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Review on Strengthening the Characteristics of Concrete Using Oil Coated Coconut Fibre

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Abstract: ***Sustainability is a widely acknowledged concept in modern day construction scenario. Although the construction industry is transforming in a substantial way in terms of the material used and the equipment used, the construction cost has risen steeply along with the worse impact on the environment due to this it has resulted in the acceptance of method like the use of natural fiber for example Coconut fibre for improving the strength of concrete. Coconut fiber is easily and widely available in abundance, which makes it fairly sustainable as form of reinforcement material in concrete. The use of coconut fibre as in form of reinforcement has also emerged as new source of income for the coconut producer. In addition, it can also be seen as a new effective way for the discarding of coir mattress wastage. The major problem of coconut fibre i.e. high water absorption rate of the fibre can be reduced to certain extent by coating the fibres with appropriate oil. In addition to this, the fibres which are naturally occurring is also ecologically sustainable and can lower the global carbon track effectively. This study aims to analyse the difference in strength of coconut fibre (processed fibres coated with oil and oil raw fibres coated with oil) reinforced concrete at various fibre contents and to collate it with the traditional concrete. The different strength aspects which are analysed in this study are the tensile, compressive and flexural strength of the concrete reinforced with coconut fibre at different percentages like 4%, 5% & 6% by the weight of cement of fibre. The optimum percentage of the raw fibre meshes and processed fibre were found and the optimum percentage of super-plasticizer required for the desired workability was also examined.***

Keywords: Coconut Fibre, Flexural Strength, Compressive Strength, Reinforcement, Fibre Reinforced Concrete

I. INTRODUCTION

The construction industry is nowadays transforming in various ways like the way being the development in high performance construction materials and the development of construction techniques, such as using programmed tools in construction industry widely, other in the way such as the introduction of concrete with high strength. Amongst all these high performance materials, introduction of fibre reinforced concrete is progressively achieving approval from civil engineers worldwide. The advantage of fibre reinforced concrete over other different materials of construction are their high tensile strength to weight ratio and probable great resistance to varying environmental conditions, thereby making them material with low maintenance cost. These properties mentioned above makes fibre reinforced concrete a good substitute option for advanced sustainable construction. The application of fibre reinforced concrete in construction includes building new advanced structures & upgrading the structures which are currently existing.

A chief obstruction in the direction of development of high performance concrete with the usage of steel fibres is the involvement high cost, availability of the material and a major problem related to the corrosion of the material. Coconut fibre has emerged as great alternative to others in way being one of the most ductile amongst all natural fibres available & having that potential to be used as reinforcement in concrete. It can be easily decomposed with an advantage of having minimalistic impact on the environment making it a sustainable material in the field of construction. Adopting fibre as reinforcement material will also make an innovative way to dispose off the fibres which are seen as a waste material in coir based manufacturing units. Fibres are way easily available, low in cost and also has property of being non-abrasive. The aim of this study is to deeply recognize that is there any improvement in the strength characteristic of the concrete with the addition of the coconut fibre coated with oil. In this study, coconut fibre is added to concrete and Plain Cement Concrete (PCC) is used to study application of coconut fibre reinforcement and its effect on compressive, tensile and flexural strength properties. before adding coconut fibre, it is coated properly with oil so as to reduce the water absorption by the fibre. The advantages which were observed are, good specific strength, decent thermal insulation, reduction in wear, low-cost and capability of material to be recycled with minimalistic impact on the environment. Thus, making it sustainable waste management technique in addition to the main function of improving the overall physical characteristics of concrete.

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II. OBJECTIVES AND FRAMEWORK OF STUDY

A. Objectives

1) Being familiar with the conventional concrete and coconut fibre reinforced concrete.
2) Learning and understanding the basics that how to use coconut fibre as reinforcement in concrete.
3) Comparing the strength of conventional concrete and coconut fibre reinforced concrete.
4) Knowing the advantages of coconut fibre as reinforcement in concrete.
5) To study about weight and economy of concrete.

III. LITERATURE REVIEW

(Yalley P 2008) The addition of coconut fibres as reinforcement has significantly improved many of the concrete characteristics, particularly the tensile strength, toughness and torsion. It has also helped in the enhancement of the ability to resist spalling and cracking as well. However, the addition of coconut fibres as reinforcement has adversely affected the compressive strength, as expected, due to problems in compaction which subsequently led to increase in number of voids. Even with its excellent characteristics, coconut fibre as reinforcement for enhancement of concrete is unlikely to substitute steel for the huge structures. Experiment and various projects around the globe have shown that natural fibre as reinforcement for enhancement of concrete is a feasible, eco-friendly and cost effective substitute to the traditional building materials.

(Majid Ali 2011) Most of natural fibres contain, hemi-cellulose, cellulose and lignin as major component. The properties of the natural fibres available depend upon its composition. The pre-treatment done to the natural fibres till some extent changes the composition and eventually changes the characteristics of the natural fibres. Sometimes it increases the behaviour of fibres as reinforcement but sometimes its effect is not as desired. The use of natural fibres, as reinforcement of composites (such as cement paste, mortar and/or concrete), are economically feasible and can be considered for increasing their certain characteristics like, shear strength, tensile strength, durability or combinations of all these. For all these we need to be sure that natural fibres need to be tested properly and results should be noted properly in a systematic way to avoid any mistake.

In this paper S.B. Shinde purposes is to spread awareness about using coconut fibre as an ingredient in concrete. In this paper M 20 grade of concrete is used in which coconut fibre (coir fibre) as reinforcement was added. In this paper around forty-five cylinders were casted and their workability and split tensile strength were calculated at 7, 14 and 28 days. It was observed that as the quantity of coir fibre is increased the tensile strength and the workability of concrete also increased up to certain extent. Concrete produced by 1%, 2%, 3%, 4% & 5% addition of the fibre as reinforcement achieved tensile strength of 2.68, 2.90, 3.11, 3.25, 2.33 respectively at 28 days. These results exhibited that Coir Fibre can be used as reinforcement in reinforced concrete construction. Utilization of coir fibre as reinforcement is also ecofriendly. In conclusion, it can be said that- Increase in percentage addition by coir increases the tensile strength but, if coir as reinforcement is added beyond 5%, then strength of concrete decreases.

(Aditya Tom) Among the high-performance materials, fibre reinforced concrete (FRC) is progressively acquiring approval from civil engineers worldwide. In recent years, investigation and expansion of fibres and matrix materials and fabrication process related to construction industry have grown rapidly. The advantage of fibre reinforced concrete over other different materials of construction are their high tensile strength to weight ratio and probable great resistance to varying environmental conditions, thereby making them material with low maintenance cost. These properties mentioned above makes fibre reinforced concrete a good substitute option for advanced sustainable construction. The application of fibre reinforced concrete in construction includes building new advanced structures & upgrading the structures which are currently existing. The different strength aspects which are analysed in this study are the tensile, compressive and flexural strength of the concrete reinforced with coconut fibre at different percentages like 4%, 5% & 6% by the weight of cement of fibre. The optimum percentage of the raw fibre meshes and processed fibre were found and the optimum percentage of super-plasticizer required for the desired workability was also examined**.**

(Chouw 2012) examined the feasibility of using coconut fibre ropes as vertical reinforcement in mortar free low cost housing in seismic areas. The rope anchorage is attained by inserting it in the foundation and top tie-beams. It was observed that the bond between the concrete and rope plays pivotal role in providing stability to the structure and it was also seen that the tensile strength of rope is also subsequently high. The rope tension produced due to earthquake loading should be less than both the pull out force and the rope tensile load to avoid the structure downfall. The study determined that the pull out energy upsurges with an increase in embedment length, rope diameter, fibre content and cement in the matrix.

(Liu, 2011) examined the impact of 1%, 2%, 3% and 5% at fibre lengths of 2.5, 5 and 7.5 cm on concrete characteristics. For proper analysis the characteristics of plain cement concrete were used as reference. It was clearly observed that damping of coconut fibre reinforced concrete beams increases with an increase in the content of fibre.

It was observed that coconut fibre reinforced concrete with a length of fibre as 5 cm and content of fibre as 5% yields the best outcomes. In this study the optimum percentage of coconut fibre added was about 5%, which made to implement adding 4%,5% and 6% coconut fibre by weight of cement.

(Bhatia, 2001) Examined the effectiveness of fibre reinforced concrete in numerous civil engineering applications. Fibres include natural fibres (coconut fibre), synthetic fibres and steel fibre each of which offers different properties to the concrete. The study also discovered that the structural integrity is increased due to the fibrous material. These studies made us to implement natural fibres as reinforcement material which are available in abundance and are economical as well.

IV. CASTING PROCEDURE

A. *Casting of Normal Concrete*

Concrete which is mixture of cement, sand, aggregate and admixtures is mixed either mixed using mechanical equipment or simply mixing with hands. The quantity of every material present in the mixture affects the characteristics of the final hardened concrete. The prepared mix should not be too sloppy or too stiff as if the mixture is too stiff this will cause difficulties in preparing good test specimen.

Mix Proportion

1) Cement = 9.5 kg
2) Water = 4.75 kg
3) Coarse aggregate = 27 kg
4) Fine aggregate = 16.5 kg
5) Water cement ratio = 0.5
6) Fiber = 4%, 5% & 6% of cement
7) Super plasticizer = 0.2%, 0.4% & 0.6% of cement respectively

For casting the concrete mixture, moulds are cleaned and application of oil is done at the inner surface properly. Moulds are tightened properly and to correct dimension before casting of the concrete mixture. Special attention is paid towards that there should not be any gaps left which may result in possible leakage of the slurry. The fine aggregate and coarse aggregate are properly measured by volume batching on a water tight surface. Then water is added carefully to the mixture and is important to make sure that there is no water loss during the mixing process. The mould for every category is then placed on the vibrating table respectively and the is filled with the concrete mixture in three layers. Vibration is given to the mould and stopped as soon as the cement slurry appears on the top surface of the mould. These specimens are allowed to remain in the steel mould for the first 24 hours. Then after the moulds are demoulded with proper care so as to ensure that there are no edges broken and then the cubes are placed in the tank for the process of curing for 7 days and 28 days.

B. *Casting of Processed Coir Fibre Reinforced Concrete*

The calculated quantity of fine aggregate and cement is mixed well together till a uniform mix is attained. The quantities of fibre adopted are in the range from 0% to 6% of cement. Fibre strands are cut into specific length washed properly so as to remove the residual and dust particles this will help in augmenting the contact between the fibre and the concrete which will eventually help in increasing the bonding between the concrete and the fibre reinforcement which will ultimately increase the overall strength. Now the fibre and are soaked in oil for few time and then finally is left to get dried in sunlight for a period of 24 hours. Coarse aggregates are then added to the same mixture and are properly mixed then required quantity of water is added to the mix. It should be ensured that water should be carefully be added and to be added in stages so as to avoid the bleeding which will affect the overall strength of the concrete.

Admixture is added to the mixture towards end of the last stage of addition of water so as to gain sufficient time for mixing before the concrete hardens. Then the complete mixture is placed in the mould again in three layers also properly compacted and finished to the top. After this again the prepared cubes are placed in water for the curing process and then the compressive strength for 7 days and 28 days is obtained.

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Fig. 1: Coconut Fibres

C. Casting of Raw Coir Fibre Reinforced Concrete

The calculated amount of cement and fine aggregate is mixed well together till a uniform mix is attained. The quantities of fibre adopted are in the range from 4% to 6% of cement. Raw and non-uniform coir fibres are cut into specific square chips of size 5cm x 5cm. They are then washed properly so as to remove the residual and dust particles this will help in augmenting the contact between the fibre and the concrete which will eventually help in increasing the bonding between the concrete and the fibre reinforcement which will ultimately increase the overall strength, now the fibre and are soaked in oil for few time and then finally is left to get dried in sunlight for a period of 24 hours. Coarse aggregates are then added to the same mixture and are properly mixed then required quantity of water is added to the mix. It should be ensured that water should be carefully be added and to be added in stages so as to avoid the bleeding which will affect the overall strength of the concrete. Admixture is added to the mixture towards end of the last stage of addition of water so as to gain sufficient time for mixing before the concrete hardens. Then the complete mixture is placed in the mould again in three layers also properly compacted and finished to the top. After this again the prepared cubes are placed in water for the curing process and then the compressive strength for 7 days and 28 days is obtained.

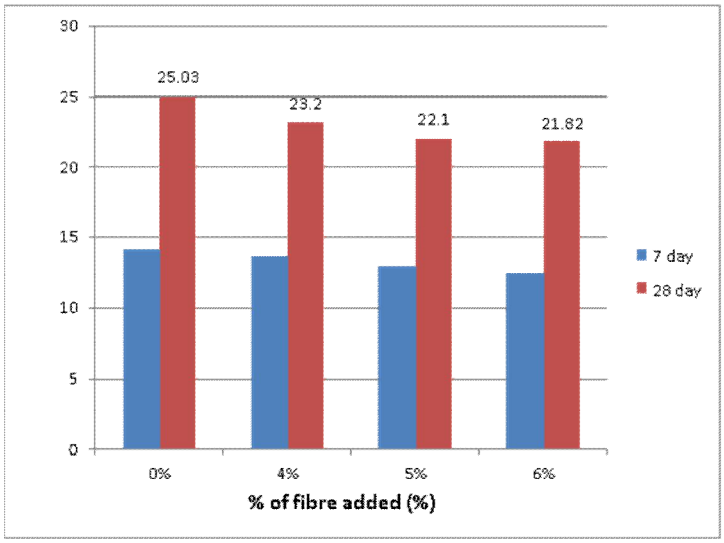

Fig. 2: Varying Compressive strength for raw coconut fibre content

- *Interpretation:* The value of compressive strength is still less than that of plain concrete. This can also be due to the presence of dust and other impurities on the surface of fibres which may interfere with proper bonding of mix and subsequent strength formation. Additional important factor is the influence of shape of fibres. Only properly combed fibre strands can be used for reinforcing concrete as presence of bulk fibres can result in improper compaction

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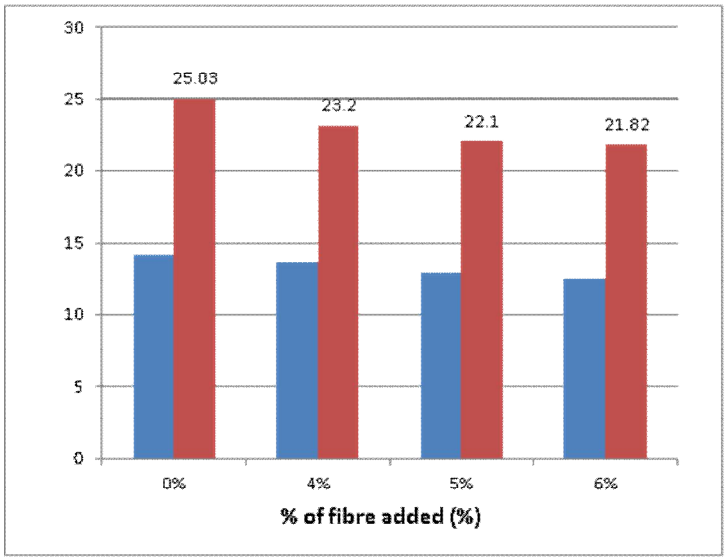

Fig. 3: Varying Compressive strength for processed coconut fibre content

- *Interpretation:* The value obtained for 5% addition of coconut fibre water cement ratio 0.5 generated maximum results for the compressive strength. However, the compressive strength decreased on the increase in fibre addition. This is due to the fact when fibres are added primarily the fine aggregates enter into the surface pores in the fibre creating a better bonding between the concrete mixture and the fibre, further addition of fibres to the mixture causes formation of bulk fibre in the mixture thereby decreasing the bonding. Hence there is an optimum value of cement ratio to fibre, after which the compressive strength decreases. Hence optimum fibre content was taken as 5% and 0.5 was taken as the optimum water cement ratio.

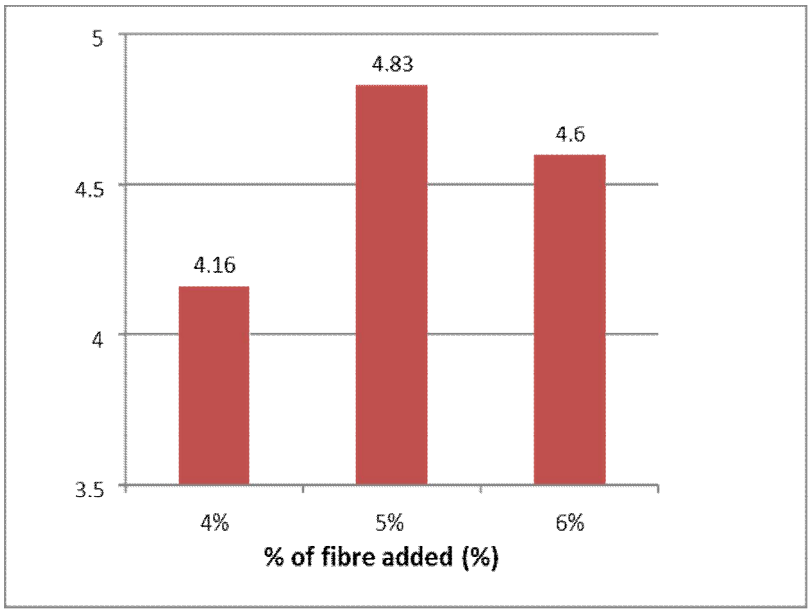

Fig. 4: Varying Flexural strength for processed coconut fibre content

- *Interpretation:* From the graph above it can be interpreted that when content of fibre is increased there is a significant increase in the flexural strength maximum at 5% of fibre. It is seen that when the content of fibre is increased past this value a downward slope of the graph is observed.

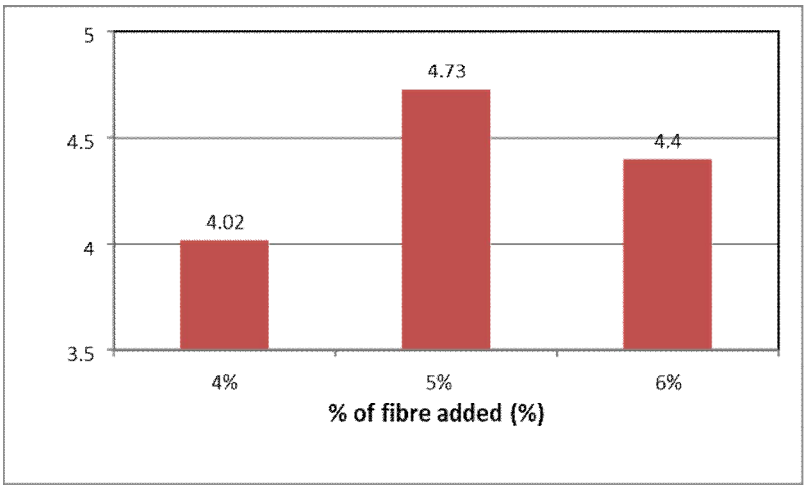

Fig. 3: Varying Flexural strength for raw coconut fibre content

- *Interpretation:* From the graph above it can clearly be interpreted that when content of fibre is increased there is a significant amount of increase in the flexural strength maximum at 5% of fibre. However, when the content of fibre is increased past this value a downward slope of the graph is observed. This must be due to balling of fibres which can hinder the binding and formation of strength f in concrete.

V. CONCLUSION

A. It was observed that by adding 5% of coconut fibre with a water cement ratio as 0.5, compressive strength tests came up with comparatively best results. Though, it was further observed that addition of more coconut fibre results in reduction of the compressive strength reason being the fact that when the fibres are added initially to concrete, the fine sized aggregates enter into the surface pores in the fibre therefore creating a well bonding amongst the mixture & coconut fibre, however, it was also observed that further addition of the coconut fibres has resulted in creation of bulk fibre in the mixture which will eventually leads to decrease in bonding. According to that it can said that there is a certain optimum value of the fibre to cement ratio. Hence the compressive strength of concrete decreases subsequently beyond a certain value of cement to fibre ratio. So it can be said that optimum fibre content is till 5% & the optimum water cement ratio is 0.5.

B. There is a certain increase in the split tensile strength maximum at 5% when the content of fibre is increased in the mixture. However, it is observed that when the content of fibre is increased beyond this value there is reduction in the tensile strength.

C. As per the coconut fibre reinforced concrete (CFRC) cracking pattern and its tensile properties it can be said that it will be really helpful at construction sites in seismic zones due to its high tensile strength.

D. Due to its comparatively higher ductility and tensile strength, coconut fibre reinforced concrete can be a good alternative for asbestos fibres sheets in roofing, as it is naturally occurring will cause less harm to the environment.

E. When the content of fibre is increased at 5% of fibre there is a significant increase in flexural strength of the concrete mixture. Although, a downward slope is observed on the graph when the content of fibre in mixture is increased beyond this value reason being the binding property of coconut fibre.

F. It may also be said that with help of addition of the admixtures there was reduction in the voids in the concrete mixture which ultimately results in improving the overall strength characteristics of the concrete mix.

G. Coconut fibre possess low density it helps in the reduction of the overall weight of the coconut fibre reinforced concrete (CFRC) which makes it a product to be used as light weight concrete in light weight structures.

H. It has been also observed that with the application of oil on the coconut fibre has been quite helpful to avoid the absorption of water by the fibre which makes the strength of concrete much better which was creating strength issues when it was not coated oil.

VI. FUTURE SCOPE

The outcome of coconut fibres on concrete of high strength should be studied and researched upon consequently the use of fibre reinforced concrete should be stretched into the big commercial and industrial projects. As coconut fibre has good insulation property so it can improve the thermal characteristics of concrete. The coconut fibre reinforced concrete is predominantly very useful in a tropical country like India where the temperature is reasonably high during most part of the year. Since the room temperature will be relatively cool it can also reduce the load on air conditioning systems thereby reducing the overall power consumption. The acoustic characteristics of concrete reinforced with other natural fibres have also been studied in the past using an impedance tube apparatus and according to that it can comfortably be said that the coconut fibre reinforced concrete can be used as an alternative option to others.

VII. ACKNOWLEDGEMENT

I want to extend my sincere thanks to my Guide Asst. Prof Veena Ganvir Ma'am for her guidance at all stages of this project and for all the support in critically analyzing the parameters of the project to ensure best results from the project.

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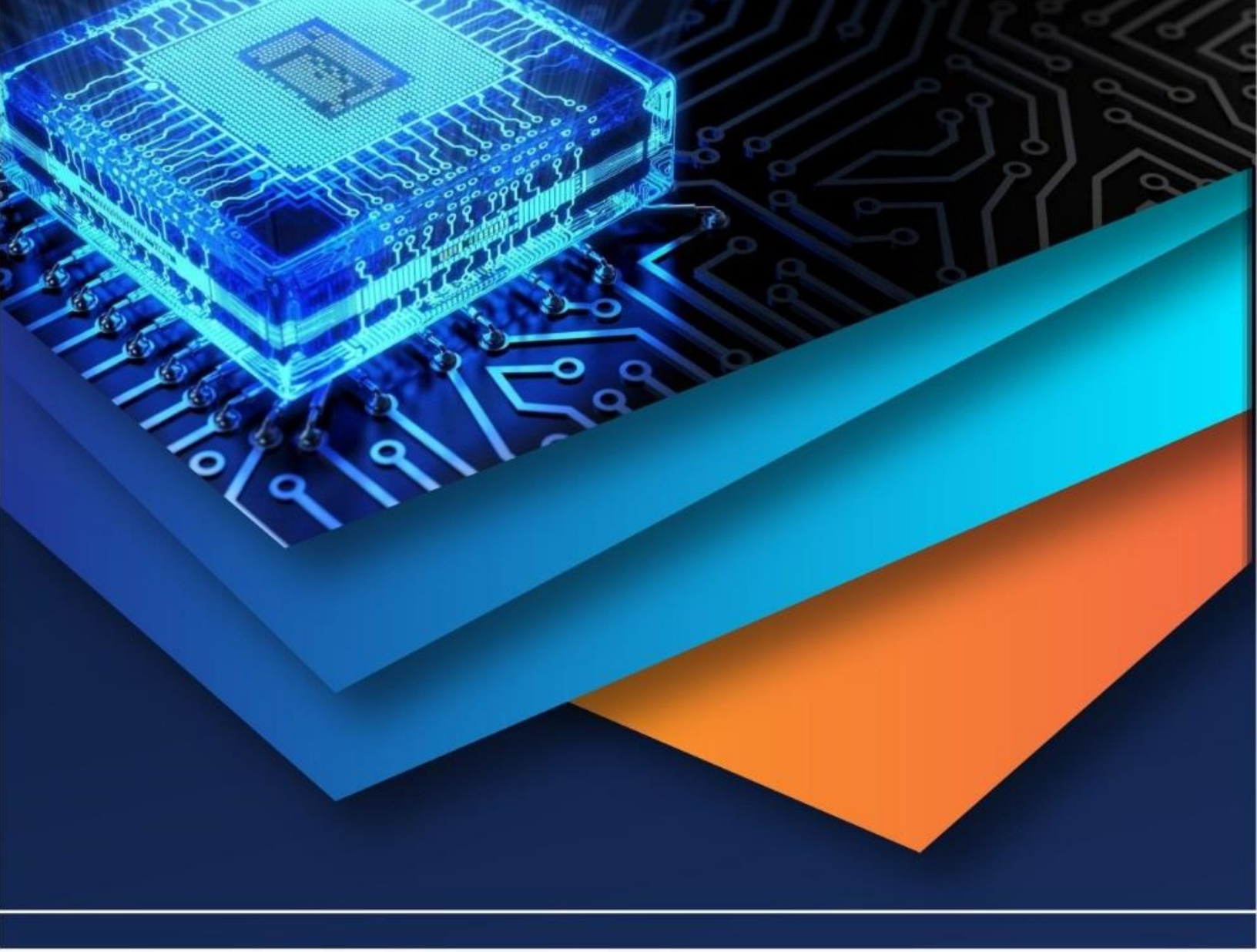

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