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A Review Study on Use of Steel Fiber Chip as Partial Replacement with Coarse Aggregate In Concrete

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Abstract: ***All through the world, concrete is being widely used for the construction of most of the buildings, bridges etc. Hence, it has been properly labeled as the backbone to the infrastructure development of a nation. Right now, our nation is taking real activities to enhance and build up its infrastructure by constructing express highways, power projects and modern structures to rise as a major economic power and it has been estimated that the infrastructure segment in our nation is expected to see investments to the tune of Rs.4356 billion by the year 2013. To meet out this rapid infrastructure development a huge quantity of concrete is required. Unfortunately, India is not self sufficient in the production of cement, the main ingredient of concrete and the demand for exceeds the supply and makes the construction activities very costlier. Hence, currently, the entire construction industry is in search of a suitable and effective the waste product that would considerably minimize the use of cements and ultimately reduces the construction cost.***

Key words: Course aggregate, Steel fiber chip, Slump value compressive strength. Split tensile strength

I. INTRODUCTION

The construction industry relies heavily on conventional materials such as cement, sand and granite for production of concrete. Concrete is the basic civil engineering composite. The quality concrete is determined by the quality of paste/mix. It is the world's most consuming man made material. Its great versatility and relative economy in filling wide range of needs has made it a competitive building material. The demand for concrete for today's infrastructural development is rising day-by -day. In light of this, the non-availability of natural resources to future generation has also been realized. Concrete production is not only a valuable source of societal development but also a significant source of employment. Following a natural growth in population, the amount and type of waste materials have increased accordingly creating thus vironmental problems. Historically agricultural and industrial wastes have created waste management and pollution problems. Different alternative waste materials and industrial by-products such as fly ash, bottom ash, recycled aggregates, crumb rubber, saw dust, brick bats etc. were replaced with natural aggregates. Although these materials are traditionally considered as "primitive" and therefore inferior to more highly processes in terms of safety, durability, performance, occupant's health and comfort with respect to environmental issue, consumption of environmental products and energy within the construction industry has created a significant demand for raw materials and for production thereby contributing to the many environmental problems associated with diverse ecosystem.

A. Fibre Reinforced Concrete

For improving the tensile properties of plain concrete many methods have been evolved. Many of the methods succeeded in making the concrete members resistant to tension, but none of them increased the inherent tensile properties of plain concrete. The dispersion of fibres in concrete matrix to improve its tensile properties has been practiced worldwide over 3 past decades. The addition of small closely spaced and uniformly dispersed fibres to concrete would act as crack arrester and would substantially improve its static and dynamic properties. This type of concrete is known as fibre reinforced concrete. Fibre reinforced concrete can be defined as a composite material consisting of mixtures of cement, mortar, or concrete and discontinuous, discrete, uniformly dispersed suitable fibres. Continuous meshes, woven fabrics and long wires or rods are not considered to be discrete fibres.

B. Properties of Fibre Reinforced Concrete

Fibre reinforced concrete (FRC) is a new structural material and it is gaining importance. Addition of fibre reinforcement in discrete form improves many engineering properties of concrete. The modern development of fibre reinforced concrete (FRC) started in the

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early sixties. Addition of fibres to concrete makes it a homogeneous and isotropic material. When concrete cracks, the randomly oriented fibres start functioning, arrest crack formation and propagation, and thus improve strength and ductility. The failure modes of FRC are either bond failure between fibre and matrix or material failure. In this paper, the Steel Fibre Reinforced Concrete is discussed and results of tests done are discussed.

C. Steel Fibre Chips

Stainless steel chip were taken as steel fibres for this study. These are industrial waste of high-grade stainless steel. Since each chip is made of a single strand of stainless steel, they will not tear or splinter. Also, they will not corrode. It has a good tensile strength and the fibre strips length vary by 1, 1.5 and 2 inches. These fibres will improve toughness, durability and tensile strength of concrete.

Fig Steel Fibre Chips

D. Aim

The aim of in this project is to use the Steel Fibre chips as reinforcement to concrete and study various strength parameters
The strength properties being studied in our thesis are as follows:

1) Slump test
2) Compressive strength
3) Split tensile Strength
4) Flexural strength

E. Objectives

The objectives of the research are outlined below:

1) To achieve the desire strength in high performance concrete.
2) To find out the dosage of the steel fibre chips at which the concrete gain the higher strength.
3) Determination of the compressive strength split tensile strength, and flexural strength of the concrete.
4) Steel fibre chips is also industrial waste by the use of it we can reduced the environmental degradation.

II. LITERATURE REVIEW

A. Omanakuttan Athira, An Experimental investigation on Strength Behavior of Steel Fiber, Glass Fibre with Fly Ash and Rice Husk Ash (IJARIIT-2017) ISSN: 2454-132X (P394-400)

Half breed Fibre-fortified cement is a composite material comprising of blends of bond, fine total, coarse total, steel fibre and glass fibre. The half breed fiber fortified solid displays better weakness quality and expanded static and dynamic rigidity. In this task, the quality of fibre strengthened cement was explored with incomplete supplanting of bond with rice husk slag and fly fiery debris. Steel fibre and glass fibre was included the request of 0.25%, 0.5% and 0.75% by volume of concrete and 0.25%, 0.5% and 0.75% by weight of bond. Rice Husk Ash was utilized to supplant conventional Portland bond by 20% and fly powder 20% by weight of concrete extent.

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B. *Aswani Sabu and Thomas Paul, Experimental Study on Comparison of Hooked-End and Crimped Steel FibresInternational Journal for Research in Applied Science & EngineeringTechnology (IJRASET) Volume 4 Issue IX, September 2016*

Fibers are generally used as a common engineering material for crack resistance and strengthening of concrete. Their properties and characteristics greatly influence the properties of concrete which has been proved already in many previous researches. Accordingly it has been found that steel fibers give the maximum strength in comparison to glass and polypropylene fibers. In this experimental study, two types of steel fibers namely hooked end and crimped fibers are used. The volume fractions taken are 0.75%, 1.0% and 1.25% and M30 grade concrete is adopted. Cement has been replaced with 25% of Class F flash. The primary focus is to compare the mechanical properties of concrete using both fibres.

C. *R. Madheswaran, S. Arun Singh, K.S. Sathyanarayanan Experimental Study On Hardened Concrete By Using Steel Fibers With Mineral Admixture International Journal of Civil Engineering and Technology (IJCIET)Volume 5, Issue 5, May (2014), pp. 114-122*

Concrete is likely the most broadly utilized development material on the planet. The primary fixing in the regular cement is Portland concrete. The measure of bond generation produces around rise to measure of carbon dioxide into the climate. Concrete creation is devouring noteworthy measure of characteristic assets. That has brought weights to lessen bond utilization by the utilization of supplementary materials. Accessibility of mineral admixtures checked opening of another period for planning solid blend of ever more elevated quality. Fly Ash and silica smolder is another mineral admixture, whose potential isn't completely used. Also just restricted investigations have been completed in India on the utilization of silica smolder for the improvement of high quality cement with expansion of steel strands. The examination centers around the compressive quality execution of the mixed cement containing diverse level of silica smoke and Fly Ash and steel fiber as an incomplete substitution of OPC. The bond in concrete is supplanted as needs be with Silica seethe content was use from 0% to 10%in the interim of 2% in weight premise and furthermore fly cinder content was use from 10% in weight premise. So to enhance the quality of solid steel filaments were included 0.5%, 1%, 1.5%, 2% by weight of steel fiber. Solid 3D shapes are tried at the age of 3, 7, and 28 days of curing. At last, the quality execution of Fly slag and silica rage mixed fiber fortified cement is contrasted and the execution of customary cement. From the exploratory examinations, it has been watched that, the ideal substitution Fly fiery remains and silica smoke to bond and steel fiber without changing much the compressive quality is 10% - 8 % and 1.5 % individually for M25 review Concrete

D. *Hoe Kwan MahyuddinRamli, Flexural quality and effect protection investigation of fiber strengthened cement in mimicked forceful ecological Construction and Building Materials 63 (2014) 62– 71*

Notwithstanding being presented to chloride and sulfate assaults, marine structures are liable to seismic and affect loads coming about because of waves, affect with strong protests, and water transports. Accordingly, the flexural conduct and effect protection of Fiber-Reinforced Concrete (FRC) in marine condition must be clarified. Nonetheless, such data is barely announced. Along these lines, this examination plans to investigate the impacts of mimicked forceful conditions on flexural quality and effect protection of FRC and to recognize the connection between the two parameters. Three sorts of filaments, specifically, coconut fiber, Barsrap fiber (BF), and soluble base safe glass fiber, were utilized as a part of this investigation. The fiber measurements extended from 0.6%to 2.4% of the cover volume. All blends have consistent water/folio proportion of 0.37 and their compressive qualities were all surpassing 60 MPa. The examples were arranged and presented to three diverse forceful presentation situations, in particular, tropical atmosphere, cyclic air and seawater conditions, and seawater condition for up to 180 days. Results demonstrate that flexural quality and effect protection of FRC have an immediate association with fiber content. Regardless, change in fiber write is more critical than expanding fiber dose in improving flexural quality yet modification in the two issues would fundamentally affect the effect protection. Rigidity of an individual BF (640 MPa) is significantly higher than the flexural quality of the BFRC composite. Along these lines, disappointment of solid lattice was seen to happen preceding the crack of the fiber which thusly brought about fiber haul out from the solid grid. Among the different FRC analyzed, FRC containing the most elevated BF content (2.4%) exhibited the best flexural quality execution. The flexural quality of the Bar srap FRC was seen to be expanded by 11– 13% in all presentation situations following 180 days. The pre-break vitality ingestions, which were resolved through effect stack test, were found to increment by 60– 63% when contrasted with the control solid, which showed no post-split vitality assimilation. In the interim, the post-break vitality retentions of the2.4BF were found to go between 3.67 J and 3.71 J for different ecological introduction conditions. Examination of fluctuation (ANOVA) comes about demonstrated that flexural qualities were fundamentally expanded following a half year of presentation to the different forceful condition conditions, particularly in seawater. This could be

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because of arrangement of salt gems which contributed towards improving the fiber/lattice frictional bond. Notwithstanding, the presentation situations have no noteworthy impact on affect protection execution.

E. Su-Jin Lee, Jong-Il WonFlexuralbehavior of precast strengthened solid composite individuals fortified with basic nano-manufactured and steel filaments Composite Structures 118 (2014) 571– 579

In this investigation, basic nano-engineered and steel filaments were utilized to lessen the measure of steel rebar appropriated in precast fortified solid composite individuals. The flexural execution of the individuals was assessed utilizing longitudinal steel proportions of 1.65 and 1.20 and a transverse steel proportion of 0.20. Cross breed fiber blends comprising of different measures of auxiliary nano-manufactured and snared end steel filaments were utilized as fortifying materials alongside the steel rebar. The nano-manufactured fiber volume parts were 0.4, 0.5, and 0.6 vol. %, and the steel fiber substance were 5, 10, and 20 kg/m3. Flexural execution tests were completed for the subsequent half breed fiber-strengthened bond composites. The test outcomes exhibited that the half breed fiber-fortified concrete composites fulfilled the essential conditions to supplant the general strengthening bars as per the RILEM standard when the blend contained 0.4 vol. % of nano-manufactured fiber and 20 kg/m3 of steel fiber. The flexural conduct of a 350 * 180 *1500-mm precast composite part fortified by such a half and half fiber blend and steel rebar was assessed; its most extreme load was 30% more noteworthy than the outlined extreme load and 3.5% more prominent than that of a steel fiber-strengthened composite part. The material execution of cement with a half and half blend of fortifying basic nano-engineered and steel filaments was assessed. The best blend was then tried in a precast RC composite part utilizing the most reduced conceivable steel proportion to assess the flexural execution. The trial results can be compressed as takes after.

1) Similar flexural qualities were gotten for all blends paying little heed to the fiber volume division. Be that as it may, the flexural sturdiness enhanced with the fiber volume division, and higher flexural durability esteems were gotten for blends with 20 kg/m3 of steel fiber. The half and half NSyn04St20 blend, containing 0.4 vol. % of auxiliary nano-engineered fiber and 20 kg/m3 of steel fiber, displayed the best flexural execution.

2) St05, which contained 0.5% steel fiber, and NSyn04St20, which utilized 0.4 vol. % basic nano-manufactured fiber and20 kg/m3 steel strands, was reasonable for general support as per the RILEM standard

3) The most extreme heap of the precast HFRC part was 30.1% more prominent than its planned extreme load, and its execution was proportional to the precast SFRC part. The precast HFRC part was additionally more flexible

F. Lijun Wang, Jing Zhang, Xu Yang, Chun Zhang, Wei Gong, Jie Yu Flexural properties of epoxy syntactic froths strengthened by fiberglass work or potentially short glass fiber Materials and Design 55 (2014) 929– 936

Epoxy syntactic froths containing 15 wt.% empty glass smaller scale expand were strengthened by fiberglass work as well as short glass fiber, and the flexural conduct of these froths were examined. Flexural tests comes about demonstrated that the nearness of glass fiber or fiberglass work prompted expanded estimations of quality and modulus in syntactic froths contrasted and unreinforced syntactic froths. Furthermore, fiberglass work was observed to be considerably more productive. By adding two-layer fiberglass work to the glass fiber fortified syntactic froths, the flexural quality and modulus additionally expanded just about 2.5 and 2 times, individually, while the thickness of the strengthened froth just expanded by 9.3%. Moreover, it was discovered that the position and layers of fiberglass work had huge impact of the flexural properties. The disappointment modes and instruments of various fortified syntactic froths are inspected and the basic contrasts are talked about. Flexural properties of strengthened syntactic froths are explored in this examination. Fiberglass work and additionally short glass fiber stirred as support to get three arrangements of composites. Results demonstrate that the flexural properties are improved by the nearness of glass fiber or fiberglass work and fiberglass work is observed to be significantly more proficient. The flexural quality and modulus expanded by _28% and _19%, individually, for the fiber-fortified syntactic froths as for that of the unreinforced syntactic froths. Be that as it may, the expansion of one-layer fiberglass work created an essential change in flexural quality and modulus (165%and 38%, individually) contrasted and unreinforced froth, when the area of the fiberglass work was far from the pressure surface (x/h = 1). Syntactic froths strengthened by 0.5 wt.% glass fiber and two-layer fiberglass work demonstrated 2.8 and 2.4 times higher flexural quality and modulus than that of the plain syntactic froths while the thickness of fortified froth just expanded by9.3%. The crack surface demonstrated that the impact of area of work on the flexural properties was because of various disappointment components. Amid flexure, the fiberglass work on the tractable side can stop the small scale breaks engendering while the arbitrarily scattered short glass strands can connect splits at short interims and diminish their spread rate. Hypothetical investigation indicated assist improvement in flexural quality might be accomplished by enhancing the interface bond between fiber work and polymer lattice.

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III. MATERIALS

A. Materials

The materials used in this investigation were: Portland cement, coarse aggregate of crushed rock with a maximum size of 20 mm, fine aggregate of clean river sand and portable water & Steel Fibre chips is used. The detailed properties are given in subsequent contents.

B. Cement

Portland cement of 43 grades conforming to IS 8112-1989 was used. Tests were carried out on various physical properties of cement and the results are shown.

C. Fine Aggregate

Natural river sand was used as fine aggregate. The properties of sand were determined by conducting tests as per IS: 2386 (Part- I). The results are shown in Table 3.2. The results obtained from sieve analysis are furnished in Table 3.3. The results indicate that the sand conforms to Zone II of IS: 383 – 1970

D. Coarse Aggregate

Crushed granite stones obtained from local quarries were used as coarse aggregate. The maximum size of coarse aggregate used was 20 mm. The properties of coarse aggregate were determined by conducting tests as per IS: 2386 (Part – III).

E. Water

Water plays an important role in the formation of concrete as it participates in chemical reaction with cement. Potable water is generally considered satisfactory for mixing. Potable water free from salts was used for casting and curing of concrete as per IS: 456 – 2000 recommendations.

F. Steel Fiber Chip

Stainless steel chips were taken as steel fibres for this study. These are industrial waste of high-grade stainless steel to handle toughest jobs. Since each chip is made of a single strand of stainless steel, they will not tear or splinter. Also, they will not corrode. It has a good tensile strength and the fibre strips length vary by 25 to 50 mm. These fibers will improve toughness, durability and tensile strength of concrete

Table. 1 Physical Properties of 43 Grade Portland cement

S.No.	Physical Properties	Values of Portland Cement used	Requirements as per IS 8112-1989
1	Standard Consistency	29.2 %	-
2	Initial Setting Time	45 Minutes	Minimum of 30 minutes
3	Final Setting Time	265 Minutes	Maximum of 600 minutes
4	Specific gravity	3.15	-
5	Compressive strength in N/mm2 at 3 days	29	Not less than
6	Compressive strength in N/mm2 at 7	38.5	Not less than

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	days		
7	Compressive strength in N/mm2 at 28 days	48	Not less than

Table 2. Physical Properties of Fine Aggregate (Tests as per IS: 2386 – 1968: Part III)

S. no	Physical properties	Values
1	Specific gravity	2.6
2	Fineness Modulus	2.83
3	Water Absorption	0.75%
4	Bulk density (kg/m3)	1654
5	Free moisture content	0.1%

Table 3. Physical Properties of Coarse Aggregate
(Tests as per IS: 2386 – 1968 Part III)

S. No	Physical properties	Values
1	Specific gravity	2.6
2	Fineness Modulus	2.73
3	Water Absorption	0.5%
4	Bulk density (kg/m3)	1590
5	Free moisture content (%)	0.2%
6	Aggregate Impact value (%)	11.2
7	Aggregate Crushing value (%)	25.12

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Table 4. Properties of Steel Fiber Chips

S. No	Properties of Fibres	Steel Fiber Chip
1	Length used (mm)	40 to 60
2	Diameter (mm)	0.50
3	Available form	winded
4	Color	silver thin wires
5	Specific gravity	0.87
6	Water Absorption (%)	210

IV. METHODOLOGY

A. Experimental Procedure

The laboratory test programmed is summarized below.

B. Physical properties of coarse aggregates (20mm and 10mm size)

1) Sieve analysis and fineness modulus
2) Specific gravity
3) Water absorption

C. Physical properties of cement

1) Fineness
2) Specific gravity

D. Physical properties of fine aggregates

1) Sieve analysis
2) Specific gravity
3) Water absorption

E. Mix design (M 35 grade) as per IS 10262:2009.

1) Concrete Cube of size 150x150x150

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2) Mortar Cube of size 70.5x70.5x70.5mm
3) Concrete Cylindrical columns of Dia 150mm and length 300 mm.
4) Concrete beams of size 150x150x700 mm.

V. EXPECTED OUTCOMES

The aim of the Study is to assess the performance and durability of concrete material by addition of steel fibre chips. Based on previous reviews on the concrete material work it is evident that waste steel fibre chips reinforced concrete is characterized as having high toughness but low strength and stiffness. The lower strength and stiffness can be compensated by limiting the small fibre content in the concrete. As larger sized steel fibre chips are very easy to produce, it is expected that the strength of larger sized steel fibre chips modified concrete has to be improved. Various other steps will also be taken to improve the strength and stiffness of the waste tyre modified concrete. All necessary investigations will be conducted in this aspect.

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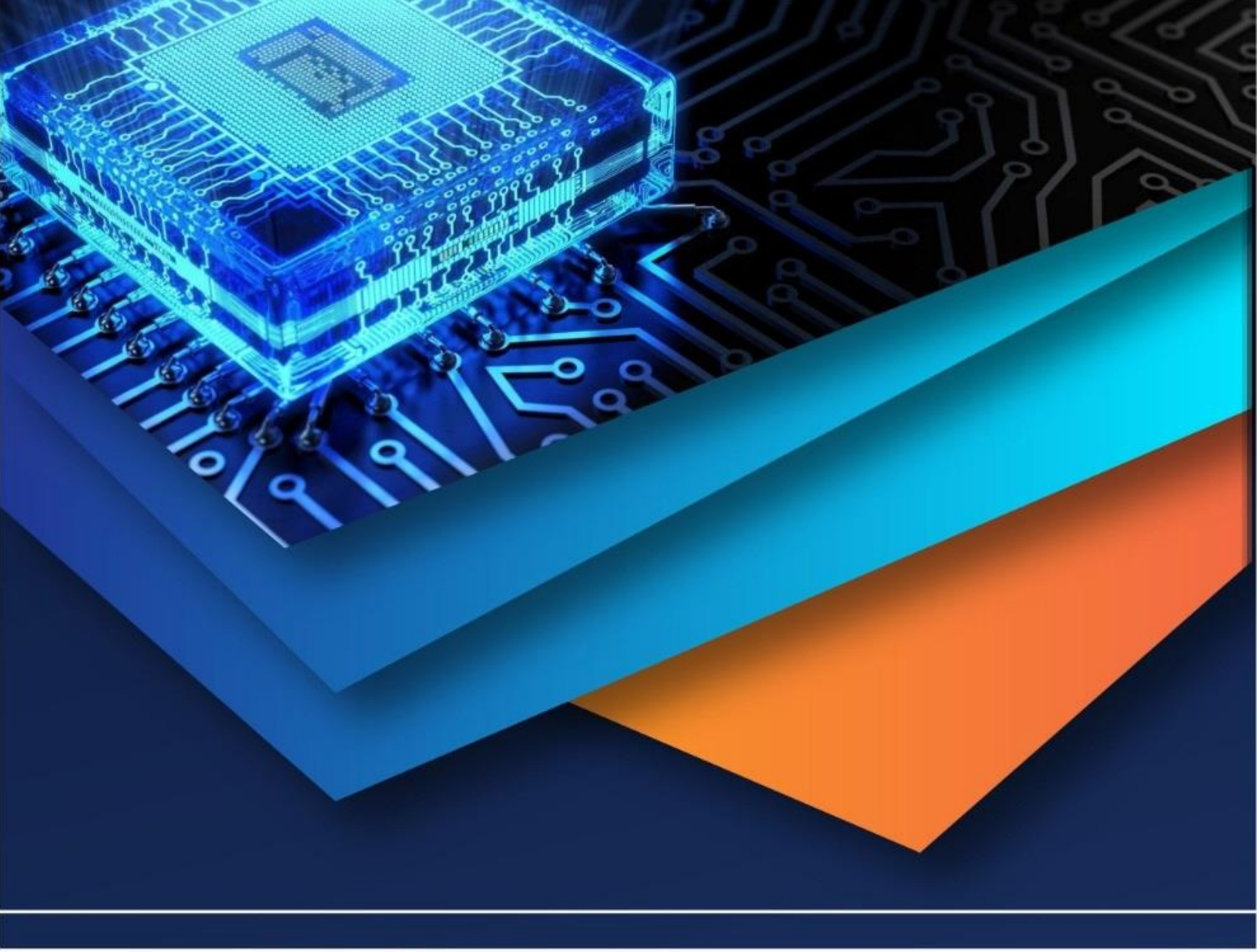

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