iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** VII **Month of publication:** July 2022

DOI: https://doi.org/10.22214/ijraset.2022.45658

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue VII July 2022- Available at www.ijraset.com

Seismic Analysis of G+4 Storey Building With X-Bracing Under Zone V

Abhishek R[1], Dr. R. Subhash Chandra Bose[2], Pallavi H J[3]
[1]*Post graduation student,* [2]*Associate professor,* [3]*Associate professor, Department of civil engineering, ACS College of Engineering, Bengaluru*

Abstract: ***In general, the most suitable choices in improvement of reinforcement concrete frame against lateral loading is use of bracing system. This paper deals with the, "SEISMIC ANALYSIS OF G+4 STOREY BUILDING WITH X-BRACING UNDER ZONE V". In this paper, the seismic analysis of reinforced concrete (RC) buildings with X type of bracing with rectangular and reinforced concrete (RC) buildings without bracing with rectangular are compared. For this analysis of work a four-storey (G+4) building is considered which is situated in seismic zone V. The building models are analysed by equivalent static analysis as per recommendation given by IS 1893:2002 using ETABS software. This paper includes the comparison of seismic analysis of building with rectangular columns by using X-bracing system mentioned above and also the comparison between the response of the structure with bracings and structure without bracings.***
KEYWORDS: Multistory building, Rectangular Column, Seismic zone, Bracing system

I. INTRODUCTION

An earthquake (also known as a quake, tremor or temblor) is the shaking of the outer layer of the Earth coming about because of an unexpected arrival of energy in the Earth's lithosphere that creates seismic waves. Quakes can go in size from those that are frail to the point that they can't be felt to those fierce enough to impel articles and individuals up high, and unleash obliteration across whole urban areas. The seismicity, or seismic action, of a region is the recurrence, type, and size of tremors experienced throughout a specific time span. The word tremor is likewise utilized for non-quake seismic thundering. At the Earth's surface, tremors manifest themselves by shaking and uprooting or disturbing the ground. When the epicentre of a huge tremor is found seaward, the seabed might be uprooted adequately to cause a tsunami. Quakes can likewise trigger landslides and, every so often, volcanic movement. In its most broad sense, the word earthquake is used to portray any seismic occasion whether regular or brought about by people that creates seismic waves. Seismic tremors are caused generally by burst of geological faults but additionally by different occasions like volcanic action, avalanches, mine impacts, and nuclear tests. A seismic tremor's place of introductory burst is called its hypo-centre or centre. The epicentre is the point at ground level straight over the hypo-centre. Shudder cause shaking and dislodging or disturbing of the ground at the Earth's surface. The seabed may be evacuated with the end result of causing a tsunami when the point of convergence of an immense tremor is viewed as toward the ocean. Torrential slides are to a great extent set off by quakes. In its broadest sense, the term tremor suggests any seismic event that makes seismic waves, whether or not typical or achieved by individuals. Shudders are primarily achieved by the explosion of geological weaknesses, yet they can moreover be achieved by various episodes like torrential slides, volcanic development, nuclear tests and mine effect.

II. LITERATURE REVIEW

T. T. NAHAR, A. Z. MORSHED (2017) has carried out their research on, "Seismic Analysis of First Soft Storied Steel Frame Building with and Without Steel Bracing"- 2.1in this paper they learned with regards to the metropolitan region open first story is by and large exceptionally well known because of business, private and public structure. Additionally, it has consistent open space which has utilized in multi celebrated steel working for more comfort. Be that as it may, in seismic zone it has been truly weak condition in view of getting tedious account tallness and diminishing the solidness of the sidelong burden opposing framework. This paper features the seismic investigation of first delicate celebrated building outlines considering a structure plan with two burden mixes. Giving propping in first delicate story in various two game plans is the elective strategy to comprise in the embedding of fitting uprooting decrease framework.

RAJESHWARI A. MURADE, MOHD. SHAHEZAD (2015) have done a research on, "Review on Seismic Response of Multi-Storied RCC Building Infill with Masonry Infill and Steel Bracing" –this paper is about the review in light of Infill boards are generally utilized as segment dividers as well as outside dividers of the structure to fill the hole between RC outlines.

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Non-underlying part might give extensive solidness to the structure and thus might work on the presentation of the RCC working during ground movements.

ZThe impact of ground movement on RCC outline building has been completed by considering with and without the firmness of infill divider. Steel propping framework is one of the exceptionally proficient sidelong burden opposing frameworks for multi-story structures. Steel bracings are by and large utilized in steel constructions to oppose parallel powers; this idea is reached out to RCC structures.

PATTEWAR MANIK HEMANT, PROF. K. S. UPASE (2021) have done research on, "Comparative Study of Steel Bracing and Its Effects on Irregular Building Under Wind Load" – In reasonable Civil designing work, we order elevated structure as ordinary formed (even) and unpredictable melded (unsymmetrical) building. The presentation of anomaly in structure make complex while it's plan. Additionally, its conduct changes under various sort of loading and another necessary plan factor. So, it is vital to concentrate on conduct of unsymmetrical structures regarding different sort of stacking and another plan boundary. For the most part Plus shape, C-shape, L-shape, H-shape and so forth building should be visible. Among them, we will have a relative investigation of in addition to shape, C-shape and L-shape unsymmetrical structure. At the point when a tall structure is developed it is exposed to different burdens like dead burden, live burden, seismic burden, wind load, snow load and so forth the breeze load is a vital part for such a tall structure. In this near concentrate on we are going to investigation an elevated structure with wind loads.

SAGAR BELGAONKAR, PRABHA PATIL (2020) have done research on, "Seismic Analysis of Vertically Irregular RC Framed Structure using X-bracing and Bundle Tube using STAAD PRO Software" –in this paper they have done an exploration on the idea of tall constructions comes as a top priority because of the expanding populace. Because of headway in common innovation the idea is being fruitful now daily. The stature of the constructions with the quantity of floor is chosen by engineers. Seismic tremor is the one which is the primary peculiarities making harm the construction. As the tallness of the construction increments it retains enormous seismic powers. On the off chance that design is standard in its rise strength appropriation will be uniform. On the off chance that there is abnormality there will be breakages in strength which is the primary driver for disappointment. To beat this there are a few horizontal burden opposing frameworks, among which the support and cylinder framework is utilized. In this project the construction is examined with X Brace and pack tube. This is contrasted and the design without support and pack tube.

TARUNA R KAMBLE, DR.G.D.AWCHAT (2018) have done research on, "Seismic Analysis and Design of Multi-Storied RC Building Using STAAD Pro and ETABS" - the guideline objective of this task is to break down the skyscraper (G +20 celebrated) constructing (three-dimensional casing) utilizing STAAD.Pro and ETABS. Project includes dynamic investigation of RC working with shear divider to know seismic conduct of construction. Notwithstanding that venture incorporates the Response Spectrum Analysis for actually looking at reaction of building framework with long segment in key arrangement. STAAD.Pro and ETABS highlights a condition of-workmanship UI, representation instruments, and Powerful investigation, plan motors with cutting edge limited component and dynamic examination capacities.

III. OBJECTIVES

1) To model G+4 storey building without bracings in ETABS software
2) To model G+4 storey building with Single diagonals steel bracings in ETABS software
3) To model G+4 storey building with Cross or X steel bracings in ETABS software
4) To model G+4 storey building with V steel bracings in ETABS software
5) To study the seismic behaviour of the structure without bracings.
6) To study the behaviour of structure with different types of bracings.
7) To compare the overall outcomes obtained with and without bracing.

IV. METHODOLOGY

A. Step By Step Procedure Followed To Achieve The Above Objectives Is

1) A broad writing audit is completed to layout the above targets for the scaled-down project work.
2) A G+4 celebrated substantial edge with and without X-bracings is selected.
3) ETABS programming is picked for displaying and examination of chosen structures.
4) To discover the seismic boundaries like story storey drift and storey displacements.
5) The G+4 RCC multi-story with X-bracings and unbraced structures are taken and dynamic investigations are to be completed utilizing the product ETABS.
6) Using codal arrangement for plan, they are IS456:2000, IS800:1998, and IS1893:2002 (Part-2)

7) To plan for M30 grade of cement and Fe415 steel

B. BUILDING DETAILS

Dimension = 15m * 12m
Storey height = 3m
Grid spacing along X direction = 3m
Grid spacing along Y direction = 3m
No of stories in X direction = 5
No of stories in Y direction = 4
Grade of concrete = M 30
Grade of steel = Fe 415
Density of concrete = 25 kN/m^3
Young's modulus of concrete = 27386.13 kN/m^2
Column size = 300mm*400mm
Beam size = 300mm*300mm
Slab thickness = 120 mm
Live load = 3 kN/m^2
Earthquake load = 1.5 kN/m^2
Zone = V
Impact factor, I = 1
Response reduction factor, R = 5
Soil type = II = Medium

C. Model Description

1) Model 1: G+4 multi-story building without bracings

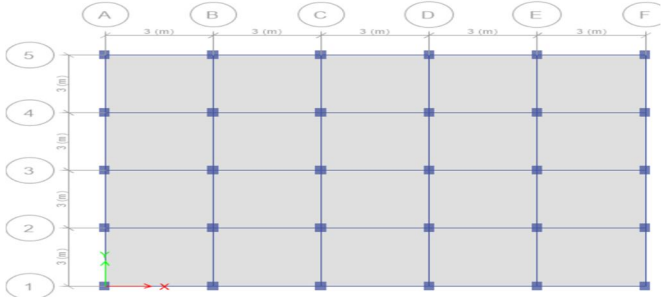


Fig 3.1 Plan of the Building without Bracings.

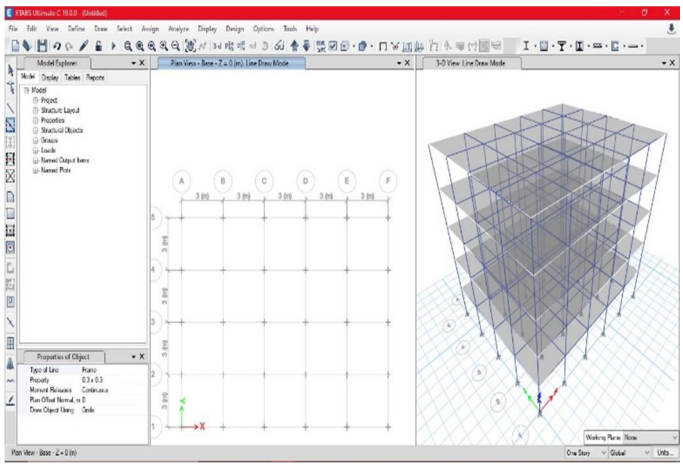


Fig 3.2 3–D view without bracings

2) Model 2: G+4 multi-story building with bracings and diaphragms.

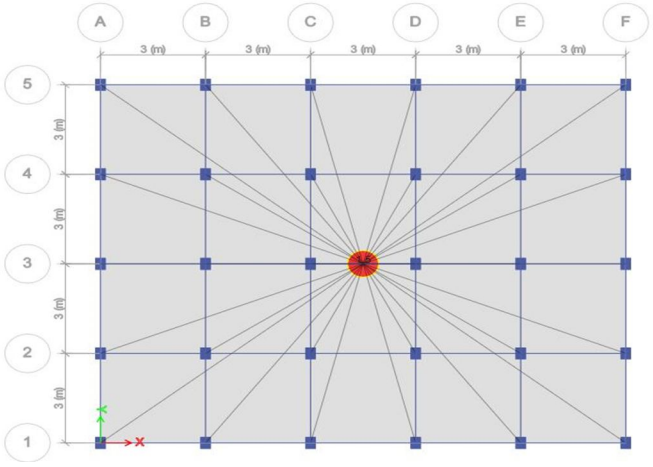


Fig 3.3 The plan with diaphragms

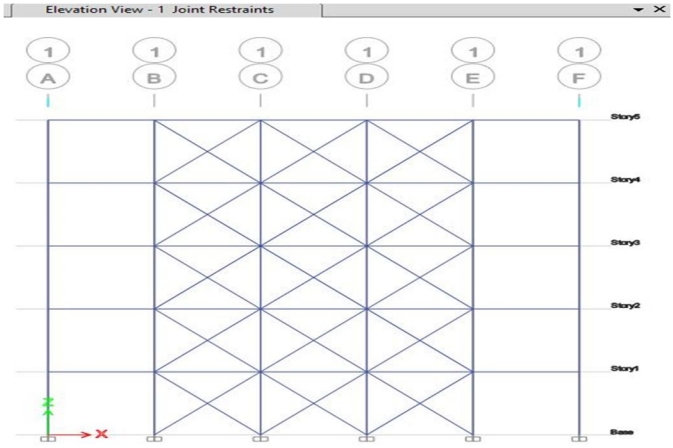


Fig 3.4 Elevation of the plan with bracings

V. RESULTS AND DISCUSSIONS

A. Story Drift

1) Response Spectrum

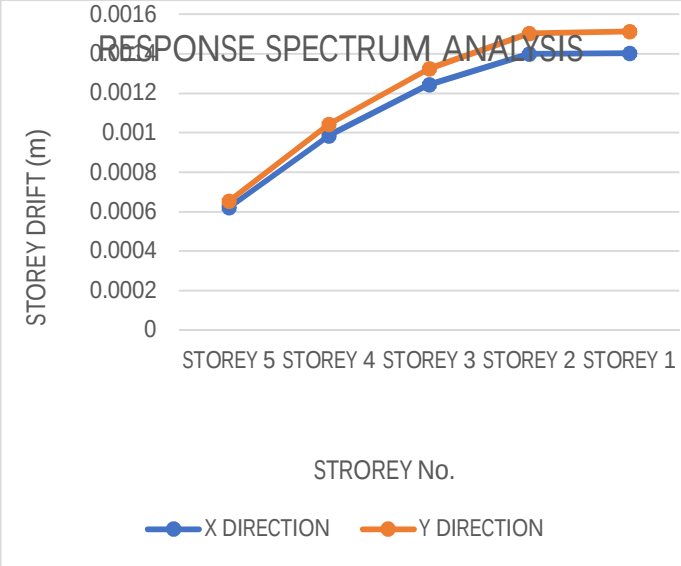
Table: 4.1

STOREY	X DIRECTION	Y DIRECTION
STOREY 5	0.0006215	0.0000325
STOREY 4	0.000985	0.0000575
STOREY 3	0.0012445	0.000082
STOREY 2	0.0014015	0.0001035
STOREY 1	0.0014046	0.0001091

Table: 4.2

STOREY	X DIRECTION	Y DIRECTION
STOREY 5	0.0019905	0.000063
STOREY 4	0.0036145	0.000133
STOREY 3	0.004964	0.0002095
STOREY 2	0.0057035	0.0002655
STOREY 1	0.00618	0.000395

STOREY	X DIRECTION	Y DIRECTION
STOREY 5	0.003923	0.003568
STOREY 4	0.007094	0.007008
STOREY 3	0.009708	0.009212
STOREY 2	0.011116	0.011053
STOREY 1	0.008117	0.007087



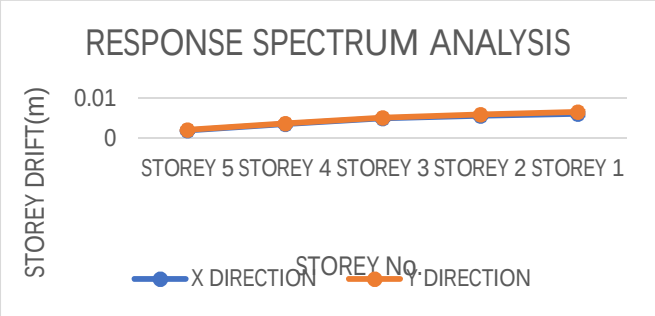


Fig 4.2 Response spectrum analysis without *Bracings*

B. Earth Quake Analysis

Table: 4.3

STOREY	X DIRECTION	Y DIRECTION
STOREY 5	0.001224	0.001022
STOREY 4	0.001933	0.001563
STOREY 3	0.002435	0.002156
STOREY 2	0.002733	0.002425
STOREY 1	0.00242	0.00198

Table: 4.4

STOREY	X DIRECTION	Y DIRECTION
STOREY 5	0.003923	0.003568
STOREY 4	0.007094	0.007008
STOREY 3	0.009708	0.009212
STOREY 2	0.011116	0.011053
STOREY 1	0.008117	0.007087

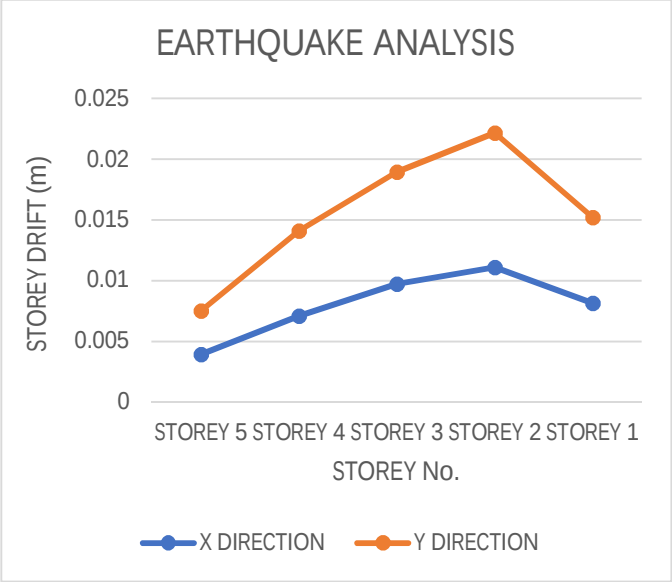


Fig 4.3 Earthquake analysis without bracings

C. Earthquake Analysis Without Bracings

The story drift values are considered along the x and y direction as per IS 1893:2016. From the above results the story drift is more for building without bracings when compared to buildings with bracings.

For any building maximum story drift value should not exceed the limited values specified in IS codes. So, by providing bracings we can reduce the story drift of the building due to the action of seismic and wind loads.

D. STORY DISPLACEMENT

1) Model 1: Story displacement in the modal without the provision of bracings.

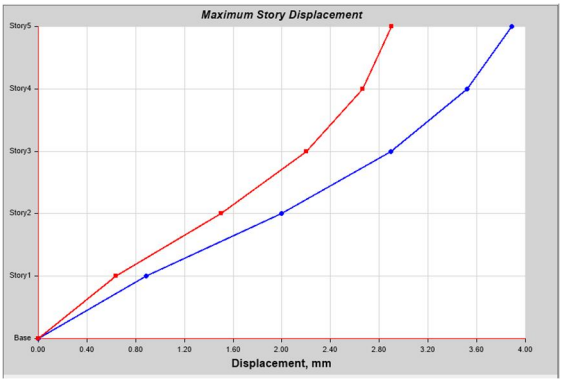


Fig 4.5: Maximum story displacement of earthquake loading in the X-direction is 3.884 mm

2) Model 2: Story displacement in the model with X-bracings

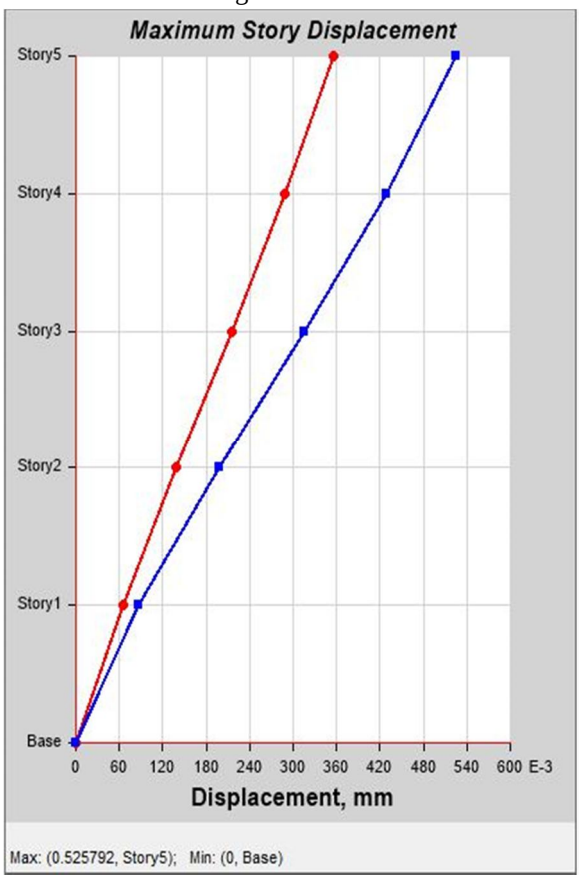


Fig 4.7 Maximum story displacement of earthquake loading in the X-direction is 0.528 mm.

VI. CONCLUSION

For a G+4 storey even structures the seismic investigation is completed by straight static strategy and reaction range examination, and following are the conclusions made and finished up from the current analysis outcomes:

1) Form this above outcomes the storey drift, storey displacement is maximum for a structure without bracings.
2) By providing X-bracings or other types of bracings in a structure it reduces the story displacement, storey drift up to 5 times that of without bracings.
3) The maximum storey displacement is 3.884 mm for seismic load without the provision of X-bracings.
4) The maximum storey displacement is 0.526 mm for seismic load with the provision of the X-bracings. For structures without bracings the story drift will be maximum compared to structures with bracings
5) By observing above all the results if X-bracings is provided in the building, that will reduce the story displacement due to earthquake load in both the directions compared to building without bracings

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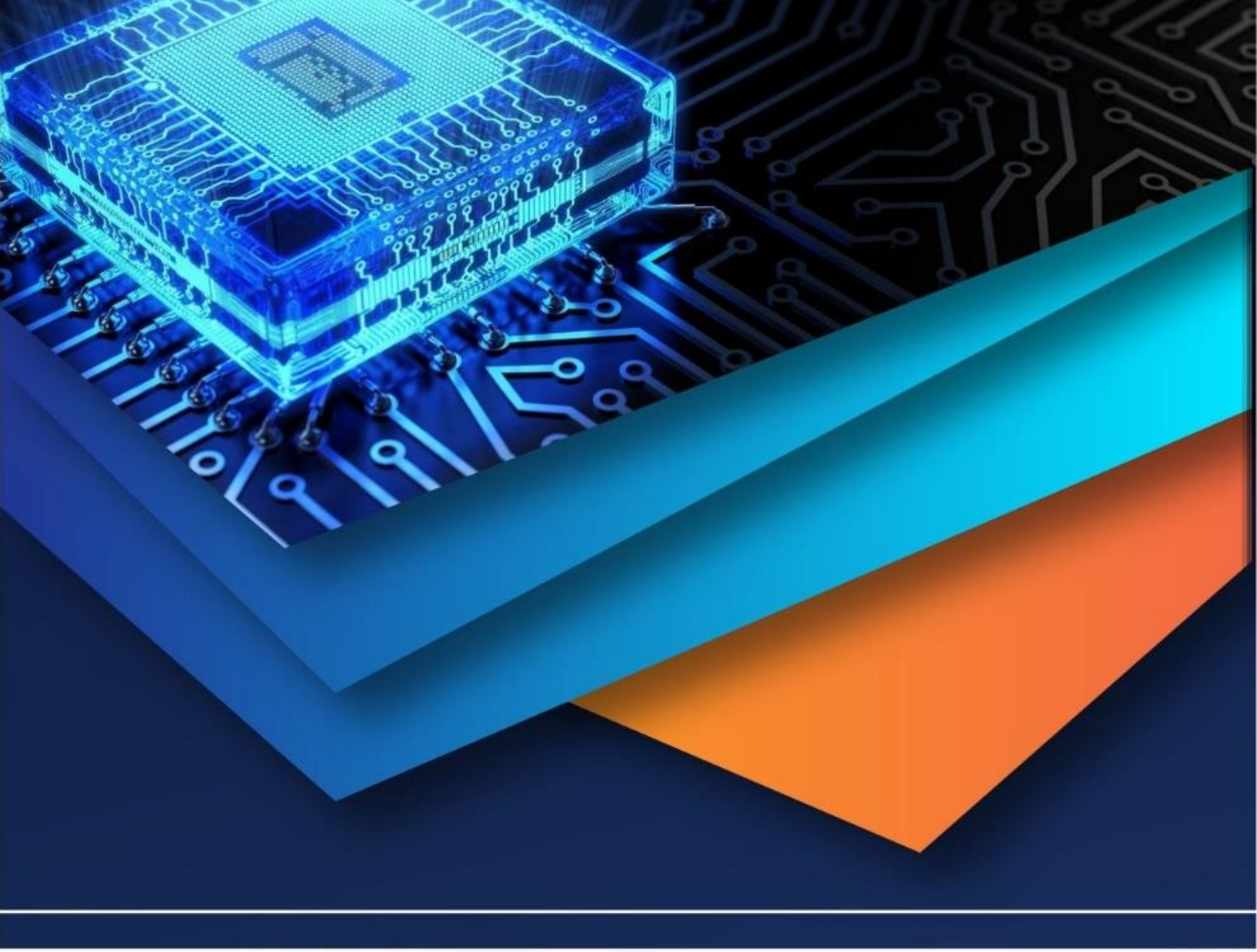

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