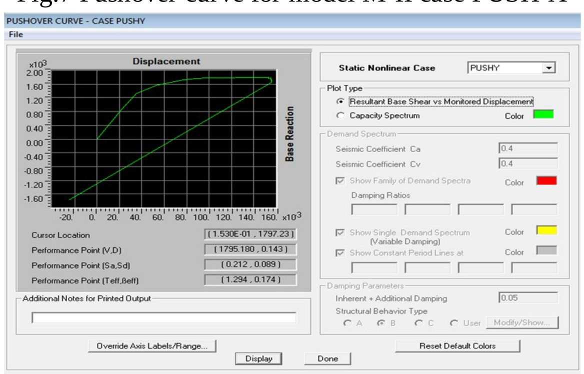

Fig.8 Pushover curve for model M-II case PUSH-Y

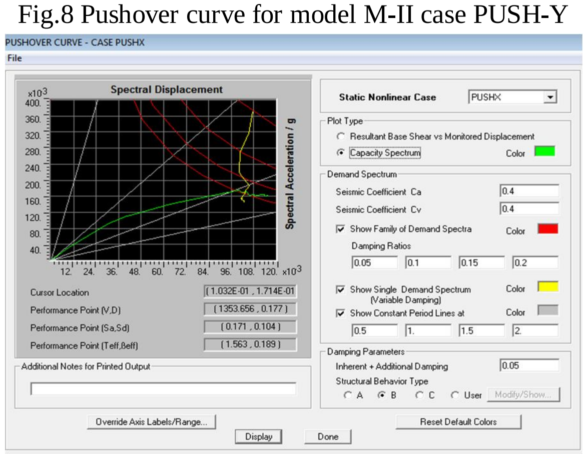

Fig.9 Capacity and demand curves of model M-II PUSH X load case

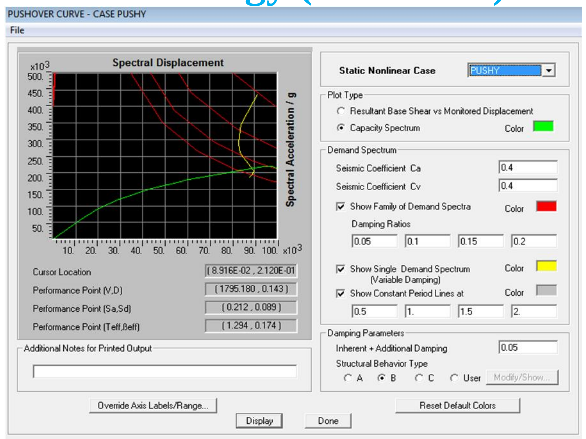

Fig.10 Capacity and demand curves of model M-II PUSH Y load case

For PUSH X and PUSH Y Case base shear at the performance point is 1353.7 kN and 1795.2 kN respectively.

V. PUSHOVER ANALYSIS

A. Storey displacement

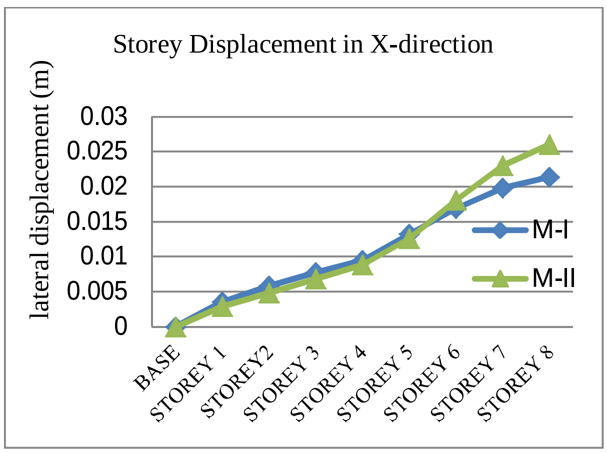

Fig.11 Variation in Storey displacement (X)

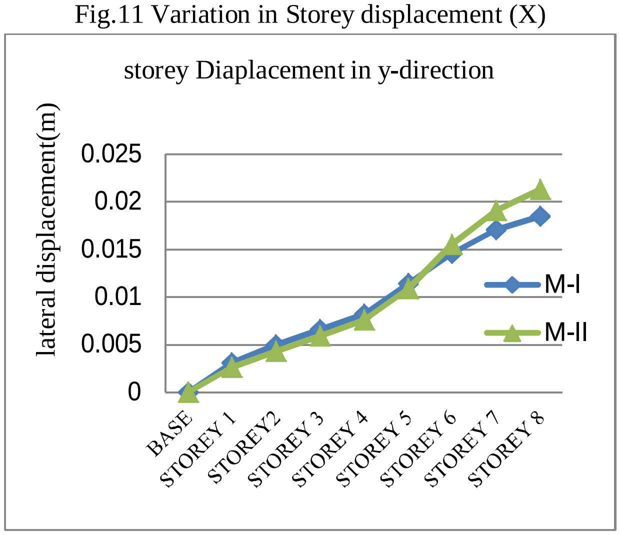

Fig.12 Variation in Storey displacement (Y)

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B. Storey Drift

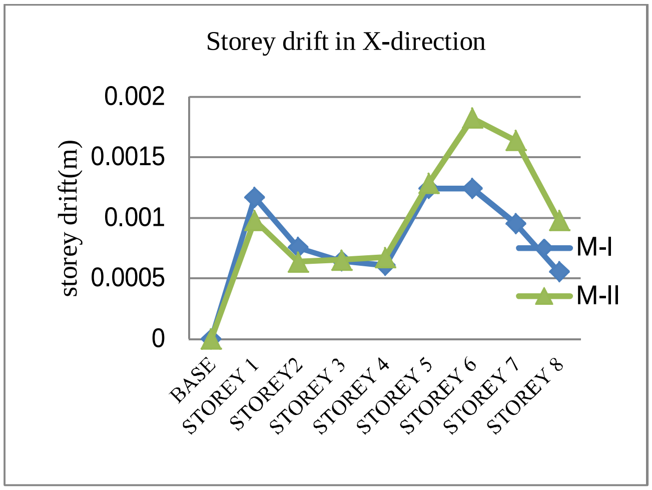

Fig.13 Variation in Storey drift (X)

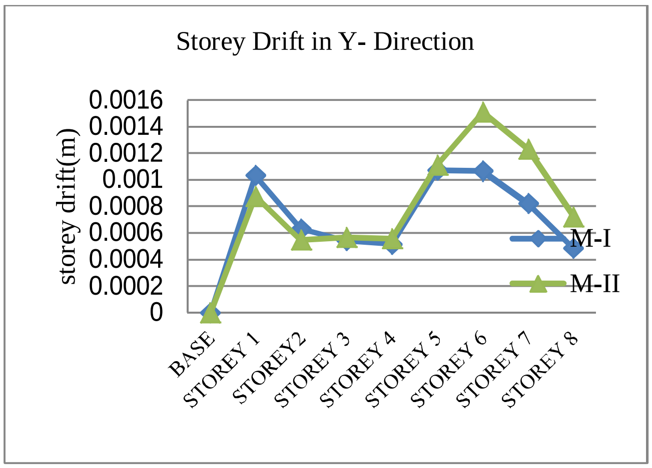

Fig.14 Variation in Storey drift (Y)

C. Storey Shear

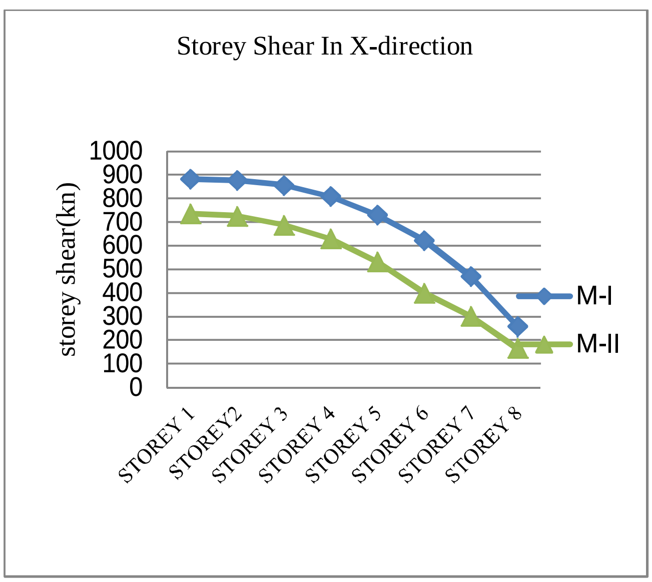

Fig.15 Variation in Storey shear (X)

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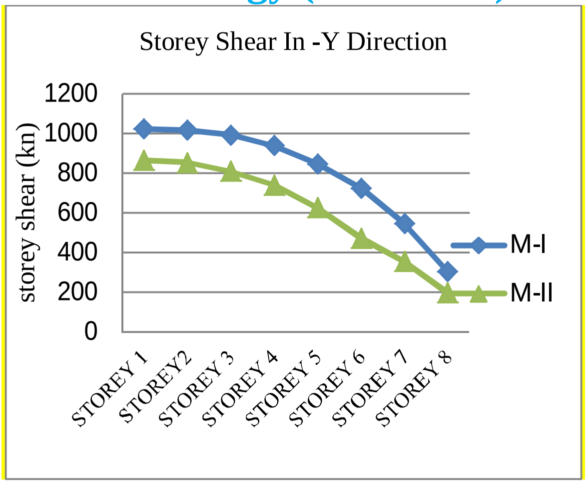

Fig.16 Variation in Storey shear (Y)

VI. ANALYSIS RESULTS

Table 1-Pushover analysis Result

MODEL	M-I		M-II	
PARAMETER	X	Y	X	Y
Base shear at performance point (kN)	1963	2184.5	1353.7	1795.2
Displacement at performance point (kN)	0.239	0.214	0.177	0.143
Story displacement (m)	0.021	0.0185	0.026	0.0213
Story Drift (m)	0.001	0.0011	0.0018	0.0016
spectral acceleration (m/s2)	0.067	0.074	0.171	0.212
Spectral Displacement (m)	0.185	0.167	0.104	0.089

VI. CONCLUSIONS

The following conclusions are drawn based on present study:

A. The building frame with vertical irregularity undergoes maximum storey displacement as compared to the building frame without vertical irregularity.(fig.11 and fig.12)

B. Due to provision of vertical irregularity there is increase in storey drift. (fig.13 and fig.14)

C. In case of irregular building frame there is decrease storey shear as compared to the regular building frame. (fig.15 and fig.16)

D. Vertical irregular structure has less seismic performance as compared to regular structure.(table 1)

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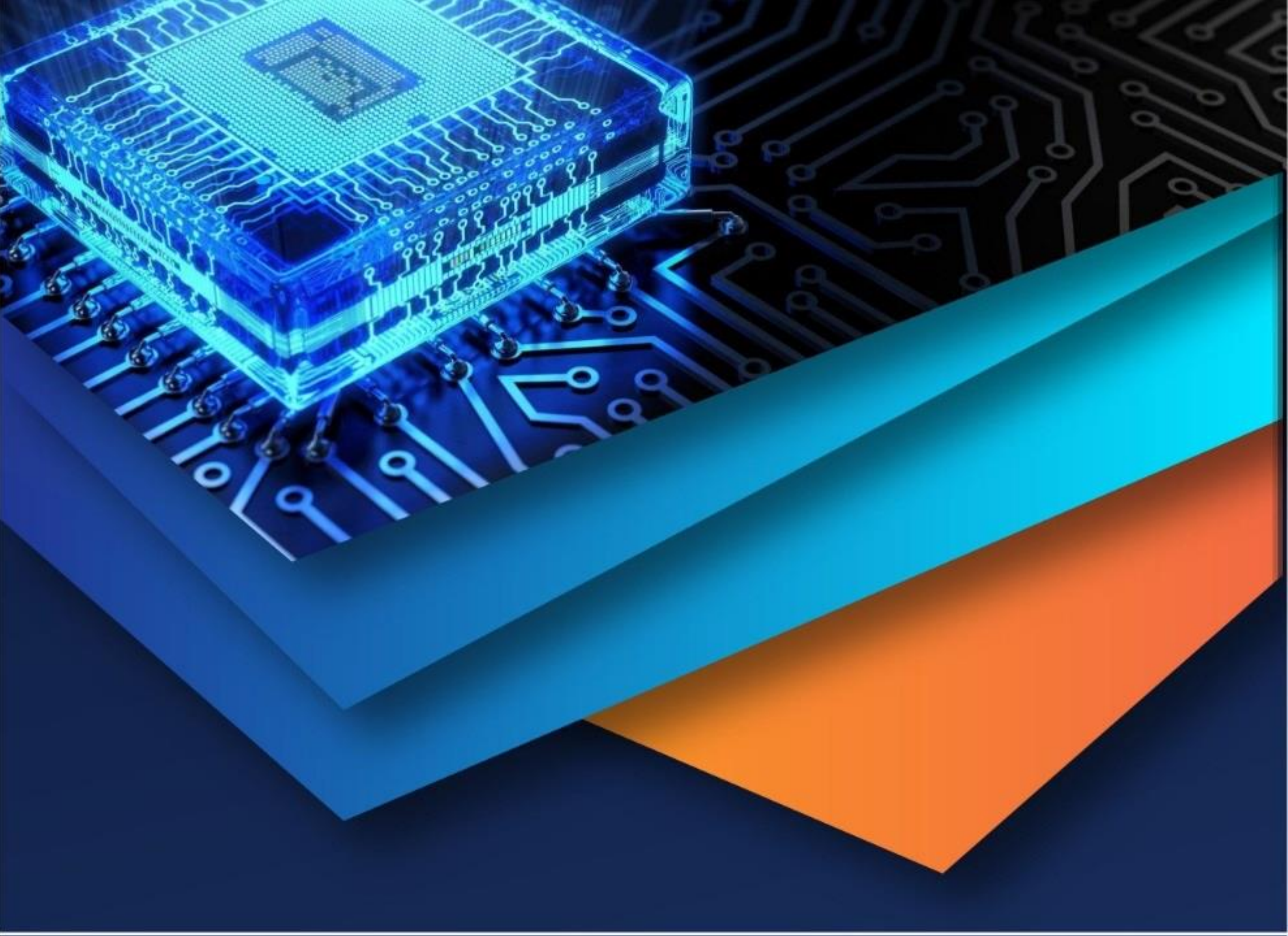

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