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Comparative Study on Design & Analysis of Multi-Storied Building and Mono-Column Building

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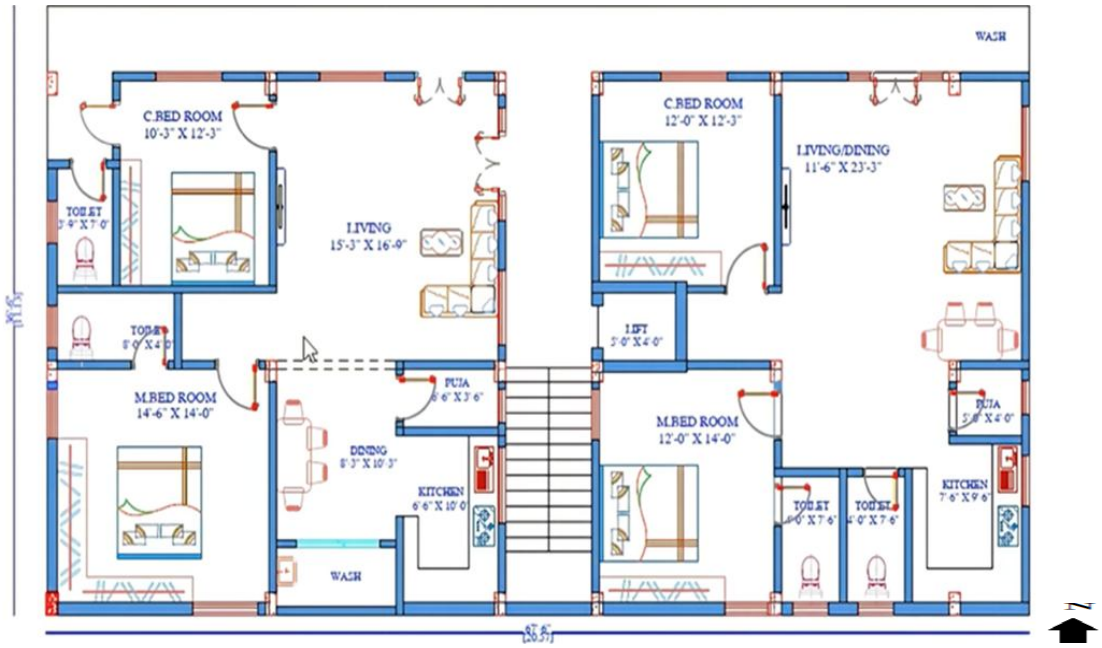
Abstract: ***The comparative study on analysis of RCC Frame structure supported on a mono-column and multi-column is done in this paper. Economic comparisons, Land space comparison is done between RCC mono-column and RCC multi-column structure. This project presents structural modelling, stress, bending moment, shear force and displacement, deflection design considerations for a structure and it is analysed by using STAAD-Pro software. Various steps concerned in designing of RCC Frame structure supported on a mono-column and multi-column by using STAAD-Pro software are Geometric Modelling, providing material properties and sectional Properties, fixing supports and boundary conditions, providing loads & load combinations, Special Commands, Analysis Specification , Design Command and report.***

Keywords: ***Mono-column building, Multi-storied building, STAAD-Pro, Design, Analysis***

I. INTRODUCTION

Urbanization and rapid rise in population and shortage of land increases the demand of multi-storeyed structure so to save the ground space for parking and other activities and less area is provided for the foundation, structure is supported on single vertical column is called monocolumn building, it gives the better asthetical view as compared to structure supported on many columns.

The design and analysis of tall structures are crucial in ensuring their structural integrity, safety, and overall performance. Monocolumn and multicolumn configurations represent two widely adopted approaches in structural engineering, each with distinct advantages and limitations. This research paper presents a comprehensive comparative study between monocolumn and multicolumn structures, evaluating their performance in terms of structural behaviour, design efficiency, and construction feasibility.



Built up area (single floor): 2474.16 Sq. Feet (67'6"×36'6")

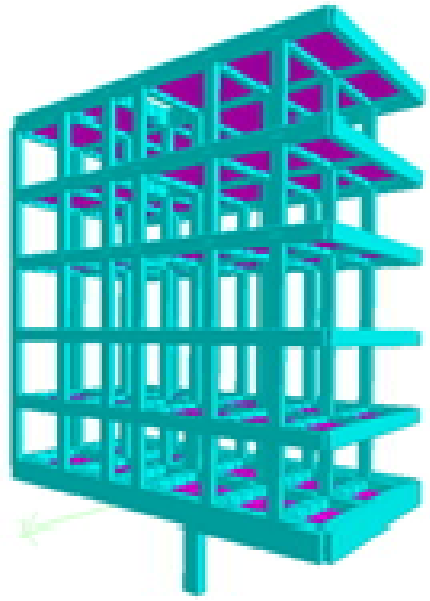


Fig. G+5 Mono-column structure

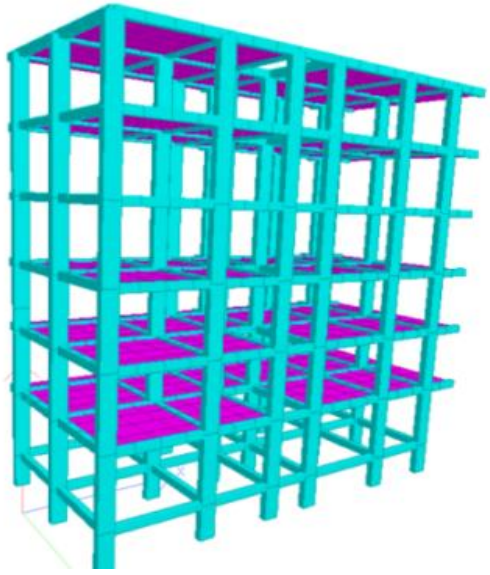


Fig. G+5 Multi-column structure

II. LITERATURE REVIEW

Dr. S.G. Makarande, Mr. Jayant S. Ramtekeet.al.(2019) "A Review On Comparative Study And Analysis Of A Conventional Multi-Storey Building And A Single Column Building" The comparative study and analysis of RCC frame structure supported on single column and multicolumn is done in this project. Design and analysis of structure is done by using STAAD Pro softwareG+4 building is designed.[1]

Madireddy Satyanarayana (2016) "Design of Multi Storey Building Resting on Single Column" In this paper he studied to analyse and design of multi-storey building rests on the single column by using the different IS code. First the layout plan of the building is drawn by using AUTO CAD.

This miltistorey building consists of ground floor plus five floors. The each floor consists of one house and the separate staircase is provided. The planning of building is done as per Indian standard code provisions. From this research paper it is concluded that limit state of design is used.

The author had done the design aspects of the structure manually and by using software. He used code provision of the SP 16 and SP 34 (design aids for the concrete and detailing) [2]

EK Mohanraj et.al. (2002) "Analysis and Design of an Office Building with Mono Column" In this paper analysis and design of single column, satisfies all the required stability.

Ring beams and inclined beams are provided to reduce the cantilever span of beam. They consider maximum space utilization provides maximum serviceability. [3]

T.Subramani (2019) "Design And Analysis of Mono Column Using STAAD Pro" In this paper design and layout of single column building at a site of 190m2 in Salem Autocad was used for drawing the plan and the structure was analysed by using STAAD Pro and checked manual calculations. Also studied the lateral displacement of building [4]

Ankur Pandey, Vaibhav Singh et.al.(2018), "Mono Column Single Storey Structural System Using Composite Material" This paper presents the rapid growth in population and the scarcity of land tends to development of construction technology and high rise building the single column building compares with the structure with regular column. [5]

III. OBJECTIVE

1) To find out the various design parameters acting upon the cantilever beams and structures.
2) To analyse and design G+ 5 storied structure in STAAD Pro Software.
3) To compare analysis between the mono-column and multi-column structure.

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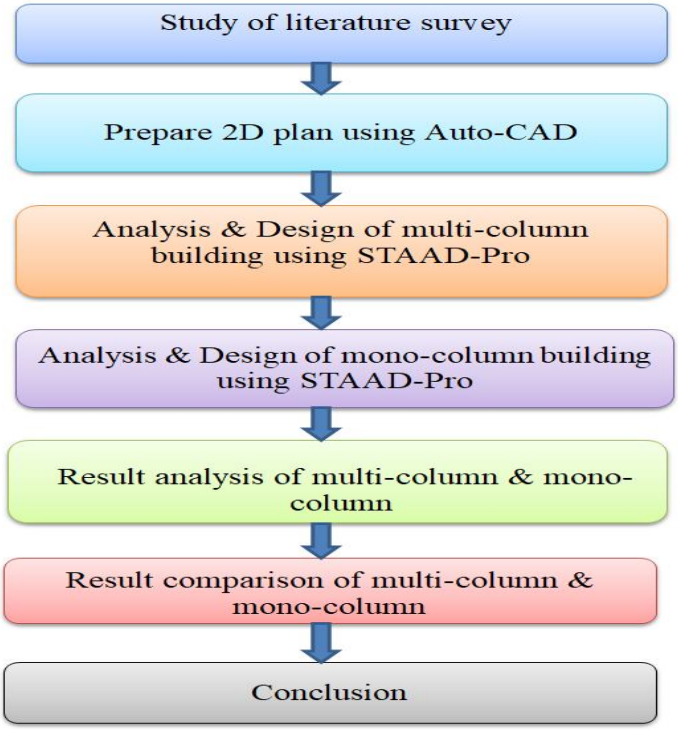
IV. METHODOLOGY



V. COMPARISION POINTS

A. Axial Load

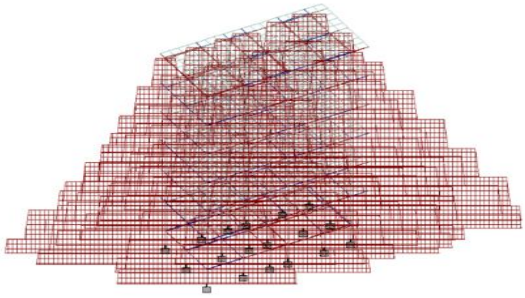


Fig.1 Axial Force On Multicolumn

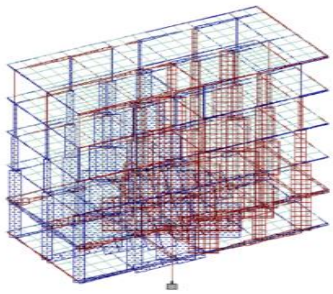


Fig.2 Axial Force On Mono Column

B. Torsion

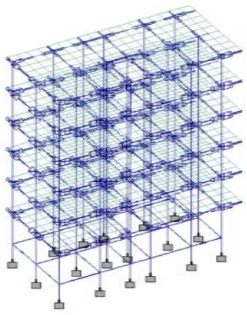


Fig.3 Torsion On Multicolumn

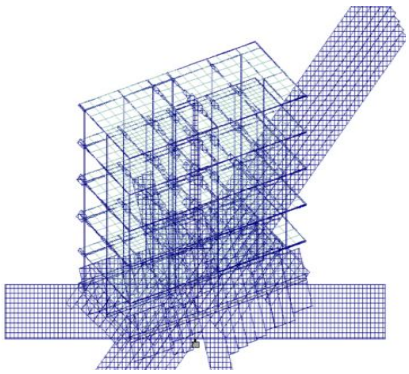


Fig.4 Torsion On Monocolumn

C. Bending moment (y direction)

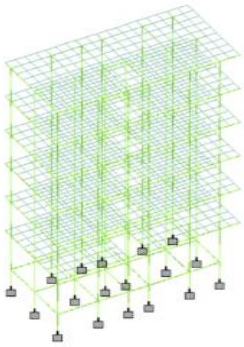


Fig.5 Bending Moment On Multicolumn (Y Direction)

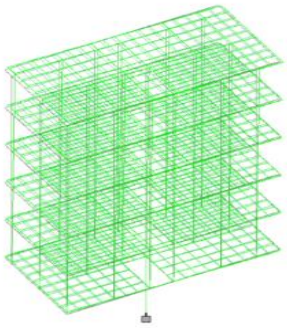


Fig.6 Bending Moment On Monocolumn (Y Direction)

D. Beam stress

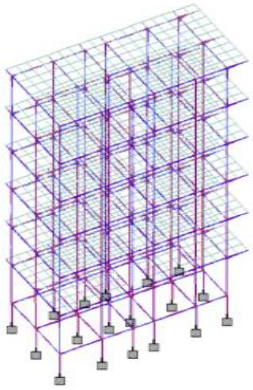


Fig.7 Beam Stress on Multicolumn

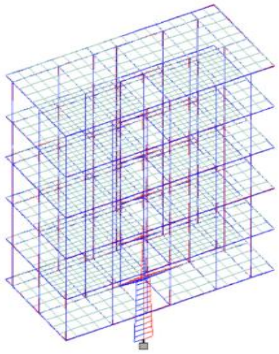


Fig.8 Beam Stress On Monocolumn

E. Deflection

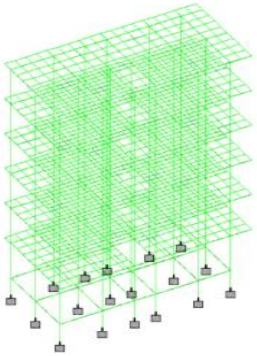


Fig.9 Deflection On Multicolumn

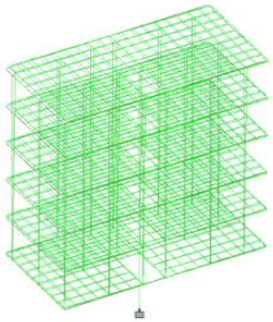
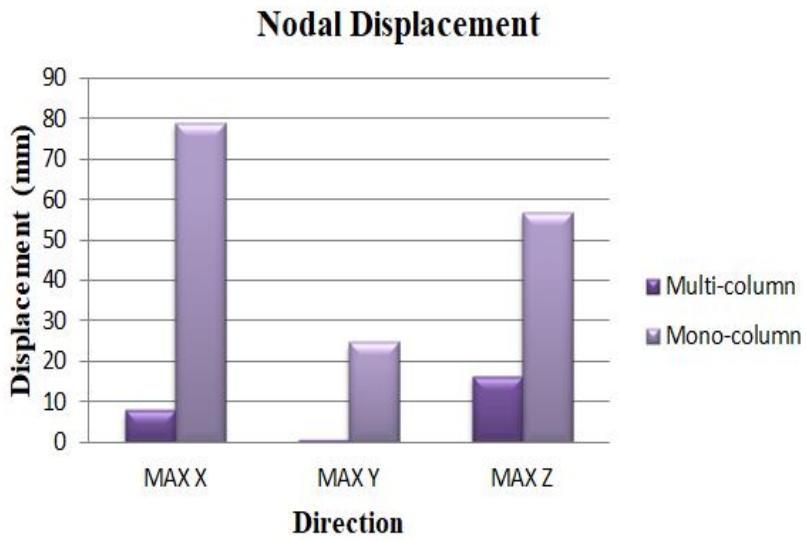


Fig.10 Deflection On Monocolumn

F. Nodal Displacement

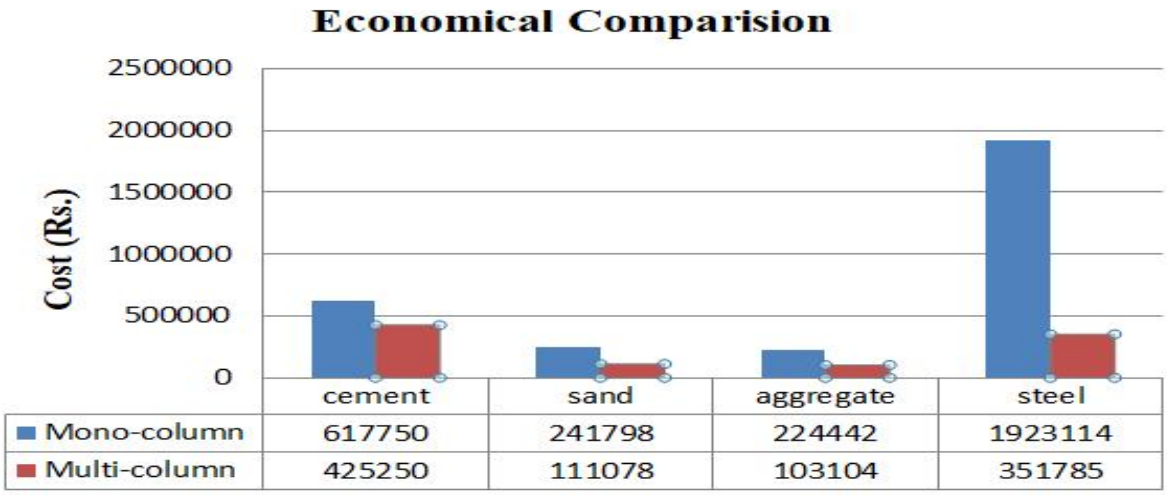
In STAAD.Pro, nodal displacement refers to the movement or displacement of a node (a point where members of a structure are connected) in a three-dimensional space. Nodal displacements are essential for understanding the structural behaviour, deformation, and stability of a system under applied loads.

	Multi-column(mm)	Mono-column(mm)	% increase
Max X	8.014	79.026	89.86
Max Y	0.823	24.669	96.66
Max Z	16.293	56.981	71.40



G. Economic Comparison

Content	Rate (Rs.)	Multi-column		Mono-column	
		Quantity	Amount (Rs.)	Quantity	Amount (Rs.)
Cement	350/bag	1215	4,25,250	1765	6,17,750
Sand	1689/m^3	65.766	1,11,078	143.16	2,41,798
Aggregate	900/m^3	114.5615	1,03,104	249.38	2,24,442
Steel	66500/tonne	5.29	3,51,785	28.919	19,23,114
		Total	991217	Total	3007104



VI. CONCLUSION

The present project presented the idea for using the advanced structural tool STAAD Pro to solve complicated engineering problems with great ease and in very less time. It has been revealed that the load combinations involving wind forces were critical amongst all combinations. Hence the design was carried out for those combinations.

1) The deflection of multi-column building is 0.243mm and deflection of Mono-column building is 5.679mm which is under permissible limit.

2) The cost of mono-column building is 30, 07,104 and multi-column is 9, 91,217. Hence cost of mono-column structure is three times greater than the cost of multi-column structure.

3) The area of mono-column & multi-column are 2.2 m2 & 0.18 m2 (single column area) respectively.

4) Area of tensile steel required for mono-column is 8633mm2 & for multi-column is 1440mm2 (single column Ast.).

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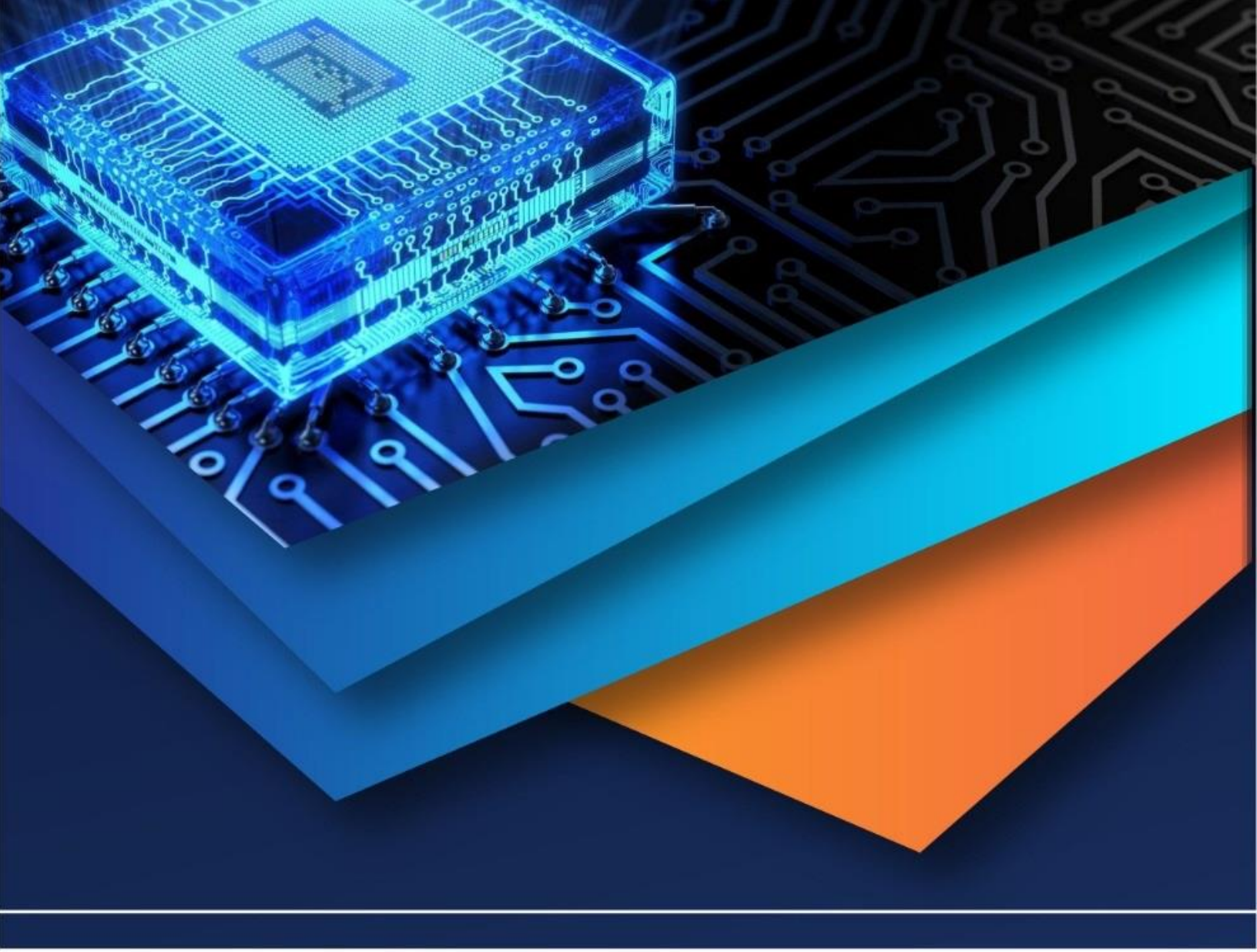

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