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Shear Failure Mechanism of Reinforced Concrete Haunched Beam by using Steel Fibre and Carbon Fibre

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Abstract: Haunched beams are used in buildings for many reasons among them as they favor a more efficient use of materials to clear a given span or to provide a reasonable clear height for the storeys of buildings. Reinforced concrete haunched beams (RCHBs) are widely used in simply supported and continuous bridges, structural portal frames, mid-rise framed buildings and cantilevers. Such beams can reduce the weight of structures and contribute to the appearance from the aesthetic viewpoint, while using the concrete and steel bars more efficiently. Some- times, they are also used to ease the placement of the facilities and equipment (electrical, air conditioning, piping, etc.) by providing more space under the ceiling. This study aims to clarify the shear failure mechanism of reinforced concrete haunched beams (RCHBs). There is an architectural, structural and economic importance of the study of the reinforced concrete haunched beams (RCHBs). In this study, mechanical behavior of fiber reinforced concrete haunched beams have to determine. The study included twenty four concrete beams. Percentage of fibres used in RC haunched beams are varying as 5%, 10% and 20%. The stress strain graphs are plotted for each type of beam.
Keyword: Haunched Beam, Steel Fibre, Carbon Fibre.

I. INTRODUCTION

Haunched beam is a beam whose cross section is thicker at the supports than in the middle of the span. Haunched beams are used in buildings for many reasons among them as they favor a more efficient use of materials to clear a given span or to provide a reasonable clear height for the storeys of buildings. Indeed, tapered elements in general and Haunched beams in particular have been traditionally difficult to model in a practical manner. The most common forms of structural members that are non- prismatic have haunches that are either stepped or tapered or parabolic in shape. Non-prismatic concrete beams can provide steel and concrete savings when used to replace equivalent strength prismatic elements. The non-prismatic members having varying depths are frequently used in the form of haunched beams. The cross section of the beams can be made non-prismatic by varying width, depth, or by varying both depth and width continuously or discontinuously along their length. Variation in width causes difficulty in construction. Therefore, beams with varying depth are generally provided. Either the soffit or top sur- face of the beam can be inclined to obtain varying cross- section, but the former practice is more common. The soffit profile may have triangular or parabolic haunches. Effective depth of such beams varies from point to point and the internal compressive and tensile stress resultants are inclined. It makes the analysis of such beams slightly different from prismatic beams. Reinforced concrete haunched beams (RCHBs) are used in cantilever retaining wall, framed buildings, simply supported and continuous bridges for economic and aesthetic reasons. The shear capacity of RCHBs is affected mainly by the inclination of haunched portion and the effective depth at the mid span. After the static loading test, also conducted the cyclic loading test to investigate the deformation and energy dissipation capacities. However, the experimental information is still not sufficient normally the researchers fixed the effective depth at the support and changed the haunch’s inclination (the effective depth at the mid span was changed consequently). Since the splitting cracks or debonding cracks along the tensile longitudinal rebars and the main diagonal cracks initiating near the bending position of tensile rebars were observed four new parameters that may affect such crack patterns and the shear behavior are investigated in this study. The positions of haunched portions, the thickness of the concrete cover, and the arrangement of the tensile rebar may affect the propagation of the debonding cracks and diagonal cracks directly, while the presence of stirrups may affect them indirectly. Hence, with the objective of investigating the shear carried by concrete and stirrups in RCHBs to clarify the shear resistance mechanism, four series of ten RCHBs based on these four new parameters were tested. In addition, since the shape of the compression zone, which dominates the arch action in RC beams, could not be perfectly measured in the experiments, nonlinear FEM analyses were conducted to evaluate the compression zone and verify the results. It can be a good complement for the experiment and help to under- stand the shear resistance mechanism better.

A. Application of Haunched Beam

The main principle in the design of a haunched composite beam is that framing into the columns reduces the design moment and deflection of the beams. It would not normally be practical to introduce large quantities of reinforcement into the slab as adequate moment transfer can usually be achieved through the haunch. Indeed at edge columns it would be difficult to develop the required anchorage of the reinforcement, unless it is connected to the column (e.g. by anchorage into the concrete encasement).

B. Objectives

1) To determine the load carrying capacity of member.
2) To determine the deflection of member at different loading.
3) To study the stress strain properties of member.

II. MATERIALS AND METHODOLOGY

A. Steel Fibre: The study on the introduction of effect of steel fibers can be still promising as steel fiber reinforced concrete is used for sustainable and long-lasting concrete structures. Steel fibers are widely used as a fiber reinforced concrete all over the world. Lot of research work had been done on steel fiber reinforced concrete and lot of researchers work prominently over it. This review study tried to focus on the most significant effects of addition of steel fibers to the concrete mixes. The steel fibers are mostly used fiber for fiber reinforced concrete out of available fibers in market. According to many researchers, the addition of steel fiber into concrete creates low workable or inadequate workability to the concrete, therefore to solve this problem of Superplasticizer without affecting other properties of concrete may introduce.

B. Carbon Fibre: Carbon Fibres are produce by bonding carbon atoms together in a crystals that are aligned parallel to the axis of Fibre. Carbon Fibres have been manufactured with petroleum and coal pitch with 5-10 micrometer in diameter with specific gravity near about 1.9. The crystal alignment gives the Fibre high strength to volume ratio and the modulus of elasticity is higher than steel and it is twice or thrice stronger than steel. They have high stiffness, high chemical resistance, high temperature tolerance and low thermal expansion.

Table 1 Quantity of material per cubic meter of concrete (M20)

Material	Proportion by weight	Weight in kg/m^3
Cement	1	311.12
F.A	2.79	868
C.A	3.70	1150
W/C	0.45	140 lit

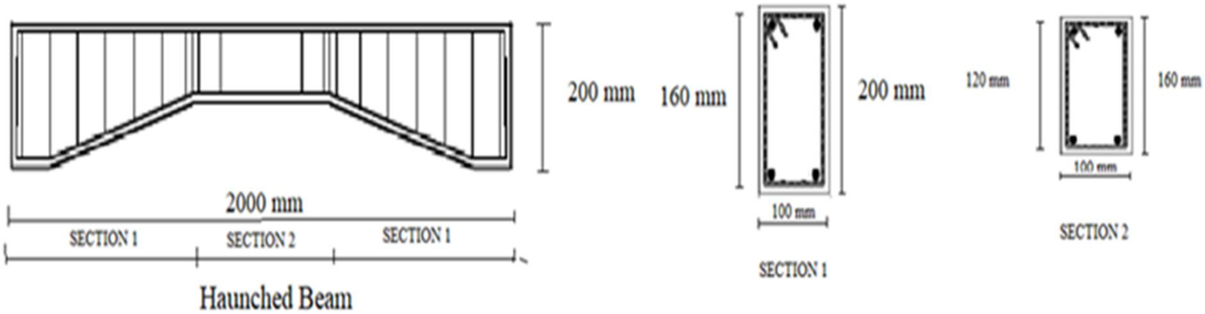

Fig. 1 Haunched section details

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Volume 7 Issue IX, Sep 2019- Available at www.ijraset.com

Table 2 Casting details

Sr. No.	Type of Specimen		No. of Specimen
1	Conventional Beam	A1	1
2		A2	1
3		A3	1
4	Haunched Beam	B1	1
5		B2	1
6		B3	1
7	Steel + RC Beam	5% C1	3
8		10% C2	3
9		15% C3	3
10	Carbon + RC Beam	5% D1	3
11		10%D2	3
12		15%D3	3
Total no of specimen			24

Photo 1 Testing of Conventional Beam

Photo 2 Testing of Haunched Beam

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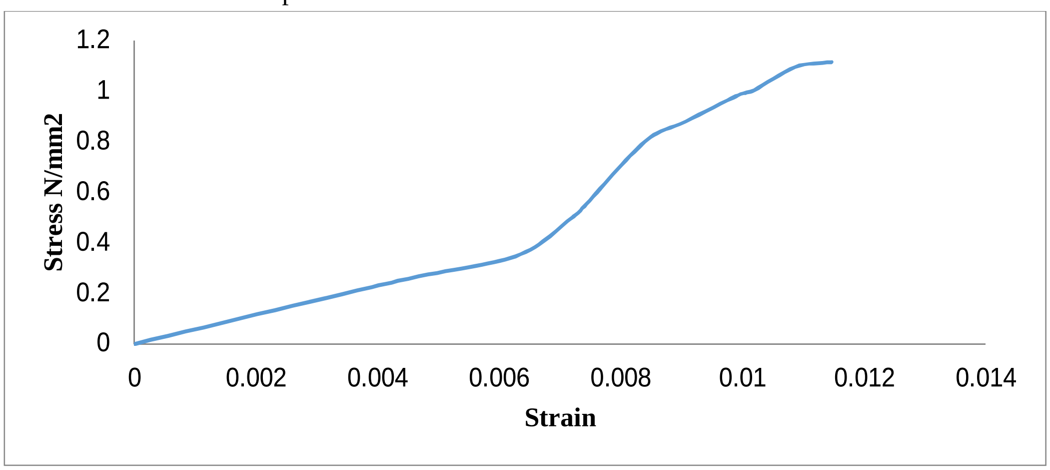
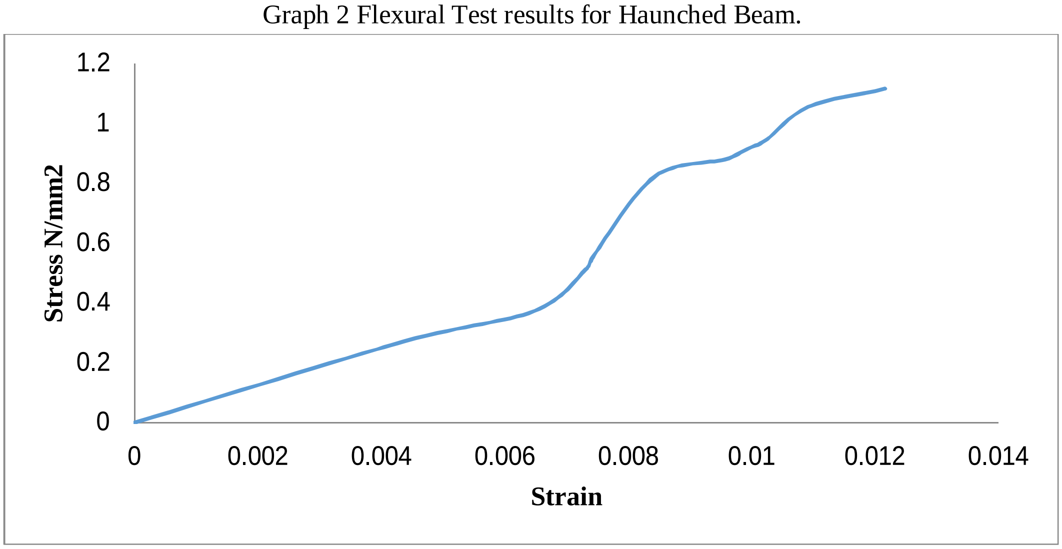
Photo 3 Two point loading set up

III. RESULTS

Graph 1 Flexural Test results for Conventional Beam



Graph 2 Flexural Test results for Haunched Beam.



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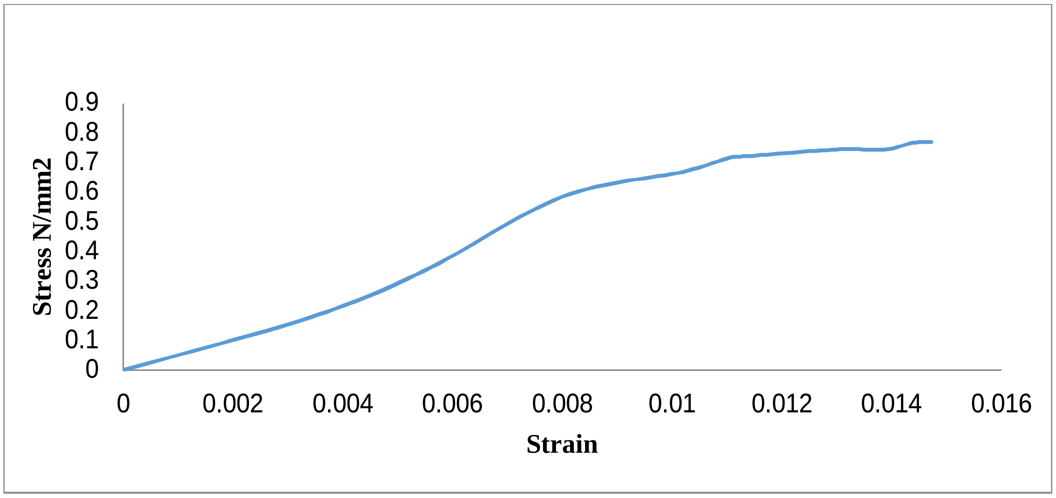
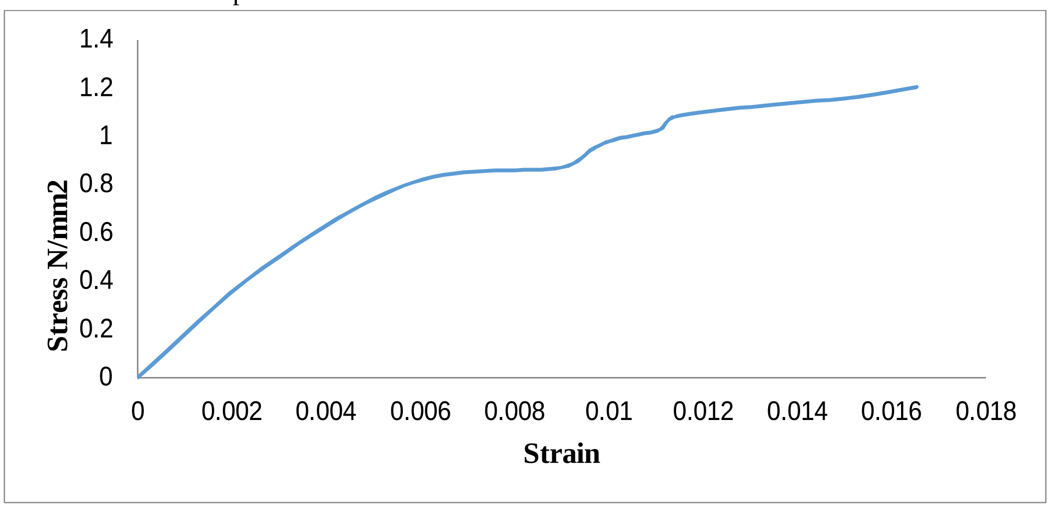
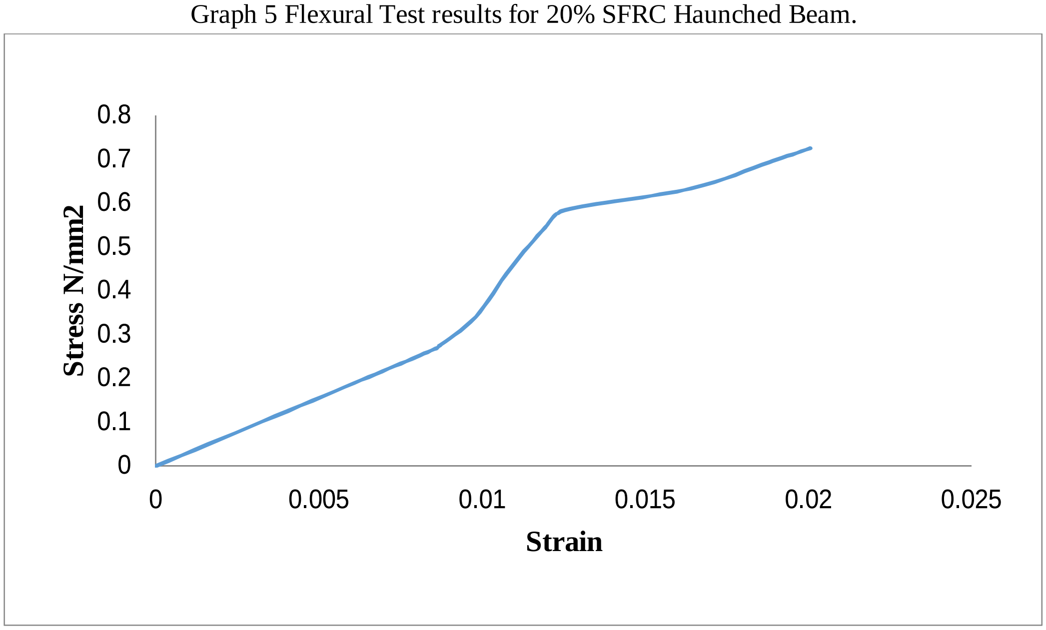
Graph 3 Flexural Test results for 5% SFRC Haunched Beam.



Graph 4 Flexural Test results for 10% SFRC Haunched Beam.



Graph 5 Flexural Test results for 20% SFRC Haunched Beam.



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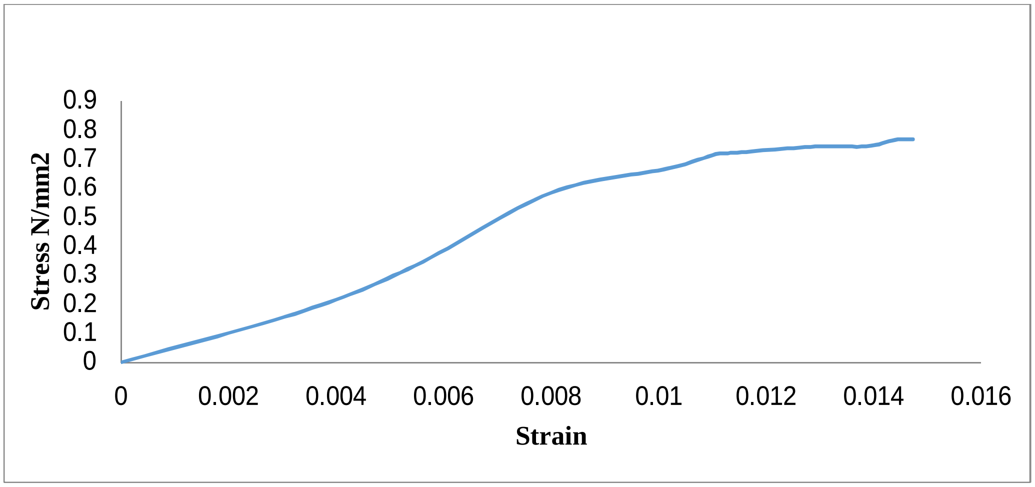
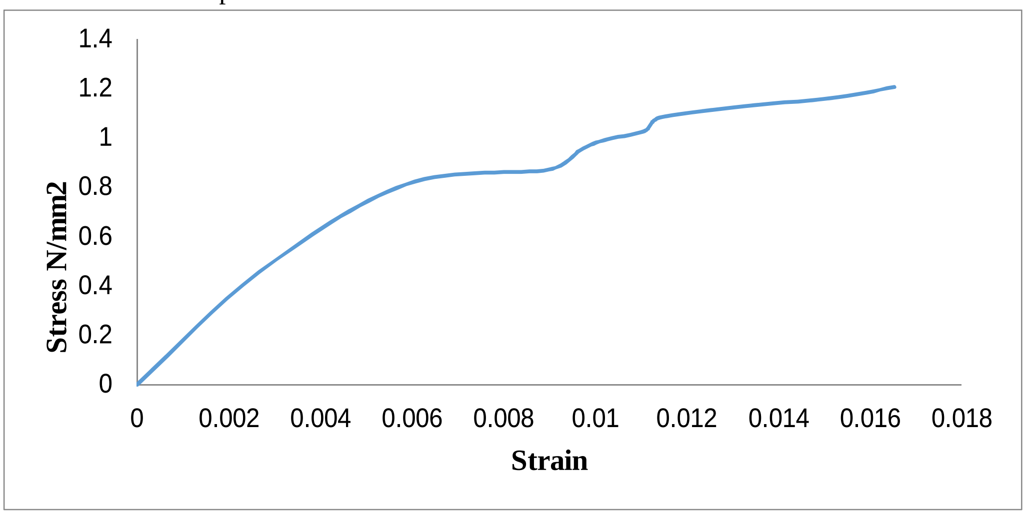
Volume 7 Issue IX, Sep 2019- Available at www.ijraset.com

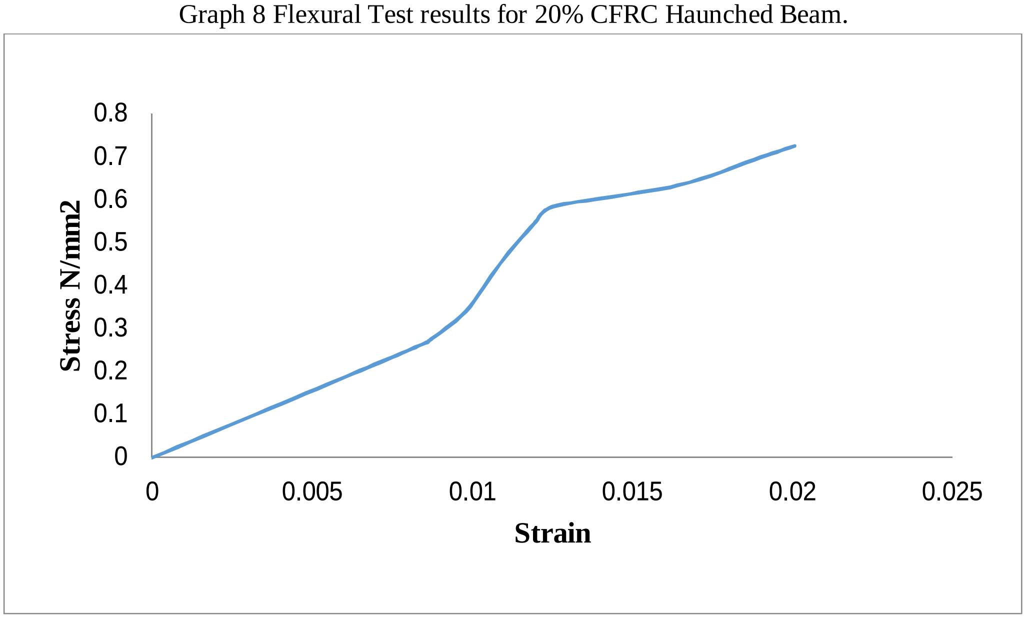
Graph 6 Flexural Test results for 5% CFRC Haunched Beam.



Graph 7 Flexural Test results for 10% CFRC Haunched Beam.



Graph 8 Flexural Test results for 20% CFRC Haunched Beam.



IV. CONCLUSION

The approximations obtained with commercial testing for a set of 24 RC and Plain concrete member with symmetric haunched beams (linear tapering of the web depth) under lateral loading are reported when compared to those obtained with a traditional beam theory when shear deformations are included.

It was shown that the haunch solution should provide and effective strength for the structure. The test program will throw light on the major strength parameters.

For change the haunch inclination (α) from positive to negative the number of shear and flexure cracks decreases at the same level of loading. But cracking and ultimate loads increase.

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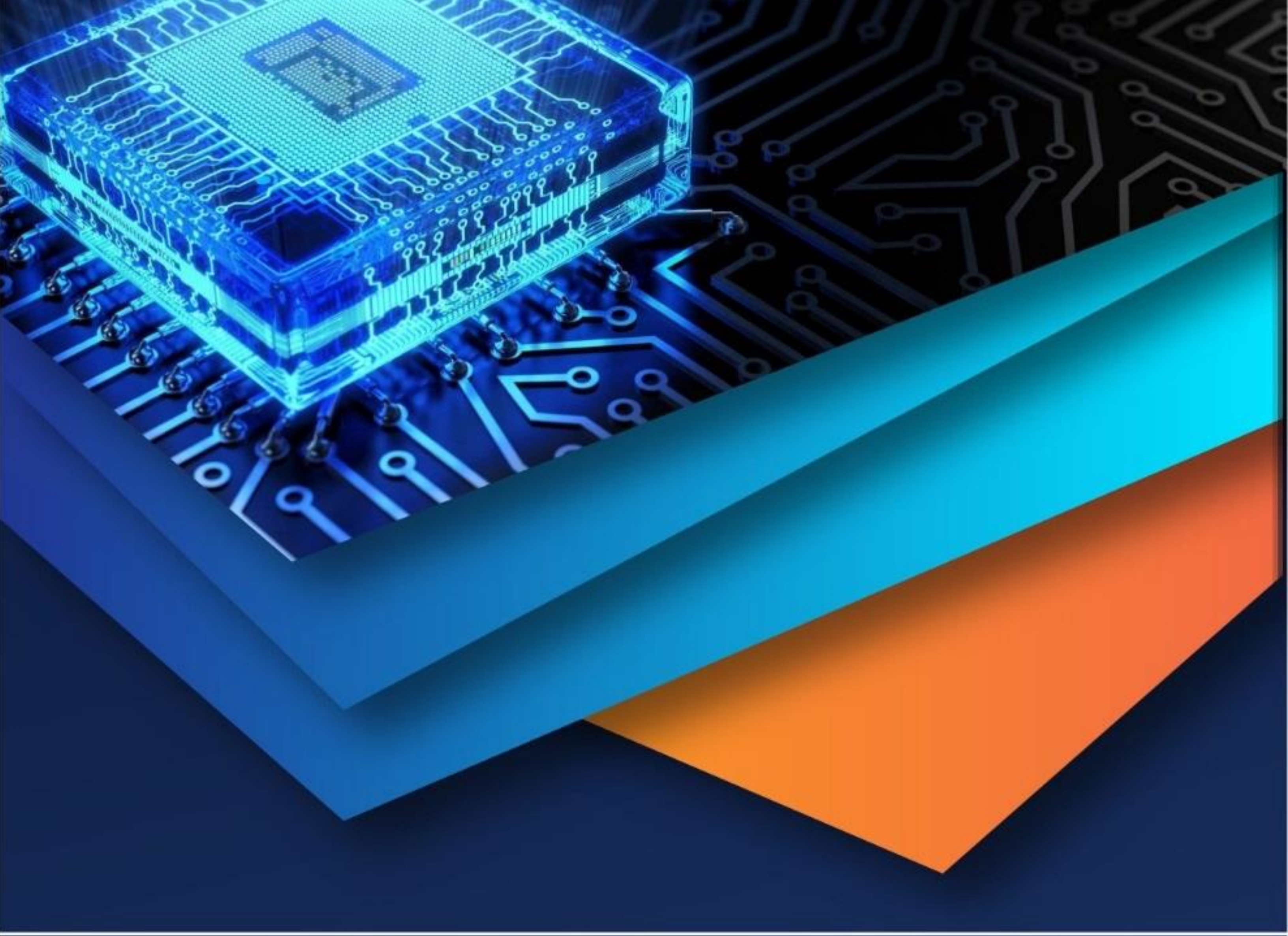

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