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Comparative Seismic Analysis of G+13 Storey RC Building Frame Structure

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Abstract: ***In this Research project, we analyzed the G+13, RC Building Frame structure with seismic Zone III and Zone V with considered soft, Medium and Hard soils by using Linear Static method in a Staad Pro V8i civil software as per IS 1893 (Part I). In this work we adopted various parameters like plan of building 24.02mX24.02m symmetrical along to X and Z direction respectively, Damping ratio 5 percent, importance factor 1.5 for important structure, Special RC Moment Resisting Frame as 5. The comparative analysis of this frame structure in the term of maximum displacement, maximum shear forces, maximum bending moment, maximum storey-wise displacement. Comparative results found that, the seismic zone III and V the maximum support reaction and axial force is achieved in zone V with soft soil while zone III and Zone V with medium and hard soils support reaction and axial force are same. As comparing the bending moment, shear force and node displacement are observed as maximum in zone V with soft soil but minimum in zone III with hard soil. It means that decreased the seismic zones and change the soft to hard soil, the seismic effect is also decreased. Story-wise displacement, observed that maximum at Zone V with soft soil and minimum at zone III with hard and also founded that story is increased , story-wise node displacement id also increased that mean number storey is proportional to the displacement.***
Keywords: Staad Pro, Seismic Zone, Soil Condition, Seismic analysis etc.

I. INTRODUCTION

Today's time Structural Engineers appreciable challenge in today's structure is constructing earthquake resistant structure. The challenge further increases due to increased eye pleasant high rise structures with architectural trouble. These architecturally pleasant structures with formation deformity, when subjected to destructive earthquake are a matter of concern. The bearing of a building during earthquakes depends reproving on its overall shape, size and geometry, in addition to how the seismic forces are carried to the ground. Sahyadri Engineering college building is used for the case study. A detailed study of this building for gravity loads and seismic loads are investigation and outcome like shear, moment carrying capacity and reinforcements required are differentiate. For the gravity load case a suitable method of retrofitting is approved if it is below production quantity. With better understanding of earthquake demand on structures and with our current experiences with large seismic zone near city centers, the need of earthquake retrofitting is well allow.

Dr. Syed Aqueel Ahmad, Rajiv Banarjee et.al. (2018) , studied that Seismic Analysis &Desiging of G+10 Storied Building by Strut &Staad pro Software with different loading conditions and compared the results. He observed that shear wall should be placed at a point by coinciding the center of gravity and centroid of the building.

Amit Kumar, Krishna Murari et.al. (2014) , Studied that the Seismic analysis & Capacity based resistant design of Multi-storey rigid joint Building Frame in a Staad Pro. He analyzed the 3D RC Frame building (G+6) structure in seismic zone II (Ranchi City) considered the medium soil conditions. He compared and found that the conventional design methods for earthquake resisting structures although this method is little costlier but more effective in resisting the earthquake forces.

Sumit Sharma et.al.(Feb-2018) , Studied that the seismic analysis of G+12 SMRF building by using Staad and Etabs Civil software. He analyzed the structure in the seismic zone IV and the building is tested for the base shear, lateral forces at each storey. He observed that the base shear obtained for the models varies a little and design horizontal seismic coefficient by Staad Pro and Etabs software matched with code.

A Primary Objective of this research works

1) To performed the Seismic Analysis of RC building framed structure by using Staad Prof. software.
2) To comparative Study of Seismic Analysis of Building Frame Structure considered with different zone.
3) To Comparative Analysis of Building frame with different soil conditions**.**

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II. MATHEDOLOGY

In the recent time, Civil & Structural software's analysis is more effectively used in analysis and design of different civil engineering structures. In this work, we using Staad pro software and analyzed the structure as per IS 1893:2002. The following steps are adopted:

1) *Step-1* Modeling of building frame in Node & Transitional repeat with different type of soils, symmetrical (24.02mX24.02m)G+13 story of 3D frame. Fig. 2.1

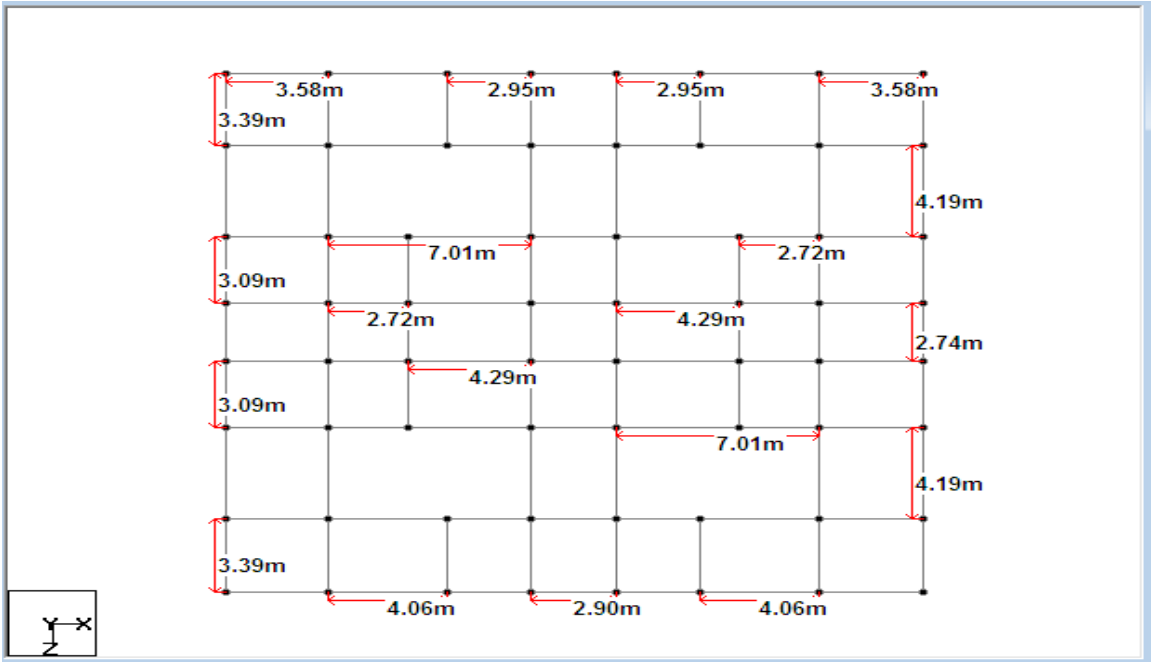


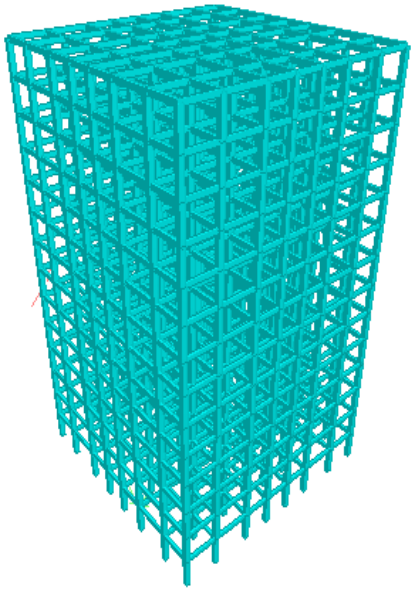
Fig. 2.1 Plan of Building

2) *Step-2* Selection of Building Geometry: Plan of Building 24.02mX24.02m , Size of Columns 450mmX450mm, Size of Beam 230mm X 450mm, Thickness of Slab 150mm; Height of each floor 3.0m, Unit weight of RCC 25KN/m^3, Unit weight of bricks 20KN/m^3 and Fixed supports.
3) *Step-3* selection of Seismic Zone and soil conditions As per IS Code.
4) *Step-4* Load combinations.

Load case no.	Load cases
1	DL
2	LL
3	EQ,X+
4	EQ,X-
5	E.Q,Z+
6	E.Q,Z-
7	1.5(DL+LL)
8	1.5(DL+E.Q.,X)
9	1.5(DL-E.Q.,X)
10	1.5(DL+E.Q.,Z)
11	1.5 (DL-E.Q.,Z)
12	1.2(DL+LL+E.Q.,X)
13	1.2 (D.L+L.L-E.Q.,X)
14	1.2 (DL+LL+E.Q.,Z)
15	1.2 (DL+LL-E.Q.,Z)

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5) *Step-5* Designing of building frames using STAAD.Pro v8i software in 3D rendered view.



6) *Step-6* Analysis considering different types of soil condition providing different seismic zones.
7) *Step-7* Comparative the results in the term of storey-wise displacement, shear force, bending moment, node displacement etc.

A. Flow Chart Diagram

For this Project Work, Flow chart of proposed method of this analysis.

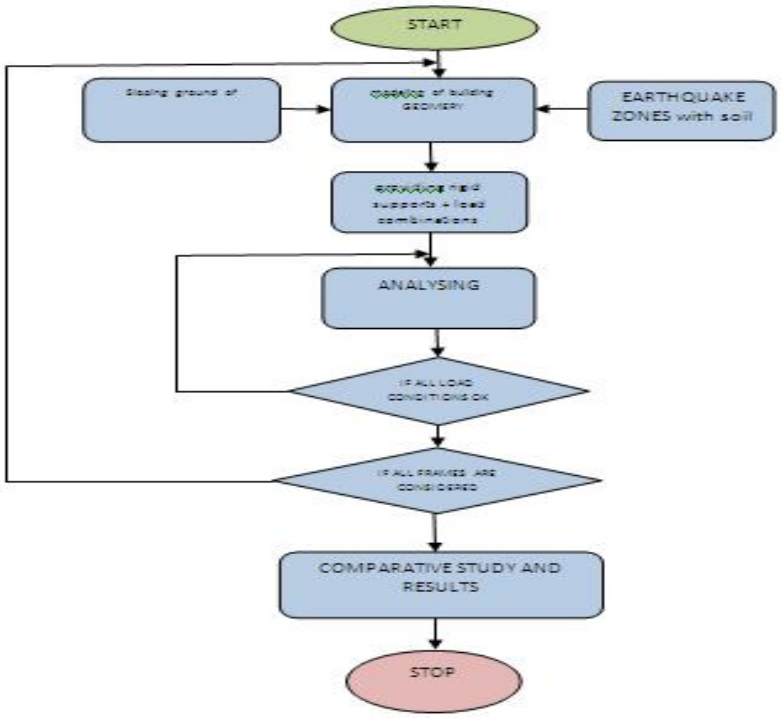


Fig. Flow Chart Diagram

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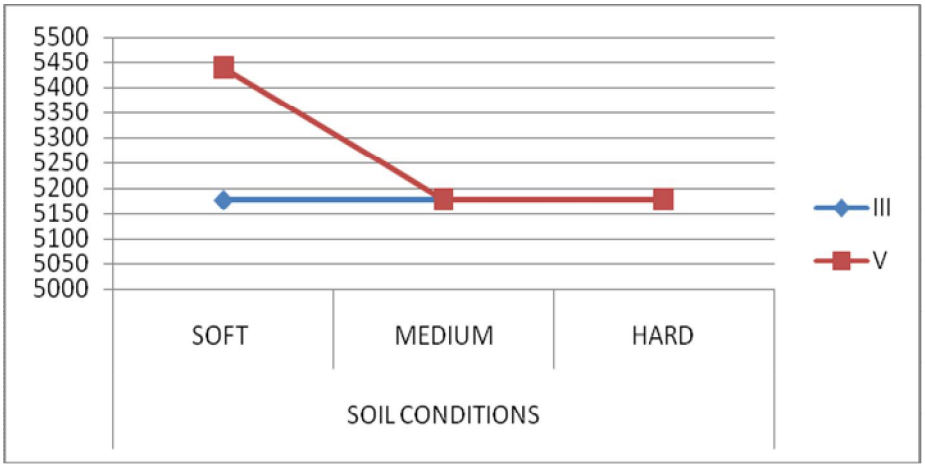
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III.RESULTS AND ANALYSIS

A. *Support Reaction:*

SUPPORT REACTION IN KN

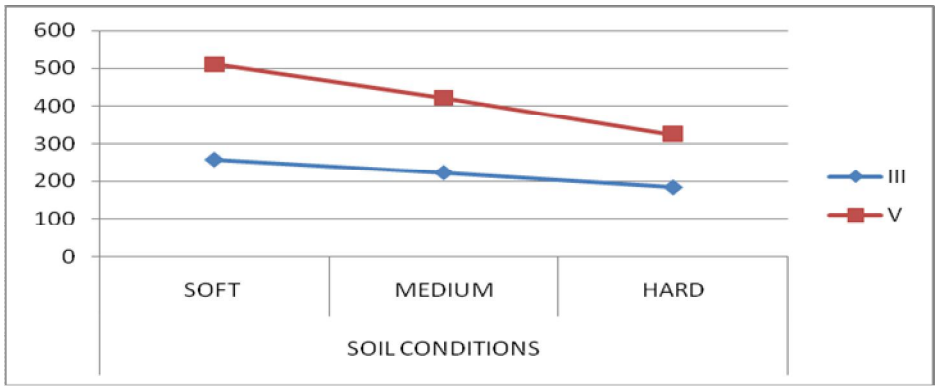
ZONE	SOIL CONDITIONS		
	SOFT	MEDIUM	HARD
III	5177.04	5177.04	5177.04
V	5439.906	5177.04	5177.04



B. *Maximum Bending Moment*

Maximum Bending Moment IN KN-m

ZONE	SOIL CONDITIONS		
	SOFT	MEDIUM	HARD
III	257.581	222.921	183.667
V	509.944	420.81	323.889

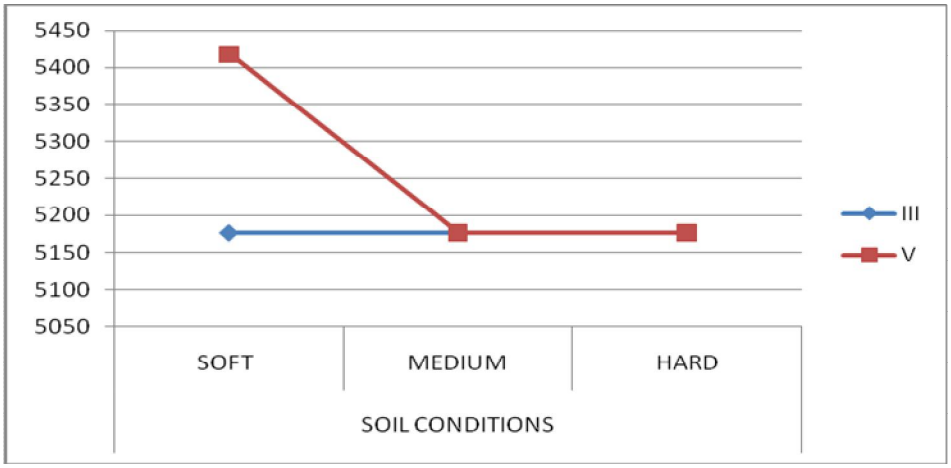


C. *Axial Forces*

Maximum Axial Force in KN

ZONE	SOIL CONDITIONS		
	SOFT	MEDIUM	HARD
III	5177.04	5177.04	5177.04
V	5418.436	5177.04	5177.04

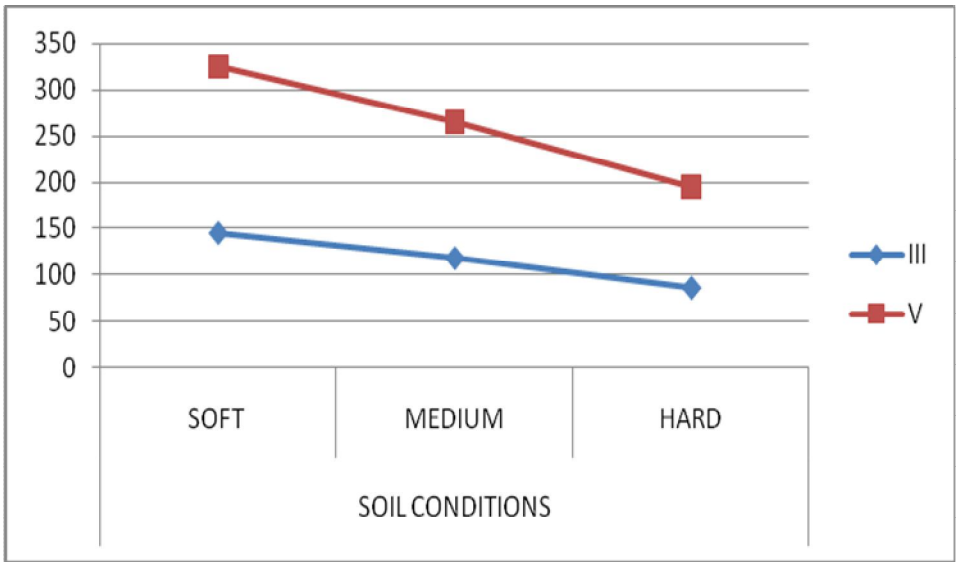
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D. Maximum Displacement

Maximum Displacement IN mm

ZONE	SOIL CONDITIONS		
	SOFT	MEDIUM	HARD
III	144.852	118.008	86.834
V	325.618	265.218	195.077

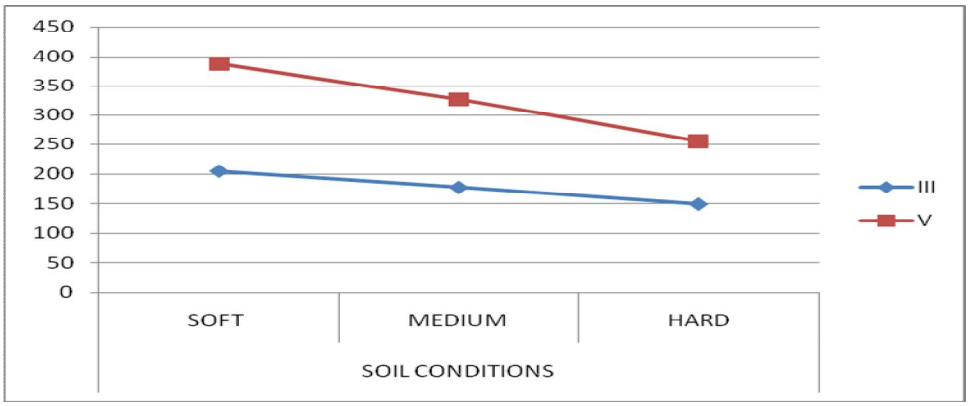


E. Shear Forces

Maximum Shear Force in KN

ZONE	SOIL CONDITIONS		
	SOFT	MEDIUM	HARD
III	204.076	176.714	148.738
V	388.329	326.764	255.27

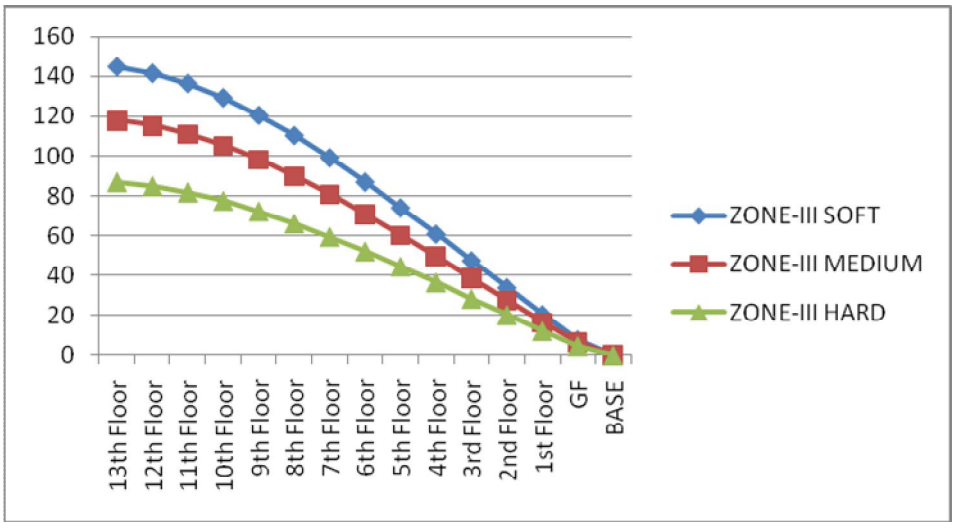
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F. Story-wise Node Displacement

Story-Wise Node Displacement in Zone III (mm)

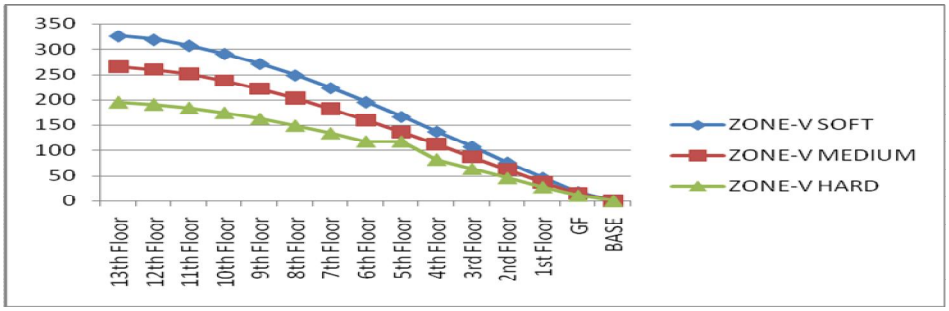
STOREY	ZONE-III		
	SOFT	MEDIUM	HARD
13th Floor	144.852	118.008	86.834
12th Floor	141.583	115.305	84.789
11th Floor	136.522	111.181	81.752
10th Floor	129.442	105.415	77.512
9th Floor	120.649	98.254	72.247
8th Floor	110.45	89.948	66.14
7th Floor	99.149	80.745	59.374
6th Floor	86.98	70.835	52.087
5th Floor	74.175	60.408	44.421
4th Floor	60.94	49.63	36.496
3rd Floor	47.454	38.648	28.421
2nd Floor	33.88	27.594	20.294
1st Floor	20.434	16.644	12.242
GF	7.85	6.393	4.702
BASE	0	0	0



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Story-Wise Node Displacement in Zone V (mm)

STOREY	ZONE-V		
	SOFT	MEDIUM	HARD
13th Floor	325.618	265.218	195.077
12th Floor	318.538	259.411	190.748
11th Floor	307.167	250.149	183.935
10th Floor	291.241	237.179	174.397
9th Floor	271.454	221.065	162.549
8th Floor	248.504	202.376	148.807
7th Floor	223.075	181.667	133.581
6th Floor	195.693	159.368	117.185
5th Floor	166.881	135.905	117.185
4th Floor	137.1	111.653	82.101
3rd Floor	106.754	86.94	63.93
2nd Floor	76.211	62.067	45.641
1st Floor	45.965	37.434	27.527
GF	17.659	14.382	10.575
BASE	0	0	0



IV. CONCLUSIONS

We observed that, the seismic zone III and V the maximum support reaction and axial force is achieved in zone V with soft soil while zone III and Zone V with medium and hard soils support reaction and axial force are same. As comparing the bending moment, shear force and node displacement are observed as maximum in zone V with soft soil but minimum in zone III with hard soil. It means that decreased the seismic zones and change the soft to hard soil, the seismic effect is also decreased. Story-wise displacement, observed that maximum at Zone V with soft soil and minimum at zone III with hard and also founded that story is increased , story-wise node displacement id also increased that mean number storey is proportional to the displacement.

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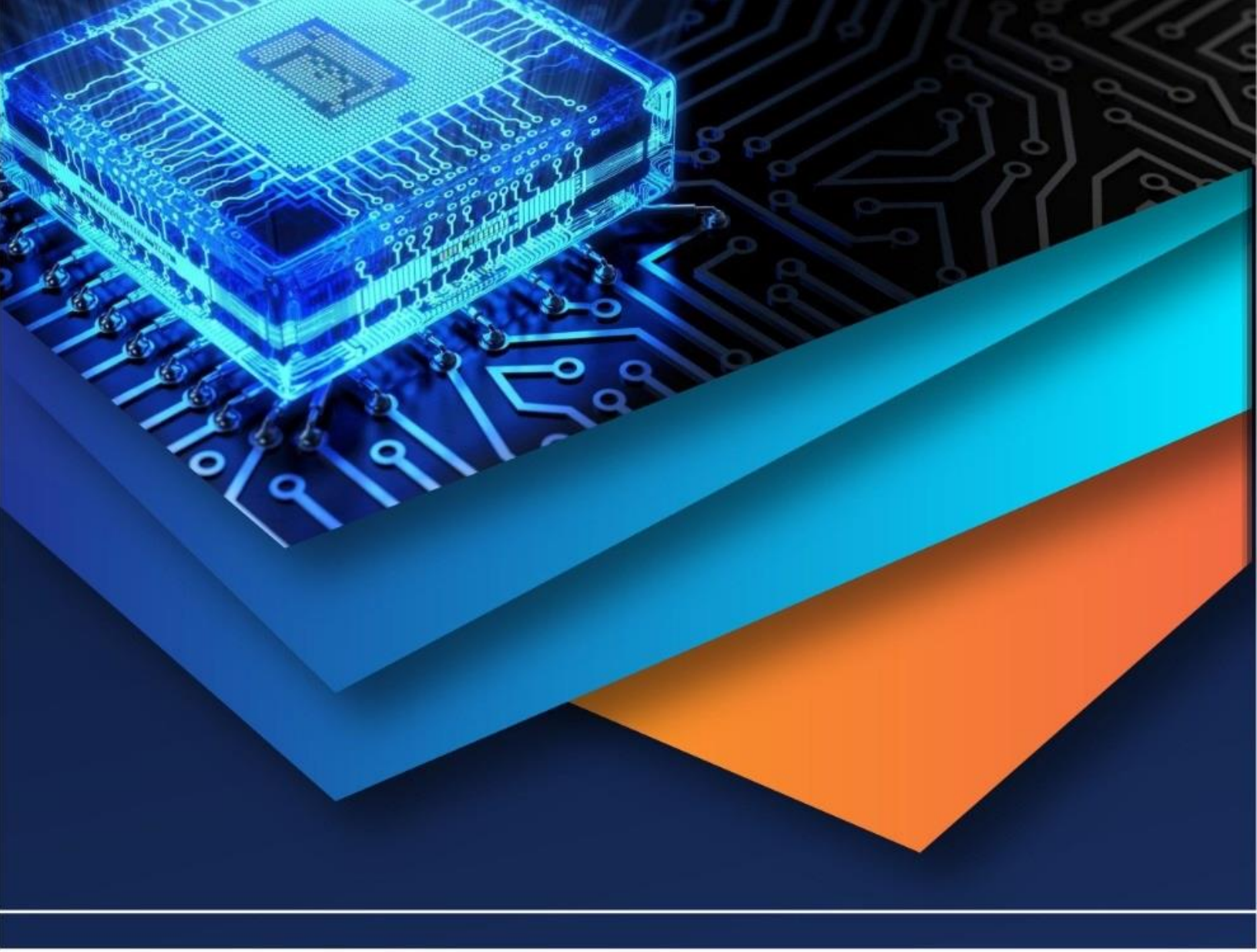
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