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Seismic Behaviour of Asymmetric RC Structures

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Abstract: The result of an earthquake is generally due to the aspects such as load path distribution irregularities in structures, effects of source and local site. Earthquake causes vibration in ground and structures resting on it which will be subjected to ground motion. In this work an effort is made to study the behaviour of asymmetric structure with plan irregularities when subjected to nonlinear static analysis. Analysis is done using ETABs software. 5 no of G+5 RC frame structures were considered, where one is the Regular(Rectangular) in plan and others are H, L, U, E shape in plan. Results like storey displacement, storey shear, storey drift and Capacity curve are computed using ETABS and the values extracted are compared with each other.

Keywords: Plan Irregularity, Nonlinear Analysis, ETABS, Storey displacement, Storey drift, Storey shear, Capacity curve.

I. INTRODUCTION

Modern multi-storey buildings are constructed with Irregularities such as mass irregularity, plan irregularity and vertical irregularity. And it is observed that most of RC structures with these kind of irregularities are undesirable for seismic activity. As all know earthquake is most destructive of all natural disaster and safety measures must be considered while construction. In this study we have chosen plan irregularity. In the thesis 5 models with different plan i.e, Regular (Rectangular), H, L, U, E shapes are modelled using ETABS software and nonlinear static analysis is performed. Parameters such as, storey displacement, storey shear, storey drift, Capacity curve are computed from ETABS and compared with one another.

II. OBJECTIVES

In this work effort is made to study the behaviour of asymmetric structure with plan irregularities when subjected to nonlinear static analysis. The study is set to the following objectives.

1) To study the lateral response of the structure with plan irregularities under incremental lateral loading.
2) To study the storey drift of the structure with plan irregularities under incremental loading.
3) To study the lateral load carrying capacity of the structure with plan irregularities under incremental loading.
4) To study the storey shear of the structure with plan irregularities under incremental lateral loading

III. STRUCTURAL DATA AND MODELLING

A. Load On The Structure

Live load	3KN/m2
Roof live load	1KN/m2
Floor finish	1KN/m2

B. Seismic Details

Earth quake zone	III
Importance factor	I
Type of soil	Soft soil
Type of structure	All general RC frame
Response reduction factor	5(SMRF)
Time period	Program calculated

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C. Geometric Data

Thickness of slab	160mm
Depth of beam	380mm
Width of beam	300mm
Dimension of column	300mm x 450mm
Thickness of out wall	230mm
Height of each floor	3.0m
No. Of Floor	G+4

D. Models Considered

MODEL 1: (Regular shape)

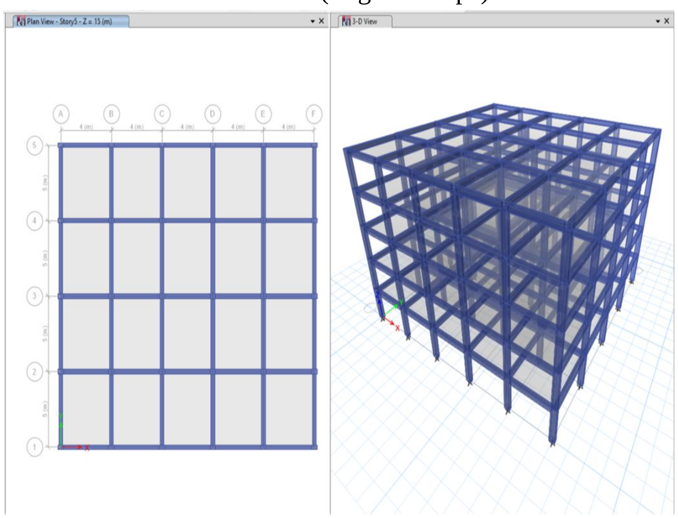

Fig-01: Regular Shape

MODEL2: (H shape)

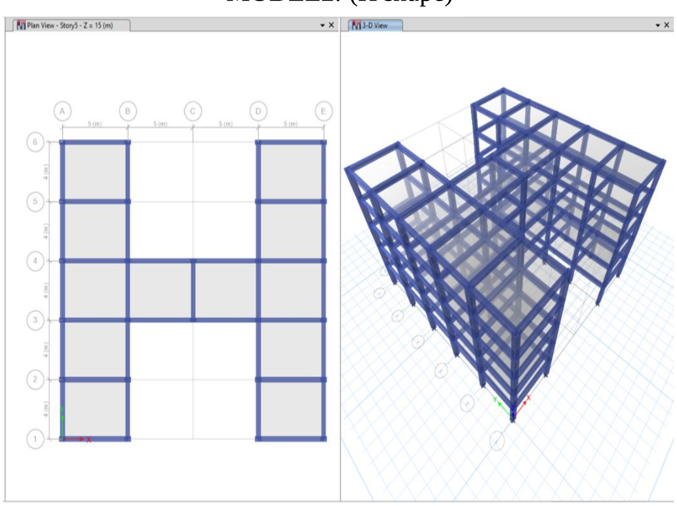

Fig-02: H shape

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MODEL 3: L shape

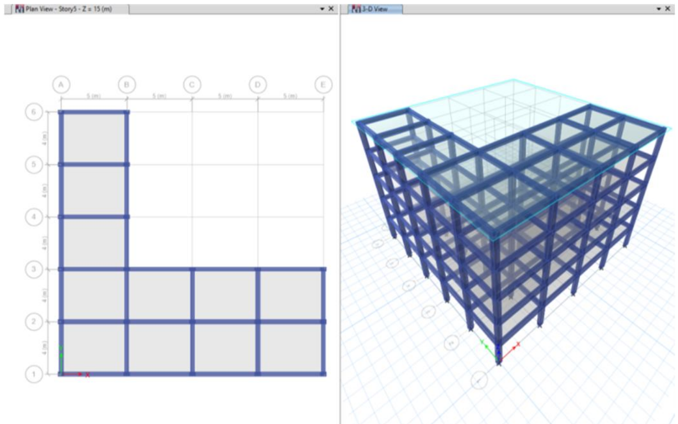

Fig-03: L shape

MODEL 4: U shape

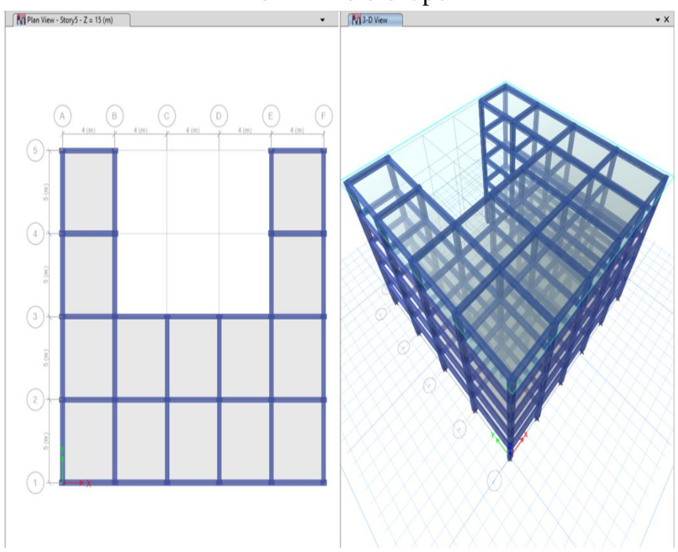

Fig-04: U shape

MODEL5: E shape

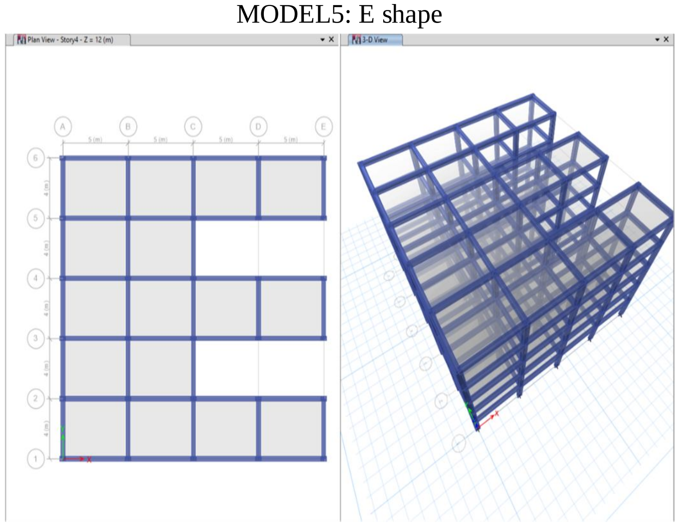

Fig-05: E shape

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IV. RESULT AND DISCUSSION

A. *Storey Displacement*

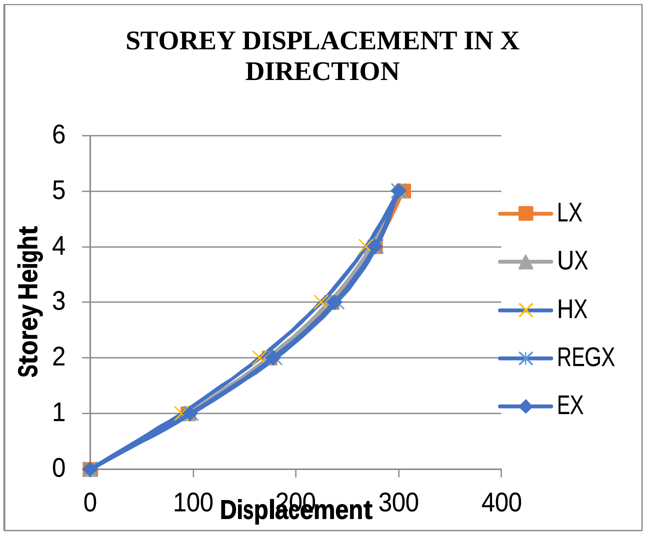

Fig-06: storey displacement for all models in X directions

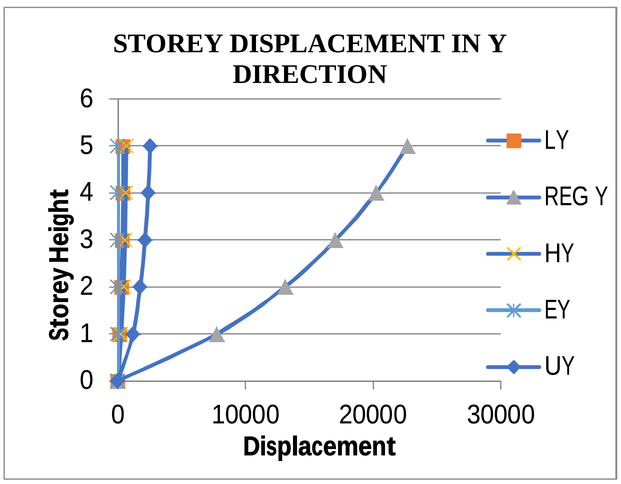

Fig-07: storey displacement for all models in Y directions

B. *Storey Drift*

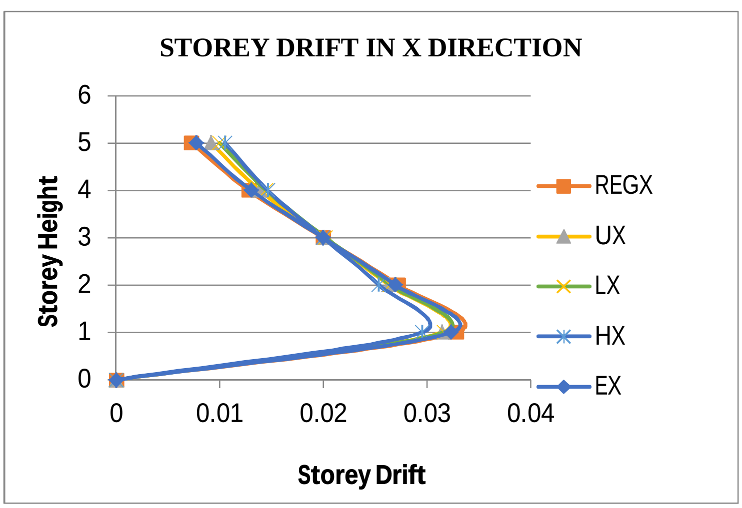

Fig-08: storey drift for all models in X direction

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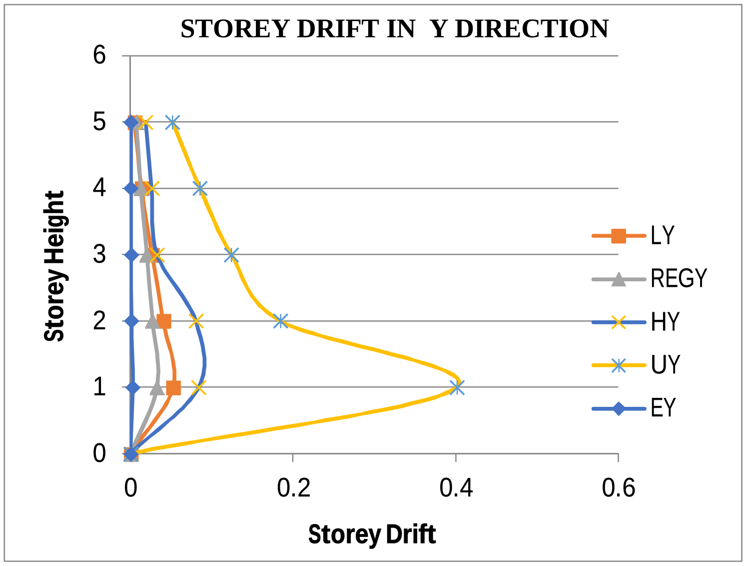

Fig-09: storey drift for all models in Y direction

C. Storey Shear

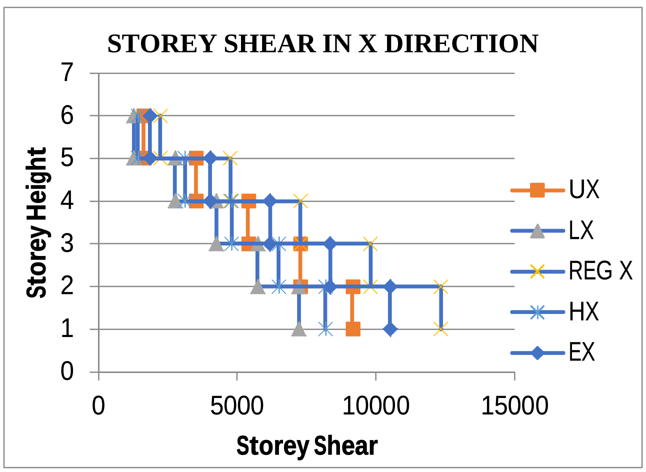

Fig-10: Storey shear for all the models in x direction

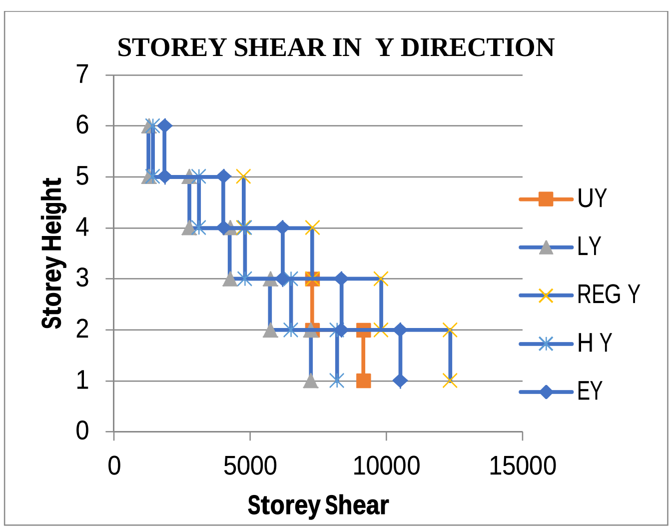

Fig-11: Storey shear for all the models in y direction

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V. CAPACITY CURVE

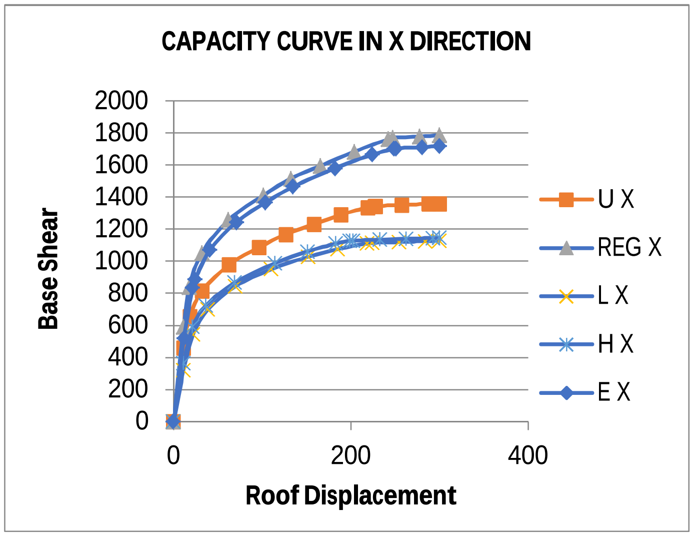

Fig-12: Capacity curve for the all models in X direction

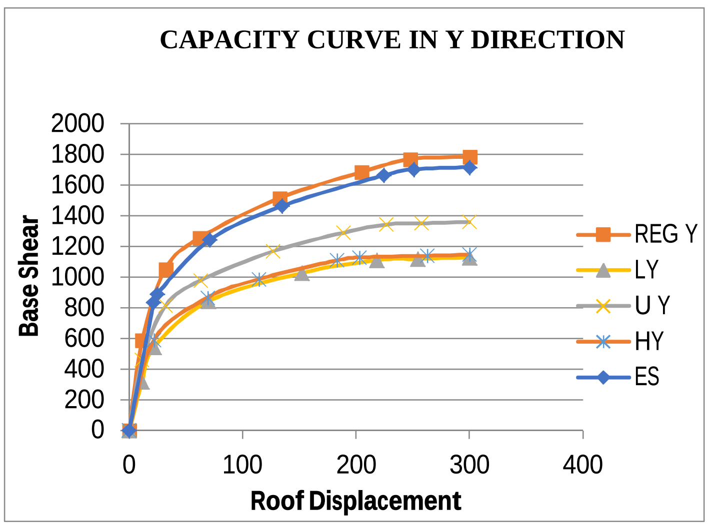

Fig-13: Capacity curve for the all models in Y direction

VI. CONCLUSION

A. Fig 6 and fig 7 shows the displacement of each storey along the height of the building for different shape of the models along X and Y directions respectively. From the data presented in table 5.1 for displacement of the building in X and Y directions, it can be observed that, the displacement in X direction is almost same for all the models from base to roof. In Y direction regular building shows more displacement from base to top but in other shape like L, H, E, U displacement is observed very less from base to top.

B. Storey lateral displacement is more in E shape and regular shape in x direction and it more in regular building in y direction

C. Fig 8 and Fig 9 shows the storey drift along the height of building for each model in X and Y direction respectively. From the data tabulated in table 5.2 it can be observed that the storey drift is zero at base and more at storey1 for all the models. in X direction H shape shows more drift compared to other models, in Y direction U shape has more storey drift. storey drift in storey 2 decreases from 0.4 to 018.

D. Storey drift in E shape and regular shape is more in x direction and its more in U shape in y direction.

E. Fig 10 and 11 shows storey shear along height of building for each model in X and Y direction respectively. From the data tabulated in table it can be observed that the storey shear decrease with storey height. storey shear for regular building is 12346.335KN in X direction which is maximum among all the different shapes of buildings and L shape minimum of 7229KN.

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Even in Y direction regular building as maximum storey shear with 12346.335KN and L shape with minimum shear of 7229.12KN. There is no much difference in storey shear for different models in both X and Y direction.

F. Storey shear is more in regular shape and less in L shape both in x and y direction.

G. Fig 12 and Fig 13 shows the capacity curve for each models along X and Y directions respectively. Form the data present in table can be observed that regular shape is having more base shear of 1785.1 for 300mm displacement compared to other models in X direction and base shear of 1785.2 for 300mm displacement in Y direction compared to other models

H. Capacity curve increases in regular building and decreases in L shape both in x and y direction.

I. Finally we can say that regular shape of the building perform well during Earthquake

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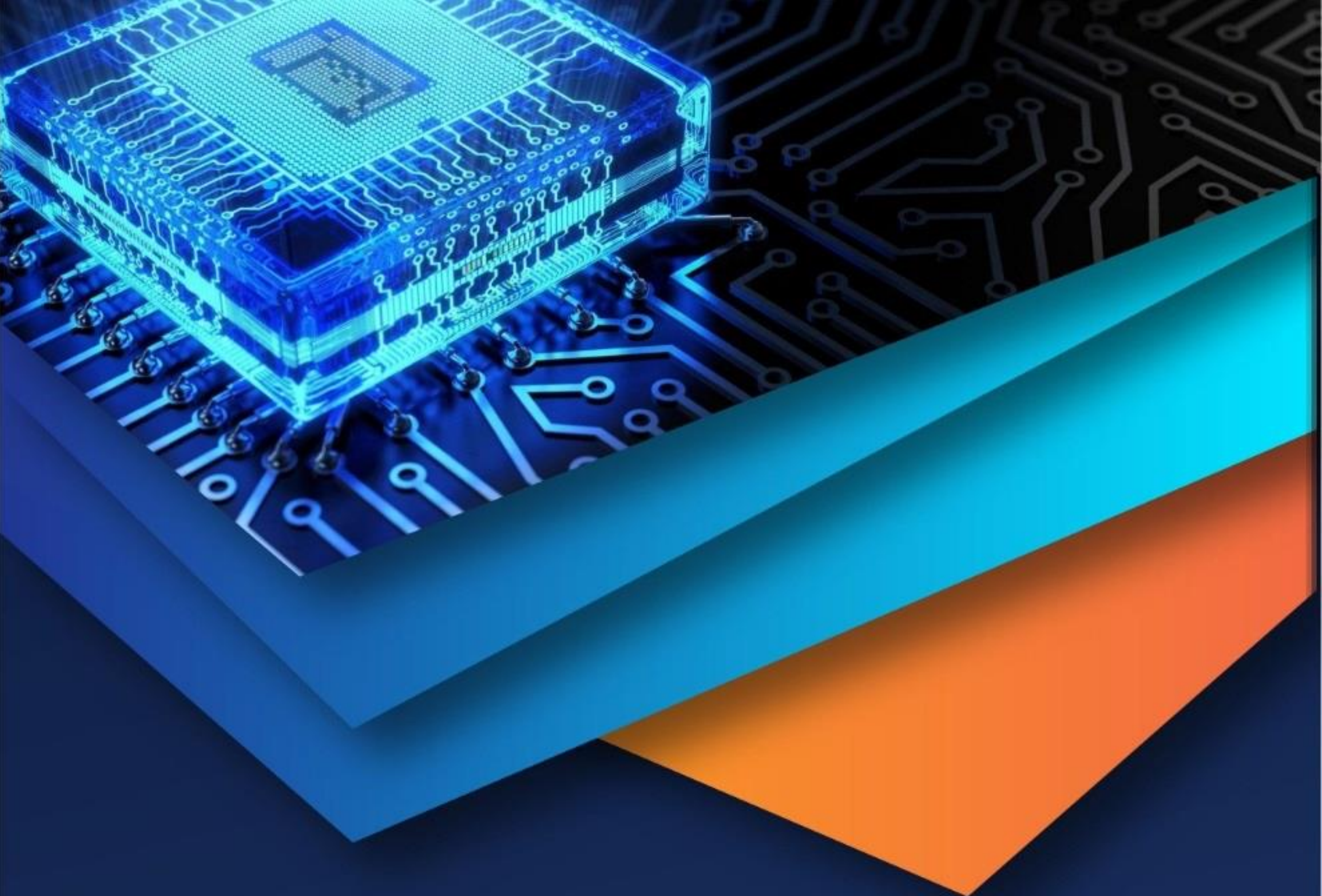

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